DEPARTMENT OF THE AIR FORCE
27TH SPECIAL OPERATIONS CIVIL ENGINEER SQUADRON (AFSOC)
CANNON AIR FORCE BASE NEW MEXICO

ENTERED

AUG 2 2 2011

AUG 2011

Ronald A. Lancaster
Chief, Asset Management
506 N DL Ingram Blvd
Cannon AFB NM 88103-5003

Mr David Cobrain
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East Bldg 1
Santa Fe NM 87505-6063

Dear Mr Cobrain

Attached is the Site Investigation at Eight Sites Project Activities Work Plan for Cannon Air Force Base, New Mexico, August 2011 for your review and approval.

If you have any questions regarding this submittal please contact our office at (575) 784-1146 or 1092.

Sincerely

RONALD A. LANCASTER, REM, CHMM

Attachment:
Site Investigation at Eight Sites Project Activities Work Plan, Cannon Air Force Base, New Mexico, August 2011

cc:
Environmental Protection Agency, Region VI, Ms Wendy Jacques (w/o Attachment)

Document with December 2012

Air Commandos

SITE INVESTIGATION AT EIGHT SITES PROJECT ACTIVITIES WORK PLAN

CANNON AIR FORCE BASE NEW MEXICO

December 2012

Prepared for:

Air Force Special Operations Command

27th Special Operations Wing

Under contract to:

Air Force Civil Engineer Center

URS
12120 Shamrock Plaza, Suite 100
Omaha, Nebraska 68154

Section 1 Introduction 1-1
1.1 Authority 1-1
1.2 Purpose and Scope 1-1
1.3 Facility Description and Background 1-3
1.3.1 Setting – Physical Geography 1-3
1.3.2 Demographics and Land Use Near Cannon AFB 1-3
1.3.3 Climatology 1-3
1.3.4 Geology 1-4
1.3.5 Hydrogeology 1-6
1.3.6 Soils 1-7
1.3.7 Background Metals Concentrations in Soil 1-8
1.3.8 Water Quality 1-8
1.4 Project Schedule 1-8

Section 2 Project/Task Organization 2-1
2.1 Roles And Responsibilities 2-1
2.1.1 Cannon Air Force Base 2-1
2.1.2 AFCEE 2-1
2.1.3 NMED 2-1
2.1.4 URS 2-1
2.2 Contractor Responsibilities 2-3
2.2.1 EMAX Laboratories Project Manager 2-3
2.2.2 Laboratory QA Officer 2-4
2.2.3 Direct Push Services 2-4
2.2.4 Drill Rig Services 2-4

Section 3 Decision Process 3-1
3.1 Description of Decision Process 3-1
3.2 Development of Preliminary Site Conceptual Exposure Models 3-2
3.3 Critical Data 3-4
3.4 Detection Limits 3-5
3.5 Evaluation of Background Concentrations 3-5
3.6 Human Health Screening-Level Evaluation Methodology 3-5
3.7 Ecological Screening-Level Evaluation Methodology 3-7

Section 4 Site Descriptions and Background 4-1
4.1 Former AGE Dispatch Facility Spills Site (SS-C501) 4-1
4.1.1 Site Description and Background (SS-C501) 4-1
4.1.2 Previous Investigation Results (SS-C501) 4-2
4.2 Former Gas Station Site (ST-C502) 4-2
4.2.1 Site Description and Background (ST-C502) 4-2
4.2.2 Previous Investigation Results (ST-C502) 4-3
4.3 Base Support/Operations Generator Former UST Site (ST-C503) 4-4
4.3.1 Site Description and Background (ST-C503) 4-4

4.3.2 Previous Investigation Results (ST-C503) 4-5
4.4 Hospital Abandoned UST Site (ST-C504) 4-6
4.4.1 Site Description and Background (ST-C504) 4-6
4.4.2 Previous Investigation Results (ST-C504) 4-7
4.5 Flightline Generator Underground Storage Tanks Site (ST-C505) 4-8
4.5.1 Site Description and Background (ST-C505) 4-8
4.5.2 Previous Investigation Results (ST-C505) 4-9
4.6 Former POL Yard Refueling Area Site (SS-C507) 4-11
4.6.1 Site Description and Background (SS-C507) 4-11
4.6.2 Previous Investigation Results (SS-C507) 4-15
4.7 Surface Disposal Area Site (SD-C508) 4-15
4.7.1 Site Description and Background (SD-C508) 4-15
4.7.2 Previous Investigation Results (SD-C508) 4-16
4.8 Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129) ... 4-16
4.8.1 Site Description and Background (TA/AS-C129) 4-16
4.8.2 Previous Investigation Results (TA/AS-C129) 4-18

Section 5 Field Sampling Plan 5-1
5.1 Mobilization 5-1
5.1.1 Acquire Base Passes 5-1
5.1.2 Facility Safety Requirements 5-2
5.1.3 Locate Utilities 5-3
5.1.4 Surveying of Soil Borings 5-3
5.2 Surface Soil Sample Collection 5-3
5.3 Subsurface Drilling and Soil Sampling 5-5
5.3.1 Direct Push Sampling Procedures 5-6
5.3.2 Drill Rig Sampling Procedures 5-6
5.3.3 Subsurface Soil Analytical Sample Collection 5-6
5.4 Field Screening and Headspace Analysis 5-7
5.5 Sample Identification, Handling, and Documentation 5-8
5.5.1 Field Documentation 5-8
5.5.2 Sample Identification 5-9
5.5.3 Sample Labeling and Handling 5-10
5.6 Quality Assurance/Quality Control Samples 5-10
5.7 Equipment and Personnel Decontamination 5-11
5.7.1 Sampling Equipment 5-11
5.7.2 Drilling and Heavy Equipment 5-12
5.7.3 Equipment Leaving the Site 5-12
5.7.5 Responsible Authority 5-12
5.7.6 Wastewater 5-13
5.7.7 Documentation 5-13
5.8 Investigation-Derived Waste 5-13
5.9 Former AGE Dispatch Facility Spills Site (SS-C501) 5-14
5.9.1 Sampling Objectives and Rationale (SS-C501) 5-14
5.9.2 Sampling Locations, Frequencies and Analysis (SS-C501) 5-14
5.10 Former Gas Station Site (ST-C502) 5-14

5.10.1 Sampling Objectives (ST-C502).....5-14
5.10.2 Sampling Locations, Frequencies, and Analysis (ST-C502) 5-15
5.11 Base Support/Operations Generator Former UST Site (ST-C503).....5-16
5.11.1 Sampling Objectives and Rationale (ST-C503) 5-16
5.11.2 Sampling Locations, Frequencies and Analysis (ST-C503) 5-16
5.12 Hospital Abandoned UST Site (ST-C504) 5-17
5.12.1 UST Location (ST-C504).....5-17
5.12.2 Sampling Objectives (ST-C504).....5-17
5.12.3 Sampling Locations, Frequencies and Analysis (ST-C504) 5-17
5.13 Flightline Generator Underground Storage Tanks Site (ST-C505) 5-18
5.13.1 Sampling Objectives (ST-C505).....5-18
5.13.2 Sampling Locations, Frequencies and Analysis (ST-C505) 5-19
5.14 Former POL Yard Refueling Area Site (SS-C507).....5-19
5.14.1 Sampling Objectives (SS-C507).....5-19
5.14.2 Sampling Locations, Frequencies and Analysis (SS-C507).....5-20
5.15 Surface Disposal Area Site (SD-C508) 5-21
5.15.1 Sampling Objectives (SD-C508) 5-21
5.15.2 Sampling Locations, Frequencies and Analysis (SD-C508).....5-22
5.16 Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129) ...5-22
5.16.1 Sampling Objectives (TA/AS-C129).....5-22
5.16.2 Sampling Locations, Frequencies and Analysis (TA/AS-C129).....5-23

Section 6 Project Documentation and Reporting.....6-1
6.1 Project Monitoring 6-1
6.2 Field Form Management..... 6-1
6.3 SI at Eight Sites Report..... 6-1
6.4 Project File 6-2

Section 7 References.....7-1

List of Appendices

Appendix A Uniform Federal Policy–Quality Assurance Project Plan
Appendix B Site Safety and Health Plan
Appendix C Standard Operating Procedures
Appendix D Site Background Information

List of Tables (Tables are included at the end of each section.)

Table 1-1 Summary of Background Elemental Concentrations in Soil Samples at Cannon AFB, New Mexico
Table 2-1 Key Project Personnel

Table 2-2 Field Personnel

Table 4-1 Summary of Previous Samples for Chemical Analysis, Former AGE Dispatch Facility Spills Site (SS-C501)

Table 4-2 Summary of Previous Analytical Data and Screening Results, Former AGE Dispatch Facility Spills Site (SS-C501)

Table 4-3 Summary of Previous Samples for Chemical Analysis, Former Gas Station Site (ST-C502)

Table 4-4 Summary of Previous Analytical Data and Screening Results, Former Gas Station Site (ST-C502)

Table 4-5 Summary of Previous Samples for Chemical Analysis, Base Support/Operations Generator Former UST Site (ST-C503)

Table 4-6 Summary of Previous Analytical Data and Screening Results, Base Support/Operations Generator Former UST Site (ST-C503)

Table 4-7 Summary of Previous Samples for Chemical Analysis, Hospital Abandoned UST Site (ST-C504)

Table 4-8 Summary of Previous Analytical Data and Screening Results, Hospital Abandoned UST Site (ST-C504)

Table 4-9 Summary of Previous Samples for Chemical Analysis, Flightline Generator UST Site (ST-C505)

Table 4-10 Summary of Previous Analytical Data and Screening Results, Flightline Generator UST Site (ST-C505)

Table 4-11 Summary of Previous Samples for Chemical Analysis, Former POL Yard Refueling Area Site (SS-C507)

Table 4-12 Summary of Previous Analytical Data and Screening Results, Former POL Yard Refueling Area Site (SS-C507)

Table 4-13 Summary of Previous Samples for Chemical Analysis, Surface Disposal Area Site (SD-C508)

Table 4-14 Summary of Previous Analytical Data and Screening Results, Surface Disposal Area Site (SD-C508)

Table 4-15 Summary of Previous Samples for Chemical Analysis, Waste Oil Storage Facility 244 And Leach Field Site (TA/AS-C129)

Table 4-16 Summary of Previous Analytical Data and Screening Results, Waste Oil Storage Facility 244 And Leach Field Site (TA/AS-C129)

Table 5-1 Summary of Planned Sampling Locations and Analytical Parameters, Former AGE Dispatch Facility Spills Site (SS-C501)

Table 5-2 Summary of Planned Sampling Locations and Analytical Parameters, Former Gas Station Site (ST-C502)

Table 5-3 Summary of Planned Sampling Locations and Analytical Parameters, Base Support/Operations Generator Former UST Site (ST-C503)

Table 5-4 Summary of Planned Sampling Locations and Analytical Parameters, Hospital Abandoned UST Site (ST-C504)

Table 5-5 Summary of Planned Sampling Locations and Analytical Parameters, Flightline Generator UST Site (ST-C505)

Table 5-6 Summary of Planned Sampling Locations and Analytical Parameters, Former POL Yard Refueling Area Site (SS-C507)

Table 5-7 Summary of Planned Sampling Locations and Analytical Parameters, Surface Disposal Area Site (SD-C508)

Table 5-8 Summary of Planned Sampling Locations and Analytical Parameters, Waste Oil Storage Facility 244 And Leach Field Site (TA/AS-C129)

List of Figures (Figures are included at the end of each section.)

Figure 1-1 Installation Location Map

Figure 1-2 Site Location Map

Figure 1-3 Generalized Geologic Strata at Cannon Air Force Base

Figure 1-4 Elevation and Configuration of the Water Table in the Region of Cannon Air Force Base

Figure 1-5 Water Well Locations on and near Cannon Air Force Base

Figure 1-6 Distribution of Soils by Type at Cannon Air Force Base

Figure 1-7 Project Schedule

Figure 2-1 Project Team and Lines of Authority

Figure 3-1 Decision Diagram for Site Investigation at Eight Sites

Figure 3-2 Preliminary Site Conceptual Exposure Model (ST-C501)

Figure 3-3 Preliminary Site Conceptual Exposure Model (ST-C502)

Figure 3-4 Preliminary Site Conceptual Exposure Model (ST-C503)

Figure 3-5 Preliminary Site Conceptual Exposure Model (ST-C504)

Figure 3-6 Preliminary Site Conceptual Exposure Model (ST-C505)

Figure 3-7 Preliminary Site Conceptual Exposure Model (ST-C507)

Figure 3-8 Preliminary Site Conceptual Exposure Model (ST-C508)

Figure 3-9 Preliminary Site Conceptual Exposure Model (TA/AS-C129)

Figure 4-1a Site Map with Previous Investigation Locations (Base Map) (SS-C501)

Figure 4-1b Site Map with Previous Investigation Locations (Aerial Photo Map) (SS-C501)

Figure 4-2a Site Map with Previous Investigation Locations (Base Map) (ST-C502)
Figure 4-2b Site Map with Previous Investigation Locations (Aerial Photo Map) (ST-C502)
Figure 4-3a Site Map with Previous Investigation Locations (Base Map) (ST-C503)
Figure 4-3b Site Map with Previous Investigation Locations (Aerial Photo Map) (ST-C503)
Figure 4-4a Site Map with Previous Investigation Locations (Base Map) (ST-C504)
Figure 4-4b Site Map with Previous Investigation Locations (Aerial Photo Map) (ST-C504)
Figure 4-5a Site Map with Previous Investigation Locations (Base Map) (ST-C505)
Figure 4-5b Site Map with Previous Investigation Locations (Aerial Photo Map) (ST-C505)
Figure 4-6a Site Map with Previous Investigation Locations (Base Map) (SS-C507)
Figure 4-6b Site Map with Previous Investigation Locations (Aerial Photo Map) (SS-C507)
Figure 4-7a Site Map with Previous Investigation Locations (Base Map) (SD-C508)
Figure 4-7b Site Map with Previous Investigation Locations (Aerial Photo Map) (SD-C508)
Figure 4-8a Site Map with Previous Investigation Locations (Base Map) (TA/AS-C129)
Figure 4-8b Site Map with Previous Investigation Locations (Aerial Photo Map) (TA/AS-C129)
Figure 5-1a Planned Soil Sampling Locations (Base Map) (SS-C501)
Figure 5-1b Planned Soil Sampling Locations (Aerial Photo Map) (SS-C501)
Figure 5-2a Planned Soil Sampling Locations (Base Map) (ST-C502)
Figure 5-2b Planned Soil Sampling Locations (Aerial Photo Map) (ST-C502)
Figure 5-3a Planned Soil Sampling Locations (Base Map) (ST-C503)
Figure 5-3b Planned Soil Sampling Locations (Aerial Photo Map) (ST-C503)
Figure 5-4a Planned Soil Sampling Locations (Base Map) (ST-C504)
Figure 5-4b Planned Soil Sampling Locations (Aerial Photo Map) (ST-C504)
Figure 5-5a Planned Soil Sampling Locations (Base Map) (ST-C505)
Figure 5-5b Planned Soil Sampling Locations (Aerial Photo Map) (ST-C505)
Figure 5-6a Planned Soil Sampling Locations (Base Map) (SS-C507)
Figure 5-6b Planned Soil Sampling Locations (Aerial Photo Map) (SS-C507)
Figure 5-7a Planned Soil Sampling Locations (Base Map) (SD-C508)
Figure 5-7b Planned Soil Sampling Locations (Aerial Photo Map) (SD-C508)
Figure 5-8a Planned Soil Sampling Locations (Base Map) (TA/AS-C129)
Figure 5-8b Planned Soil Sampling Locations (Aerial Photo Map) (TA/AS-C129)

Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
µg	microgram
27 SOCES	27th Special Operations, Civil Engineer Squadron
AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
AGE	Aerospace Ground Equipment
ANSI	American National Standards Institute
AST	aboveground storage tank
bgs	below ground surface
B.P.	before the present
BRA	Baseline Risk Assessment
BTEX	benzene, toluene, ethylbenzene and total xylenes
CAC	corrective action complete
CADD	computer-aided design and drafting
CDRL	Contract Data Requirements List
CEC	cation exchange capacities
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CoC	chain of custody
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CPSMR	Contractor's Progress, Status, and Management Report
CSEM	conceptual site exposure model
DERA	Defense Environmental Restoration Account
DL	detection limit
DQO	data quality objective
DRO	diesel range organics
EMAX	EMAX Laboratories
EOD	Explosives Ordnance Disposal

ERPIMS	Environmental Resources Program Information Management Systems
ESL	ecological screening level
ESSL	Ecological Soil Screening Level
FIPS	Federal Information Processing Standard
FMER	Funds and Man-Hour Expenditure Report
FSP	Field Sampling Plan
ft	feet
FTL	Field Team Leader
gal	gallon
gpm	gallon per minute
GPS	global positioning system
GRO	gasoline range organics
HQ	hazard quotient
hr	hour
HSO	Health and Safety Officer
IDW	investigation-derived waste
IRP	Installation Restoration Program
JP	jet propellant
Keers	Keers Technical Services
kg	kilogram
km	kilometer
L	liter
Lee Wan	Lee Wan Associates, Inc.
m	meter
MEC	munitions and explosives of concern
mg	milligram
min	minute
mm	millimeter
MOGAS	motor gasoline
mph	miles per hour
MS/MSD	matrix spike/matrix spike duplicate
msl	mean sea level

NAD83	North American Datum of 1983
NMED	New Mexico Environment Department
No.	number
ORO	oil range organics
OSHA	Occupational Safety and Health Administration
OWS	oil/water separator
Parallax	Parallax, Inc.
PAWP	Project Activities Work Plan
PCB	polychlorinated biphenyl
PE	proficiency evaluation
PES	Plains Environmental Services
PID	photoionization detector
PM	Project Manager
POC	point of contact
POL	petroleum, oil and lubricants
PPC	Project Planning Chart
PPE	personal protective equipment
PSA	preliminary site assessment
QA	quality assurance
QC	quality control
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RPM	Restoration Program Manager
RSL	Regional Screening Level
SC	clayey sand
SCEM	site conceptual exposure model
SCFS	Sample Collection Field Sheet
sec	second
SI	Site Investigation
SLERA	Screening Level Ecological Risk Assessment
SM	silty sand
SOP	standard operating procedure

SOW	statement of work
SSHP	Site Safety and Health Plan
SSL	soil screening level
SSO	Site Safety Officer
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TBD	to be determined
TCL	target compound list
TCLP	Toxicity Characteristic Leaching Procedure
TPH	total petroleum hydrocarbon
TRPH	total recoverable petroleum hydrocarbons
TTCP	Technical Cooperation Program
UFP-QAPP	Uniform Federal Policy–Quality Assurance Project Plan
URS	URS Group, Inc.
U.S.	United States
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
UTL	upper tolerance limit
UXO	unexploded ordnance
VOC	volatile organic compound
W-C	Woodward-Clyde

This document presents the Project Activities Work Plan (PAWP) Addendum (Air Force Center for Engineering and the Environment [AFCEE] Contract Data Requirements List [CDRL] A007) for the Site Investigation (SI) at eight sites at Cannon Air Force Base (AFB) near Clovis, New Mexico (**Figure 1-1**). The eight sites include the following:

- **The Former Aerospace Ground Equipment (AGE) Dispatch Facility Spills Site (SS-C501)** includes at least two diesel fuel spills (up to 60 gallons each) that occurred on the asphalt parking lot to the northeast of Building 186.
- **The Former Gas Station Site (ST-C502)** includes the three former 10,000-gallon motor gasoline (MOGAS) and diesel fuel underground storage tanks (USTs), and associated fuel lines and dispensers, where fuel spills or leaks may have occurred.
- **The Base Support/Operations Generator Former Underground Storage Tank (UST) Site (ST-C503)** includes a former 500-gallon diesel fuel UST that may have leaked.
- **The Hospital Abandoned UST Site (ST-C504)** includes an abandoned in place 25,000-gallon diesel fuel UST that may have leaked.
- **The Flightline Generator USTs Site (ST-C505)** includes two former 500-gallon diesel fuel USTs that may have leaked.
- **The Former Petroleum, Oil and Lubricants (POL) Yard Refueling Area Site (SS-C507)** includes historical fuel spills or leaks associated with fuel unloading areas, refueling stations, fuel pumps, aboveground storage tanks (ASTs), and aboveground and below ground fuel piping.
- **The Surface Disposal Area Site (SD-C508)** includes visible burned debris disposed at the surface.
- **The Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129 [Solid Waste Management Unit (SWMU) 129])** includes a waste oil disposal/storage area, a former oil/water separator (OWS), and an associated leach field used to discharge water from the former OWS.

1.1 AUTHORITY

URS Group, Inc. (URS) has been contracted by the AFCEE under Contract Number (No.) FA8903-08-D-8783, Task Order 0169 to complete an SI at eight sites at Cannon AFB. This SI is being addressed under the Environmental Restoration Program for Cannon AFB.

1.2 PURPOSE AND SCOPE

This PAWP describes the field sampling requirements to complete an SI at eight sites at Cannon AFB. The site location map (**Figure 1-2**) shows the locations of the eight sites that are the subject of this investigation. This PAWP also describes the investigative activities that will be used to provide the information necessary to further define the horizontal and vertical extent of known soil contamination, determine the presence or absence of other chemicals of potential

concern (COPC) in soil, and determine if unacceptable risks to human health or the environment exists at these eight sites.

This PAWP provides the technical approach, rationale, field procedures, and data quality objectives (DQOs) to be followed to achieve the objectives of the SI in accordance with the AFCEE statement of work (SOW) dated January 19, 2011. This project will include preparing planning documents, completing a field investigation (discrete surface and subsurface soil sampling), analyzing soil samples for site-specific analytical parameters, evaluating the chemical data, comparing the analytical results to established soil screening criteria and ecological screening criteria, updating the preliminary site conceptual exposure models (SCEMs) and preparing the SI Report.

This PAWP is organized as follows:

- **Section 1** presents the authority, purpose and scope, facility description and background, and anticipated project schedule.
- **Section 2** lists the project and task organization for this SI at eight sites, including roles and responsibilities.
- **Section 3** presents the decision process, including DQOs developed for this project, a description of SCEM development, evaluation of background concentrations, and screening level evaluation methodology.
- **Section 4** presents the site description and backgrounds, including summaries of previous investigations conducted at each site.
- **Section 5** presents the Field Sampling Plan (FSP) (AFCEE CDRL A005) to be used for this project.
- **Section 6** provides the project documentation and reporting requirements.
- **Section 7** provides references used to develop the PAWP.

The appendices contain the following information:

- **Appendix A** – Uniform Federal Policy–Quality Assurance Project Plan (UFP–QAPP) (AFCEE CDRL A004)
- **Appendix B** – Site Safety and Health Plan (SSHP) (AFCEE CDRL A004)
- **Appendix C** – Standard Operating Procedures (SOPs)
- **Appendix D** – Historical Site Information (Previous Site Documentation, Historical Aerial Photos, As-built Drawings, Photographic Logs)

1.3 FACILITY DESCRIPTION AND BACKGROUND

1.3.1 Setting – Physical Geography

Cannon AFB is situated in the Southern High Plains Physiographic Province in the Llano Estacado subprovince. The Llano Estacado is a nearly flat plain sloping gently (10 to 15 feet per mile) to the east and southeast. Elevations in the eastern New Mexico portion of the Llano Estacado exceed 4,000 feet above mean sea level (msl). In the vicinity of Cannon AFB, elevations range from 4,250 feet to 4,350 feet above msl.

The most prominent geomorphic features in the vicinity of Cannon AFB are blowouts and broad, widely spaced valleys. Less common landforms are relict sand dunes located along the northern side of the Portales Valley to the south of the base. Relict dunes are not found on or near Cannon AFB.

Blowouts are broad shallow depressions, which form as the result of soil eroded by wind. Blowouts commonly collect surface runoff from small to moderate sized drainage areas. During periods of rainfall, runoff collects in blowouts to form ephemeral playa lakes. Playas have no external surface drainage. Water is lost by infiltration to the soil and evaporation; without recharge, playa lakes persist for only a few days or weeks. Three playas are located within the base, and several more are found to the north and east of the base.

Stream valleys tend to be fairly broad and widely spaced. Streams are ephemeral and drainages are poorly developed. No streams exist on or near Cannon AFB. Running Water Draw and Frio Draw (located about 10 and 20 miles, respectively, north of Cannon AFB) are the nearest streams. These are second-order streams. Both streams are very straight, flow southeast, and have rectilinear drainage patterns with short laterals (Woodward-Clyde [W-C] 1991).

1.3.2 Demographics and Land Use Near Cannon AFB

Cannon AFB is located just west of the City of Clovis, New Mexico, and just south of United States (U.S.) Highway 60/84 in a farming and ranching area. The majority of the land surrounding Cannon AFB is productive, irrigated farmland or grassland. The major crops are wheat, sorghum, sugar beets, corn, cotton, alfalfa, barley, and peanuts. The land is also used for cattle grazing, both beef and dairy, and Clovis is considered the "Cattle Capital of the Southwest." There were 33,063 people living in Clovis in 2004, according to U.S. Census data, while the Cannon AFB population was estimated to be 2,600 in 2008.

1.3.3 Climatology

The climate of east-central New Mexico is classified as tropical semi-arid, with summer temperature and precipitation maxima. Average monthly temperatures range from a January low of 12 degrees Celsius (°C) (39 degrees Fahrenheit [°F]) to a July high of 26°C (78°F). Extreme daily temperatures range from –24°C (–11°F) to 41°C (106°F) (Lee Wan Associates, Inc. [Lee Wan] 1990). Average monthly precipitation ranges from 1 centimeter (cm) (0.4 inches) in winter to 6.9 cm (2.7 inches) in July. The maximum-recorded 24-hour rainfall is 12.2 cm

(4.8 inches), which occurred in the month of August. Rainfall occurs on eight or more days per month during the summer precipitation maximum. Mean annual precipitation is approximately 41 cm (16 inches). The mean annual evapotranspiration rate is 181.4 centimeters per year (71.4 inches per year) (Lee Wan 1990). Prevailing winds are from the west at an average of 5 kilometers per hour (km/hr) (3.1 miles per hour [mph]) during fall, winter, and spring. During the summer, winds are from the south at an average of 3.7 km/hr (2.3 mph).

The atmosphere around the area of Cannon AFB is generally well mixed. The seasonal and annual average mixing heights can vary from 400 meters in the morning to 4,000 meters in the afternoon. The afternoon mixing heights are typically greater during the spring and fall seasons. The morning mixing heights are usually low, due to nighttime heat loss from the ground, producing surface-based temperature inversions. After sunrise, these inversions break up, and solar heating of the earth's surface causes vertical mixing in the atmosphere.

Dust is frequently entrained into the atmosphere in this region of the country because of gusty winds and the semiarid climate. The Texas Panhandle-eastern New Mexico area is considered the worst area in the United States for windblown dust. Occasionally, this windblown dust is of sufficient quantity to restrict visibility. Most of the seasonal dust storms occur in March and April, when the wind speeds are typically high (i.e., average 5 km/hr) (W-C 1991).

1.3.4 Geology

A generalized geologic section at Cannon AFB is shown in **Figure 1-3**. The near surface stratigraphic units of interest at Cannon AFB are the Late Miocene-Late Pliocene-age Ogallala Formation and the Early Triassic Dockum Group.

The Dockum Group consists of three formations. Stratigraphically, the lowest unit is the Santa Rosa Sandstone. Overlying the Santa Rosa Sandstone are the Chinle and Redonda Formations. The Chinle and Redonda Formations are composed mainly of red shales with lesser interbedded sands, and are known locally as "redbeds." The top of the Dockum Group is marked by an erosional nonconformity having relief of up to several hundred feet (Lee Wan 1990).

Overlying the Dockum Group redbeds is the Ogallala Formation. The Ogallala Formation extends from eastern New Mexico and Colorado into Texas, Oklahoma, Kansas, Nebraska, and South Dakota. According to Lee Wan and Associates, Inc. (Lee Wan) (1990), drillers' logs from Cannon AFB indicate that the Ogallala Formation varies from 360 feet to 415 feet in thickness. The incised upper surface of Triassic redbeds strongly influences Ogallala thickness. Paleo valleys in the post Triassic nonconformity are deep and trend dominantly east to west. Ogallala thickness may thus vary significantly over short north to south distances.

The Ogallala Formation is erosionally truncated to the south along the abandoned Portales Valley, to the west along the Pecos River Valley, and to the north in a series of ephemeral stream valleys. The Ogallala Formation extends more than 125 miles to the east before terminating as an escarpment in Briscoe County, Texas. Springs and seeps are common along the erosional margins of the Ogallala.

The Ogallala Formation dips gently and monoclinally to the southeast in the vicinity of Cannon AFB. As reported in Lee Wan (1990), data suggest that some quaternary warping may have occurred; however, most of these structures are located well to the northwest and southwest of Cannon AFB. No faults or buried structural lineaments are known to exist in the vicinity of Cannon AFB.

The Ogallala Formation is composed of unconsolidated poorly sorted gravel, sand, silts, and clays. The base of the Ogallala is generally marked by a gravel, cobble, and boulder deposit. This basal member contains sediments derived from igneous and sedimentary rocks transported from the mountains to the west. The Ogallala Formation was laid down as stream and overbank deposits formed within coalescing alluvial fans. These fans form a broad pediment along the eastern flank of the Rocky Mountains. As is typical of alluvial deposits, Ogallala internal stratigraphy varies vertically and horizontally over short distances.

Except where strongly cemented by calcium carbonate (caliche), the sediments of the Ogallala are loose and friable. Authigenic and allogenic clays are found as a trace to abundant matrix mineral (Lee Wan 1990). As reported by Lee Wan (1990), five zones have been distinguished within the Ogallala of east central New Mexico on the basis of clay minerals. Smectites (montmorillonites) and attapulgite (with sepeotite) are the dominant clays throughout the Ogallala. Illite is a lesser, but persistent clay, as is kaolinite. Smectite is a swelling clay, causing deep cracks to form in dry surface soils. Smectite in particular and, to a lesser extent, attapulgite and illite, are clays with moderate to high cation exchange capacities (CEC). The formation as a whole should therefore have a relatively high CEC, which should inhibit the migration of charged contaminants, and especially ionic forms of metals.

Caliche is a major feature of the Ogallala Formation, occurring as nearly continuous to discontinuous layers throughout. Caliche is hard, white to pale tan on fresh surfaces, weathering to gray, and has a chalky appearance. Caliche forms as calcium carbonate, leached from overlying sediments, and precipitates in the pore space of the host sediments. Precipitation is caused by the evaporation of downward percolating water. The caliche may thus mark the position of ancient vadose zones. As reported in Lee Wan (1990) radiocarbon dates for the upper "climax" caliche range from approximately 27,000 years before the present (B.P.) to approximately 42,000 years B.P.

Caliche is relatively soluble in acidic water (i.e., water with a pH less than 7) or in waters containing dissolved carbon dioxide. The top surface of the uppermost or "climax" caliche in a fresh outcrop typically shows solution etching.

The Ogallala has numerous continuous to discontinuous caliche layers throughout its thickness. The climax caliche is pisolitic (i.e., consisting of spherical concentrically laminated aggregates 1 to 10 millimeters [mm] in diameter) (Lee Wan 1990). The pisolites are thought to have formed as the caliche was repeatedly chemically weathered and brecciated during Pleistocene pluvials (wet climate episodes) and later recemented during drier intervals. This upper caliche crops out around playas and the bounding escarpments of the Ogallala, and is locally termed "caprock." The climax caliche is typically 3 to 5 feet thick. Caliches that occur lower in the Ogallala are platy and harder. Caliche may be thin or absent below playas (W-C 1991).

1.3.5 Hydrogeology

The lower portion of the Ogallala Formation is the primary regional aquifer for both potable and irrigation water. No deeper aquifers are utilized in the vicinity of Cannon AFB. The Ogallala aquifer is part of the High Plains Aquifer that extends continuously from Wyoming and South Dakota into New Mexico and Texas. In east-central New Mexico, the Ogallala aquifer rests on Dockum Group redbeds, which serve as the basal confining layer. The Ogallala is a water table, or unconfined, aquifer (Lee Wan 1990). The Ogallala aquifer has a southeasterly regional gradient of about 17 feet per mile (0.0032 meters per meter, see **Figure 1-4**). Well yields vary from less than 1 gallon per minute (gpm) in thin silts and sands, and up to 1,600 gpm in thick sands and gravels (Lee Wan 1990). Water quality is generally good, with hardness and fluorides being somewhat high (Lee Wan 1990).

At Cannon AFB, the depth to groundwater is greater than 200 feet, and the Ogallala aquifer has an average saturated thickness of 120 feet based on mid-1960s data. Saturated thickness ranges from 93 to 143 feet, and is influenced by the configuration of the erosional nonconformity surface marking the top of the Dockum Group. The local groundwater gradient is southeasterly at 7.5 feet per mile (Lee Wan 1990). Yields in tests of Cannon AFB water wells have ranged from 776 liters per minute (L/min) (205 gpm) to 4,353 L/min (1,150 gpm). Specific capacities range from 0.14 cubic meters per meter (m^3/m) (11.4 gallons per foot [gal/ft]) to 0.35 m^3/m (27.9 gal/ft) (Lee Wan 1990).

Very rough estimates of hydraulic conductivity were made from well pump tests in water wells 5 and 9 (**Figure 1-5**) using the Theis equation. An estimate of hydraulic conductivity for water well 8 was based on water level recovery data using the Bouwer and Rice approach (Lee Wan 1990). The data used in these calculations were obtained to evaluate pump rates, efficiency, and well yield, and were not intended for use in calculating aquifer properties. The results of these calculations should therefore be considered as first approximations.

Hydraulic conductivity values for water wells 5 and 9 were found to be approximately 2.0 x 10^{-3} centimeters per second (cm/sec). Calculations for water well 8 resulted in a hydraulic conductivity of 2.0 x 10^{-2} cm/sec. In addition, slug testing of two monitoring wells (MW-O and MW-N) was completed by W-C in February 1995 (W-C 1995a). The estimated hydraulic conductivities from these slug tests were both 3 x 10^{-3} cm/sec. These estimates appear to be low when compared to published hydraulic conductivity data for sands and gravels. As reported in Lee Wan (1990), a groundwater flow velocity of about 45 meters per year (150 feet per year) has been estimated. This calculates out to a hydraulic conductivity of approximately 1.4 x 10^{-4} cm/sec. Again, this appears to be low when compared with published data (Freeze and Cherry 1979).

The presence of interstitial clays may account for both the variability and the low values of hydraulic conductivities. Boring logs from Cannon AFB projects and published reports (Lee Wan 1990) indicated that interstitial and interstratified clays are abundant in the Ogallala Formation.

Recharge to the Ogallala is primarily through precipitation. As reported in Lee Wan (1990), a recharge rate of 0.5 inches/year was calculated using the Theis equation. Lee Wan (1990) reported that the recharge rate may be as much as 1.0 inches/year. Due to the high evapotranspiration rate and low precipitation, recharge probably occurs only during heavy rainfall events in which the infiltration capacity of the soil is exceeded and runoff occurs, or during cool months when precipitation exceeds evapotranspiration. Excess runoff flows to playas, and the presence of water in playas may allow deep percolation to the aquifer. The occurrence of this process is evidenced by the presence of clay deposits in, and thin or nonexistent caliche layers directly below, playas. Caliche is soluble in acidic rainwaters, and is leached over time to form percolation pathways.

Discharge from the Ogallala occurs through well pumping and springs along the eroded margins of the formation. Spring discharge does not occur on or near Cannon AFB. Domestic and irrigation water wells are common on and around the base, however. The rate of discharge exceeds the rate of recharge. Water levels in the Ogallala have declined steadily from the 1930s to the present. A decline of 50 to 100 feet has been observed in the area around Clovis, New Mexico for the period from the 1930s to 1980. Lee Wan (1990), states "the largest area of water level decline exceeding 100 feet occurs south of the Canadian River extending from Curry County, New Mexico to Crosby County, Texas."

The dominant uses of groundwater in the Cannon AFB area are as potable and irrigation water. Numerous wells are found in the Cannon AFB area, most of which provide only irrigation water (**Figure 1-5**).

The Ogallala will continue to be used as the primary source of potable and irrigation water for eastern New Mexico. The New Mexico State Engineer designated Curry County as a Water Basin in 1989. This designation allows for regulation of water rights, usage, and well drilling (W-C 1991).

1.3.6 Soils

Soils in the vicinity of Cannon AFB are classified as silty sand (SM) to clayey sand (SC) under the Unified Soil Classification System, and as aridisols (calciorthids) under the Soil Conservation Service Comprehensive Soil Classification System. The following summary is based on the Soil Conservation Service Curry County Soil Survey as reported in Lee Wan (1990).

The most common soil type on the base is the Amarillo fine sandy loam, 0- to 2-percent slope phase (map symbol Ab on **Figure 1-6**). This soil consists of a thin sandy A horizon, well-defined clayey B1-3 horizons, with a calcic B3 horizon at depths below 40 inches. The calcic B3 horizon lies on a calcic C horizon, or on caliche. The Amarillo fine sandy loam is present on all relatively flat surfaces at the base, but is also found on slopes associated with playas (map symbol Ac).

Clovis fine sandy loams, 0- to 2-percent slope phase (map symbol Cb) and 2- to 5-percent slope phase (map symbol Cc), are very similar to Amarillo fine sandy loams. In the Clovis soils, the

depth to the calcic C horizon ranges from 28 to 56 inches. The depth to caliche exceeds 56 inches. Clovis and Amarillo fine sandy loams occur in close association.

In a few limited areas, particularly along the steeper slopes around playas, Mausker fine sandy loam, 0- to 2-percent slope phase (map symbol Ma), and 2- to 5-percent phase (map symbol M6) are found. Mausker fine sandy loams have no B horizons and are very calcareous. The calcic C horizon is within 2 feet of the surface.

The A and B horizons of Amarillo and Clovis fine sandy loams are rapidly to moderately permeable. Mausker fine sandy loam A and Ac horizons are rapidly permeable. Permeabilities in calcic B and C horizons are moderate (Lee Wan 1990).

1.3.7 Background Metals Concentrations in Soil

The natural soils in the vicinity of Cannon AFB are alkaline and generally rich in metals. Typically high concentrations of aluminum, iron, magnesium, manganese, and potassium combine with elevated levels of many other metals in the natural soils. Calcium is naturally present in the soils at levels up to nearly 2.00E+05 milligrams per kilogram (mg/kg). Tightly cemented layers of "caliche" are present in several horizons in the natural soils and the Ogallala aquifer below. As stated in **Section 1.3.4**, the Ogallala Formation as a whole should have a relatively high CEC, which should, in turn, inhibit the migration of charged contaminants, especially the ionic forms of metals.

The background levels of inorganic compounds in surface and subsurface soil at Cannon AFB are presented in **Table 1-1** in the form of a mean value and statistical information on the ranges encountered for each element. **Table 1-1** has been adapted from a final report by W-C dated September 1997 entitled "Naturally Occurring Concentrations of Inorganics and Background Concentrations of Pesticides at Cannon Air Force Base, New Mexico." This report summarizes background data for soil from numerous past investigations in the vicinity.

The upper tolerance limits (UTLs) presented in **Table 1-1** will be the background levels used in the screening of surface and subsurface soil chemical results for this SI at eight sites.

1.3.8 Water Quality

The groundwater quality at Cannon AFB is generally good, with dissolved solids ranging from 2.50E+02 to 5.00E+02 milligrams per liter (mg/L) (Gutentag, et al. 1984) and fluorides ranging from 2.2E+00 to 2.7E+00 mg/L (William Matotan and Associates, Inc. 1985).

1.4 PROJECT SCHEDULE

Fieldwork is scheduled for the spring/summer of 2012. Preparation for field sampling activities including mobilization, acquisition of base passes and utility locates is described in **Section 5** of this PAWP. The proposed project schedule (i.e., Project Planning Chart [PPC]) (AFCEE CDRL B002) is provided in **Figure 1-7**. The PPC will be updated on a monthly basis, and will be

provided with the monthly Contractor's Progress, Status, and Management Report (CPSMR) (AFCEE CDRL B004).

TABLE 1-1

SUMMARY OF BACKGROUND ELEMENTAL CONCENTRATIONS[1] IN SOIL SAMPLES[2] AT CANNON AFB, NEW MEXICO

	Mean (x)		Standard Deviation (s)		95% Upper Tolerance Limit of Background Concentrations	
Element	Surface Soil	Subsurface Soil	Surface Soil	Subsurface Soil	Surface Soil	Subsurface Soil
Aluminum	5,508	5,932	1,964	2,183	8,950	12,214
Antimony	ND (3)	ND (3)	ND (3)	ND (3)	3.15 (3)	16 (3)
Arsenic	2.1	2.1(4)	0.48	0.96 (4)	3.6	4.3 (4)
Barium	100	210	165	199	670	890
Beryllium	0.35 (4)	0.35 (4)	0.13 (4)	0.17 (4)	0.78 (4)	0.73 (4)
Cadmium	ND (3)	ND (3)	ND (3)	ND (3)	0.435 (3)	1.3 (3)
Calcium	5,645	89,410	11,366	64,611	44,800	237,498
Chromium (total)	7.1	5.6	1.3	2.33	10.5	13.3
Cobalt	2.9	2.6 (4)	1.0	1.4 (4)	6.6	4.7 (4)
Copper	6.8	3.8 (4)	4.6	1.97 (4)	18.3	8.3 (4)
Iron	6,458	5,148	1,349	2,262	10,100	13,148
Lead	6.8	4.7	1.6	1.7	12	8.7
Magnesium	1,066	4,260	390	3,856	1,930	19,300
Manganese	139	83	51	50	307	333
Mercury	0.025 (4)	ND (3)	0.016 (4)	ND (3)	0.056 (4)	0.019 (3)
Nickel	5.5	5.9 (4)	1.6	2.41 (4)	11	14.9 (4)
Potassium	1,345	1,222	413	417	2,691	2,512
Selenium	ND (3)	0.47 (4)	ND (3)	0.31 (4)	0.26 (3)	1.1 (4)
Silver	--- (5)	ND (3)	--- (5)	ND (3)	0.4 (5)	2.65 (3)
Sodium	91	351(4)	10	253 (4)	102	1,227 (4)
Thallium	ND (3)	ND (3)	ND (3)	ND (3)	0.6 (3)	2.65 (3)
Vanadium	14.9	16	2.8	5.2	23.3	32.8
Zinc	15.4	12.1	5.2	4.8	32.2	30.6

Notes:

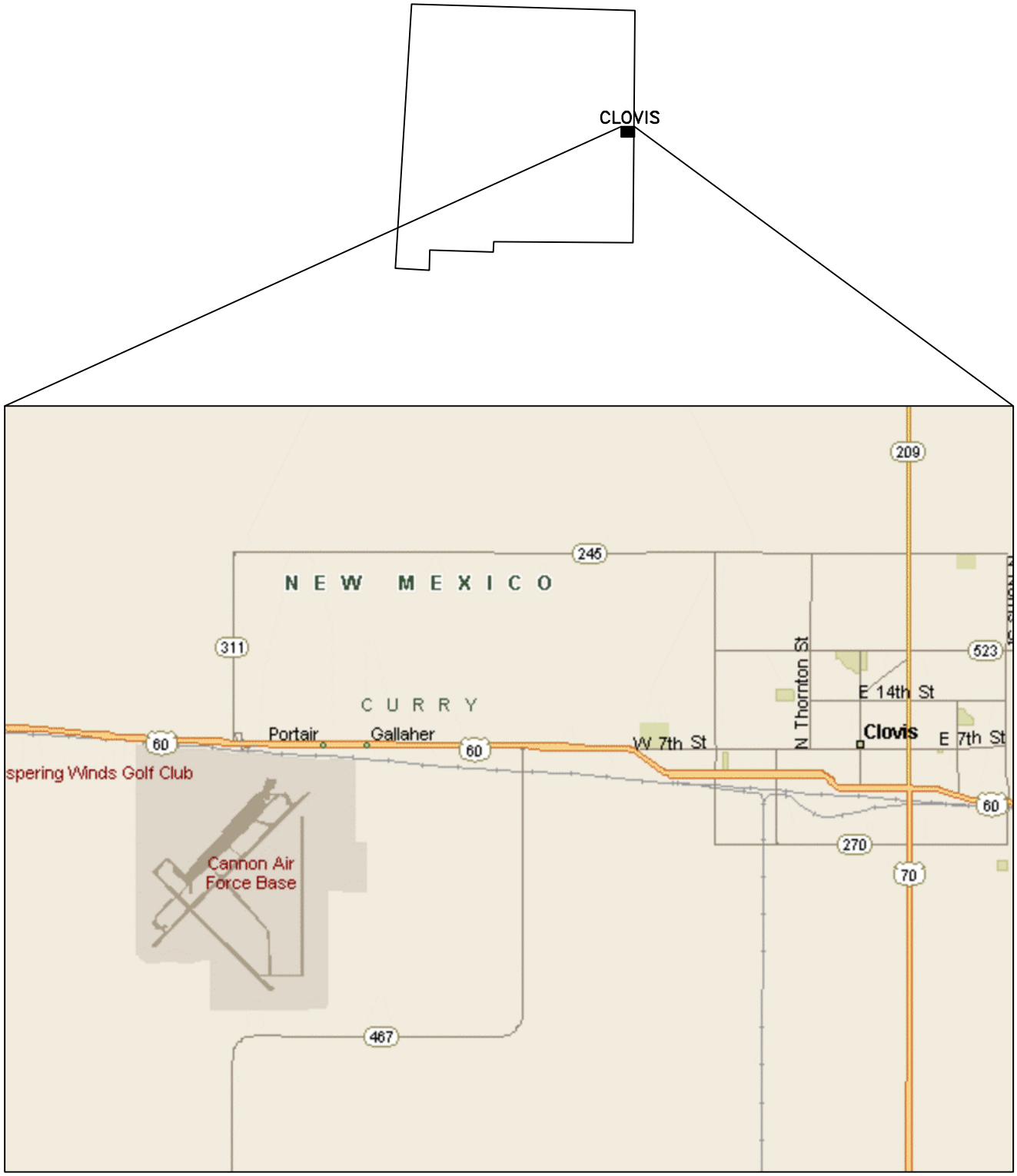
(1) All concentrations are in mg/kg.

(2) From report entitled "Naturally Occurring Concentrations of Inorganics and Background Concentrations of Pesticides at Cannon Air Force Base, New Mexico" (W-C 1997).

(3) All analytical samples were nondetect; therefore, a mean and standard deviation were not calculated. One-half the highest reporting limit is used as the 95% UTL. The actual mean, standard deviation, and UTL may be less than these values.

(4) Values determined from a data set including one-half of the reporting limits for nondetects.

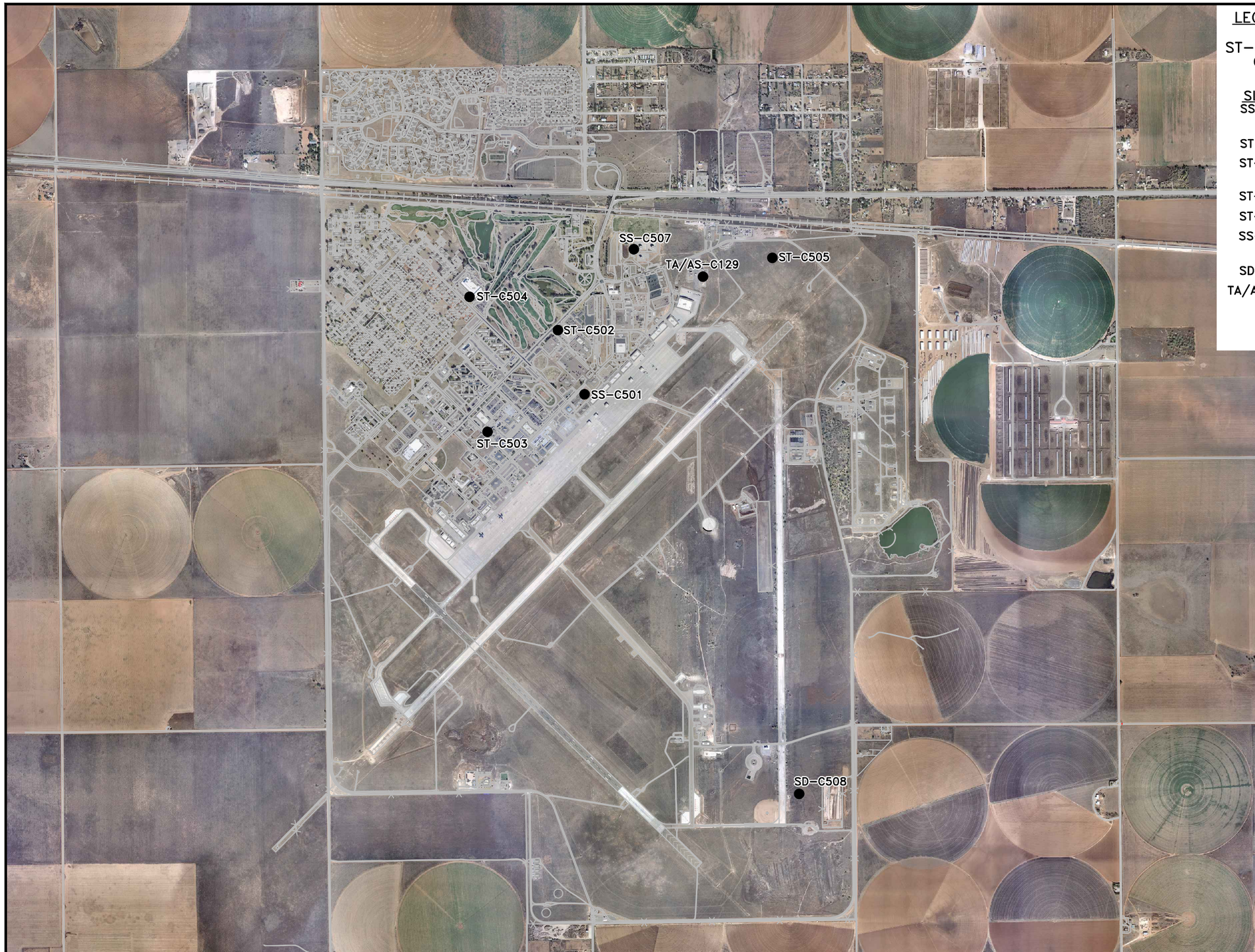
(5) Silver was detected in only one sample; therefore, a mean and standard deviation were not calculated. The single detected concentration is used as the 95% UTL.



INSTALLATION LOCATION MAP
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 05/16/11	PROJECT NO. 16170622	FIG. NO. 1-1
CHK'D. BY: CSA	REVISION: 0		

June 10, 2011 3:57:42 p.m.
Drawing: T:\CANNON\16170622\200\1-1.dwg



LEGEND

ST-C505 ● SITE LOCATION AND IDENTIFIER

SITE ID	DESIGNATED AREA
SS-C501	FORMER AEROSPACE GROUND EQUIPMENT (AGE) DISPATCH FACILITY SPILLS SITE
ST-C502	FORMER GAS STATION SITE
ST-C503	BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE
ST-C504	HOSPITAL ABANDONED UST SITE
ST-C505	FLIGHTLINE GENERATOR UST SITE
SS-C507	FORMER PETROLEUM, OIL AND LUBRICANTS (POL) YARD REFUELING AREA SITE
SD-C508	SURFACE DISPOSAL AREA SITE
TA/AS-C129	WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE

N

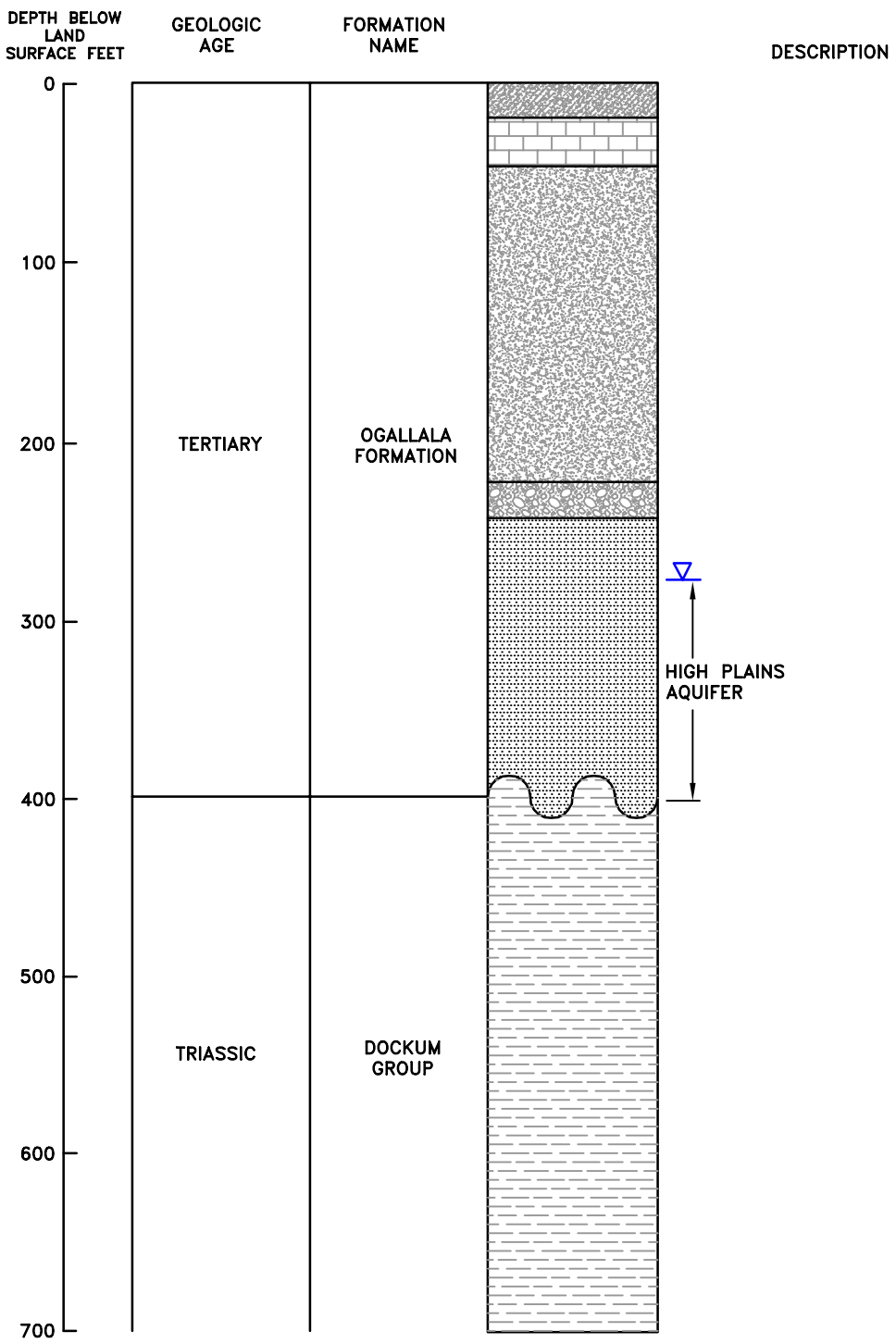
2000 1000 0 2000

SCALE IN FEET

SITE LOCATION MAP
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/05/11	PROJECT NO. 16170622	FIG. NO. 1-2
CHK'D. BY: CSA	REVISION: 0		

August 08, 2011 3:50:28 p.m.
Drawing: T:\CANNON\16170622\200\1-2.dwg



LEGEND

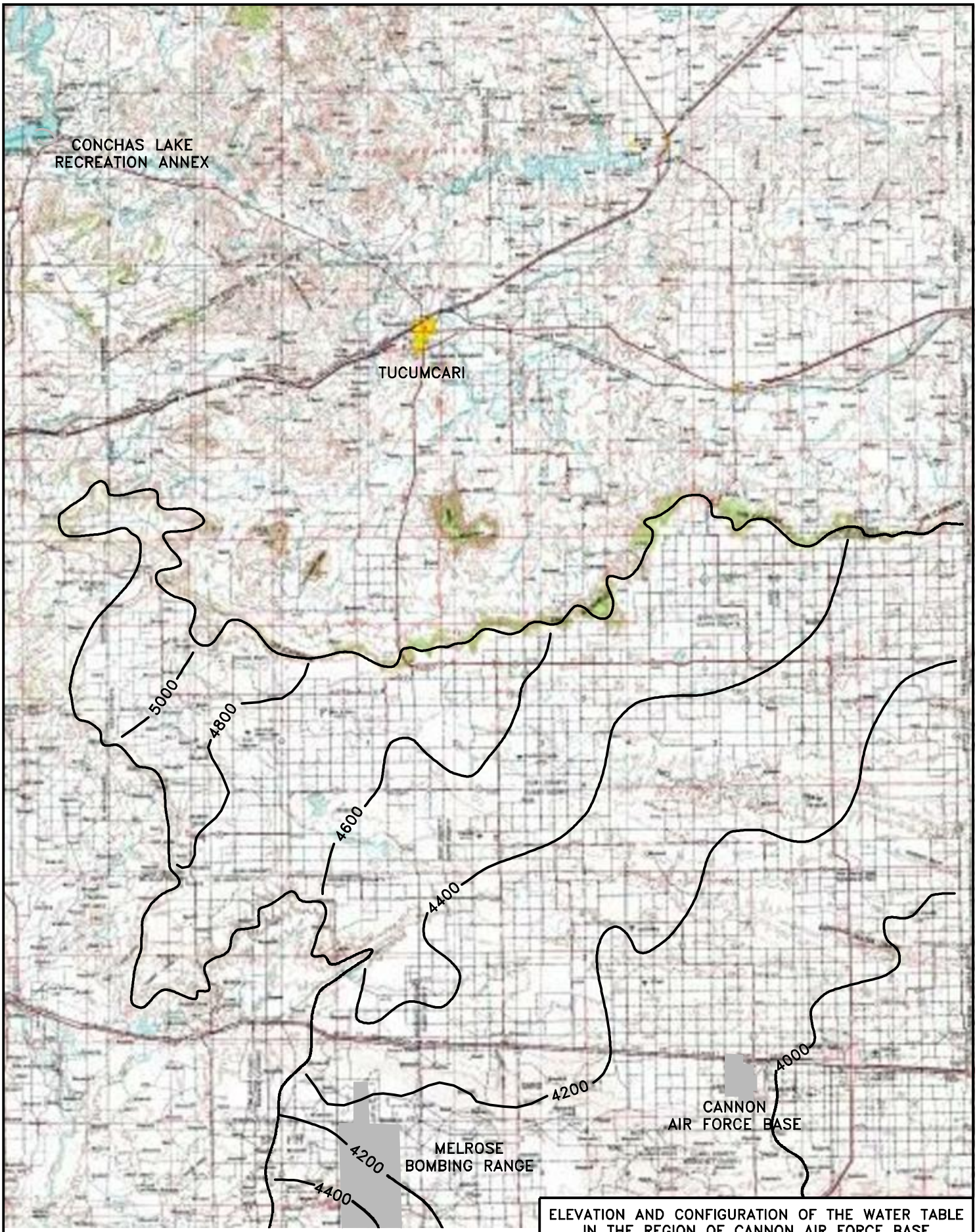
- SILTY SAND WITH CALICHE
- CALICHE
- SAND AND SILTY SAND
- SANDY GRAVEL
- SAND
- SANDSTONE (RED BEDS)
- LITHOLOGIC CONTACT
- EROSIONAL UNCONFORMITY
- WATER LEVEL

SOURCE: MODIFIED FROM GUTENTAG ET.AL., 1984

GENERALIZED GEOLOGIC STRATA AT CANNON AIR FORCE BASE
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/11/11	PROJECT NO. 16170622	FIG. NO. 1-3
CHK'D. BY: CSA	DATE: 04/11/11		

June 10, 2011 4:03:00 p.m.
Drawing: T:\CANNON\16170622\200\1-3.dwg



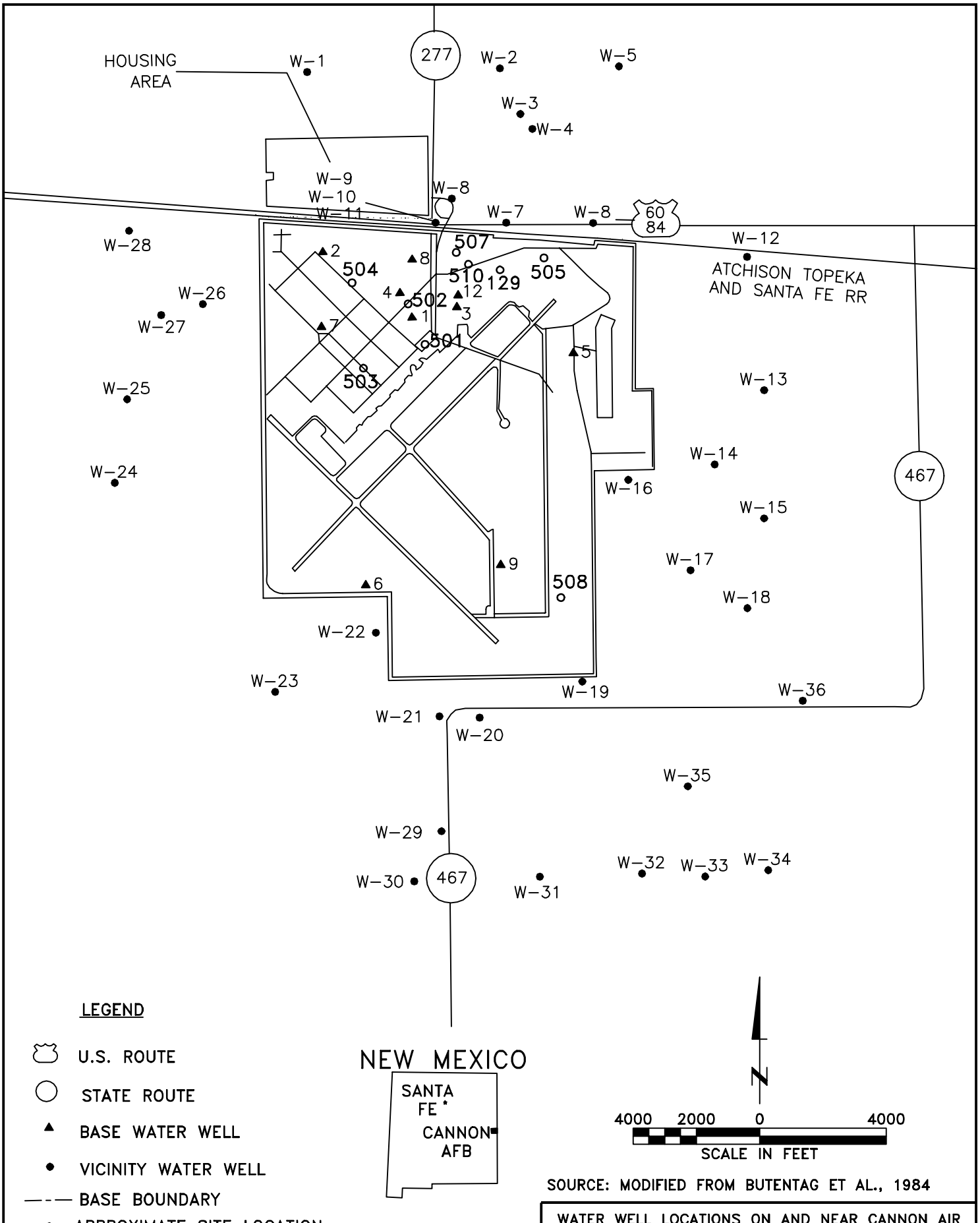
NOTE: ADAPTED FROM LEE WAN AND ASSOCIATES 1990
ORIGINAL SOURCE: USGS

8 4 0 8
SCALE IN MILES

June 10, 2011 4:03:55 p.m.
Drawing: T:\CANNON\16170622\200\1-4.dwg

ELEVATION AND CONFIGURATION OF THE WATER TABLE
IN THE REGION OF CANNON AIR FORCE BASE
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/11/11	PROJECT NO. 16170622	FIG. NO. 1-4
CHK'D. BY: CSA	REVISION: 0		

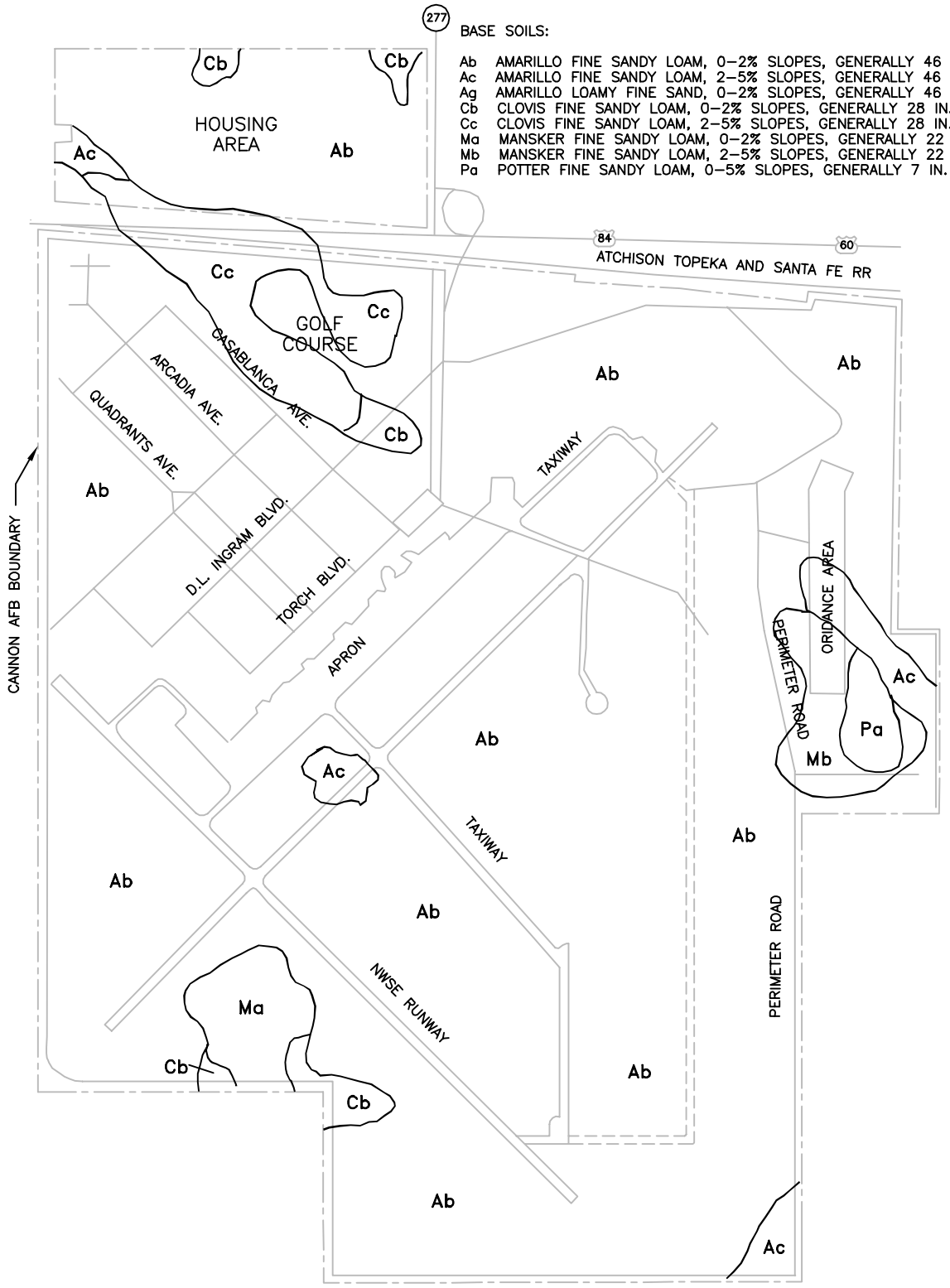


SOURCE: MODIFIED FROM BUTENTAG ET AL., 1984

WATER WELL LOCATIONS ON AND NEAR CANNON AIR FORCE BASE
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 05/16/11	PROJECT NO. 16170622	FIG. NO. 1-5
CHK'D. BY: CSA	DATE: 05/16/11		

June 10, 2011 4:05:16 p.m.
Drawing: T:\CANNON\16170622\200\1-5.dwg



BASE SOILS:

Ab AMARILLO FINE SANDY LOAM, 0–2% SLOPES, GENERALLY 46 IN. THICK
Ac AMARILLO FINE SANDY LOAM, 2–5% SLOPES, GENERALLY 46 IN. THICK
Ag AMARILLO LOAMY FINE SAND, 0–2% SLOPES, GENERALLY 46 IN. THICK
Cb CLOVIS FINE SANDY LOAM, 0–2% SLOPES, GENERALLY 28 IN. THICK
Cc CLOVIS FINE SANDY LOAM, 2–5% SLOPES, GENERALLY 28 IN. THICK
Ma MANSKER FINE SANDY LOAM, 0–2% SLOPES, GENERALLY 22 IN. THICK
Mb MANSKER FINE SANDY LOAM, 2–5% SLOPES, GENERALLY 22 IN. THICK
Pa POTTER FINE SANDY LOAM, 0–5% SLOPES, GENERALLY 7 IN. THICK

N

2000 1000 0 2000
SCALE IN FEET

SOURCE: USDA–S.C.S., SOIL SURVEY OF CURRY COUNTY N.M., 1958

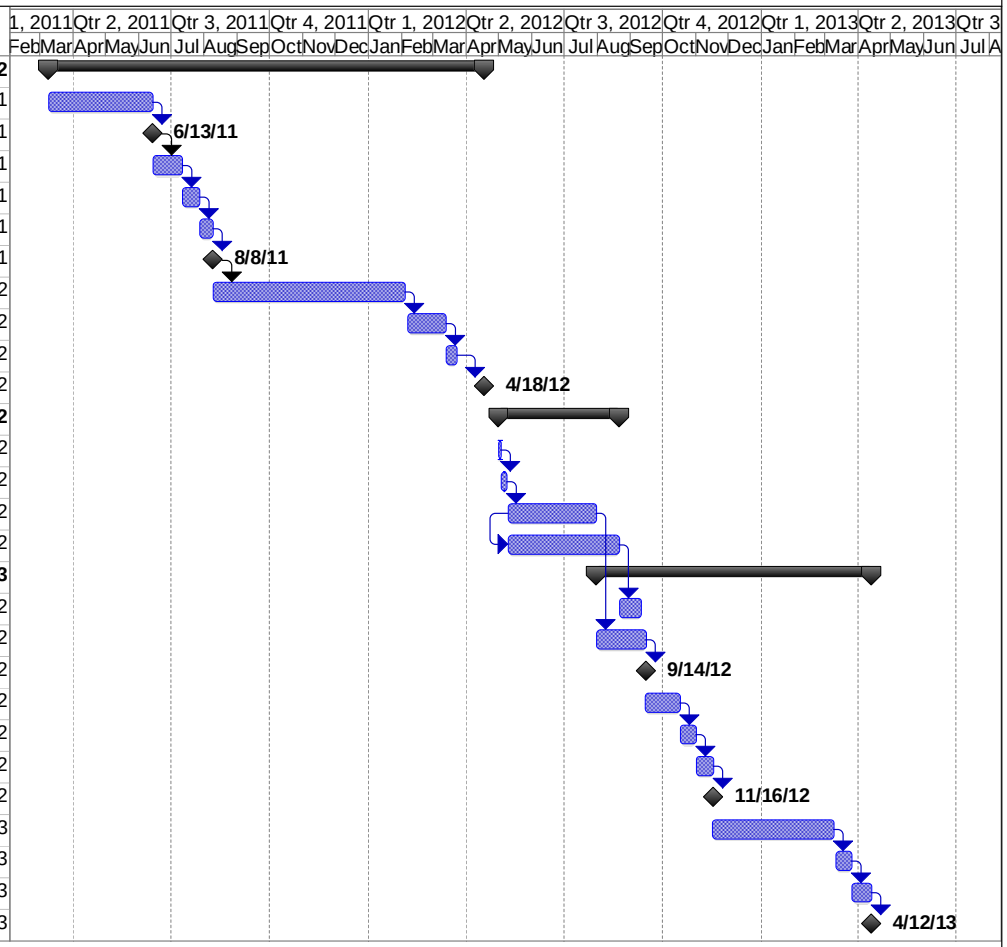
DISTRIBUTION OF SOILS BY TYPE AT
CANNON AIR FORCE BASE
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/11/11	PROJECT NO. 16170622	FIG. NO. 1–6
CHK'D. BY: CSA	DATE: 04/11/11		

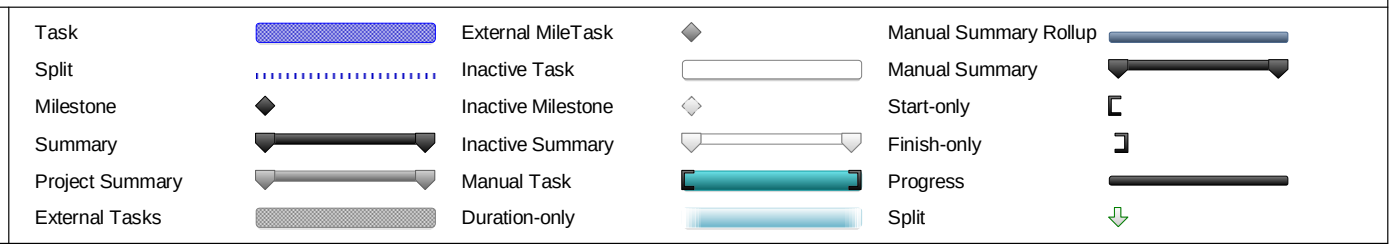
June 10, 2011 4:05:41 p.m.
Drawing: T:\CANNON\16170622\200\1-6.dwg

FIGURE 1-7
SI AT EIGHT SITES
CANNON AIR FORCE BASE, NEW MEXICO

Task Name	Duration	Start	Finish
Project Activities Work Plan, HSP, and SAP	**406 days**	**Wed 3/9/11**	**Wed 4/18/12**
Complete Draft Version	97 days	Wed 3/9/11	Mon 6/13/11
Submit Draft	0 days	Mon 6/13/11	Mon 6/13/11
Cannon AFB Review of Draft	28 days	Tue 6/14/11	Mon 7/11/11
RTCs on Draft	16 days	Tue 7/12/11	Wed 7/27/11
Cannon AFB Concurrence on RTCs	12 days	Thu 7/28/11	Mon 8/8/11
Submit Draft Final	0 days	Mon 8/8/11	Mon 8/8/11
Cannon AFB and NMED Review of Draft Final	179 days	Tue 8/9/11	Fri 2/3/12
RTCs on Draft Final	36 days	Mon 2/6/12	Mon 3/12/12
Cannon AFB Concurrence on RTCs	10 days	Tue 3/13/12	Thu 3/22/12
Submit Final	0 days	Wed 4/18/12	Wed 4/18/12
Field Sampling and Analysis	**112 days**	**Tue 5/1/12**	**Mon 8/20/12**
Obtain Base Passes	2 days	Tue 5/1/12	Wed 5/2/12
Utility Clearances	6 days	Thu 5/3/12	Tue 5/8/12
Field Sampling	82 days	Thu 5/10/12	Mon 7/30/12
Laboratory Analysis	103 days	Thu 5/10/12	Mon 8/20/12
Site Investigation Report	**256 days**	**Tue 7/31/12**	**Fri 4/12/13**
Analytical Data Review and Validation	21 days	Tue 8/21/12	Mon 9/10/12
Complete Draft Version	46 days	Tue 7/31/12	Fri 9/14/12
Submit Draft	0 days	Fri 9/14/12	Fri 9/14/12
Cannon AFB Review of Draft	33 days	Fri 9/14/12	Tue 10/16/12
RTCs on Draft	15 days	Wed 10/17/12	Wed 10/31/12
Cannon AFB and NMED concurrence on RTCs	16 days	Thu 11/1/12	Fri 11/16/12
Submit Draft Final	0 days	Fri 11/16/12	Fri 11/16/12
Cannon AFB and NMED review of Draft Final	113 days	Fri 11/16/12	Fri 3/8/13
RTCs on Draft Final	15 days	Mon 3/11/13	Mon 3/25/13
Cannon AFB and NMED concurrence on RTCs	18 days	Tue 3/26/13	Fri 4/12/13
Submit Final	0 days	Fri 4/12/13	Fri 4/12/13



Notes:
-Draft versions will be submitted to AFCEE and Cannon AFB.
-Draft Final and Final versions will be submitted to AFCEE, Cannon AFB, and NMED.
-This schedule includes approximately 100 days for NMED review. By law NMED has 270 days to perform its review.
-This schedule will be updated monthly based on actual NMED review times.



The project management team and lines of authority are presented in **Figure 2-1**. This chart includes all individuals discussed below. The names of all key participants identified in **Figure 2-1**, including organization names and telephone numbers for project, field, and laboratory project managers, are presented in **Table 2-1** and will be updated as needed.

2.1 ROLES AND RESPONSIBILITIES

2.1.1 Cannon Air Force Base

The Cannon AFB Restoration Program Manager (RPM) has the overall responsibility for all activities associated with the SI at eight sites as it pertains to Cannon AFB.

2.1.2 AFCEE

The AFCEE Project Manager (PM) will oversee all aspects of the investigation and serve as a point of contact (POC) who will communicate directly with the Cannon AFB RPM and the URS Program Manager. In addition, the AFCEE PM will maintain approval authority for all subcontractors and suppliers used to complete the SI at eight sites. The AFCEE PM has the authority, with Cannon AFB and New Mexico Environment Department (NMED) approval, to modify the field activities specified in this PAWP. The AFCEE PM is also responsible for project quality, as well as budget and schedule control. The AFCEE PM will coordinate with Cannon AFB representatives, AFCEE staff, NMED, and URS to ensure that the AFCEE field work meets quality objectives, budget, and schedule.

2.1.3 NMED

The NMED PM has overall responsibility to ensure the environmental program at Cannon AFB, including the field work for this project, complies with the State of New Mexico's environmental program. NMED is the lead regulatory agency for this field work. The NMED PM will coordinate NMED's involvement and receive all notices, reports, plans, and other documents prior to, during, and following the project. Where necessary, NMED will be responsible for coordinating efforts of other regulatory agencies. In addition to the NMED PM, other NMED personnel may be involved in this project and may be on site during all or part of the AFCEE field work.

2.1.4 URS

2.1.4.1 Program Manager

The URS Program Manager will be responsible for monitoring the overall progress of the project, reviewing monthly progress reports, and ensuring that necessary resources are available to the URS PM. The URS Program Manager will also maintain close communication with AFCEE, Cannon AFB, and the NMED to assess client satisfaction during performance on this contract.

2.1.4.2 Project Manager

The URS PM is responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements. The URS PM's primary function is to ensure technical, financial, and scheduling objectives are achieved successfully. The URS PM is responsible for the following:

- Define project objectives and develop a detailed work schedule.
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
- Develop site specific DQOs and ensure compliance with project DQOs.
- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints.
- Orient all support staff concerning the project's special considerations.
- Monitor and direct the project staff.
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness.
- Review and analyze overall task order performance with respect to planned requirements and authorizations.
- Approve all reports (deliverables) before their submission to AFCEE, Cannon AFB, and NMED.
- Ultimately be responsible for the preparation and quality of draft, draft final, and final reports.
- Represent the project team at meetings.
- Update and submit the project schedule as necessary (i.e., PPC [AFCEE CDRL B002]).
- Submit monthly progress reports (i.e., CPSMR [AFCEE CDRL B005] and Funds and Man-Hour Expenditure Reports [FMER] [AFCEE CDRL C001]).

2.1.4.3 URS Field Team Leader

The URS Field Team Leader (FTL) reports directly to the URS PM and is responsible for completion of his assigned activities (i.e., site visits, report preparation, etc.). The FTL is responsible for understanding and implementing provisions of the project documents as they apply to project activities.

2.1.4.4 URS Project Chemist

The URS Project Chemist reports to the URS PM and also works directly with other project personnel. This person is responsible for the data review of all sample results from the analytical laboratories. The URS Chemist will be the POC for subcontractor laboratories.

2.1.4.5 URS Health and Safety Officer

The URS Health and Safety Officer (HSO) will advise the URS PM on health and safety issues; however, the HSO operates independently of the URS PM and can also work directly with the URS Site Safety Officer (SSO). The URS HSO has the responsibility to monitor and verify work is performed in accordance with URS safety requirements.

2.1.4.6 URS Site Safety Officer

The SSO monitors all site activities and is responsible for the implementation of and compliance with URS safety requirements. The SSO reports to the HSO.

2.1.4.7 URS Quality Assurance/Quality Control Officer

The Quality Assurance/Quality Control (QA/QC) Officer will ensure that all QA/QC procedures for this project are being followed.

2.1.4.8 URS Senior Technical Reviewer

The URS Senior Technical Reviewer will be responsible for reviewing project documents prior to delivery. The review will be conducted to ensure that the data presented and conclusions made are reasonable and accurate.

2.1.4.9 URS Risk Assessor

The URS Risk Assessor will be involved in determining risks to human health and/or the environment based on the results of the investigation.

2.2 CONTRACTOR RESPONSIBILITIES

All subcontractors chosen for the project will meet pre-established industry standards of quality criteria and experience for the types of work to be completed. Subcontractors for the project will include analytical laboratories and direct push services.

2.2.1 EMAX Laboratories Project Manager

The EMAX Laboratories (EMAX) PM will report the laboratory results to the URS Project Chemist and will communicate with the URS Project Chemist to facilitate the completion of laboratory activities for the project.

2.2.2 Laboratory QA Officer

The laboratory QA Officer has the overall responsibility for data generated by the laboratory, as well as the adherence to acceptable practice. The laboratory QA Officer will communicate data issues through the laboratory PM. In addition, the laboratory QA Officer will:

- Oversee laboratory QA.
- Oversee QA/QC documentation.
- Conduct detailed data review.
- Determine whether to implement laboratory corrective actions, if required.
- Define appropriate laboratory QA procedures.
- Prepare laboratory SOPs.

2.2.3 Direct Push Services

The direct push subcontractor will be Plains Environmental Services (PES). They will be responsible for adhering to all PAWP procedures according to contractual arrangements and all other associated plans.

2.2.4 Drill Rig Services

The drill rig subcontractor (if necessary) will be Talon/LPE, Ltd. (Talon). They will be responsible for adhering to all PAWP procedures according to contractual arrangement and all other associated plans.

TABLE 2-1
KEY PROJECT PERSONNEL
CANNON AFB, NEW MEXICO

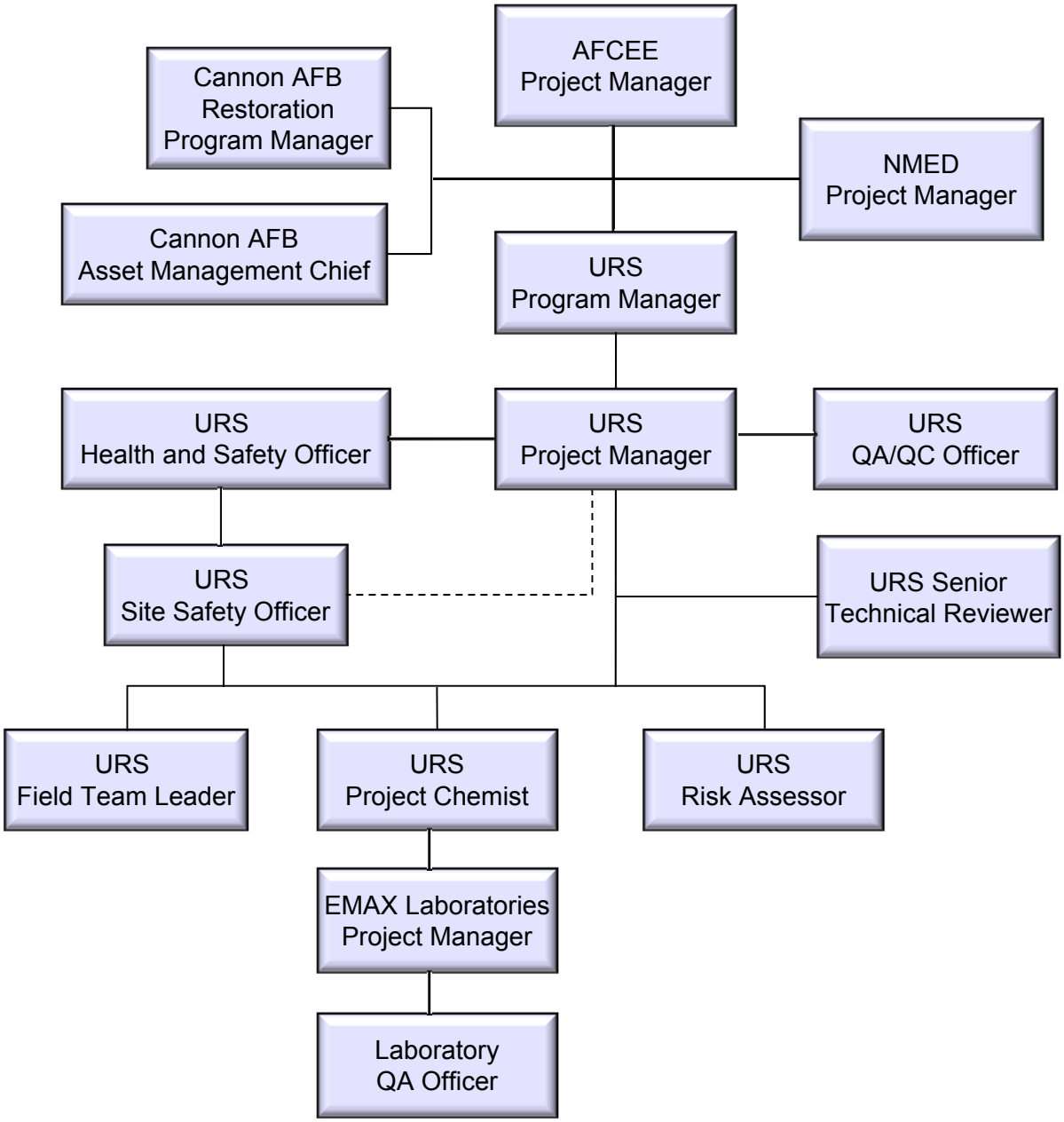
Name	Title	Address	Phone Number
Eliud Burgos	Project Manager AFCEE	2261 Hughes Avenue, Suite 155 Lackland AFB, TX 78236-9854	(210) 395-8626
Ron Lancaster	Asset Management Flight Chief Cannon AFB	27 SOCES, 506 North DL Ingram Boulevard Cannon AFB, New Mexico 88103-5003	(575) 784-1146
Matthew Higginbotham	Restoration Program Manager Cannon AFB	27 SOCES, 506 North DL Ingram Boulevard Cannon AFB, New Mexico 88103-5003	(575) 784-1092
Anita Lafuente	TSCA Program Manager Cannon AFB	27 SOCES/CEAN, 506 North DL Ingram Boulevard Cannon AFB, New Mexico 88103-5003	(575) 784-6391
John E. Kieling	Program Manager, Hazardous Waste Bureau, NMED	2905 Rodeo Park Drive East, Building 1 Santa Fe, New Mexico 87505-6303	(505) 476-6035
Jeff Voelker	Program Manager URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2558
Dennis Day	Health and Safety Officer URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2525
Corey Anderson	Project Manager URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2551
Juan Szymanski	QA/QC Officer URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2510
Jennifer Allen	Site Safety Officer URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2574
Stephen Jacobson	Field Team Leader URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2544
Tony Sedlacek	Project Chemist URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2532
Ryan Carpenter	URS Senior Technical Reviewer URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2538
Christine Copenhaver	URS Risk Assessor URS Corporation	1000 Corporate Center Drive, Suite 250 Franklin, TN 37067	(615) 224-2106
Molly Nguyen	Project Manager EMAX Laboratories	1835 West 205th Street Torrance, CA 90501	(310) 618-8889
Kennette Pimentel	Laboratory QA Manager EMAX Laboratories	1835 West 205th Street Torrance, CA 90501	(310) 618-8889
Lynn Newcomer	Office Manager Plains Environmental Services	1900 Tony's Road Salina, KS 67401	(785) 827-4545
Simon Walshe	Project Manager Talon/LPE, Ltd.	921 North Bivins Amarillo, TX 79107	(806) 467-0607

TABLE 2-2
FIELD PERSONNEL
CANNON AFB, NEW MEXICO

Field Personnel	Company	Field Position	8-Hour Supervisor	40-Hour Training	8-Hour Refresher	First Aid	CPR	Medical Clearance
Jeff Voelker	URS Corporation	Program Manager	Sep-00	Mar-96	Feb-12	Mar-11	Mar-11	Mar-12
Corey Anderson	URS Corporation	Project/Technical Manager	Mar-01	Mar-98	Feb-12	Feb-10	Feb-10	Mar-12
Stephen Jacobson	URS Corporation	Field Team Leader	Aug-10	Dec-04	Feb-12	Feb-12	Feb-12	Sep-12
Jennifer Allen	URS Corporation	Sampling Team Member	Mar-10	May-06	Feb-12	Jul-10	Jul-10	Feb-12
Shavi Challa	URS Corporation	Alternate Sampling Team Member	Nov-08	Sep-03	Feb-12	Feb-12	Feb-12	Nov-12

Notes:
Medical clearance, First Aid certification and CPR certification are valid for two years.

FIGURE 2-1
PROJECT TEAM AND LINES OF AUTHORITY
CANNON AFB, NEW MEXICO



This section present the decision process that will be used to assess the data needs and approach at the eight sites. The soils investigation decision process is designed to identify appropriate actions for each of the eight sites based on three potential recommendations: corrective action complete (CAC) without controls, CAC with controls, or further investigation and evaluation. Due to the small size and highly developed nature of six of the eight sites, these six sites do not support suitable habitat for ecologically sensitive species and, therefore, do not support suitable habitat for ecological receptors. Two of the sites (SS-507 and SD-508) are considered potential habitat for ecological receptors, and therefore COPCs at these sites will be evaluated using screening methods for ecological receptors. Site-specific recommendations for the selection of an appropriate action will depend on whether COPCs are detected in soils at each site at levels that may pose an unacceptable risk to human health or the environment. This section provides a summary of the decision making process that will be used.

3.1 DESCRIPTION OF DECISION PROCESS

The following decision process will be used to assess the data needs and investigative approach for the eight sites. The DQO evaluation process is designed to provide soil data of sufficient quality and quantity to evaluate whether a release has occurred that could pose a risk to human health and to evaluate the need for further evaluation, such as collection of additional data, completion of a Baseline Risk Assessment (BRA), or completion of a Feasibility Study.

A general decision diagram (**Figure 3-1**) was developed for the eight sites to present a logical decision process that will be used to evaluate the data resulting from the investigation to ensure that project objectives are met.

The decision process will be implemented by first evaluating and summarizing existing historical information and analytical data. Historical information will be used to identify COPCs and to identify potential sites of chemical release.

Surface and subsurface soil will be sampled and analyzed for COPCs. COPCs are defined as chemicals that are site-related If COPCs without appropriate toxicity criteria are identified at concentrations exceeding background levels during this investigation, additional evaluation of COPCs may be recommended. Lead will be evaluated quantitatively using screening levels developed using the IUEBK model. COPCs were derived from the analyte list described in the Uniform Federal Policy–Quality Assurance Project Plan (UFP-QAPP), included as **Appendix A** of this PAWP.

The potential for site-related contaminants to impact groundwater will be assessed by evaluating the vertical distribution of contaminants in the soil column. If the concentrations of COPCs decrease with depth and the concentrations are below levels that are likely to migrate to groundwater (based on fate and transport properties of the contaminant and the vadose zone), then the potential for transport to groundwater will be considered insignificant and no further action will be recommended. If the concentrations do not decrease with depth, further evaluation of the groundwater pathway will be recommended. If concentrations are at levels that could potentially migrate to groundwater (based on comparison to appropriate screening levels), fate

and transport modeling will be recommended to evaluate the potential for contaminant transport to groundwater.

Concentrations of COPCs will be evaluated for potential risks by comparing maximum detected concentrations to risk screening criteria. This conservative screening approach will identify the sites that pose no unacceptable risk under highly conservative exposure assumptions and, therefore, warrant no further evaluation or action. This approach will also identify sites that may warrant further evaluation based on exceedance of stringent risk based concentrations. Derivation of human health and ecological risk screening criteria are presented in **Sections 3.6.1** and **3.6.2**, respectively.

The results of this evaluation will be used to make recommendations regarding the two alternatives stated above. The recommendations will be made on the following basis:

- If the vertical and lateral extent of contamination has been defined, no threat to human health exists above residential screening criteria, and no potential threat to the environment is apparent, then CAC without controls will be recommended.
- If the vertical and lateral extent of contamination has been defined, no threat to human health exists above other screening criteria, and no potential threat to the environment is apparent, then CAC with controls will be recommended.
- If there is a potential threat to human health or the environment, then further investigation and/or evaluation will be recommended for the site. Further investigation and/or evaluation may include additional field investigation and/or a BRA.

3.2 DEVELOPMENT OF PRELIMINARY SITE CONCEPTUAL EXPOSURE MODELS

The initial step in the evaluation of each of the eight sites is the development of a preliminary SCEM, which provides a framework for evaluating potential risks associated with the site, aids in the identification of data needs, and assists in the identification of appropriate preliminary remediation goals targeted at significant exposure pathways. The preliminary SCEMs for the eight sites are presented in **Figures 3-2** through **3-9**. Upon completion of the field sampling program, the SCEMs will be reviewed and modified (if necessary) in order to reevaluate the sites, taking into consideration the analytical results of all chemicals of concern for surface and subsurface soil.

The SCEMs present chemical release sources and transport media, potential human or ecological receptors, and intake-mechanisms for each potential exposure pathway. An exposure pathway describes the means by which release, transport, and intake by receptor populations of COPCs occurs. An exposure pathway consists of four necessary elements:

- A source and transport mechanism of chemical release to the environment
- An environmental exposure medium for the released chemical (e.g., surface or subsurface soil)

- A point of potential human or ecological exposure to transported chemicals (e.g., a domestic drinking water well)
- A human or ecological intake mechanism (e.g., inhalation or ingestion) at the point of exposure

All four elements must be present for an exposure pathway to be complete and for chemical exposure to occur. In the SCEMs, potentially significant pathways are denoted with solid lines.

Potential exposure pathways are evaluated with respect to potential chemical sources at the eight sites. Exposure pathways are considered to be potentially complete if there are chemical release and transport mechanisms and identified exposure points and receptors for that exposure pathway. Incomplete exposure pathways do not result in actual exposure to human or ecological receptors and, therefore, do not pose a potential risk. Partial or possible pathways are those that could conceivably be complete and result in an exposure, but the resulting exposure would undoubtedly be at levels that would not pose a significant risk.

The primary sources at each of the eight sites are provided below:

- **The Former AGE Dispatch Facility Spills Site (SS-C501)** – primary sources include at least two diesel fuel spills (up to 60 gallons each) that occurred on the asphalt parking lot.
- **The Former Gas Station Site (ST-C502)** – primary sources include the three former 10,000-gallon MOGAS and diesel fuel USTs, and associated fuel lines and dispensers, where fuel spills or leaks may have occurred.
- **The Base Support/Operations Generator Former UST Site (ST-C503)** – primary source includes a former 500-gallon diesel fuel UST that may have leaked.
- **The Hospital Abandoned UST Site (ST-C504)** – primary source includes an abandoned in place 25,000-gallon diesel fuel UST that may have leaked.
- **The Flightline Generator USTs Site (ST-C505)** – primary source includes two former 500-gallon diesel fuel USTs that may have leaked.
- **The Former POL Yard Refueling Area Site (SS-C507)** – primary sources include historical fuel spills or leaks associated with fuel unloading areas, refueling stations, fuel pumps, and above and below ground fuel piping.
- **The Surface Disposal Area Site (SD-C508)** – primary source includes visible burned debris disposed at the surface.
- **The Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129 [SWMU 129])** – primary sources include historical spills or leaks associated with a waste oil disposal/storage area, a former OWS, and an associated leach field used to discharge water from the former OWS.

Chemicals from the primary sources may be transported away from the primary source areas, affecting other media that may in turn act as secondary sources. Leaching of the chemicals to the subsurface soil are shown as primary chemical release mechanisms. Subsurface soils are an

important secondary source of potential chemical releases. COPCs in surface and subsurface soils could leach or percolate through the subsurface soil and be released to groundwater, even though the depth to groundwater is nearly 300 feet.

Other release mechanisms, such as direct contact (soil ingestion and dermal contact), surface runoff, wind erosion, or volatilization to the atmosphere, are also depicted in the SCEMs. Transport by storm runoff is not considered a significant pathway for human exposure at the eight sites because there are no developed drainageways at the sites and portions of the sites are covered with pavement.

Surface soils may provide exposures to base workers (occupational exposures), hypothetical future construction workers, future trespassers, or residents. Air emissions (volatile and particulates) from surface soil may also expose base workers, construction workers, trespassers, and residents. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may expose construction workers. Groundwater is used for domestic purposes on and off base, but the depth to groundwater in the area is nearly 300 feet.

Contact with surface soil is considered to be the only complete and significant pathway for ecological receptors. However, due to the small size and highly developed nature at six of the eight sites, these six sites do not support suitable habitat for ecologically sensitive species and, therefore, do not support suitable habitat for ecological receptors. Two of the sites (SS-C507 and SD-C508) are considered potential habitat for ecological receptors. Therefore, preliminary ecological screening levels for any detected COPCs will be used to determine whether further investigation at these sites is necessary.

3.3 CRITICAL DATA

Critical data are data that are crucial for decision-making (e.g., determining whether a site warrants no further investigation or whether additional investigation should be considered). Critical data may be from a select sampling location or from a selected subset of samples from locations of roughly equal importance. Data from a specific field sample, such as a soil sample immediately downgradient of a discharge point, may be designated as critical if it is necessary to evaluate contaminant concentrations at that specific location for source or exposure pathway characterization. In other cases, data from a select number of field samples (e.g., a subset of all surface soil samples collected at a site) may be designated as critical when the objective is to estimate mean contaminant concentrations over an area.

Following USEPA guidelines (USEPA 2001, 2004), critical data must be from environmental media representing each major exposure pathway and must be 100-percent complete, that is, valid results must be obtained for all data deemed critical. A complete set of critical data may be taken from more than one sample (i.e., if one sample has missing or rejected analytes, data from another comparable sample can be used to complete the critical data set). If the missing or rejected data do not hinder the decision-making process (e.g., they are not COPCs), they are not considered critical data, and the critical data set is still 100-percent complete. If decisions cannot be made because of missing or rejected data, a recommendation for an appropriate corrective

action will be made. This allows for the retention of valid data from the original data set and compiling a complete, representative, and valid set of critical data without unnecessary resampling.

3.4 DETECTION LIMITS

To select appropriate analytical methods, detection limits (DLs) have been compared with analyte-specific concentrations of concern. Analytical methods selected for this SI at eight sites, and their associated DLs, are presented in Worksheet #15 of the UFP-QAPP (**Appendix A**).

3.5 EVALUATION OF BACKGROUND CONCENTRATIONS

At sites where metals are detected in surface and/or subsurface soil, the metals concentration data will be compared to established background concentrations to determine whether metals detected are site-related.

Soils are derived from parent geologic materials as a result of physical, chemical, and biological processes. The soil system is naturally a highly heterogeneous matrix of inorganic and organic components. The relative proportions of these components are dependent upon factors influencing soil formations, such as topography, climate, depositional processes, and time (Sposito and Page 1984). Total concentrations of metals in soils may vary depending upon location; for example, at the surface, soils are influenced by leaching, runoff, atmospheric deposition, and biotic uptake, as well as anthropogenic activity. The ranges of naturally occurring or "background" concentrations of metals in soils vary greatly due to the composition of parent material; therefore, care must be taken in the interpretation of metals data generated during an investigation.

Metals concentrations identified in soil samples during this investigation will be compared to background soils concentrations presented in "Naturally Occurring Concentrations of Inorganics and Background Concentrations of Pesticides at Cannon Air Force Base, New Mexico" (W-C 1997). Background concentrations of metals at Cannon AFB are summarized in **Table 1-1**. The approach will compare the maximum concentrations detected at a given site to the 95-percent UTL of the background concentrations. Using this technique, individual samples at the sites with high concentrations relative to background levels (i.e., which could represent a site-related release) can be identified.

3.6 HUMAN HEALTH SCREENING-LEVEL EVALUATION METHODOLOGY

This section describes the approach used in the screening level human health risk evaluation for the eight sites, as well as the screening level ecological risk evaluation for SS-C507 and SD-C508. Potential human health impacts will be evaluated by comparing maximum chemical concentrations (above background) found at the site with NMED human health soil screening levels (SSLs) for residential exposure (NMED 2012). Where SSLs are not available, concentration data will be compared with USEPA human health Regional Screening Levels

(RSLs) for residential exposure (USEPA 2011). In addition, total petroleum hydrocarbons (TPH) data will be compared to NMED TPH screening guidelines for Vapor Migration and Inhalation of Groundwater – Residential Direct Exposure for Unknown Oil (Table 6-3) (NMED 2012).

Although none of the sites that are a part of this SI are used for residential purposes, the residential SSLs are more stringent than other SSLs (e.g., occupational, construction worker). Screening against residential SSLs would account for possible future changes in land use. If residential SSLs are exceeded, then existing concentrations will be compared to industrial SSLs in order to determine the level of potential risk present.

In general, soil may be considered a potential exposure interval for construction workers and residents at depths from 0 to 10 feet below ground surface (bgs). If any surface or subsurface soil COPC exceeds background and the human health screening criteria, then additional investigation and/or evaluation will be recommended. If no potential human health risks are indicated for a site using these conservative criteria, then CAC without controls will be recommended for the site based on human health exposure.

The SSLs and RSLs provided in Worksheet #15 of the UFP-QAPP (**Appendix A**) are based on 1×10^{-5} excess cancer risk, or a hazard quotient (HQ) equal to 1.0 for noncarcinogens. This is a highly conservative approach used for screening purposes only; risks estimated in a site-specific quantitative BRA are likely to be much lower than the risk levels calculated using these screening criteria. A maximum chemical concentration that exceeds a human health screening level does not mean that a health risk exists because the maximum concentration detected is not the concentration to which people would routinely be exposed, and the exposure assumptions used to derive the human health screening levels are not site-specific.

A range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) is USEPA's target excess cancer risk range for cleanup under both the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA) (USEPA 1991). NMED SSLs are based on a 1×10^{-5} (1 in 100,000) target excess cancer risk. Therefore, SSLs and RSLs are conservative (protective) values, and exceedances of these do not necessarily mean that a health risk is present. However, exceeding the SSLs and RSLs does mean that further evaluation of chemical concentrations, exposure assumptions, and carcinogenicity may be warranted.

For noncarcinogens, SSLs and RSLs are the concentrations in soil estimated to result in an HQ of 1.0. An HQ is the ratio of the estimated daily dose from the assumed exposure to a reference dose, which is considered safe for a lifetime of daily exposure. An HQ of 1.0 means that no toxic effects are likely to occur, even to sensitive individuals exposed for a lifetime. An HQ above 1.0 does not mean that toxic effects will necessarily occur, but that further evaluation of exposures and chemical toxicity may be warranted. It should be noted that unlike the risks for multiple carcinogens, the HQs for multiple noncarcinogens could not simply be added together to account for the additive risks associated with chemical mixtures. If necessary, effects of noncarcinogenic chemicals will be evaluated on an additive basis (as a first-tier screening approach) (NMED 2012).

SSLs and RSLs for soil exposures are based on the ingestion, inhalation, and dermal exposure routes. Soil SSLs and RSLs are available for residential and industrial scenarios. The eight sites are located in industrialized areas of the base; however, for the initial assessment of investigation data, residential SSLs and RSLs will be used for screening.

It is important to note that SSLs and RSLs are not cleanup goals. Cleanup goals are determined on a site-specific basis. Instead, comparing soil concentrations to SSLs and RSLs is used as a means of determining whether the chemicals in soils could pose a threat to human health. If the SSLs and RSLs are not exceeded, CAC without controls will be recommended. If the SSLs and RSLs are exceeded, further investigation and/or evaluation of potential risks will be recommended.

3.7 ECOLOGICAL SCREENING-LEVEL EVALUATION METHODOLOGY

The ecological evaluation will be conducted consistent with NMED's Risk Assessment Guidance for Investigations and Remediation, Volume 2, Tier 1: Screening-Level Ecological Risk Assessment, Phase I, Scoping Assessment (NMED 2012). NMED screening guidance consists of four components:

1. Scoping Assessment – in which basic site information will be presented, contaminants of potential ecological concern (COPECs) will be identified, and a preliminary conceptual site exposure model (CSEM) will be developed (i.e., relevant transport and exposure routes will be described).
2. Site Exclusion Criteria.
3. Technical Decision Point – a decision is made: 1) for no further ecological evaluation; 2) further evaluation; or, 3) a removal or remedial action.
4. Screening-Level Ecological Risk Assessment (SLERA).

As part of the scoping assessment, site history and information on suspected contaminants have been reviewed and site reconnaissance has been conducted. At six of the eight sites, viable ecological habitat and potential ecological receptors are absent and no complete exposure pathways exist at or in the locality of the sites. These six sites meet the ecological site exclusion criteria, which will be summarized in the ecological scoping assessment in the SI Report. For the two sites being considered as potential habitat for ecological receptors (SS-C507 and SD-C508), this SI will attempt to obtain enough information to determine if a SLERA is necessary, or if one or both sites may be eliminated from further ecological consideration based on a lack of suspected ecological risk. If determined necessary, a SLERA may be conducted for one or both of these sites.

Preliminary SCEMs have been developed and relevant potential transport and exposure routes have been described in **Section 3.2**. Preliminary SCEMs for SS-C507 and SD-C508 are provided in **Figures 3-7** and **3-8**, respectively. In regards to ecological receptors, soil from 0 to 5 feet bgs is considered a potential source of exposure to non-burrowing animals; 0 to 10 feet bgs for plants and burrowing animals.

Similar to the human health evaluation, potential ecological impacts at SS-C507 and SD-C508 will be evaluated by comparing maximum chemical concentrations (above background) found at the sites with USEPA Ecological Soil Screening Levels (ESSLs) (USEPA 2010). Where ESSLs are not available, concentration data will be compared with other available ecological screening levels. Ecological screening levels will be selected from the following sources in order of priority:

1. USEPA (2005-2007) Ecological Soil Screening Levels (ESSLs); the lowest of plant, soil invertebrate, bird and mammal ESSLs
2. The lower of:
   a. Technical Cooperation Program – Energetic Materials (TTCP 2009)
   b. Los Alamos National Laboratory Ecological Screening Levels (ESLs) (LANL 2011)
3. USEPA Region 5 ESLs (USEPA 2003);
4. Other published literature (for example, Efroymson et al. 1997).

The selected ESSLs and ESLs are provided in Worksheet #15 of the UFP-QAPP (**Appendix A**). As described previously for the human health risk, screening criteria are intended to be highly conservative and used for screening purposes only; risks estimated in a site-specific quantitative Baseline Ecological Risk Assessment are likely to be much lower than the risk calculated using these screening criteria. A maximum chemical concentration that exceeds an ESSL or ESL does not mean that an ecological risk exists because the maximum concentration detected is not the concentration to which ecological receptors would routinely be exposed, and the exposure assumptions used to derive the ESSLs and ESLs are not site-specific. It is important to note that ESSLs and ESLs are not cleanup goals. Cleanup goals are determined on a site-specific basis.

If ESSLs or ESLs (or background concentrations) are not exceeded, ecological exposure pathways will be considered incomplete and the technical decision point will be that no further ecological evaluation will be conducted. This action will be documented in the SI Report. A CAC without controls will be recommended. Chemicals exceeding ESSLs or ESLs will be considered chemicals of potential ecological concern (COPECs) and further evaluation of potential risks will be recommended.

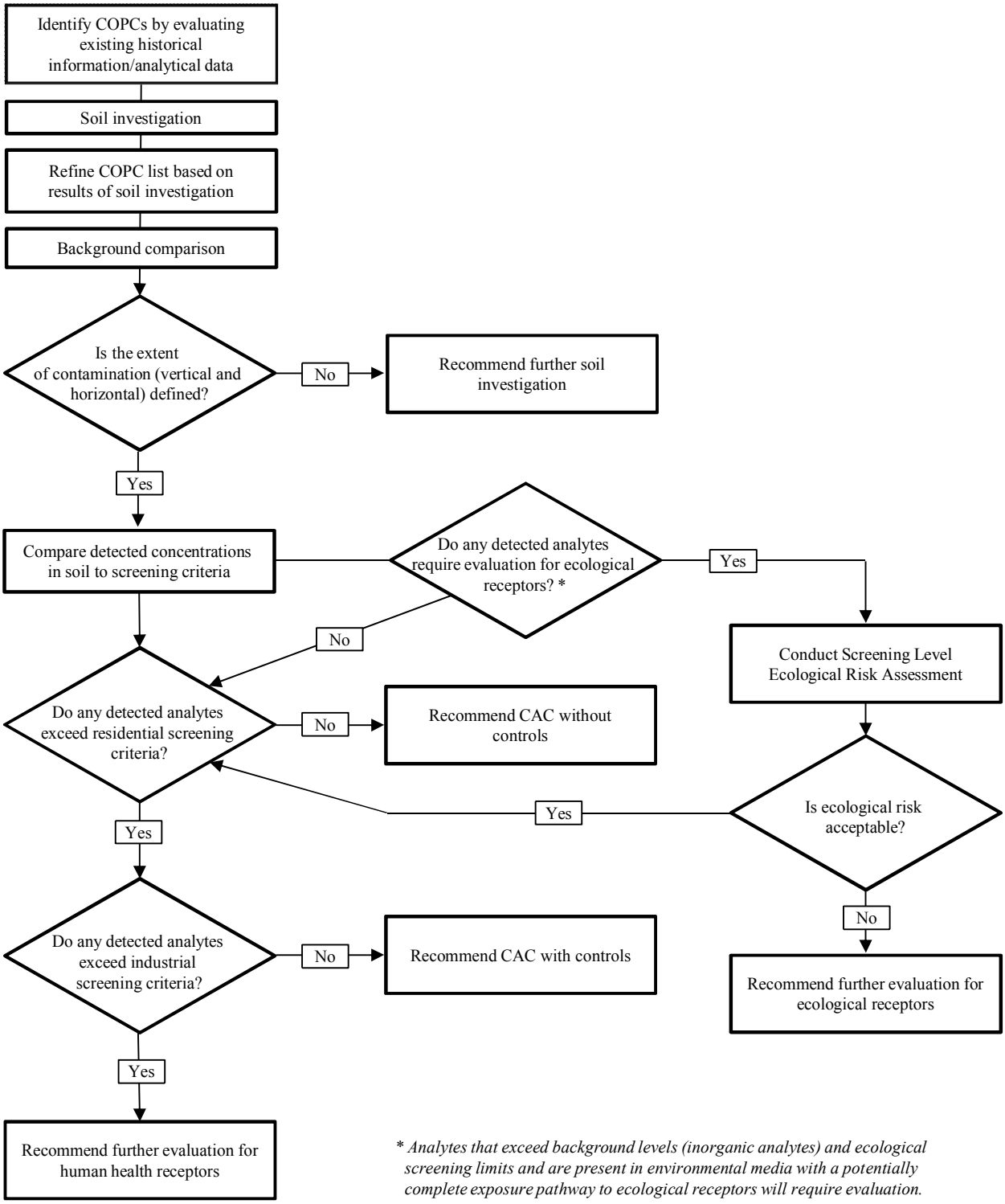
Specifically, if the preliminary SCEM and COPEC screening indicate the potential presence of complete exposure pathways, a screening-level risk assessment (SLERA) will be considered (NMED 2012). In the SLERA, the environmental setting of the site will be more completely described, potential receptors and assessment endpoints will be identified and the preliminary SCEM will be refined.

Evaluation of ecological exposure pathways will include identification of valued biological resources potentially associated with the site and potentially exposed to unreasonable adverse effects from releases of hazardous substances associated with Air Force operations. Such biological resources may include special-status plant and animal species identified by the State of New Mexico and/or the federal government. Unless otherwise identified as special status, soil invertebrates and small mammals will not be considered a "valued biological resource;"

however, they will be considered as potential prey or forage (i.e., contaminant transport pathways) for higher trophic-level receptors, if present.

Once assessment endpoints have been selected and representative receptors identified, the SLERA will proceed as outlined in NMED's ecological risk assessment guidance (NMED 2012). The SLERA will include an Exposure Assessment, Effects Assessment and Risk Characterization.

FIGURE 3-1
DECISION DIAGRAM FOR SITE INVESTIGATION AT EIGHT SITES



** Analytes that exceed background levels (inorganic analytes) and ecological screening limits and are present in environmental media with a potentially complete exposure pathway to ecological receptors will require evaluation.*

FIGURE 3-2
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
FORMER AEROSPACE GROUND EQUIPMENT (AGE) DISPATCH FACILITY SPILLS SITE (SS-501)

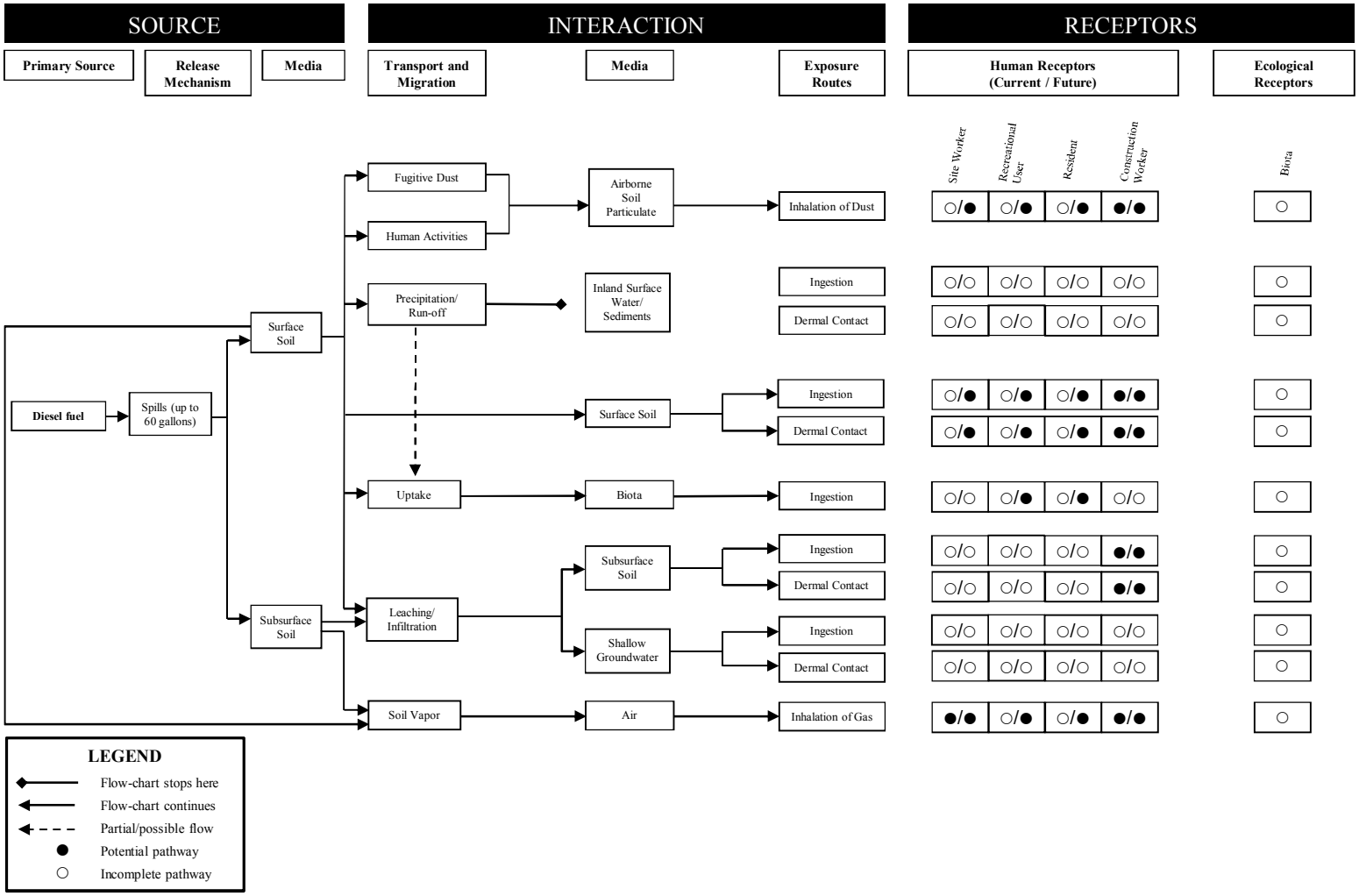


FIGURE 3-3
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
FORMER GAS STATION SITE (ST-502)

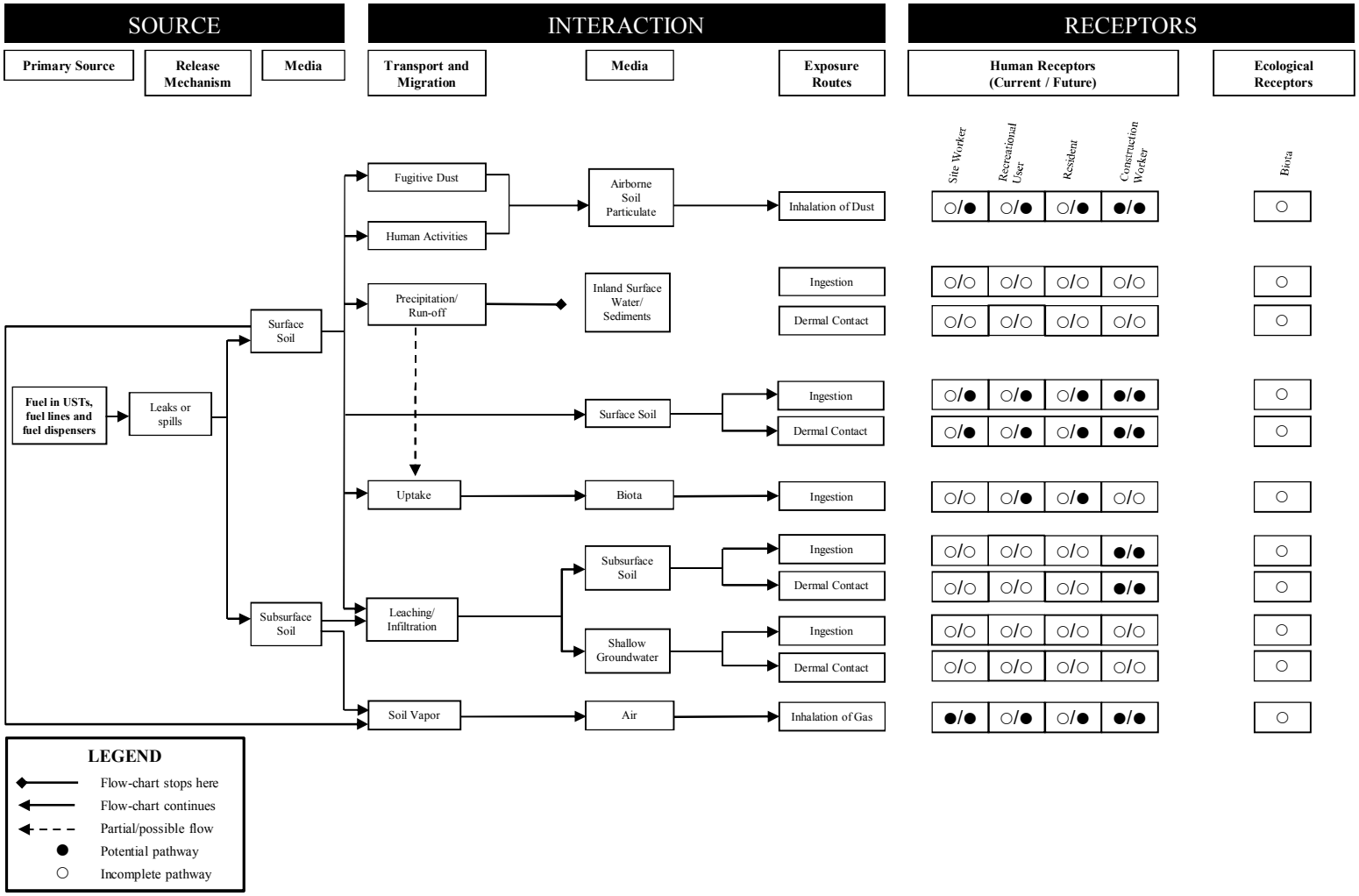


FIGURE 3-4
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-503)

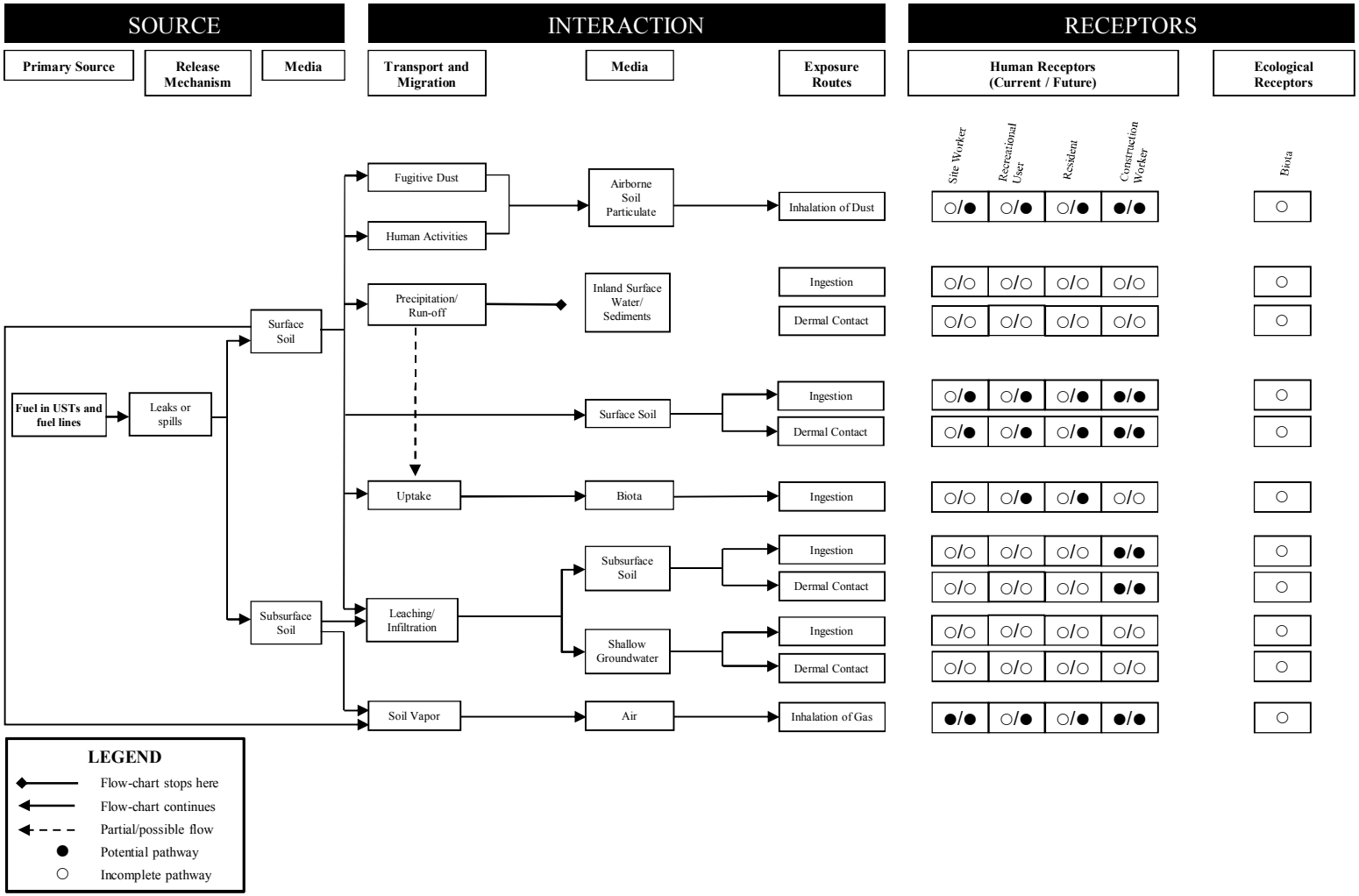


FIGURE 3-5
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
HOSPITAL ABANDONED UST SITE (ST-504)

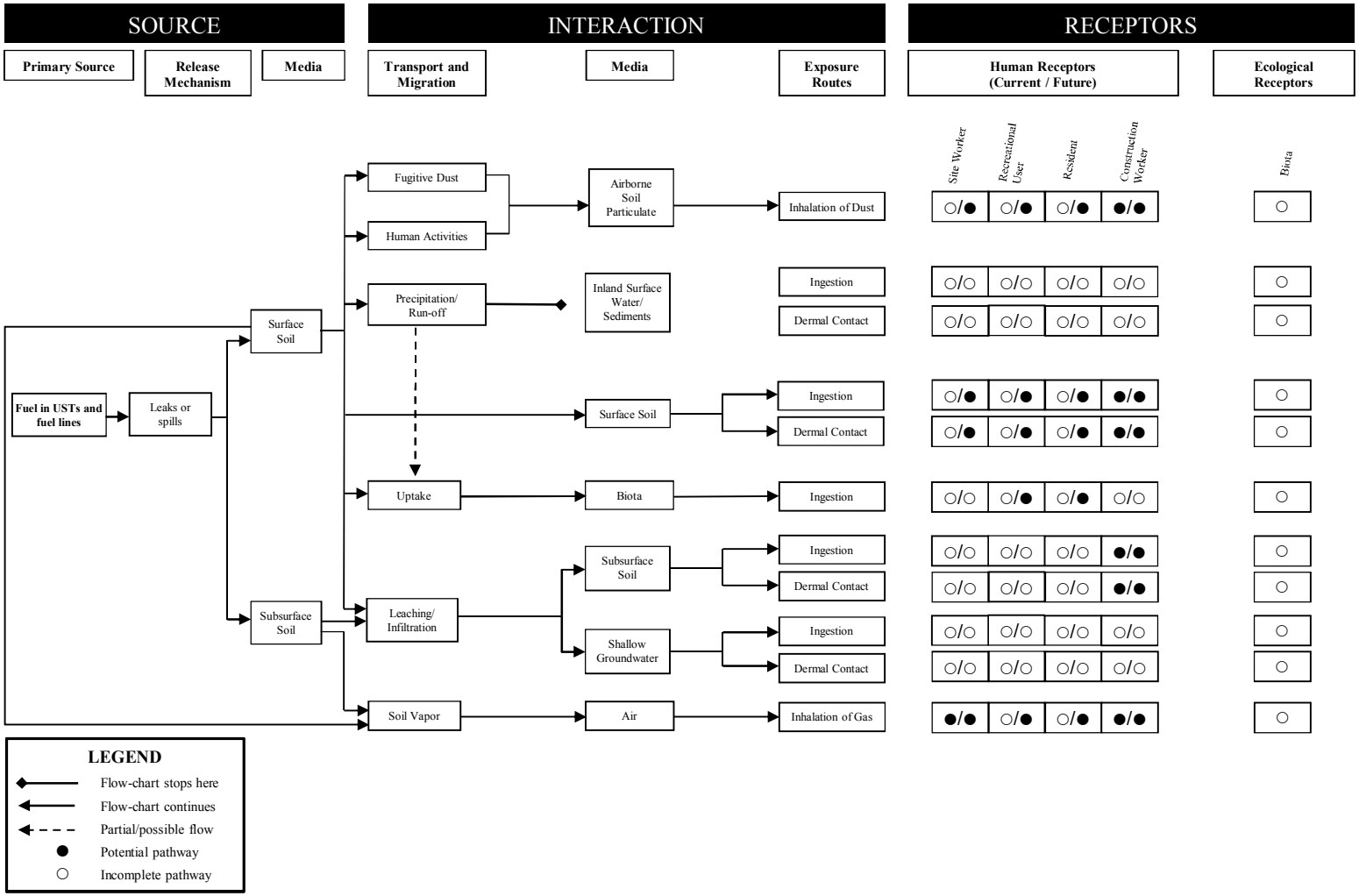


FIGURE 3-6
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
FLIGHTLINE GENERATOR USTs SITE (ST-505)

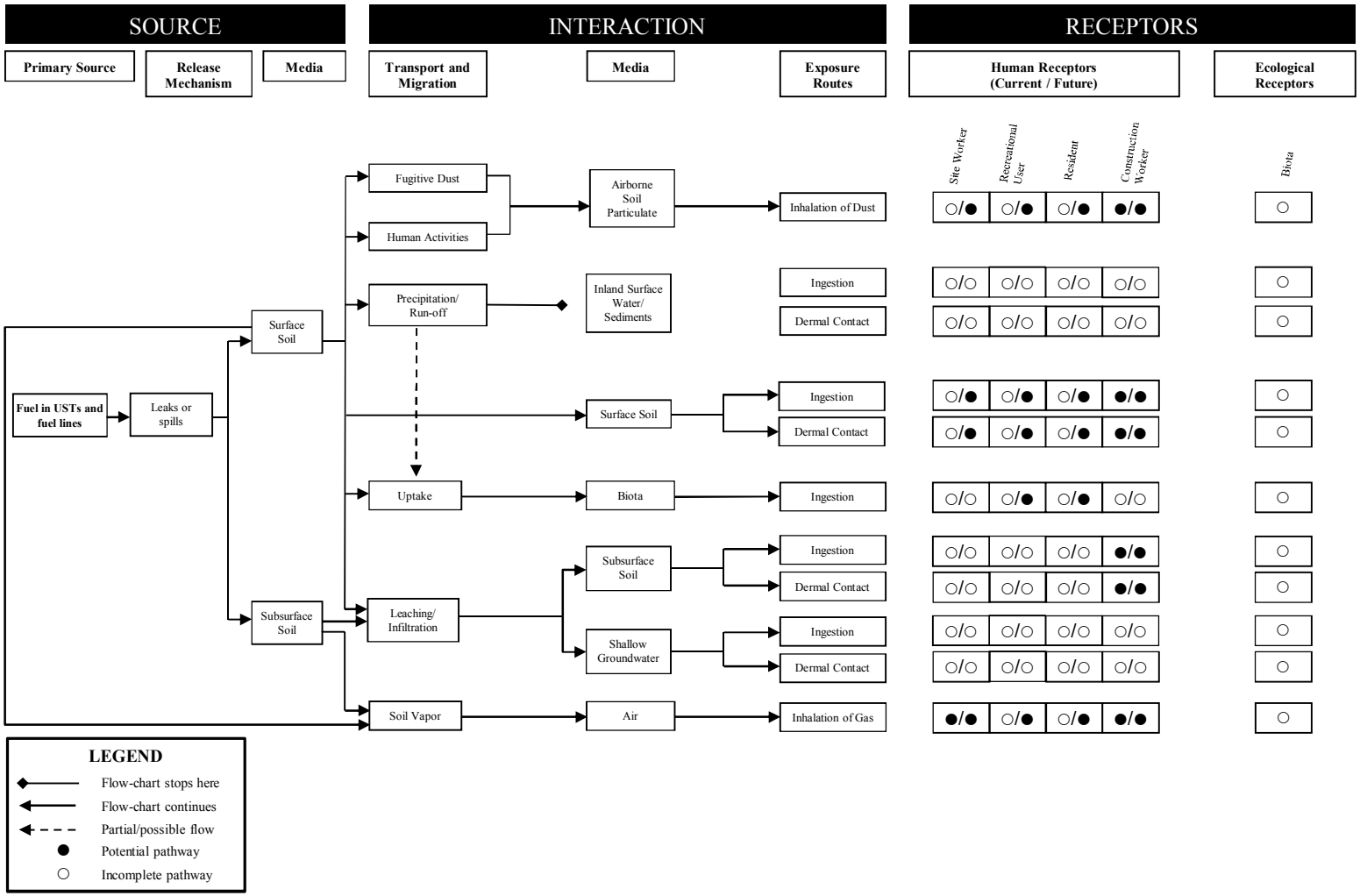


FIGURE 3-7
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
FORMER PETROLEUM, OIL AND LUBRICANTS (POL) YARD REFUELING AREA SITE (SS-507)

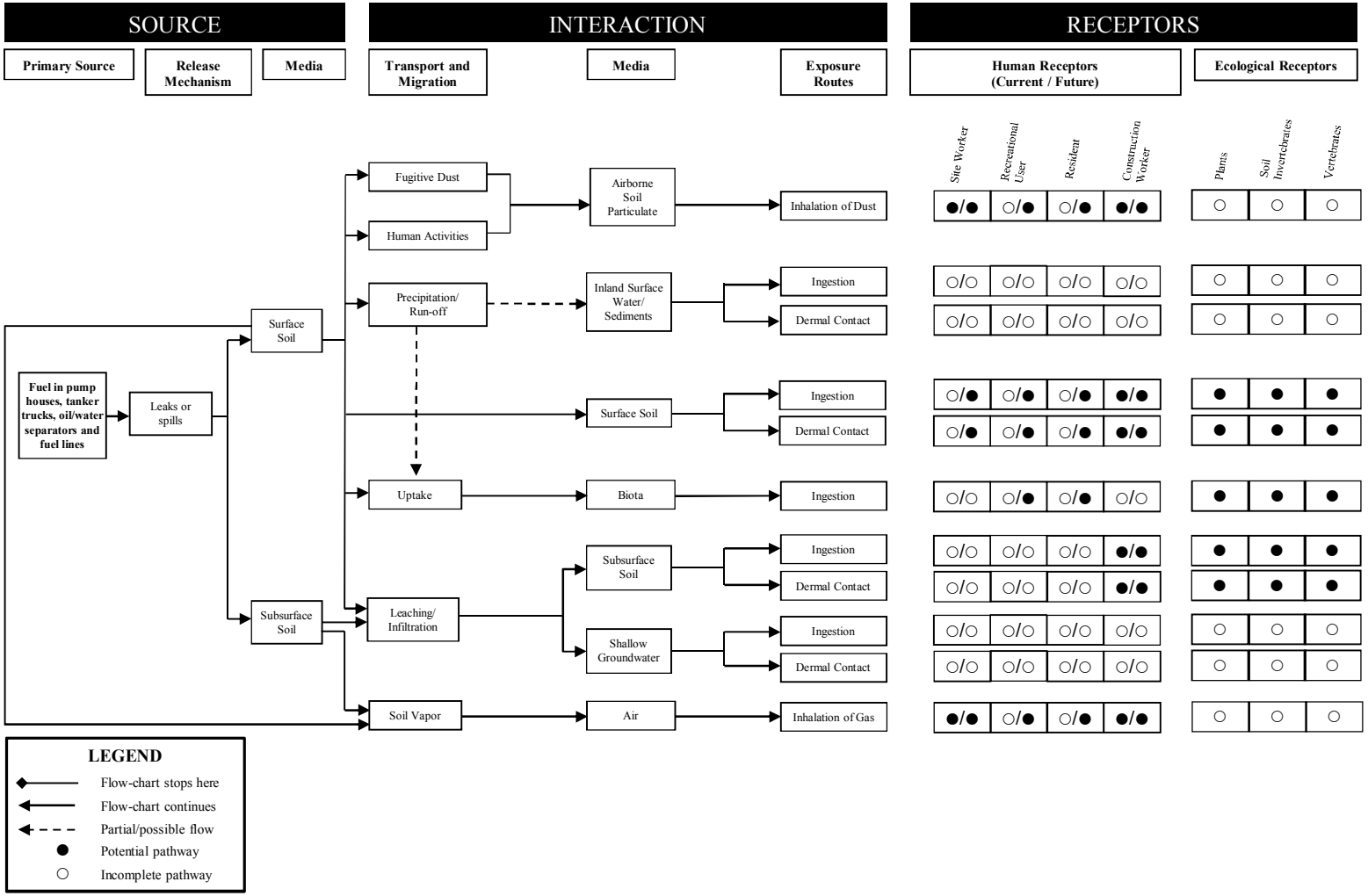


FIGURE 3-8
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
SURFACE DISPOSAL SITE (SD-508)

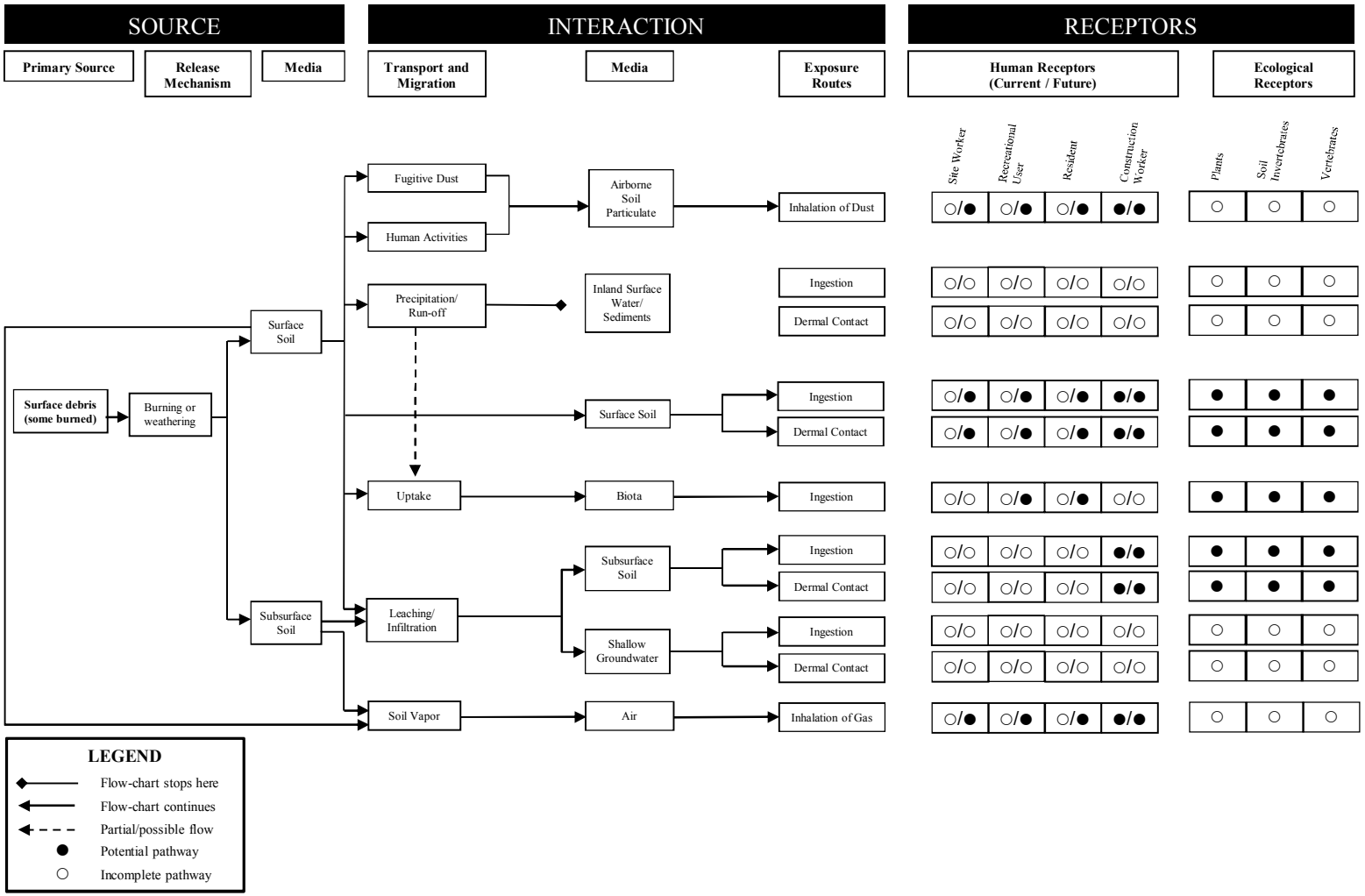
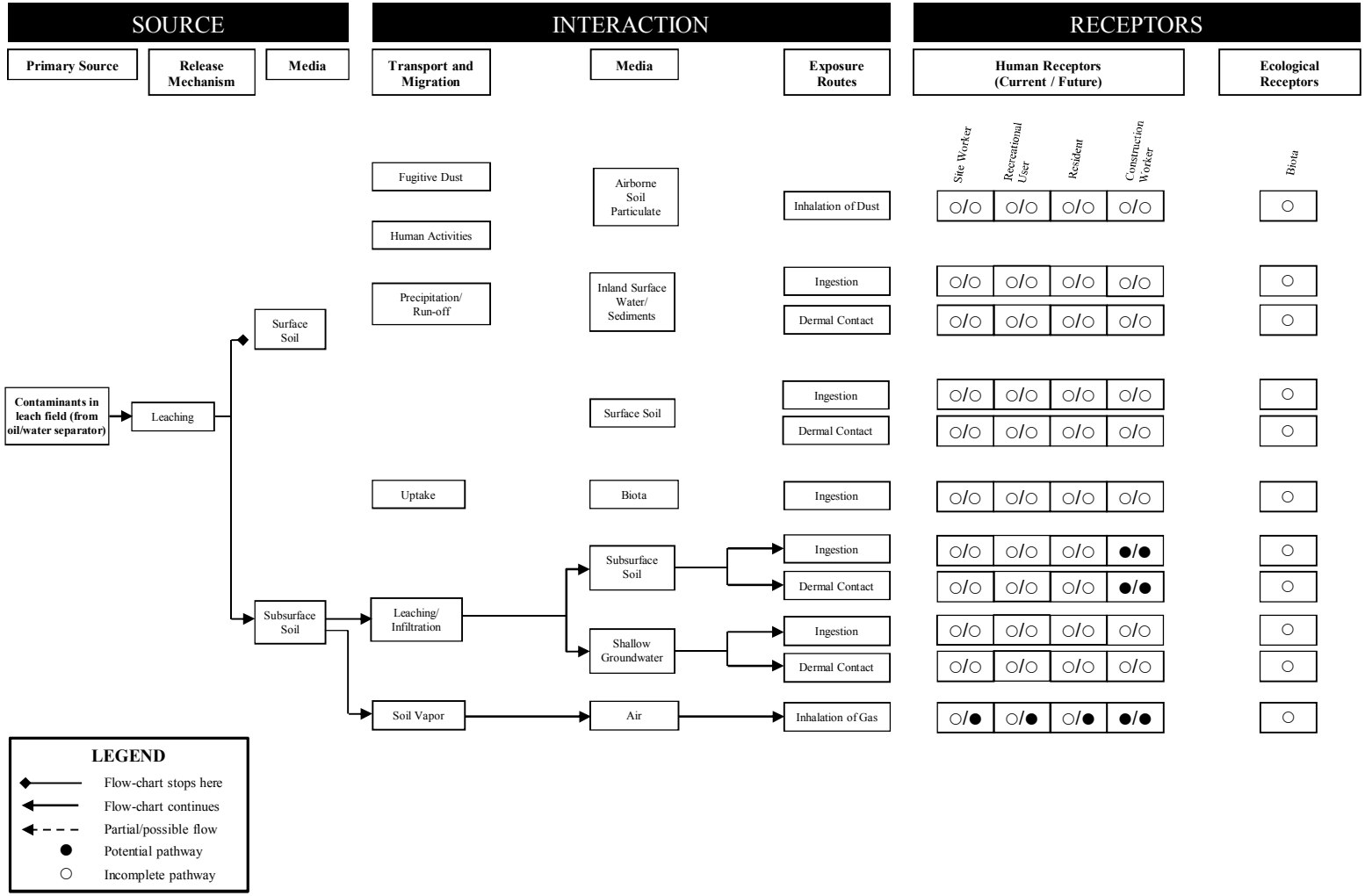


FIGURE 3-9
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)



This section provides site descriptions and backgrounds for the eight sites included in this investigation. Site history and background information is from historical documents (e.g., available written communication between Cannon AFB and NMED regarding notification of a petroleum release, available tank closure and tank excavation worksheets, previous environmental investigation documents, and as-built drawings) and interviews with Cannon AFB personnel conducted by URS during the 2011 site visit. Additionally, historical aerial photographs, historical site photographs, and current site photographs were obtained and reviewed in order to help identify any additional areas of potential concern at each site. Available historical documentation, Cannon AFB personnel interviews, historical aerial photographs, and historical/current site photographs are provided in **Appendix D**. The eight sites being investigated for this project include the following: SS-C501, ST-C502, ST-C503, ST-C504, ST-C505, SS-C507, SD-C508, and TA/AS-C129 (SWMU 129).

4.1 FORMER AGE DISPATCH FACILITY SPILLS SITE (SS-C501)

4.1.1 Site Description and Background (SS-C501)

The Former AGE Dispatch Facility Spills Site (SS-C501) is located in the central portion of Cannon AFB, northeast of Building 186, and adjacent to Torch Boulevard. The site (for purposes of this investigation) includes only the asphalt parking lot formerly used to store AGE. The site is approximately 450 feet long and 120 feet wide (approximately 1.2 acres). The site map with the site boundary (shown in red) is shown on **Figures 4-1a** and **4-1b**.

In June 2009, the asphalt parking lot, formerly used to store AGE equipment, was repaved. Prior to 2009, Buildings 191 and 193 (located south and east of the parking lot) were removed and a canopy structure, used for personnel training, was constructed near the former location of Building 191. Buildings 191 and 193 were used as staging areas for transferring personnel and gear on and off of airplanes, previously had no known or suspected potential contamination associated with them, and are not part of the site. The former buildings and the canopy structure are mentioned only as geographic references.

Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), the site was formerly used as an AGE dispatch facility where AGE was stored. At the time AGE was stored at the site the asphalt pavement was cracked in several areas. At least two diesel fuel spills (up to 60 gallons each) have historically occurred at this site. Although the exact locations are not known, the spills reportedly occurred in the north-central and south-central portions of the site.

The only environmental site investigation completed to date at SS-C501, was a shallow soil sampling investigation conducted as part of the 2009 Compliance Clean-up Site Identification and Evaluation of DERA Eligibility for AFCEE project (URS 2009). Results of this investigation are discussed in **Section 4.1.2**.

4.1.2 Previous Investigation Results (SS-C501)

During the 2009 shallow soil sampling investigation (URS 2009), a total of four soil samples were collected, via hand augering, from depths of 1 to 3 feet below ground surface (bgs). Samples were analyzed for TPH–diesel range organics (TPH-DRO), benzene, toluene, ethylbenzene, and xylene (BTEX), and polychlorinated biphenyls (PCBs). Samples were nondetect for BTEX and PCBs. Results indicated a release of TPH-DRO at two sample points (maximum concentration of 1.10E+01 mg/kg at SS-C501-100, and 6.00E+00 mg/kg at SS-C501-103) (URS 2009). **Table 4-1** summarizes previous samples collected for chemical analysis. **Table 4-2** summarizes the previous analytical data and screening results. **Figures 4-1a** and **4-1b** show the previous sampling locations.

4.2 FORMER GAS STATION SITE (ST-C502)

4.2.1 Site Description and Background (ST-C502)

The Former Gas Station Site (ST-C502) is located in the north central portion of Cannon AFB, on the east corner of DL Ingram Boulevard and Kermit Evans Avenue (formerly Argentia Avenue). The site boundary (for purposes of this investigation) encompasses all of the former site features and the asphalt parking area surrounding the former gas station. The site is approximately 145 feet by 165 feet (approximately 0.5 acres) and is bound by the sidewalk adjacent to DL Ingram Boulevard to the northwest, the curb of Kermit Evans Avenue to the southwest, the end of the asphalt parking lot to the southeast, and the edge of the asphalt parking lot to the northeast. The site currently contains the Cannon Federal Credit Union building (Building 368), a grassed area northwest of Building 368, an asphalt parking lot, and drive-thru lanes adjacent to Building 368 (to the northeast). The site map with the site boundary (shown in red) is shown on **Figures 4-2a** and **4-2b**.

This site formerly functioned as a gas station and vehicle service center. Based on three NMED UST Inspection Reports obtained during the April 2011 site visit (see **Appendix D**), the site formerly contained three 10,000-gallon MOGAS USTs, which were located in the southern corner of the site. The UST Inspection Reports indicate that the USTs were constructed of steel and upon inspection, were found to contain no holes. These reports indicate the USTs contained only MOGAS; however, based on the fact that THP-DRO has been previously detected at the site (see results in **Section 4.2.2**), it is likely diesel fuel may also have been stored and dispensed at the site. The site also contained two pump islands with four fuel dispensers, which were located to the northwest of Building 368 (USGS 1995). Additionally, two vehicle service bays were located adjacent to Building 368, which contained two hydraulic lifts, used to service vehicles. Presumably, various POLs were stored and handled frequently at the vehicle service bays. The two bays are currently used as the drive-thru lanes for the Cannon Federal Credit Union. The location of the former site features and the limits of the former UST excavation (shown on **Figures 4-2a** and **4-2b**) are based on an as-built drawing of the Former Gas Station (see **Appendix D**) and the 1995 USGS site map (USGS 1995).

The three USTs were removed in January 1995 and the soil within the excavation was sampled. The bases of the tanks were approximately 12 feet bgs. Samples were collected from approximately 2 feet below the bottom of the excavation. Sample results indicated that a release had occurred during the service life of the tank; however, excavation activities were terminated at that time, and the open excavation was backfilled (USGS 1995).

An investigation of the former UST excavation area was conducted by the USGS in April 1995 to confirm the analytical results obtained from the samples collected during the January 1995 UST removal action (USGS 1995). Following the removal of the fuel dispensers and associated underground fuel lines in July 1995, the USGS completed a follow-up investigation of the fuel pump islands. Sample results from the pump island areas indicated that a release occurred during the service life of the fuel dispensers and underground piping (USGS 1995). It does not appear that any soil sampling has been conducted in the two vehicle service bays adjacent to Building 368 to date. Results of the previous UST and pump island investigations are discussed in **Section 4.2.2**.

4.2.2 Previous Investigation Results (ST-C502)

Previous investigation results summarized in this section were taken from the 1995 USGS data submission entitled "Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico, Volume 1" (USGS 1995). **Table 4-3** summarizes previous samples collected for chemical analysis. **Table 4-4** summarizes the previous analytical data and screening results. **Figures 4-2a** and **4-2b** show the previous sampling locations.

During the January 1995 UST removal action, a private contractor collected six soil samples from the open excavation, following the removal of the three USTs. Samples were taken from the corners and sides of the excavated area at a depth 2 feet below the bottom of the tanks (approximately 14 feet bgs). One sample taken from the southwest end of the excavation had a concentration of 2.45E+03 mg/kg total recoverable petroleum hydrocarbons (TRPH). No other samples contained TRPH concentrations that exceeded reporting limits.

On April 13 and 14, 1995, the USGS conducted an investigation of the former location of the three USTs in order to validate the analytical results from soil samples taken during the UST removal action. Nine soil borings were completed and 11 subsurface soil samples were collected within and around the limits of the previous UST excavation, from depths ranging from 10 to 16 feet bgs (i.e., near the base of the former USTs). The results from the field screening (gas chromatography) indicated no contamination, and lab analysis (gasoline range organics [GRO] method) confirmed that concentrations were below reporting limits.

On July 1 and 2, 1995, the USGS began an investigation of the pump island area. Eight soil borings were advanced, and eight subsurface soil samples were collected in order to determine whether or not the recently removed fuel dispensers had leaked. Four samples were initially taken, one from each end of the two pump islands. Field screening indicated high concentrations of contamination in CAFB-FAC0368-10 (at the northeast end of the southeast island). Laboratory results identified a TPH-GRO concentration of 1.00E+03 mg/kg at a depth of 24 to

25 feet bgs at CAFB-FAC0368-10. Based on the field screening, four additional samples were taken approximately 7 feet from CAFB-FAC0368-10 at 90 degree angles to one another. All four samples were nondetect for TPH-GRO, although one sample contained 5.10E+00 mg/kg of TPH-DRO. These four samples were taken from a maximum depth of 15 feet bgs. Due to the presence of hard caliche, present in varying degrees from approximately 15 to 50 feet bgs in this area, direct push samples could not be readily obtained from depths greater than 16 feet bgs. To determine the extent of downward migration of the contamination at CAFB-FAC0368-10, a Mobile B53 drill rig was used to collect samples at this location on August 25 and 26, 1995. TPH-GRO concentrations decreased with depth, and, at 50 to 52 feet bgs, the concentration of TPH-GRO was below reporting limits (1.00E+00 mg/kg).

4.3 BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)

4.3.1 Site Description and Background (ST-C503)

The Base Support/Operations Generator Former UST Site (ST-C503) is located in the west-central portion of Cannon AFB, south and east of the intersection of DL Ingram Boulevard and Sextant Avenue, and to the southeast of Building 600. The site boundary (for purposes of this investigation) includes only the limits of the previous UST removal excavation. The site is approximately 22 by 25 feet (0.1 acres), and is bound by a brick wall to the northwest, the edge of the asphalt pavement to the southwest, a fence to the southeast, and a grass area to the northeast. The site map with the site boundary (shown in red) is shown on **Figures 4-3a** and **4-3b**.

Currently, the majority of the site is covered with sparse grass. A concrete containment area and associated active diesel fuel AST is located directly adjacent to site ST-C503 (to the southeast). The active diesel fuel AST is surrounded by a fence, and is not part of site ST-C503. Two dumpsters are also located inside the fenced area, southeast of the active diesel fuel AST. A brick wall located to the northwest of the grassed area encloses a cooling tower and an emergency generator used by Building 600. The area enclosed by the brick wall is not considered likely to be impacted by the previous UST release, based on analytical results from samples collected adjacent to the brick wall during the 1995 USGS investigation (see results in **Section 4.3.2**). An asphalt-paved service driveway associated with Building 600 is located to the southwest of the grassed area. Between the asphalt curb and the grassed area is a concrete trench with a metal cover that contains the existing diesel fuel line from the active AST to the emergency generator inside the brick wall (URS 2011).

This site formerly contained a 500-gallon diesel UST, which fueled the emergency generator, prior the UST removal in October 1994. The base of the tank was located approximately 7 feet bgs. During the UST removal action, four soil samples were taken from a depth of 2 feet below the base of the tank (approximately 9 feet bgs). Analytical results indicated that a release had occurred during the service life of the tank. Upon receipt of these results, the contractor removed an additional 2 feet of soil (down to approximately 9 feet bgs) and collected two additional samples from 4 feet below the base of the tank (approximately 11 feet bgs). Both samples had

elevated TPH concentrations; however, excavation activities were terminated at that time, and the open excavation was backfilled (USGS 1995).

An investigation of the former UST area was conducted by the USGS between April and August 1995 to confirm the analytical results of samples collected during the October 1994 UST removal action (USGS 1995). Photographs of the site were taken following the 1995 USGS investigation and are provided in **Appendix D**. In these site photographs the 1995 USGS sampling locations are marked with pin flags within an area of bare soil matching the limits of the UST excavation depicted in the 1995 USGS report. Based on results from the 1995 USGS investigation, it appears that the primary source of soil contamination was a leak in the bottom of the west side of the former UST. Additionally, results indicated soil contamination existed below the limits of the previous excavation. Results of the previous UST investigations are discussed in **Section 4.3.2**.

4.3.2 Previous Investigation Results (ST-C503)

Previous investigation results summarized in this section were taken from the 1995 USGS data submission entitled "Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico, Volume 1" (USGS 1995). **Table 4-5** summarizes previous samples collected for chemical analysis. **Table 4-6** summarizes the previous analytical data and screening results. **Figures 4-3a** and **4-3b** show the previous sampling locations.

During the October 1994 UST removal action, four soil samples were taken from a depth 2 feet below the base of the tank. The base of the tank was approximately 7 feet bgs. Three of these samples had concentrations above reporting limits, with a maximum concentration of 1.81E+04 mg/kg TPH. Following the removal of an additional 2 feet of soil, two additional soil samples were collected from 4 feet below the base of the tank. Both of these samples had elevated TPH concentrations: 7.05E+02 mg/kg on the north end of the excavation and 1.37E+03 mg/kg on the south end.

Between April and August 1995, the USGS completed an investigation of the area formerly containing the UST. Eight soil borings were advanced and 21 subsurface soil samples were collected from depths ranging from 10 to 21 feet bgs (i.e., near the base of the former UST and below the limits of the former excavation). Analytical results from these samples indicated contamination existed below the limits of the excavation. A maximum TPH-DRO concentration of 3.50E+03 mg/kg was discovered in CAFB-FAC0600-03 at a depth of 14 to 16 feet bgs. A sample from 19 to 21 feet bgs at this location contained 7.80E+00 mg/kg TPH-DRO. A concentration of 8.20E+02 mg/kg TPH-DRO was identified at CAFB-FAC0600-05 at a depth of 10-12 feet bgs. A sample from 14-16 feet bgs at this location contained 1.40E+01 mg/kg TPH-DRO. At the other six sample locations, the highest detected concentration of TPH-DRO was 1.80E+01 mg/kg at CAFB-FAC0600-07 at 14-16 feet bgs.

4.4 HOSPITAL ABANDONED UST SITE (ST-C504)

4.4.1 Site Description and Background (ST-C504)

The Hospital Abandoned UST Site (ST-C504) is located in the northwestern portion of Cannon AFB, near the northern corner of the hospital (Building 1400), and adjacent to the access road behind the hospital. The site boundary (for purposes of this investigation) includes portions of the grassed and asphalt paved areas around the abandoned UST. The site also encompasses several cooling towers, a transformer, and several concrete pads (previously used for aboveground utilities). These aboveground utilities are located inside a chain-link fence. The site is approximately 95 by 60 feet (approximately 0.13 acres), and is bordered by the hospital to the southeast, a utility garage connected to the hospital to the southwest, and hospital driveways and parking areas to the north, east, and west. The site map with the site boundary (shown in red) is shown on **Figures 4-4a** and **4-4b**.

A UST (1400B) was removed from an area to the northeast of ST-C504 on November 17, 1994. This UST was not located at ST-C504. Since this UST was not located at ST-C504 and no signs of leakage were recorded during tank removal, UST 1400B does not present a potential source of contamination to ST-C504. The tank closure documentation for UST 1400B is included in **Appendix D**.

Based on the Tank Closure Worksheet for UST 1400A (see **Appendix D**), the 25,000-gallon diesel UST was abandoned in place on October 5, 1994. The UST was formerly associated with an emergency generator at the hospital. The UST is constructed of steel and its base is approximately 18 feet bgs (USGS 1995). The abandoned UST dimensions are roughly 12 feet wide by 38 feet long (taken from the 1995 USGS site map). The exact location of the abandoned UST is unknown; however, the approximate location of the abandoned UST (shown on **Figures 4-4a** and **4-4b**) is based on a pre-1995, partial utility plan of Building 1400 (see **Appendix D**) and the 1995 USGS site map. These two maps indicate the aboveground cooling towers, located to the east of the UST, are outside the footprint of the abandoned UST. This is in contrast to the January 2008 aerial photograph (shown on **Figure 4-4b**), which shows the northeast corner of the abandoned UST underling the concrete slab that supports the westernmost cooling tower. Based on these images, it is likely that the previous cooling towers have been replaced with larger units, which now overlie the abandoned UST.

Prior to abandonment of the UST, Keers Technical Services (Keers) completed a subsurface investigation of the UST in August 1994 (Keers 1994a). Initially, a backhoe was used to locate the north and south ends of the UST. Three subsurface soil samples were then collected adjacent to the north, west-central, and southwest edge of the UST. Results of this investigation indicated that a release had occurred on the north and possibly west-central side of the UST. The Keers August 1994 report is provided in **Appendix D**.

In September 1994, Keers completed a follow-up subsurface investigation to confirm the analytical results from previously collected samples (Keers 1994b). Four subsurface soil samples were collected adjacent to and around the UST. Analytical results from the soil sample

collected on the northwest side of the UST confirmed that a release had occurred in this area. The Keers September 1994 report is provided in **Appendix D**.

An investigation of the abandoned UST area was conducted by the USGS between April and December 1995 to confirm the analytical results from samples collected by Keers. Results of the 1995 USGS investigation indicated that high concentrations of contamination existed on all sides of the abandoned UST with the exception of the southwest corner. Due to the presence of hard caliche at several intervals below 20 feet bgs, a Mobile B53 auger drilling rig and a Gardner-Denver 17W rotary drilling rig were used to obtain deeper soil samples. Based on the USGS investigation, the primary source of contamination at this site appears to be from leaks located to the northwest of the northern part of the UST and southeast of the middle part of the UST. Results of the previous UST investigations are discussed in **Section 4.4.2**.

4.4.2 Previous Investigation Results (ST-C504)

Previous investigation results summarized in this section were taken from the "Subsurface Investigation of 25,000 gallon UST Report" (Keers 1994a), the "Limited Subsurface Investigation for the Evaluation of Suspect Subsurface Contamination Report" (Keers 1994b), and the "Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico, Volume 1" (USGS 1995). **Table 4-7** summarizes previous samples collected for chemical analysis. **Table 4-8** summarizes the previous analytical data and screening results. **Figures 4-4a** and **4-4b** show the previous sampling locations.

On August 17, 1994, Keers collected three subsurface soil samples adjacent to the UST at a depth of approximately 14 feet bgs. A maximum TRPH concentration of 2.80E+03 mg/kg was detected at soil boring 94600-081794-01 located on the north side of the UST. A detection of 6.40E+02 mg/kg was also detected at soil boring 94600-081794-02 on the west-central side of the UST. The sample from soil boring 94600-081794-03 was nondetect (Keers 1994a).

On September 22, 1994, Keers collected four soil samples around the UST from depths between 18 and 20 feet bgs. Two samples were collected adjacent to the UST and two were collected to the north and northeast of the UST. A maximum TPRH concentration of 8.20E+03 mg/kg was detected at soil boring 94600-092294-02 located on the northwest side and adjacent to the UST. The three other samples collected were nondetect (Keers 1994b).

On April 12 and 14, 1995, the USGS advanced six soil borings and collected 10 subsurface soil samples in order to validate the existence of contamination at this site. Results indicated that TPH-DRO was detected at five of the six soil borings. Soil boring CAFB-FAC1400-5 was sampled at 10 feet bgs and was found to be nondetect (result was from field screening only; sample was not submitted for laboratory analysis). The highest concentrations of TPH-DRO was detected at CAFB-FAC1400-3 (located adjacent to the west-central portion of the UST) at 18 to 20 feet bgs (9.90E+03 mg/kg). Results at soil borings CAFB-FAC1400-1 (southwest), CAFB-FAC1400-2 (east-central), and CAFB-FAC1400-4 (northeast) indicated that TPH-DRO contamination existed on all sides of the abandoned UST.

In July and August 1995, USGS further investigated soil boring location CAFB-FAC1400-3 using a Mobile B53 auger drilling rig. Samples were collected vertically at 36 to 37 feet bgs, 49.5 to 50.5 feet bgs, and 65 to 66 feet bgs. Results indicated that TPH-DRO contamination extended to 66 feet bgs. The highest concentration of TPH-DRO detected at CAFB-FAC1400-3 was at 50.5 feet bgs (1.10E+04 mg/kg). Additionally, a direct push rig was used to collect shallow samples (ranging from 19 to 26 feet bgs) at step out locations CAFB-FAC1400-7 (south–southeast), -8 (northeast), and -9 (northwest). These three locations were completed 10 to 25 feet from the UST to help further define the horizontal extent of TPH-DRO contamination. Results indicated TPH-DRO contamination was present to the east and west, but at significantly lower concentrations (ranging from 2.00E+01 mg/kg to 8.90E+02 mg/kg).

In December 1995, USGS again conducted additional sampling at soil boring location CAFB-FAC1400-3 using a Gardner-Denver 17W rotary drilling rig. Samples were collected vertically at 75 feet bgs, 83 feet bgs, and 91 to 92 feet bgs. Results indicated that TPH-DRO contamination extended to 75 feet bgs (9.30E+03 mg/kg), but was not present (nondetect) at 83 and 91 to 92 feet bgs. Additionally, a direct push rig was used to collect shallow samples (ranging from 23 to 26 feet bgs) at step out locations to the west. The three step out locations were completed 10 to 15 feet to the west of previous soil boring CAFB-FAC1400-9. Results at soil borings CAFB-FAC1400-10 (west) and -11 (northwest) were nondetect for TPH-DRO. A small detection of TPH-DRO (1.60E+01 mg/kg) was present at 24 to 26 feet bgs at soil boring CAFB-FAC1400-12 (north).

Conclusions presented in the 1995 USGS report indicated that the horizontal and vertical migration of TPH-DRO contamination had been defined. Northwest and western movement of the contamination was limited to the middle of the hospital's paved road. Contamination to the north and east was within a few feet of the UST. Based on the close proximity of the impacted soil borings, it was determined that one deep soil boring would be significant in order to define the vertical migration of TPH-DRO contamination. The vertical extent of TPH-DRO contamination at deep soil boring CAFB-FAC1400-3 was determined to be approximately 75 feet bgs.

4.5 FLIGHTLINE GENERATOR UNDERGROUND STORAGE TANKS SITE (ST-C505)

4.5.1 Site Description and Background (ST-C505)

The Flightline Generator USTs Site (ST-C505) is located in the northeast portion of Cannon AFB, due north of the north end of the main runway, and approximately 300 feet south of North Perimeter Road. The site boundary (for purposes of this investigation) encompasses only the previous USTs excavation area. The site is approximately 22 by 23 feet (0.01 acres) and is bound to the west by Building 3060, an existing UST located in a concrete vault, and a concrete trench between the two. To the north, east, and south, the site boundary extends approximately 10 feet beyond the limits of the former USTs excavation. Building 3060 houses an emergency generator used in case of a power loss to the flightline electrical systems. A concrete trench covered with steel plates houses the diesel fuel line that connects the existing UST to the

generator. The site map with the site boundary (shown in red) is shown on **Figures 4-5a** and **4-5b**.

This site formerly contained two 500-gallon diesel USTs associated with the emergency generator at Building 3060. The USTs were removed in December 1994 and January 1995. The exact dimensions of the former USTs are unknown; however, the USTs bases were approximately 9 feet bgs (USGS 1995). The exact location of the two USTs and the exact limits of the USTs excavation shown on **Figures 4-5a** and **4-5b** are also unknown; however, the approximate locations are based on two Excavation Site Worksheets completed on December 14 and 15, 1994 (see **Appendix D**). These two worksheets indicate the limit of the excavation was approximately 14 by 12 feet, 9 feet deep. The approximate limits of excavation were also based on site photographs taken following the 1995 USGS investigation, which show an area of bare soil, east of Building 3060, matching the excavation dimensions on the worksheets.

The two Excavation Worksheets indicate that at UST 1A (western UST), none of the soil was contaminated. At UST 2B (eastern UST), approximately 48 cubic yards of soil removed during the excavation was deemed contaminated and removed from the site. NMED was notified of the release in a 7-Day Release Notification letter from Cannon AFB to NMED dated December 21, 1994 (see **Appendix D**). The letter indicated the release appeared to be from overflow of the UST. Following the excavation, eight soil samples were collected on December 15, 1994, and submitted to Cardinal Laboratories for analysis. Based on the sample results, additional contaminated soil was excavated and removed from the UST 2B excavation. After additional excavation, two samples were collected from the east and west sides of the UST 2B excavation on December 28, 1994. Analytical results from the 10 samples collected on December 15 and 28, 1994, are provided in **Table 4-10**. Sample location maps were not provided with the sample results, only approximate locations (e.g., northeast corner of UST). Based on the approximate nature of the sample locations, they are not shown on **Figures 4-5a** and **4-5b**. Results provided in the December 1994 analytical data reports indicated contaminated soil remained at the site; however, excavation activities were terminated at that time, and the open excavation was backfilled.

An investigation of the site was conducted by the USGS between April and August 1995 to confirm the results of previous sampling conducted at the site. Results of the 1995 USGS investigation indicated the primary source of contamination at this site was from a leak from the bottom of the west side of UST 2B. Another source appears to have been a leak from the southwest side of UST 1A. The extent of the contamination associated with UST 1A appears to be less than the extent associated with UST 2B. Results of the previous site investigations are discussed in **Section 4.5.2**.

4.5.2 Previous Investigation Results (ST-C505)

Previous investigation results summarized in this section were taken from a 7-Day Release Notification letter from Cannon AFB to NMED (December 1994) and the "Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico, Volume 1" (USGS 1995). **Table 4-9** summarizes previous samples collected for chemical analysis. **Table 4-10** summarizes the previous analytical data and screening results.

Figures 4-5a and **4-5b** show the approximate locations of the samples previously collected by the USGS. Because the exact excavation footprint was not able to be determined, soil sample locations collected during the 1994 UST removal action are not shown.

During the removal of the two USTs, eight soil samples were collected from the four corners of each tank. The bases of the two USTs were approximately 9 feet bgs. Samples were collected from 2 feet below the bases of the USTs. Results from the soil samples indicated that UST 1A samples were all below reporting limits (concentrations ranged from 6.30E+00 and 1.96E+01 mg/kg); however, UST 2B samples were all above reporting limits for TRPH. TRPH concentrations ranged from 1.19E+02 to 1.78E+03 mg/kg, with detectable concentrations of toluene (maximum of 3.40E-02 mg/kg), ethylbenzene (maximum of 7.40E-02 mg/kg), and total xylenes (maximum of 7.40E-02 mg/kg). Following the receipt of these analytical results, additional contaminated soil was excavated and removed from the UST 2B excavation. After additional excavation, results from another round of sampling identified TRPH in concentrations of 1.03E+03 mg/kg on the west end, and 1.07E+02 mg/kg on the east end of this excavation.

On April 11, 1995, the USGS completed seven soil borings (CAFB-FAC3060-01 through -07) and collected nine subsurface soil samples from this site in order to validate the analytical results from soil samples collected during the removal of the USTs. Subsurface soil sample depths ranged from 9 to 16 feet bgs. Although field screening indicated low levels of contamination, TPH-DRO laboratory results identified high levels of contamination at 9 to 11 feet bgs in two soil borings (1.30E+03 mg/kg at CAFB-FAC3060-02 and 5.30E+03 mg/kg at CAFB-FAC3060-03). TPH-DRO concentrations were significantly lower in deeper samples (14 to 16 feet bgs) collected at CAFB-FAC3060-02 (8.70E+00 mg/kg) and CAFB-FAC3060-03 (2.30E+01 mg/kg).

On June 28, 1995, the USGS completed four additional soil borings (CAFB-FA3060-08, -09, -10, and -11) and collected four subsurface soil samples to help further define the horizontal extent of contamination. Subsurface soil sample depths ranged from 9 to 13 feet bgs. Results indicated the contamination extended further to the north and west. The maximum TPH-DRO concentration in the four samples was 1.60E+02 mg/kg at CAFB-FAC3060-10.

On July 25, 1995, the USGS further investigated soil boring location CAFB-FAC3060-03 using a Mobile B53 auger drilling rig. One sample was collected vertically at 24 feet bgs, and TPH-DRO was detected at 7.80E+01 mg/kg.

On August 23, 1995, the USGS completed two additional soil borings (CAFB-FA3060-12 and -13) and collected two subsurface soil samples to help further define the northern extent of contamination. Subsurface soil sample depths ranged from 11 to 13 feet bgs. Results were nondetect for TPH-DRO.

4.6 FORMER POL YARD REFUELING AREA SITE (SS-C507)

4.6.1 Site Description and Background (SS-C507)

The Former POL Yard Refueling Area Site (SS-C507) is located near the northern boundary of Cannon AFB, southeast of the main entrance, and west of the active POL Yard. The Former POL Yard refueling area is located inside the fence that surrounds the active POL Yard. The site is approximately 580 feet by 410 feet (approximately 5.5 acres) and is bound by the POL Yard existing fence to the north, south and west, and the base of several concrete berms to the east. The concrete berms are part of the active POL Yard AST secondary containment system. The site map with the investigation site boundary (shown in red) is shown on **Figures 4-6a** and **4-6b**.

The former POL Yard Refueling Area was closed in June/July 2009 and has remained inactive. Most aboveground site features, structures, and piping have been removed. Underground piping is still present at the site, but has been properly drained and capped. An active OWS, located in a below ground concrete vault, and adjacent to a 55-gallon drum concrete secondary containment area, is still present at the site. Four other below ground concrete vaults, three containing fuel piping and one formerly containing an OWS, are also still present at the site.

Historical site activities included delivery and dispensing of fuels (diesel fuel, MOGAS, jet propellant [JP]-4, and JP-8). Delivery to the site occurred via 8,000 gallon tanker trucks, train tanker cars, and pipelines. Pipelines carried fuels from a former pipeline to the north of the site, and from the unloading areas to the various ASTs located inside the existing concrete containment berms to the east. No fuels were stored in the former POL Yard Refueling Area.

The aerial photograph, shown on **Figure 4-6b**, was taken in January 2008 when the site was still active. The various site features are labeled on **Figures 4-6a** and **4-6b,** and are described in detail below:

- The asphalt, oval shaped driveway and concrete curb surrounding the driveway are still present at the site. During the 2011 site visit (URS 2011), the asphalt was found to be in good condition with few cracks. The asphalt is sloped so that runoff is diverted to various breaks in the concrete curb, where runoff is discharged to unpaved areas. These breaks in the concrete curb are shown on **Figure 4-6a** and **4-6b**. A concrete drainage trench covered with a metal grate also exists in the asphalt driveway, south of the unpaved oval shaped area. This drainage trench slopes to the south towards a break in the concrete curb, where runoff is discharged to an unpaved area. Inside the asphalt oval shaped driveway is an unpaved, sparsely vegetated area that contains a pond and landscaped area to the north. Reportedly, both the pond and the small landscaped area were purely aesthetical and served no purpose at the POL Yard refueling area. Three gated entrance/exit points are still present at the site (one to the northwest and two to the south).
- Just inside the southeast gate is the former MOGAS unloading and dispensing area. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), vehicles would pull onto the 45-foot by 10-foot concrete area with concrete curb to unload or receive MOGAS. The aboveground fuel unloading port and a dispenser were located in an

unpaved area to the east of the concrete area. Currently, the only remaining visible feature at the MOGAS unloading and dispensing area is the capped unloading port. All underground MOGAS lines leading to the former location of Building 390 are still present at the site. The MOGAS fuel dispenser has been removed. The asphalt and concrete in the area slopes due west toward a break in the concrete curb.

- A below ground concrete vault formerly containing an OWS, and an adjacent aboveground concrete containment area for 55-gallon drums are located between the MOGAS unloading and dispensing area and the former location of Building 390. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), the OWS and drum containment area have not been used in several years. The drum containment area was built to store drums of POL and water generated by the OWS. Cannon AFB personnel also indicated that there is no leach field associated with the OWS. Currently, the only remaining visible features at this OWS location are the below ground concrete vault containing the OWS and the aboveground drum containment area.
- Two pump islands formerly containing fuel dispensers used to dispense JP-4 and JP-8 are located just southwest of the former location of Building 390. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), aircraft refueling trucks would pull onto the approximately 70-foot by 70-foot concrete area to receive either JP-4 (prior to its phase out in the mid-1990s) or JP-8. The fuel dispensers were located on the northern half of the pump islands. Currently, the only visible features remaining at the JP-4 and JP-8 refueling area are the two concrete pump islands. All underground JP-4/JP-8 lines between the pump island and the former location of Building 390 are still present at the site. The JP-4/JP-8 dispensers have been removed. The asphalt and concrete pavement in the area slopes to the west toward a concrete drainage swale. This concrete drainage swale leads to a break in the concrete curb where runoff is discharged to an unpaved area.
- Building 390 was the main pump house and fuel distribution hub for the entire former POL Yard Refueling Area. Just north of Building 390 was a canopy structure covering the aboveground fuel transfer piping. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), Building 390 previously received fuel from the MOGAS unloading area (located to the south), Building 392 (located to the west), pipelines from the north (from the city of Clovis), and diesel fuel from two unloading ports and aboveground piping located to the north. Building 390 also fed and received fuels from the POL Yard ASTs. Currently, the only visible features remaining near the former location of Building 390 are seven capped fuel lines (marked JP-8 and MOGAS) sticking out of the ground surface and a below ground concrete vault (reportedly used to remove water from the fuel lines). Underground fuel lines between Building 390 and the various fuel unloading areas are still present at the site. Building 390, the canopy structure, and all aboveground fuel lines leading to the POL Yard ASTs have been removed from the site.
- The diesel fuel unloading and dispensing area is located to the northwest of the former location of Building 390. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), diesel fuel tanker trucks would unload at one of two unloading ports (unloading port 398 to the south and 399 to the north). The unloading ports were located on the concrete driveway. The unloading ports were protected by metal bollards to

the west and a concrete curb to the east. From the unloading ports, the diesel fuel was transferred to a canopy structure covering the aboveground fuel transfer piping, formerly located to the north. Aboveground lines transferred diesel fuel between the covered diesel fuel lines and the POL Yard ASTs. To the north of the unloading ports, and east of the former location of the covered diesel fuel lines, is the diesel fuel pump island. The diesel fuel pump island is located on an approximately 60-foot by 40-foot concrete area. The dispensers were located in the center of the pump island. Currently, the only visible features remaining at the diesel refueling area are the capped diesel fuel unloading ports with protective bollards and the concrete pump island. All underground diesel fuel lines between the pump island and former location of the covered diesel fuel lines are still present at the site. The diesel fuel dispensers, canopy structure, and aboveground diesel fuel lines between the former canopy structure and the POL Yard ASTs have been removed. The asphalt and concrete pavement around the diesel fuel pump islands slopes to the west towards a break in the concrete curb where runoff is discharged to an unpaved area.

- The former fuel unloading area is located on the west side of the site. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), prior to 1992, JP-4, JP-8, and MOGAS were delivered to the fuel unloading area via train tanker cars. Based on the 1991 historical aerial photograph, a railroad spur existed between the main railroad lines along Highway 60 (to the north) and the fuel unloading area. Train tanker cars were unloaded on the west side of Building 392. A railroad yard existed further to the west (outside the current fenced area). This railroad yard was used to deliver supplies to the base. The railroad yard reportedly was not used by train tanker cars. After approximately 1994, JP-4, JP-8, and MOGAS were delivered to the fuel unloading area via 8,000-gallon tanker trucks through the northwest gate. Tanker trucks would unload on one of two concrete unloading areas located to the east of Building 392. Train tanker cars and tanker trucks would unload fuel to one of four unloading ports. The four unloading ports and associated piping were contained in concrete trenches to the west. Fuel was received at Building 392 (located between the two concrete unloading areas) and pumped to the east to Building 390. A below ground concrete vault (reportedly used to remove water from the fuel lines) existed between Buildings 392 and 390. A canopy structure, covering the aboveground fuel transfer piping, was located to the north of Building 392. On the tanker truck side (east side), potential spills that may have occurred during unloading, and stormwater runoff, would flow to shallow concrete trenches located down the center of the truck unloading areas. These shallow concrete trenches were less than 6 inches deep and were covered with metal grates. A drain at the low point of each trench (located in the middle of each trench) would receive runoff, which was piped to the east, and ultimately to an OWS contained in a below ground concrete vault. Cannon AFB personnel indicated that there was no leach field associated with the OWS. Currently, the only visible features remaining at the former fuel unloading area are the two truck unloading areas (each approximately 140 feet long and 20 feet wide) and the concrete trenches formerly containing the unloading ports and associated piping. Underground fuel lines between the former location of Building 392 and 390, and stormwater lines between the east unloading area drains and the former OWS are still present at the site. Unloading ports and associated piping formerly contained in the concrete trenches, Building

392, the canopy structure covering aboveground piping, and the OWS and OWS concrete vault have all been removed from the site.

Based on historical records and interviews with Cannon AFB personnel conducted during the 2011 site visit (URS 2011), the following spills/releases have previously occurred at the site:

- Two reported MOGAS spills (estimated at 20 gallons each) at the former MOGAS unloading and dispensing area. Spills occurred on concrete and on unpaved area to the east. No excavation was completed following the spills. The approximate location of the MOGAS spills is shown on **Figures 4-6a** and **4-6b**.
- Multiple reported JP-4 and JP-8 spills (15 spills, for an estimated total of 130 gallons) onto the concrete surrounding the two JP-4/JP-8 pump islands. No excavation was completed following the spills. The approximate location of the spills is shown on **Figures 4-6a** and **4-6b**.
- Reported JP-8 spill (approximately 400 gallons) to the north of the area formerly occupied by Building 390 and the canopy structure. A soil excavation was conducted to remove visible contaminated soil (red soil backfill is still visible at surface). The approximate JP-8 spill location and soil excavation boundary is shown on **Figures 4-6a** and **4-6b**.
- One reported JP-8 spill (estimated at 30 gallons) in the immediate vicinity of the former Building 390 and the canopy structure due to breaks in the fuel pump seals. No excavation was completed following the spill. The approximate location of the spill is shown on **Figures 4-6a** and **4-6b**.
- Reported JP-8 spill (approximately 400 gallons) on the south side of Building 392. A soil excavation was conducted to the south and west of Building 392. Approximate JP-8 spill location and soil excavation boundary is shown on **Figures 4-6a** and **4-6b**.

Additional areas that have the highest probability of containing potential contamination, and may be potential areas of concern, include the following:

- The former fuel unloading and refueling areas, including the MOGAS unloading and refueling area, the diesel fuel unloading and refueling pump islands, the JP-4/JP-8 train tanker car and tanker truck unloading area, and the JP-4/JP-8 refueling pump islands.
- The former location of aboveground fuel piping adjacent to Building 390 and under the adjacent canopy structure.
- The former location of aboveground fuel piping adjacent to Building 392 and under the adjacent canopy structure.
- The former location of the aboveground diesel fuel piping under the canopy structure.
- Break in concrete curb receiving runoff from MOGAS unloading and dispensing area and JP-4/JP-8 pump islands.
- Concrete drainage swale leading to break in the concrete curb receiving runoff from JP-4/JP-8 pump islands.

- Break in concrete curb receiving runoff from diesel fuel pump islands.
- Underground MOGAS line connecting MOGAS unloading port to MOGAS vault (approximately 130 feet long).
- Underground fuel line connecting Building 392 to Building 390 (approximately 280 feet long).

The only environmental site investigation completed to date at SS-C507 was a shallow soil sampling investigation completed as part of the 2009 Compliance Clean-up Site Identification and Evaluation of DERA Eligibility for AFCEE project (URS 2009). Results of this investigation are discussed in **Section 4.6.2**.

4.6.2 Previous Investigation Results (SS-C507)

In 2009, subsurface soil samples were collected from eight locations at and around the site. One sample (SS-C507-103) was taken from an area outside of the current site boundary. Samples were collected via hand augering to depths of 1 to 3 feet bgs and analyzed for TPH-DRO, BTEX, and PCBs. Results indicated the presence of DRO at three sample points (maximum concentration of 7.10E+00 mg/kg at SS-C507-104, 6.30E+00 mg/kg at SS-C507-100, and 5.80E+00 mg/kg at SS-C507-102) and PCB-1260 at one sampling location (2.80E-02 mg/kg at SS-C507-106). All samples were nondetect for BTEX (URS 2009). **Table 4-11** summarizes previous samples collected for chemical analysis. **Table 4-12** summarizes the previous analytical data and screening results. **Figures 4-6a** and **4-6b** show the locations of the URS previous soil sampling locations.

4.7 SURFACE DISPOSAL AREA SITE (SD-C508)

4.7.1 Site Description and Background (SD-C508)

The Surface Disposal Area Site (SD-C508) is located in the southeast portion of Cannon AFB, east of the former north-south runway and north of SWMU 107. This site is located approximately 600 feet north of an area of the base used by Cannon AFB Explosives Ordnance Disposal (EOD) personnel. The EOD site is well marked by warning signs placed 500 feet from the site. None of the SD-C508 sampling activities will be completed within the area marked with the warning signs. The site includes an area of visible debris on the ground surface (some burned), including an ammunition can lid, metal slag, and mechanical parts. The source of the visible surface debris and the history of this site are unknown. The surface disposal site was identified in 2009 while URS was conducting an investigation at an adjacent site. The site is not currently used by Cannon AFB.

During the April 2011 site visit (URS 2011) the location of the previously identified surface debris was found, the location was photographed, and coordinates were collected with a handheld global positioning system (GPS). During the site walk, burned debris was visible at the surface throughout the grassed field. The extent of the visible surface debris identified during the April 2011 site visit was found to be within a circular shaped area where the ground surface

was slightly elevated (i.e., mounded). This mounded area also had visibly different vegetation at the surface compared to the rest of the grassed field. The vegetation on the mounded area was noticeably shorter and sparser compared to the surrounding vegetation. The extent of this area was tracked with the handheld GPS, and was found to be approximately 200 by 240 feet (approximately 1 acre). The site boundary at SD-C508 was arbitrarily added to encompass the sparsely vegetated mounded area, and extends approximately 20 to 40 feet outside that area. The sparsely vegetated mounded area and site boundary (shown in red) are shown on **Figures 4-7a** and **4-7b**.

The only environmental site investigation completed to date at SD-C508, was a shallow soil sampling investigation completed as part of the 2009 Compliance Clean-up Site Identification and Evaluation of DERA Eligibility for AFCEE project (URS 2009). Results of this investigation are discussed in **Section 4.7.2**.

4.7.2 Previous Investigation Results (SD-C508)

During the 2009 shallow soil sampling investigation (URS 2009), a total of three soil borings were completed and six soil samples were collected, via hand augering, from depths of 1 to 3 feet bgs. Samples were analyzed for TPH-DRO, BTEX, PCBs, and RCRA metals. TPH-DRO was detected in four of the six soil samples, and various metals were detected. TPH-DRO was detected at a maximum concentration of 1.20E+02 mg/kg (at SD-C508-100-HA-01). Maximum concentrations of the following constituents were identified at the following locations: arsenic (3.30E+00 mg/kg at SD-C508-102-HA-01), barium (3.07E+02 mg/kg at SD-C508-100-HA-01), cadmium (2.00E+00 mg/kg at SD-C508-102-HA-01), chromium (1.08E+01 mg/kg at SD-C508-102-HA-01), lead (2.80E+01 mg/kg at SD-C508-102-HA-01), mercury (2.70E-02 mg/kg at 101-HA-01), selenium (3.70E-01 mg/kg at SD-C508-100-HA-03), and silver (1.00E+00 mg/kg at SD-C508-101-HA-01) (URS 2009). **Table 4-13** summarizes previous samples collected for chemical analysis. **Table 4-14** summarizes the previous analytical data and screening results. **Figures 4-7a** and **4-7b** show the locations of the URS previous soil sampling locations.

4.8 WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)

4.8.1 Site Description and Background (TA/AS-C129)

The Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129) is located in the northeast portion of the Cannon AFB, approximately 300 feet north of Building 208, and just south of the contractor storage area located south of North Perimeter Road. The site consists of two main areas, including the former Facility 244 and the former leach field located to the southeast. The former Facility 244 site boundary is approximately 65 by 50 feet, and is bound to the west by a fenced-in storage area that currently contains several pumps, piping, and related equipment. The former leach field site boundary is approximately 40 by 50 feet and encompasses the portions of the former leach field containing perforated piping used to discharge water into the subsurface. The site map with site boundaries (shown in red) is shown on **Figures 4-8a** and **4-8b**.

The Waste Oil Storage Facility 244 was originally built in 1991 to store waste petroleum products generated during routine maintenance of aircraft and service vehicles. The facility was used infrequently due to design and operational problems. Historically, lubricating oils, hydraulic fluids, and solvents were reportedly stored in tanks at this site. Fuels were reportedly never stored at this site (Parallax, Inc. [Parallax] 2000).

The Facility 244 site previously consisted of five 5,000-gallon ASTs supported on reinforced concrete saddles. The tanks were surrounded by an approximately 30-foot by 50-foot concrete containment pad with a 9-inch retaining curb (Parallax 2000). A fence surrounded the containment pad and a gate was located on the west side, near the northwest corner of the fence. An OWS was present on the west side of the site, with dump pits to the north. A cleanout to the south of the OWS was connected by a pipeline to a leach field.

The leach field, located to the southeast of the facility, received the water fraction from a central OWS. The leach field consisted of perforated plastic piping surrounded by crushed stone (Parallax 2000).

During the April 2011 site visit, historical records were reviewed, Cannon AFB personnel were interviewed about the site, and a site walk was conducted. Information gathered regarding the site included the following:

- An as-built drawing showing the location and dimensions of the leach field was obtained. The leach field is located approximately 95 feet southeast of the formerly present cleanout in the southeast corner of the former Facility 244. The as-built drawing depicts the main drain pipe (95 feet long) located between the cleanout and the leach field distribution box. At the distribution box, three branches of perforated pipe, each 40 feet long and spaced 10 feet apart, are aligned parallel and slope to the southeast. The as-built also depicts the leach field in cross-section, which shows the perforated pipe (4-inches in diameter), surrounded by 4 inches of 1.5- to 0.5-inch diameter crushed gravel, at a depth of 2.0 feet bgs. The as-built drawing is provided in **Appendix D**.
- A noticeable line of vegetation was present at the surface between Facility 244 and the presumed location of the former leach field. This line of vegetation is also visible on the aerial photograph on **Figure 4-8b**. Because this line of vegetation has a similar orientation and length as the main drain pipe leading to the former leach field, it is assumed that this line of vegetation is likely directly over the trench that would have been excavated to install the main drain pipe. This visible line of vegetation and the as-built drawing were used to confirm the exact location of the former leach field.
- The area around the former Facility 244 is generally paved with remnant asphalt and crushed gravel. Southeast, and near the location of the former leach field, the area is grassed. Various types of debris are present at the ground surface near the former leach field, including plastic and metal debris, dried paint, and an area covered with an approximately 6-inch layer of previously liquefied, dried soil, which appears to have been dumped at this location.

Parallax completed a voluntary corrective action at the site in 1999, which included the decommissioning of Facility 244 and a preliminary site assessment (PSA) of the underlining soils (Parallax 2000). Based on the results of the 1999 PSA, Corrective Action Complete without Controls was proposed for the site in July 2008 (URS 2009). The site was considered closed with no need for further evaluation and CAC without controls status pending, but the NMED disapproved the request for CAC without controls status, and requested additional soil sampling of the leach field that forms part of the site. In a letter from NMED to Cannon AFB dated September 14, 2009, NMED disapproved the CAC proposal based specifically on the absence of soil samples from the leach field area. On page 3 of the letter, NMED states, "If the leach field was not sampled or was not adequately investigated, the NMED considers the investigation of SWMU 129 incomplete. Until such time that the Permittee provides documentation that the leach field was adequately sampled and the results of such sampling demonstrate that contaminants are not present in concentrations exceeding appropriate cleanup criteria, SWMU 129 will not be considered for Corrective Action Complete status." NMED did not request any additional investigation of the AST portion of TA/AS-C129. Based on the results of the Closure Report/Contamination Assessment, the fact that NMED did not request any additional investigation at the AST portion of TA/AS-C129, and NMED's specific statements referenced above, Cannon AFB determined that only the leach field portion of TA/AS-C129 required additional investigation. A copy of NMED's letter is included in **Appendix D**. It does not appear that any soil sampling was conducted in the leach field area during the PSA activities. Results of the previous PSA are discussed in **Section 4.8.2**.

4.8.2 Previous Investigation Results (TA/AS-C129)

After removal of the containment pad at Facility 244, a PSA of the underlying soils was completed. The underlying soil was examined visually and representative grab soil samples were collected from each corner, the center, and in areas likely to have been contaminated (e.g., adjacent to and underlying the OWS vault, oil dump pits, and surface areas adjacent to the retaining curbs at ground level). The ambient atmosphere directly above the ground surfaces in areas of potential contamination was monitored for volatile organic compounds (VOCs) using a photoionization detector (PID) and Draeger® contaminant-specific (benzene) colorimetric tubes. Neither of these instrument surveys indicated concentrations of contaminants exceeding USEPA risk-based concentrations (RBCs) (Parallax 2000). **Table 4-15** summarizes previous samples collected for chemical analysis. **Table 4-16** summarizes the previous analytical data and screening results. **Figures 4-8a** and **4-8b** show the locations of the previous soil sampling locations.

Laboratory analysis indicated that there were no COPCs present in the soils underlying Facility 244 that exceeded USEPA RBCs (Parallax 2000). TRPH were detected at 244SS06 (north of the OWS), 244SS07 (south of the OWS) and 244SS08 (east of the OWS). The maximum TRPH concentration was 3.00E+02 mg/kg at 244SS06. Concentrations of selenium were detected at 244SS07 (2.00E+01 mg/kg) and at 244SS08 (1.70+01 mg/kg).

TABLE 4-1
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
FORMER AGE DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	BTEX (EPA 8260)	PCBs (EPA 8082)	TPH-DRO (EPA 8015)	Note(s)
June 2009							
C501-100	1-3	6/24/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C501-101	1-3	6/24/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C501-102	1-3	6/24/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C501-103	1-3	6/24/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
			Totals	**4**	**4**	**4**	

Source:

URS Group, Inc. 2009. Final Evaluation Report. Cannon Air Force Base. Air Force Compliance Clean-up Sites, Identification and Evaluation of DERA Eligibility for AFCEE, Multiple Locations, Prepared for the United States Army Corps of Engineers, Tulsa District.

Notes:

bgs = below ground surface

BTEX = benzene, toluene, ethylbenzene and total xylenes

DRO = diesel range organics

EPA = Environmental Protection Agency

PCB = polychlorinated biphenyl

PID = photoionization detector

ppm = parts per million

TPH = total petroleum hydrocarbons

URS = URS Group, Inc.

TABLE 4-2
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER AEROSPACE GROUND EQUIPMENT (AGE) DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	C501-100 1-3 June 24, 2009			C501-101 1-3 June 24, 2009			C501-102 1-3 June 24, 2009			C501-103 1-3 June 24, 2009		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)															
All BTEX compounds were nondetect	ND	0/4													
PCBs (mg/kg)															
All PCBs were nondetect	ND	0/4													
TPH-DRO (mg/kg)	1.10E+01 F	2/4	1.00E+03	1.10E+01	1.10E+01	F	<	1.20E+01	U	<	1.20E+01	U	6.00E+00	1.10E+01	F

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
MDL = method detection limit
mg/kg = milligrams per kilogram
ND = not detected
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect

TABLE 4-3
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	TPH-DRO (EPA 8015)	TPH-GRO (EPA 8015)	TRPH	Field Analysis (GC)	Note(s)
January 1995								
N corner of UST excavation	14	1/1995	USGS 1995			X		
S corner of UST excavation	14	1/1995	USGS 1995			X		
E corner of UST excavation	14	1/1995	USGS 1995			X		
W corner of UST excavation	14	1/1995	USGS 1995			X		
SE side of UST excavation	14	1/1995	USGS 1995			X		
NW side of UST excavation	14	1/1995	USGS 1995			X		
April 1995								
CAFB-FAC0368-01	10-12	4/13/1995	USGS 1995		X			
CAFB-FAC0368-01	13-15	4/13/1995	USGS 1995		X			
CAFB-FAC0368-02	10-12	4/13/1995	USGS 1995		X			
CAFB-FAC0368-02	14-16	4/13/1995	USGS 1995		X			
CAFB-FAC0368-03	12-14	4/13/1995	USGS 1995		X			
CAFB-FAC0368-04	11-13	4/13/1995	USGS 1995		X			
CAFB-FAC0368-05	10-11	4/13/1995	USGS 1995		X			
CAFB-FAC0368-06	12-14	4/13/1995	USGS 1995		X			
CAFB-FAC0368-07	13-15	4/14/1995	USGS 1995		X			
CAFB-FAC0368-08	10	4/14/1995	USGS 1995				X	Field screening only, result was nondetect
CAFB-FAC0368-09	10	4/14/1995	USGS 1995				X	Field screening only, result was nondetect
July 1995								
CAFB-FAC0368-01M	13-15	7/1/1995	USGS 1995		X			
CAFB-FAC0368-06M	12-14	7/1/1995	USGS 1995		X			
CAFB-FAC0368-10	12-14	7/1 & 7/2/1995	USGS 1995	X	X			
CAFB-FAC0368-11	10-11	7/1/1995	USGS 1995		X			
CAFB-FAC0368-12	12-14	7/1/1995	USGS 1995		X			
CAFB-FAC0368-13	10-11	7/1/1995	USGS 1995		X			
CAFB-FAC0368-14	13-15	7/1/1995	USGS 1995		X			
CAFB-FAC0368-15	12-14	7/1/1995	USGS 1995		X			
CAFB-FAC0368-16	13-15	7/1/1995	USGS 1995		X			
CAFB-FAC0368-17	13-15	7/2/1995	USGS 1995	X				
August 1995								
CAFB-FAC0368-10	24-25	8/25/1995	USGS 1995		X			Duplicate
CAFB-FAC0368-10	35-36	8/26/1995	USGS 1995		X			
CAFB-FAC0368-10	50-52	8/26/1995	USGS 1995		X			
			Totals	**2**	**21**	**6**	**2**	

Source:
United States Geological Survey. 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico.

Notes:
bgs = below ground surface
DRO = diesel range organics
EPA = Environmental Protection Agency
GC = gas chromatograph
GRO = gasoline range organics
M = resample
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
USGS = United States Geological Survey
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	N corner of UST excavation 14 January 1995			S corner of UST excavation 14 January 1995			E corner of UST excavation 14 January 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	NA			NA			NA		
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	<	unknown	U	<	unknown	U	<	unknown	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	W corner of UST excavation 14 January 1995			SE side of UST excavation 14 January 1995			NW side of UST excavation 14 January 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	NA			NA			NA		
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	**2.45E+03**	unknown		<	unknown	U	<	unknown	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-01 10-12 April 13, 1995			CAFB-FAC0368-01 13-15 April 13, 1995			CAFB-FAC0368-01M 13-15 July 1, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	5.70E-01	5.00E-01	Q	4.40E-01	5.00E-01	QJ	<	1.00E+00	U
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-02 10-12 April 13, 1995			CAFB-FAC0368-02 14-16 April 13, 1995			CAFB-FAC0368-03 12-14 April 13, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	2.70E-01	5.00E-01	QJ	<	5.00E-01	U	<	5.00E-01	U
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-04 11-13 April 13, 1995			CAFB-FAC0368-05 10-11 April 13, 1995			CAFB-FAC0368-06 12-14 April 13, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	2.50E-01	5.00E-01	QJ	5.70E-01	5.00E-01	Q	<	5.00E-01	U
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-06M 12-14 July 1, 1995			CAFB-FAC0368-07 13-15 April 14, 1995			CAFB-FAC0368-10 12-14 July 1 & 2, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			1.60E+02	4.00E+00	Q
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	<	1.00E+00	U	<	5.00E-01	U	8.00E+02	1.00E+02	Q
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-10 24-25 August 25, 1995			CAFB-FAC0368-10 35-36 August 26, 1995			CAFB-FAC0368-10 50-52 August 26, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	**1.00E+03**	5.00E+01		3.70E+01	1.00E+01	Q	9.70E-01	1.00E+00	J
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-11 10-11 July 1, 1995			CAFB-FAC0368-12 12-14 July 1, 1995			CAFB-FAC0368-13 10-11 July 1, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	<	1.00E+00	U	<	1.00E+00	U	1.80E+01	1.00E+00	
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-14 13-15 July 1, 1995			CAFB-FAC0368-15 12-14 July 1, 1995			CAFB-FAC0368-16 13-15 July 1, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	<	1.00E+00	U	<	1.00E+00	U	<	1.00E+00	U
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-17 13-15 July 2, 1995 Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	5.10E+00	4.00E+00	Q
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	NA		
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-5
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	TPH	TPH-DRO (EPA 8015)	Note(s)
October 1994 (pre-remedial excavation)						
Under UST	9	10/1994	USGS 1995	X		
Under UST	9	10/1994	USGS 1995	X		
Under UST	9	10/1994	USGS 1995	X		
Under UST	9	10/1994	USGS 1995	X		
Post-remedial excavation						
Northwest side of UST excavation	11	unknown	USGS 1995	X		
Southeast side of UST excavation	11	unknown	USGS 1995	X		
April 1995						
CAFB-FAC0600-01	10-12	4/9/1995	USGS 1995		X	Duplicate
CAFB-FAC0600-01	14-16	4/9/1995	USGS 1995		X	
CAFB-FAC0600-01	19-21	4/9/1995	USGS 1995		X	
CAFB-FAC0600-02	10-12	4/9/1995	USGS 1995		X	
CAFB-FAC0600-02	14-16	4/9/1995	USGS 1995		X	
CAFB-FAC0600-02	19-21	4/9/1995	USGS 1995		X	
CAFB-FAC0600-03	10-12	4/9/1995	USGS 1995		X	
CAFB-FAC0600-03	14-16	4/9/1995	USGS 1995		X	
CAFB-FAC0600-03	19-21	4/9/1995	USGS 1995		X	
CAFB-FAC0600-04	10-12	4/9/1995	USGS 1995		X	
CAFB-FAC0600-04	14-16	4/9/1995	USGS 1995		X	
CAFB-FAC0600-04	18-20	4/9/1995	USGS 1995		X	
CAFB-FAC0600-05	10-12	4/9/1995	USGS 1995		X	
CAFB-FAC0600-05	14-16	4/9/1995	USGS 1995		X	
CAFB-FAC0600-05	19-21	4/9/1995	USGS 1995		X	
June 1995						
CAFB-FAC0600-06	14-16	6/27/1995	USGS 1995		X	
CAFB-FAC0600-06	19-21	6/27/1995	USGS 1995		X	
CAFB-FAC0600-07	14-16	6/27/1995	USGS 1995		X	
CAFB-FAC0600-07	19-21	6/27/1995	USGS 1995		X	
August 1995						
CAFB-FAC0600-08	15-16	8/23/1995	USGS 1995		X	
			Totals	**6**	**20**	

Source:

United States Geological Survey. 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico.

Notes:

bgs = below ground surface

DRO = diesel range organics

EPA = Environmental Protection Agency

TPH = total petroleum hydrocarbons

USGS = United States Geological Survey

UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	Under UST 9 October 1994			Under UST 9 October 1994			Under UST 9 October 1994		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	NA			NA			NA		
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	**3.94E+03**	unknown		**6.76E+03**	unknown		**1.81E+04**	unknown	

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	Under UST 9 October 1994			NW end of UST excavation 11 Not specified			SE end of UST excavation 11 Not specified			CAFB-FAC0600-01 10-12 April 9, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	NA			NA			NA			2.40E+00	4.00E+00	J
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	<	unknown	U	7.05E+02	unknown		**<u>1.37E+03</u>**	unknown		NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-01 14-16 April 9, 1995		
				Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	<	4.00E+00	U
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-01 19-21 April 9, 1995			CAFB-FAC0600-02 10-12 April 9, 1995			CAFB-FAC0600-02 14-16 April 9, 1995			CAFB-FAC0600-02 19-21 April 9, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	2.60E+00	4.00E+00	J	2.60E+00	4.00E+00	J	<	4.00E+00	U	3.10E+00	4.00E+00	J
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA			NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-03 10-12 April 9, 1995		
				Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	**2.80E+03**	4.00E+02	
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-03 14-16 April 9, 1995			CAFB-FAC0600-03 19-21 April 9, 1995			CAFB-FAC0600-04 10-12 April 9, 1995			CAFB-FAC0600-04 14-16 April 9, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	**3.50E+03**	4.00E+02		7.80E+00	4.00E+00	Q	4.10E+00	4.00E+00	Q	2.90E+00	4.00E+00	J
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA			NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-04 18-20 April 9, 1995			CAFB-FAC0600-05 10-12 April 9, 1995			CAFB-FAC0600-05 14-16 April 9, 1995			CAFB-FAC0600-05 19-21 April 9, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	3.80E+00	4.00E+00	J	8.20E+02	8.00E+01	Q	1.40E+01	4.00E+00	Q	7.60E+00	4.00E+00	Q
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA			NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-06 14-16 June 27, 1995			CAFB-FAC0600-06 19-21 June 27, 1995			CAFB-FAC0600-07 14-16 June 27, 1995			CAFB-FAC0600-07 19-21 June 27, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	1.30E+01	4.00E+00	Q	6.50E+00	4.00E+00	Q	1.80E+01	4.00E+00	Q	7.40E+00	4.00E+00	Q
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA			NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-08 15-16 August 23, 1995		
				Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	<	4.00E+00	U
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-7
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	TPH-DRO (EPA 8015)	TRPH (EPA 418.1)	Field Analysis (GC)	Note(s)
August 1994							
94600-081794-01	14	8/17/1994	Keers 1994a		X		
94600-081794-02	14	8/17/1994	Keers 1994a		X		
94600-081794-03	14	8/17/1994	Keers 1994a		X		
September 1994							
94600-092294-02	18-20	9/22/1994	Keers 1994b		X		
94600-092294-04	18-20	9/22/1994	Keers 1994b		X		
94600-092294-06	18-20	9/22/1994	Keers 1994b		X		
94600-092294-08	18-20	9/22/1994	Keers 1994b		X		
April 1995							
CAFB-FAC1400-01	14-16	4/12/1995	USGS 1995			X	Field screening only, result was nondetect
CAFB-FAC1400-01	16-18	4/12/1995	USGS 1995	X			
CAFB-FAC1400-02	18-20	4/12/1995	USGS 1995	X			
CAFB-FAC1400-03	18-20	4/12/1995	USGS 1995	X			
CAFB-FAC1400-03	22-24	4/12/1995	USGS 1995	X			
CAFB-FAC1400-04	17-19	4/12/1995	USGS 1995	X			
CAFB-FAC1400-04	20-22	4/12/1995	USGS 1995	X			
CAFB-FAC1400-05	10	4/14/1995	USGS 1995			X	Field screening only, result was nondetect
CAFB-FAC1400-06	9.5-11.5	4/14/1995	USGS 1995			X	Field screening only, result was nondetect
CAFB-FAC1400-06	20-22	4/14/1995	USGS 1995	X			
July 1995							
CAFB-FAC1400-07	19-20	7/2/1995	USGS 1995	X			
August 1995							
CAFB-FAC1400-03	36-37	8/28/1995	USGS 1995	X			Duplicate
CAFB-FAC1400-03	49.5-50.5	8/28/1995	USGS 1995	X			
CAFB-FAC1400-03	65-66	8/28/1995	USGS 1995	X			
CAFB-FAC1400-08	25-26	8/26/1995	USGS 1995	X			
CAFB-FAC1400-09	25-26	8/27/1995	USGS 1995	X			
December 1995							
CAFB-FAC1400-03	75	12/14/1995	USGS 1995	X			
CAFB-FAC1400-03	83	12/14/1995	USGS 1995	X			
CAFB-FAC1400-03	91-92	12/14/1995	USGS 1995	X			
CAFB-FAC1400-10	23-25	12/12/1995	USGS 1995	X			
CAFB-FAC1400-11	22-24	12/12/1995	USGS 1995	X			
CAFB-FAC1400-12	24-26	12/12/1995	USGS 1995	X			
			Totals	**19**	**7**	**3**	

Sources:
Keers Technical Services. 1994a. Subsurface Investigation 25,000 Gallon UST Cannon AFB.
Keers Technical Services. 1994b. Limited Subsurface Investigation for the Evaluation of Suspected Subsurface Contamination at Cannon AFB, Curry County, New Mexico.
United States Geological Survey. 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico.

Notes:
bgs = below ground surface
DRO = diesel range organics
EPA = Environmental Protection Agency
GC = gas chromatograph
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
USGS = United States Geological Survey

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID			NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	94600-081794-01			94600-081794-02			94600-081794-03			94600-092294-02		
SAMPLE DEPTH (FEET BGS)				14			14			14			18-20		
DATE COLLECTED				August 17, 1994			August 17, 1994			August 17, 1994			September 22, 1994		
	Maximum	Frequency		Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	**2.80E+03**	2.00E+01		6.40E+02	2.00E+01		<	2.00E+01	U	**8.20E+03**	2.00E+01	
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	NA			NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	94600-092294-04 18-20 September 22, 1994			94600-092294-06 18-20 September 22, 1994			94600-092294-08 18-20 September 22, 1994		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	<	2.00E+01	U	<	2.00E+01	U	<	2.00E+01	U
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	NA			NA			NA		

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-01 16-18 April 12, 1995			CAFB-FAC1400-02 18-20 April 12, 1995			CAFB-FAC1400-03 18-20 April 12, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	5.10E+01	8.00E+00	Q	**6.20E+03**	4.00E+02		**9.90E+03**	4.00E+02	

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-03 22-24 April 12, 1995			CAFB-FAC1400-03 36-37 August 28, 1995			CAFB-FAC1400-03 49.5-50.5 August 28, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	3.70E+02	8.00E+00		**8.00E+03**	4.00E+02		**1.10E+04**	4.00E+02	

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-03 65-66 August 28, 1995			CAFB-FAC1400-03 75 December 14, 1995			CAFB-FAC1400-03 83 December 14, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	**5.80E+03**	4.00E+02		**9.30E+03**	4.00E+02		<	4.00E+00	U

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-03 91-92 December 14, 1995			CAFB-FAC1400-04 17-19 April 12, 1995			CAFB-FAC1400-04 20-22 April 12, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	<	1.00E-01	U	1.60E+01	4.00E+00	Q	**2.50E+03**	8.00E+01	

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-06 20-22 April 14, 1995			CAFB-FAC1400-07 19-20 July 2, 1995			CAFB-FAC1400-08 25-26 August 26, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	5.20E+00	4.00E+00	Q	2.00E+01	4.00E+00	Q	<	4.00E+00	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-09 25-26 August 27, 1995			CAFB-FAC1400-10 23-25 December 12, 1995			CAFB-FAC1400-11 22-24 December 12, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	8.90E+02	1.60E+01	Q	<	4.00E+00	U	<	4.00E+00	U

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-12 24-26 December 12, 1995 Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	1.60E+01	4.00E+00	Q

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-9
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
FLIGHTLINE GENERATOR USTS SITE (ST-C505)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	BTEX (EPA 8020)	TRPH (EPA 418.1)	TPH-DRO (EPA 8015)	Field Analysis (GC)	Note(s)
December 1994								
3060A NE Corner	11	12/15/1994	CAFB 1994	X	X			
3060A SE Corner	11	12/15/1994	CAFB 1994	X	X			
3060A SW Corner	11	12/15/1994	CAFB 1994	X	X			
3060A NW Corner	11	12/15/1994	CAFB 1994	X	X			
3060B NE Corner	11	12/15/1994	CAFB 1994	X	X			
3060B NW Corner	11	12/15/1994	CAFB 1994	X	X			
3060B SE Corner	11	12/15/1994	CAFB 1994	X	X			
3060B SW Corner	11	12/15/1994	CAFB 1994	X	X			
Blg 3060 B East	*	12/28/1994	CAFB 1994	X	X			
Blg 3060 B West	*	12/28/1994	CAFB 1994	X	X			
April 1995								
CAFB-FAC3060-01	9-11	4/11/1995	USGS 1995				X	Field screening only, result was nondetect
CAFB-FAC3060-02	9-11	4/11/1995	USGS 1995			X		
CAFB-FAC3060-02	14-16	4/11/1995	USGS 1995			X		
CAFB-FAC3060-03	9-11	4/11/1995	USGS 1995			X		
CAFB-FAC3060-03	14-16	4/11/1995	USGS 1995			X		
CAFB-FAC3060-04	9-11	4/11/1995	USGS 1995			X		
CAFB-FAC3060-05	9-11	4/11/1995	USGS 1995			X		
CAFB-FAC3060-06	9-11	4/11/1995	USGS 1995			X		
CAFB-FAC3060-07	9-10	4/11/1995	USGS 1995				X	Field screening only, result was nondetect
June 1995								
CAFB-FAC3060-08	10-12	6/28/1995	USGS 1995			X		
CAFB-FAC3060-09	9-11	6/28/1995	USGS 1995			X		
CAFB-FAC3060-10	11-13	6/28/1995	USGS 1995			X		
CAFB-FAC3060-11	10-12	6/28/1995	USGS 1995			X		
July 1995								
CAFB-FAC3060-03	24	7/25/1995	USGS 1995			X		
August 1995								
CAFB-FAC3060-12	12-14	8/23/1995	USGS 1995			X		
CAFB-FAC3060-13	11-13	8/23/1995	USGS 1995			X		Duplicate
			Totals	**10**	**10**	**14**	**2**	

Sources:

United States Geological Survey. 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico.

Cannon Air Force Base. 1994. 7-Day Written Notification for a Petroleum Release at Facility 3060.

Notes:

*Exact depth of these samples is unknown, estimated depth is 11 feet bgs based on tank depth and previous sampling depths.

bgs = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
CAFB = Cannon Air Force Base
DRO = diesel range organics
EPA = Environmental Protection Agency
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
USGS = United States Geological Survey

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	3060A NE Corner 11 December 15, 1994			3060A SE Corner 11 December 15, 1994			3060A SW Corner 11 December 15, 1994		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Toluene	3.40E-02	3/10	NE	5.27E+03	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
m-Xylene	3.10E-02	5/10	NE	7.74E+02	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
o-Xylene	5.20E-02	7/10	NE	8.98E+02	<	1.00E-03	U	9.00E-03	1.00E-03		<	1.00E-03	U
p-Xylene	1.70E-02	1/10	NE	NE	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	<	1.00E-03	U	9.00E-03	1.00E-03		<	1.00E-03	U
MTBE	ND	0/10	NE	9.01E+02	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	1.59E+01	unknown		1.08E+01	unknown		1.96E+01	unknown	
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	NA			NA			NA		

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	3060A NW Corner 11 December 15, 1994			3060B NE Corner 11 December 15, 1994			3060B NW Corner 11 December 15, 1994		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Toluene	3.40E-02	3/10	NE	5.27E+03	<	1.00E-03	U	3.40E-02	1.00E-03		1.10E-02	1.00E-03	
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	<	1.00E-03	U	4.00E-02	1.00E-03		7.40E-02	1.00E-03	
m-Xylene	3.10E-02	5/10	NE	7.74E+02	<	1.00E-03	U	1.70E-02	1.00E-03		2.20E-02	1.00E-03	
o-Xylene	5.20E-02	7/10	NE	8.98E+02	<	1.00E-03	U	2.60E-02	1.00E-03		5.20E-02	1.00E-03	
p-Xylene	1.70E-02	1/10	NE	NE	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	<	1.00E-03	U	4.30E-02	1.00E-03		7.40E-02	1.00E-03	
MTBE	ND	0/10	NE	9.01E+02	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	6.30E+00	unknown		3.08E+02	unknown		**1.78E+03**	unknown	
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	NA			NA			NA		

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	3060B SE Corner 11 December 15, 1994			3060B SW Corner 11 December 15, 1994			Blg 3060 B East * December 28, 1994		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Toluene	3.40E-02	3/10	NE	5.27E+03	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	1.10E-02	1.00E-03		<	1.00E-03	U	<	1.00E-03	U
m-Xylene	3.10E-02	5/10	NE	7.74E+02	5.00E-03	1.00E-03		3.00E-03	1.00E-03		<	1.00E-03	U
o-Xylene	5.20E-02	7/10	NE	8.98E+02	1.80E-02	1.00E-03		1.10E-02	1.00E-03		2.80E-02	1.00E-03	
p-Xylene	1.70E-02	1/10	NE	NE	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	2.30E-02	1.00E-03		1.40E-02	1.00E-03		2.80E-02	1.00E-03	
MTBE	ND	0/10	NE	9.01E+02	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	2.31E+02	unknown		1.19E+02	unknown		1.07E+02	unknown	
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	NA			NA			NA		

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	Blg 3060 B West * December 28, 1994 Result	RL	Qual	CAFB-FAC3060-02 9-11 April 11, 1995 Result	RL	Qual	CAFB-FAC3060-02 14-16 April 11, 1995 Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	<	1.00E-03	U	NA			NA		
Toluene	3.40E-02	3/10	NE	5.27E+03	2.90E-02	1.00E-03		NA			NA		
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	4.50E-02	1.00E-03		NA			NA		
m-Xylene	3.10E-02	5/10	NE	7.74E+02	3.10E-02	1.00E-03		NA			NA		
o-Xylene	5.20E-02	7/10	NE	8.98E+02	4.20E-02	1.00E-03		NA			NA		
p-Xylene	1.70E-02	1/10	NE	NE	1.70E-02	1.00E-03		NA			NA		
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	9.00E-02	1.00E-03		NA			NA		
MTBE	ND	0/10	NE	9.01E+02	<	1.00E-03	U	NA			NA		
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	**1.03E+03**	unknown		NA			NA		
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	NA			**1.30E+03**	4.00E+01		8.70E+00	4.00E+00	Q

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	CAFB-FAC3060-03 9-11 April 11, 1995			CAFB-FAC3060-03 14-16 April 11, 1995			CAFB-FAC3060-03 24 July 25, 1995		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	NA			NA			NA		
Toluene	3.40E-02	3/10	NE	5.27E+03	NA			NA			NA		
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	NA			NA			NA		
m-Xylene	3.10E-02	5/10	NE	7.74E+02	NA			NA			NA		
o-Xylene	5.20E-02	7/10	NE	8.98E+02	NA			NA			NA		
p-Xylene	1.70E-02	1/10	NE	NE	NA			NA			NA		
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	NA			NA			NA		
MTBE	ND	0/10	NE	9.01E+02	NA			NA			NA		
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	NA			NA			NA		
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	**5.30E+03**	4.00E+02		2.30E+01	4.00E+00		7.80E+01	4.00E+00	

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	CAFB-FAC3060-04 9-11 April 11, 1995			CAFB-FAC3060-05 9-11 April 11, 1995			CAFB-FAC3060-06 9-11 April 11, 1995		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	NA			NA			NA		
Toluene	3.40E-02	3/10	NE	5.27E+03	NA			NA			NA		
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	NA			NA			NA		
m-Xylene	3.10E-02	5/10	NE	7.74E+02	NA			NA			NA		
o-Xylene	5.20E-02	7/10	NE	8.98E+02	NA			NA			NA		
p-Xylene	1.70E-02	1/10	NE	NE	NA			NA			NA		
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	NA			NA			NA		
MTBE	ND	0/10	NE	9.01E+02	NA			NA			NA		
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	NA			NA			NA		
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	4.30E+00	4.00E+00	Q	3.20E+00	4.00E+00	J	3.70E+01	4.00E+00	

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	CAFB-FAC3060-08 10-12 June 28, 1995			CAFB-FAC3060-09 9-11 June 28, 1995			CAFB-FAC3060-10 11-13 June 28, 1995		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	NA			NA			NA		
Toluene	3.40E-02	3/10	NE	5.27E+03	NA			NA			NA		
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	NA			NA			NA		
m-Xylene	3.10E-02	5/10	NE	7.74E+02	NA			NA			NA		
o-Xylene	5.20E-02	7/10	NE	8.98E+02	NA			NA			NA		
p-Xylene	1.70E-02	1/10	NE	NE	NA			NA			NA		
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	NA			NA			NA		
MTBE	ND	0/10	NE	9.01E+02	NA			NA			NA		
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	NA			NA			NA		
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	1.50E+01	4.00E+00	Q	4.00E+01	4.00E+00	Q	1.60E+02	4.00E+00	Q

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	CAFB-FAC3060-11 10-12 June 28, 1995			CAFB-FAC3060-12 12-14 August 23, 1995			CAFB-FAC3060-13 11-13 August 23, 1995		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	NA			NA			NA		
Toluene	3.40E-02	3/10	NE	5.27E+03	NA			NA			NA		
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	NA			NA			NA		
m-Xylene	3.10E-02	5/10	NE	7.74E+02	NA			NA			NA		
o-Xylene	5.20E-02	7/10	NE	8.98E+02	NA			NA			NA		
p-Xylene	1.70E-02	1/10	NE	NE	NA			NA			NA		
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	NA			NA			NA		
MTBE	ND	0/10	NE	9.01E+02	NA			NA			NA		
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	NA			NA			NA		
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	2.20E+01	4.00E+00	Q	<	4.00E+00	U	<	4.00E+00	U

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-11
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	BTEX (EPA 8260)	PCBs (EPA 8082)	TPH-DRO (EPA 8015)	Note(s)
June 2009							
C507-100	1-3	6/23/2009	URS 2009	X	X	X	MS/MSD, PID reading = 0.0 ppm
C507-101	1-3	6/25/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C507-102	1-3	6/23/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C507-103	1-3	6/25/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C507-104	1-3	6/25/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C507-105	1-3	6/25/2009	URS 2009	X	X	X	Duplicate, PID reading = 0.0 ppm
C507-106	1-3	6/25/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C501-107	1-3	6/25/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
			Totals	**8**	**8**	**8**	

Source:

URS Group, Inc. 2009. Final Evaluation Report. Cannon Air Force Base. Air Force Compliance Clean-up Sites, Identification and Evaluation of DERA Eligibility for AFCEE, Multiple Locations, Prepared for the United States Army Corps of Engineers, Tulsa District.

Notes:

bgs = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
EPA = Environmental Protection Agency
MS/MSD = matrix spike/matrix spike duplicate
PCB = polychlorinated biphenyl
PID = photoionization detector
ppm = parts per million
TPH = total petroleum hydrocarbons
URS = URS Group, Inc.

TABLE 4-12
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER PETROLEUM, OIL AND LUBRICANTS (POL) YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	C507-100 1-3 June 23, 2009			C507-101 1-3 June 25, 2009			C507-102 1-3 June 23, 2009		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
All BTEX compounds were nondetect	ND	0/8											
PCBs (mg/kg)													
PCB 1016	ND	0/8	NE	3.93E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1221	ND	0/8	NE	1.49E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1232	ND	0/8	NE	1.49E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1242	ND	0/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1248	ND	0/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1254	ND	0/8	NE	1.12E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1260	2.80E-02 F	1/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
TPH-DRO (mg/kg)	7.10E+00 F	3/8	1.00E+03	NE	6.30E+00	1.10E+01	F	<	1.10E+01	U	5.80E+00	1.20E+01	F

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
MDL = method detection limit
mg/kg = milligrams per kilogram
ND = not detected
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyls
Qual = qualifier
RL = reporting limit
SSL = Soil Screening Level
TPH = total petroleum hydrocarbon
U = nondetect

TABLE 4-12
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER PETROLEUM, OIL AND LUBRICANTS (POL) YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	C507-103 1-3 June 25, 2009			C507-104 1-3 June 25, 2009			C507-105 1-3 June 25, 2009		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
All BTEX compounds were nondetect	ND	0/8											
PCBs (mg/kg)													
PCB 1016	ND	0/8	NE	3.93E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1221	ND	0/8	NE	1.49E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1232	ND	0/8	NE	1.49E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1242	ND	0/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1248	ND	0/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1254	ND	0/8	NE	1.12E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1260	2.80E-02 F	1/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
TPH-DRO (mg/kg)	7.10E+00 F	3/8	1.00E+03	NE	<	1.20E+01	U	7.10E+00	1.20E+01	F	<	1.20E+01	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
MDL = method detection limit
mg/kg = milligrams per kilogram
ND = not detected
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyls
Qual = qualifier
RL = reporting limit
SSL = Soil Screening Level
TPH = total petroleum hydrocarbon
U = nondetect

TABLE 4-12
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER PETROLEUM, OIL AND LUBRICANTS (POL) YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	C507-106 1-3 June 25, 2009			C507-107 1-3 June 25, 2009		
					Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)										
All BTEX compounds were nondetect	ND	0/8								
PCBs (mg/kg)										
PCB 1016	ND	0/8	NE	3.93E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1221	ND	0/8	NE	1.49E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1232	ND	0/8	NE	1.49E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1242	ND	0/8	NE	2.22E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1248	ND	0/8	NE	2.22E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1254	ND	0/8	NE	1.12E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1260	2.80E-02 F	1/8	NE	2.22E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
TPH-DRO (mg/kg)	7.10E+00 F	3/8	1.00E+03	NE	<	1.10E+01	U	<	1.20E+01	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
MDL = method detection limit
mg/kg = milligrams per kilogram
ND = not detected
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyls
Qual = qualifier
RL = reporting limit
SSL = Soil Screening Level
TPH = total petroleum hydrocarbon
U = nondetect

TABLE 4-13
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	BTEX (EPA 8260)	PCBs (EPA 8082)	TPH-DRO (EPA 8015)	RCRA Metals (EPA 6010B/7470A/7471A)	Note(s)
June 2009								
C508-100	0-1	6/23/2009	URS 2009	X	X	X	X	PID reading = 0.0 ppm
C508-100	1-3	6/23/2009	URS 2009	X	X	X	X	PID reading = 0.0 ppm
C508-101	0-1	6/23/2009	URS 2009	X	X	X	X	MS/MSD, PID reading = 0.0 ppm
C508-101	1-3	6/23/2009	URS 2009	X	X	X	X	PID reading = 0.0 ppm
C508-102	0-1	6/23/2009	URS 2009	X	X	X	X	PID reading = 0.0 ppm
C508-102	1-3	6/23/2009	URS 2009	X	X	X	X	Duplicate, MS/MSD, PID reading = 0.0 ppm
			Totals	**6**	**6**	**6**	**6**	

Source:

URS Group, Inc. 2009. Final Evaluation Report. Cannon Air Force Base. Air Force Compliance Clean-up Sites, Identification and Evaluation of DERA Eligibility for AFCEE, Multiple Locations, Prepared for the United States Army Corps of Engineers, Tulsa District.

Notes:

bgs = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
EPA = Environmental Protection Agency
MS/MSD = matrix spike/matrix spike duplicate
NA = not applicable
PCB = polychlorinated biphenyl
PID = photoionization detector
ppm = parts per million
RCRA = Resource Conservation and Recovery Act
TPH = total petroleum hydrocarbons
URS = URS Group, Inc.

TABLE 4-14
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	C508-100 0-1 June 23, 2009			C508-100 1-3 June 23, 2009			C508-101 0-1 June 23, 2009		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
All BTEX compounds were nondetect	ND	0/6											
PCBs (mg/kg)													
All PCBs were nondetect	ND	0/6											
RCRA METALS (mg/kg)													
Arsenic	3.30E+00	6/6	NE	3.90E+00	2.60E+00	2.80E-01		2.40E+00	3.00E-01		2.50E+00	2.80E-01	
Barium	3.07E+02	6/6	NE	1.56E+04	3.07E+02	5.70E-02		1.18E+02	6.50E-02		1.14E+02	5.80E-02	
Cadmium	2.00E+00	5/6	NE	7.03E+01	4.50E-01	1.40E-02		1.50E-01	1.50E-02		3.30E-01	1.40E-02	
Chromium	1.08E+01	6/6	NE	1.17E+05	6.70E+00	4.40E-02		9.30E+00	5.00E-02		9.30E+00	4.50E-02	
Lead	2.80E+01	6/6	NE	4.00E+02	1.66E+01	1.10E-01		1.52E+01	1.10E-01		1.71E+01	1.10E-01	
Mercury	2.70E-02	6/6	NE	1.56E+01	1.60E-02	3.80E-03		1.90E-02	3.80E-03		2.70E-02	3.80E-03	
Selenium	ND	0/6	NE	3.91E+02	<	2.40E-01	U	<	2.70E-01	U	<	3.60E-01	U
Silver	1.00E+00	4/6	NE	3.91E+02	6.10E-01	7.40E-02		3.70E-01	8.40E-02		1.00E+00	7.60E-02	
TPH-DRO (mg/kg)	1.20E+02	4/6	1.00E+03	NE	1.20E+02	2.10E+01		5.50E+00	1.10E+01	F	4.50E+01	2.10E+01	

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
J = estimated
MDL = method detection limit
mg/kg = milligrams per kilogram
NA = not available
ND = not detected
NE = not established
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RCRA = Resource Conservation and Recovery Act
RL = reporting limit
SSL = Soil Screening Level
TPH = total petroleum hydrocarbons
U = nondetect

TABLE 4-14
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	C508-101 1-3 June 23, 2009			C508-102 0-1 June 23, 2009			C508-102 1-3 June 23, 2009		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
All BTEX compounds were nondetect	ND	0/6											
PCBs (mg/kg)													
All PCBs were nondetect	ND	0/6											
RCRA METALS (mg/kg)													
Arsenic	3.30E+00	6/6	NE	3.90E+00	2.50E+00	3.00E-01		3.30E+00	2.80E-01		2.40E+00	2.90E-01	
Barium	3.07E+02	6/6	NE	1.56E+04	6.27E+01	6.30E-02		1.14E+02	5.80E-02		7.43E+01	6.20E-02	
Cadmium	2.00E+00	5/6	NE	7.03E+01	<	1.50E-02	U	2.00E+00	1.40E-02		9.30E-02	1.50E-02	
Chromium	1.08E+01	6/6	NE	1.17E+05	8.90E+00	4.80E-02		1.08E+01	4.40E-02		8.00E+00	4.70E-02	
Lead	2.80E+01	6/6	NE	4.00E+02	1.30E+01	1.10E-01		2.80E+01	1.10E-01		1.49E+01	1.10E-01	
Mercury	2.70E-02	6/6	NE	1.56E+01	1.20E-02	3.80E-03		1.40E-02	3.80E-03		9.80E-03	3.80E-03	
Selenium	ND	0/6	NE	3.91E+02	<	2.60E-01	U	<	2.40E-01	U	<	2.50E-01	U
Silver	1.00E+00	4/6	NE	3.91E+02	<	8.10E-02	U	2.70E-01	7.50E-02		<	8.00E-02	U
TPH-DRO (mg/kg)	1.20E+02	4/6	1.00E+03	NE	<	1.10E+01	U	5.70E+01	2.10E+01		<	1.10E+01	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
J = estimated
MDL = method detection limit
mg/kg = milligrams per kilogram
NA = not available
ND = not detected
NE = not established
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RCRA = Resource Conservation and Recovery Act
RL = reporting limit
SSL = Soil Screening Level
TPH = total petroleum hydrocarbons
U = nondetect

TABLE 4-15
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval	Sample Date	Source	PCBs (EPA 8082)	Pesticides (EPA 8081A)	TPH (EPA 418.1)	RCRA Metals (EPA 6010B/7470A/7471A)	Note(s)
December 1999								
244SS001	surface of excavation	12/14/1999	Parallax 2000	X	X	X	X	
244SS002	surface of excavation	12/14/1999	Parallax 2000	X	X	X	X	
244SS003	surface of excavation	12/14/1999	Parallax 2000	X	X	X	X	
244SS004	surface of excavation	12/14/1999	Parallax 2000	X	X	X	X	MS/MSD, Field Duplicate
244SS005	surface of excavation	12/14/1999	Parallax 2000	X	X	X	X	
244SS006	4 feet bgs	12/14/1999	Parallax 2000	X	X	X	X	
244SS007	2.5 feet bgs	12/14/1999	Parallax 2000	X	X	X	X	
244SS008	3.5 feet bgs	12/14/1999	Parallax 2000	X	X	X	X	
			Totals	**8**	**8**	**8**	**8**	

Source:

Parallax, Inc. 2000. Closeout Report/Contamination Assessment, SWMU 129-Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, Final. July.

Notes:

bgs = below ground surface

EPA = Environmental Protection Agency

MS/MSD = matrix spike/matrix spike duplicate

PCB = polychlorinated biphenyl

RCRA = Resource Conservation and Recovery Act

TPH = total petroleum hydrocarbons

SWMU = Solid Waste Management Unit

TABLE 4-16
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	244SS01 surface of excavation December 14, 1999			244SS02 surface of excavation December 14, 1999			244SS03 surface of excavation December 14, 1999		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
ORGANOCHLORINE PESTICIDES (mg/kg)													
All pesticides were nondetect	ND	0/8											
PCBs (mg/kg)													
All PCBs were nondetect	ND	0/8											
RCRA METALS (mg/kg)													
Arsenic	1.20E+01	8/8	NE	3.90E+00	7.80E+00	unknown		7.00E+00	unknown		1.20E+01	unknown	
Barium	3.80E+02	8/8	NE	1.56E+04	7.90E+01	unknown		4.60E+01	unknown		1.30E+02	unknown	
Cadmium	1.80E+00	8/8	NE	7.03E+01	1.20E+00	unknown		8.50E-01	unknown		1.60E+00	unknown	
Chromium	9.60E+00	6/8	NE	1.17E+05	7.70E+00	unknown		<	5.50E+00	U	9.60E+00	unknown	
Lead	1.30E+01	8/8	NE	4.00E+02	7.30E+00	unknown		5.90E+00	unknown		1.00E+01	unknown	
Mercury	ND	0/8	NE	1.56E+01	<	5.80E-01	U	<	5.50E-01	U	<	5.90E-01	U
Selenium	2.00E+01	2/8	NE	3.91E+02	<	5.80E+00	U	<	5.50E+00	U	<	5.90E+00	U
TPH (mg/kg)	3.00E+02	3/8	1.00E+03	NE	<	1.00E+01	U	<	1.00E+01	U	<	1.00E+01	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
bgs = below ground surface
ID = identification
mg/kg = milligrams per kilogram
NA = not available
ND = not detected
NE = not established
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RCRA = Resource Conservation and Recovery Act
RL = reporting limit
SSL = Soil Screening Level
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons
U = nondetect

TABLE 4-16
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

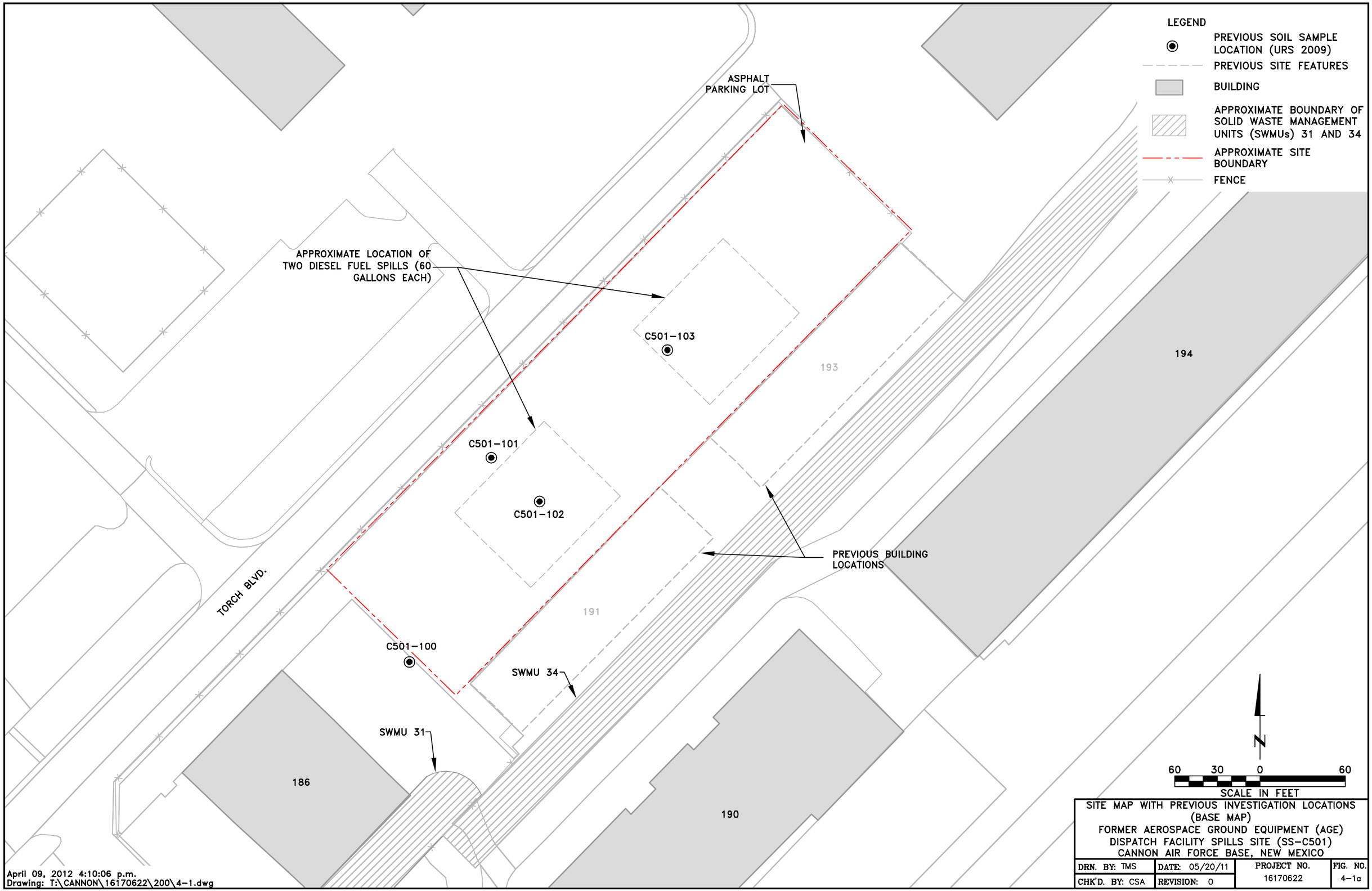
FIELD ID SAMPLE DEPTH DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	244SS04 surface of excavation December 14, 1999			244SS05 surface of excavation December 14, 1999			244SS06 4 feet bgs December 14, 1999		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
ORGANOCHLORINE PESTICIDES (mg/kg)													
All pesticides were nondetect	ND	0/8											
PCBs (mg/kg)													
All PCBs were nondetect	ND	0/8											
RCRA METALS (mg/kg)													
Arsenic	1.20E+01	8/8	NE	3.90E+00	5.80E+00	unknown		8.40E+00	unknown		7.60E+00	unknown	
Barium	3.80E+02	8/8	NE	1.56E+04	4.80E+01	unknown		5.50E+01	unknown		3.80E+02	unknown	
Cadmium	1.80E+00	8/8	NE	7.03E+01	9.00E-01	unknown		1.10E+00	unknown		1.10E+00	unknown	
Chromium	9.60E+00	6/8	NE	1.17E+05	<	5.60E+00	U	6.90E+00	unknown		5.60E+00	unknown	
Lead	1.30E+01	8/8	NE	4.00E+02	6.20E+00	unknown		9.40E+00	unknown		1.30E+01	unknown	
Mercury	ND	0/8	NE	1.56E+01	<	5.60E-01	U	<	5.60E-01	U	<	5.50E-01	U
Selenium	2.00E+01	2/8	NE	3.91E+02	<	5.60E+00	U	<	5.60E+00	U	<	5.50E+00	U
TPH (mg/kg)	3.00E+02	3/8	1.00E+03	NE	<	1.00E+01	U	<	1.00E+01	U	3.00E+02	NA	

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
bgs = below ground surface
ID = identification
mg/kg = milligrams per kilogram
NA = not available
ND = not detected
NE = not established
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RCRA = Resource Conservation and Recovery Act
RL = reporting limit
SSL = Soil Screening Level
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons
U = nondetect

TABLE 4-16
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	244SS07 2.5 feet bgs December 14, 1999			244SS08 3.5 feet bgs December 14, 1999		
					Result	RL	Qual	Result	RL	Qual
ORGANOCHLORINE PESTICIDES (mg/kg)										
All pesticides were nondetect	ND	0/8								
PCBs (mg/kg)										
All PCBs were nondetect	ND	0/8								
RCRA METALS (mg/kg)										
Arsenic	1.20E+01	8/8	NE	3.90E+00	1.10E+01	unknown		6.60E+00	unknown	
Barium	3.80E+02	8/8	NE	1.56E+04	1.70E+02	unknown		1.20E+02	unknown	
Cadmium	1.80E+00	8/8	NE	7.03E+01	1.80E+00	unknown		1.60E+00	unknown	
Chromium	9.60E+00	6/8	NE	1.17E+05	8.50E+00	unknown		7.30E+00	unknown	
Lead	1.30E+01	8/8	NE	4.00E+02	1.30E+01	unknown		9.40E+00	unknown	
Mercury	ND	0/8	NE	1.56E+01	<	5.70E-01	U	<	5.60E-01	U
Selenium	2.00E+01	2/8	NE	3.91E+02	2.00E+01	unknown		1.70E+01	unknown	
TPH (mg/kg)	3.00E+02	3/8	1.00E+03	NE	1.00E+02	NA		4.00E+01	NA	

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
bgs = below ground surface
ID = identification
mg/kg = milligrams per kilogram
NA = not available
ND = not detected
NE = not established
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RCRA = Resource Conservation and Recovery Act
RL = reporting limit
SSL = Soil Screening Level
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons
U = nondetect



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
FORMER AEROSPACE GROUND EQUIPMENT (AGE) DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO. 16170622	FIG. NO. 4-1a
CHK'D. BY: CSA	REVISION: 0		

April 09, 2012 4:10:06 p.m.
Drawing: T:\CANNON\16170622\200\4-1.dwg

SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
FORMER AEROSPACE GROUND EQUIPMENT (AGE)
DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO. 16170622	FIG. NO. 4-1b
CHK'D. BY: CSA	REVISION: 0		

LEGEND

- PREVIOUS SOIL SAMPLE LOCATION (USGS 1995)
- PREVIOUS SOIL SAMPLE LOCATION (APPROXIMATE) (LCI2 1995)
- PREVIOUS SITE FEATURES
- BUILDING
- APPROXIMATE SITE BOUNDARY
- FENCE

SIDEWALK

D L INGRAM BLVD

SIDEWALK

ASPHALT

GRASS

CAFB-FAC0368-13

CAFB-FAC0368-14

CAFB-FAC0368-12

CAFB-FAC0368-16

CAFB-FAC0368-10

CAFB-FAC0368-17

CAFB-FAC0368-15

CAFB-FAC0368-11

APPROXIMATE LOCATION OF FORMER PUMP ISLANDS

COVERED DRIVE-THRU

APPROXIMATE FORMER LOCATION OF HYDRAULIC LIFTS

368

ASPHALT PARKING LOT

CAFB-FAC0368-08

NC-UST-EX

APPROXIMATE LIMITS OF UST EXCAVATION

CAFB-FAC0368-02

NWS-UST-EX

CAFB-FAC0368-03

APPROXIMATE LOCATION OF FORMER UST C (10,000 GALLON)

WC-UST-EX

EC-UST-EX

CAFB-FAC0368-01

CAFB-FAC0368-04

CAFB-FAC0368-05

SES-UST-EX

CAFB-FAC0368-09

APPROXIMATE LOCATION OF FORMER UST B (10,000 GALLON)

CAFB-FAC0368-07

SC-UST-EX

CAFB-FAC0368-06

APPROXIMATE LOCATION OF FORMER UST A (10,000 GALLON)

SIDEWALK

KERMIT EVANS AVE

N

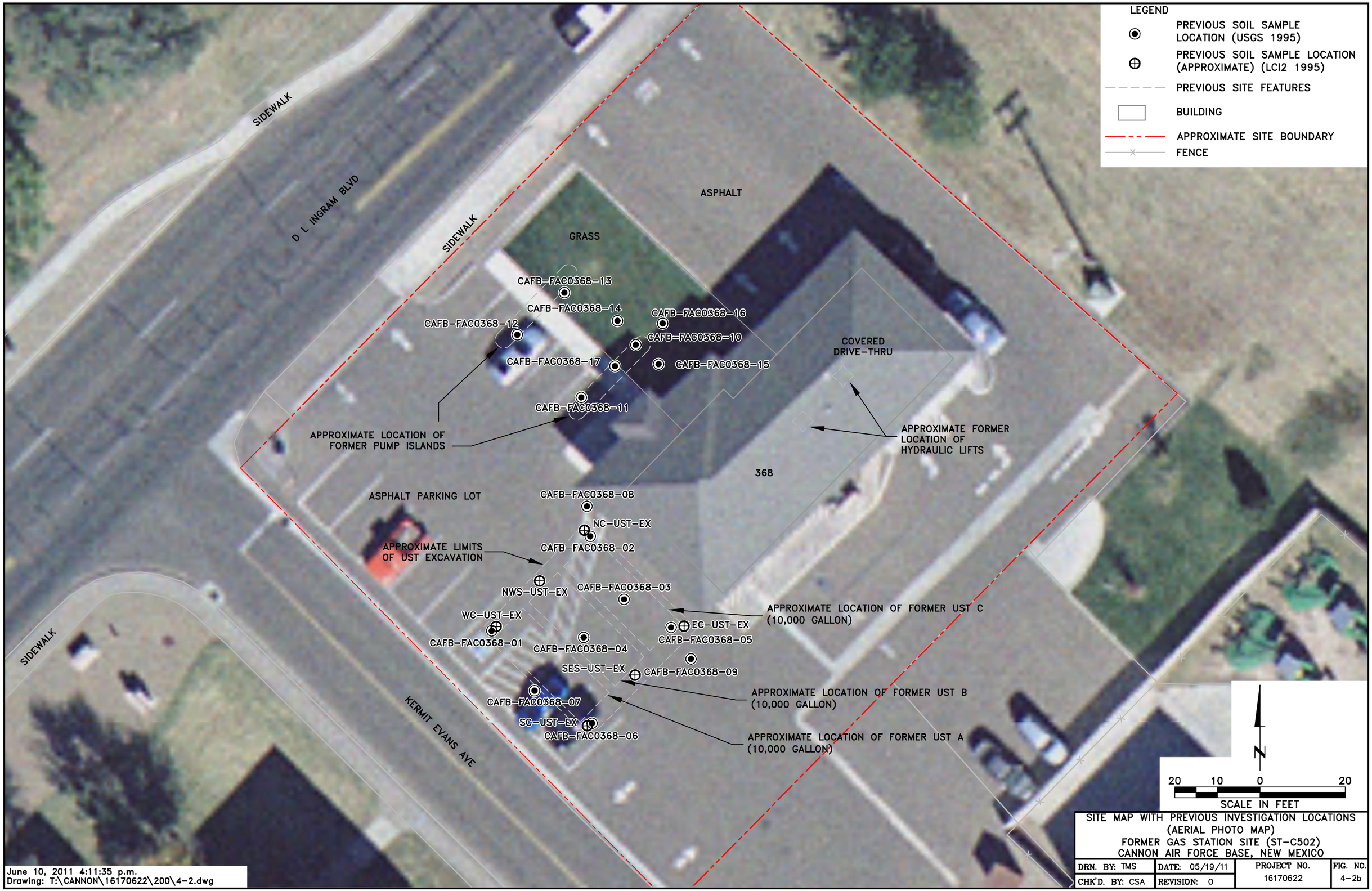
20 10 0 20

SCALE IN FEET

SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
FORMER GAS STATION SITE (ST-C502)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/19/11	PROJECT NO. 16170622	FIG. NO. 4-2a
CHK'D. BY: CSA	REVISION: 0		

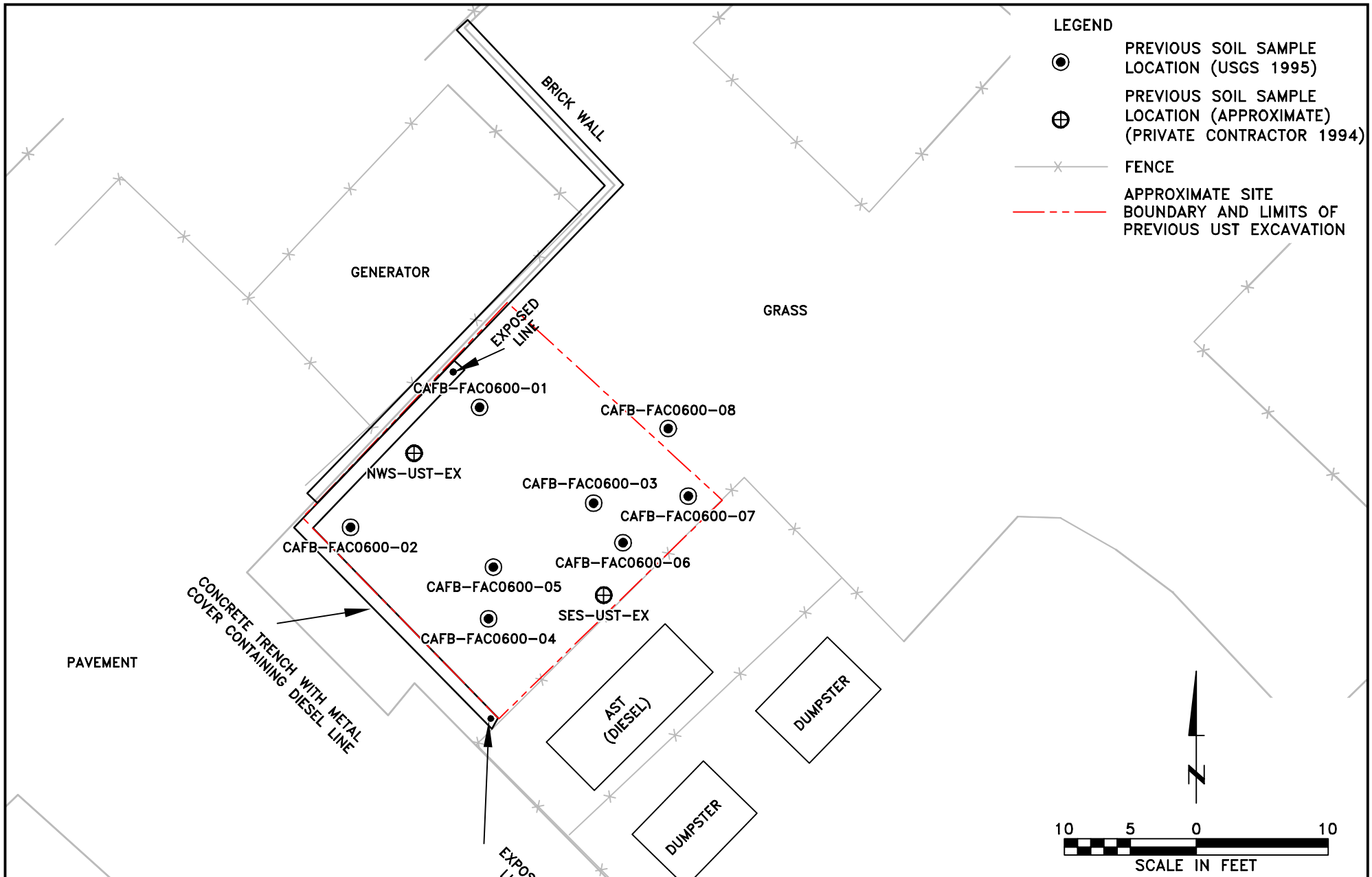
June 10, 2011 4:10:51 p.m.
Drawing: T:\CANNON\16170622\200\4-2.dwg



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
FORMER GAS STATION SITE (ST-C502)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/19/11	PROJECT NO. 16170622	FIG. NO. 4-2b
CHK'D. BY: CSA	REVISION: 0		

June 10, 2011 4:11:35 p.m.
Drawing: T:\CANNON\16170622\200\4-2.dwg



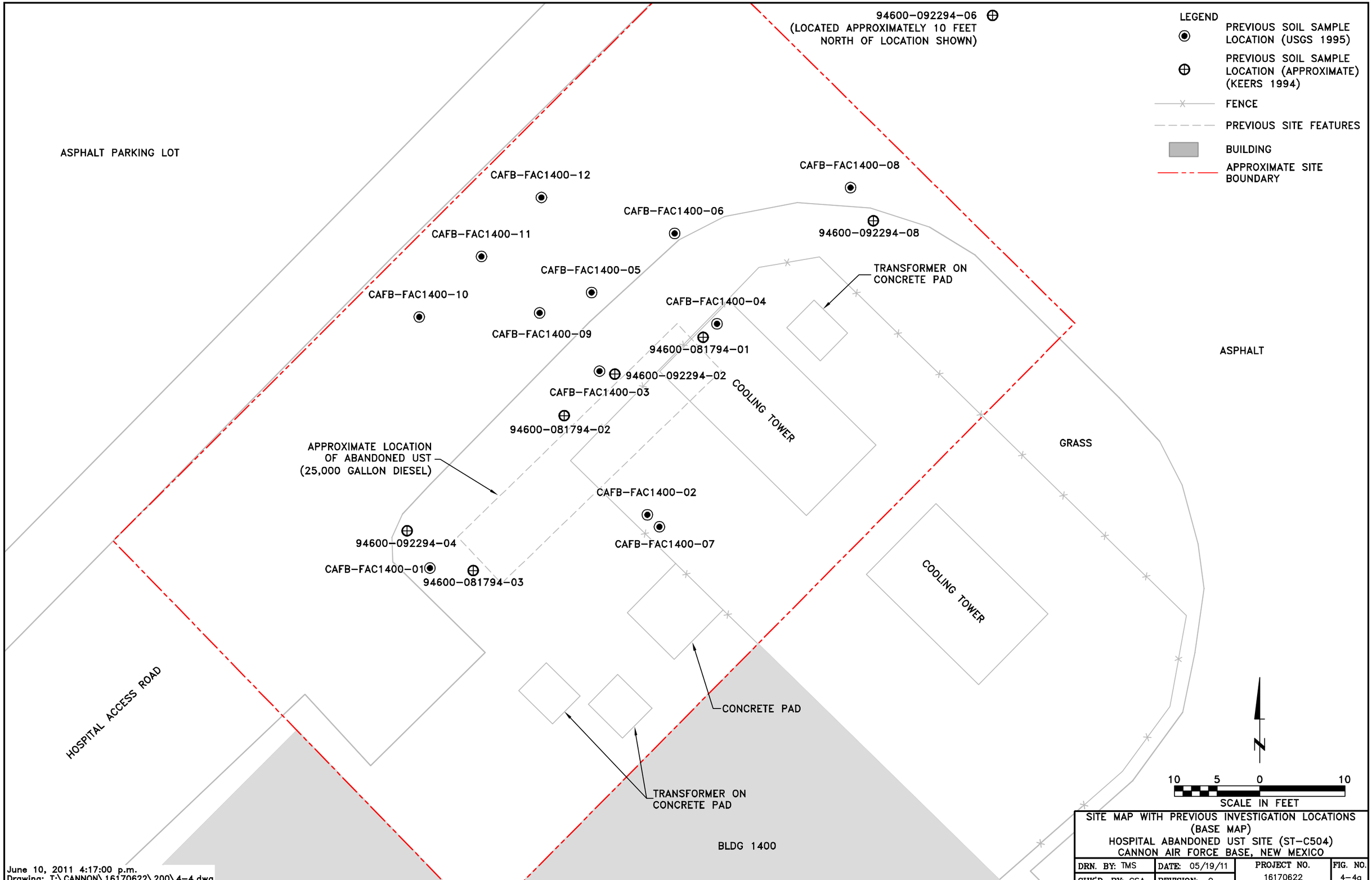
SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	4-3a

April 09, 2012 4:21:00 p.m.
Drawing: T:\CANNON\16170622\200\4-3.dwg

SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (AERIAL PHOTO MAP
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/19/11	PROJECT NO. 16170622	FIG. NO. 4-3b
CHK'D. BY: CSA	REVISION: 0		

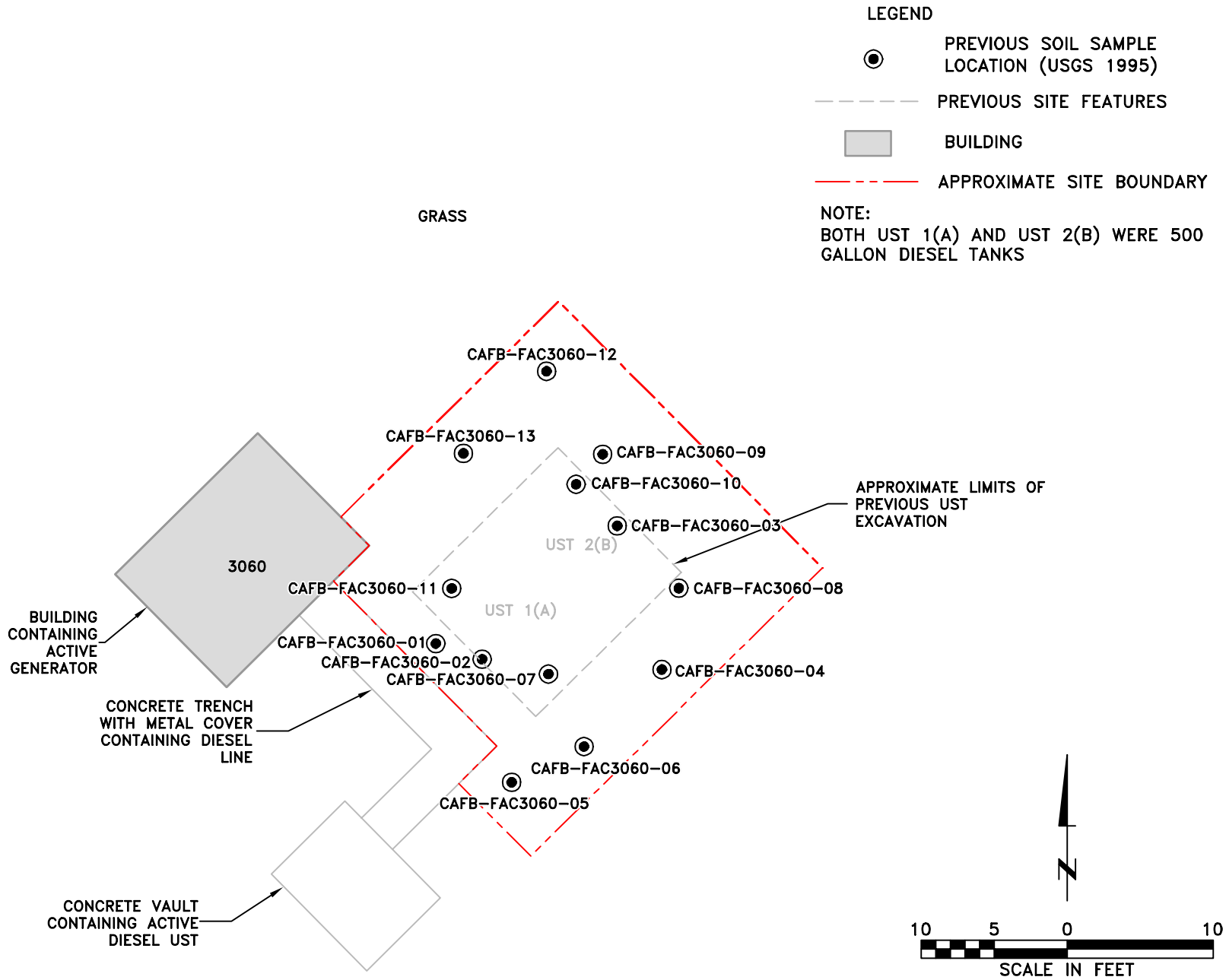


SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/19/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	4-4a

SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AIR FORCE BASE, NEW MEXICO

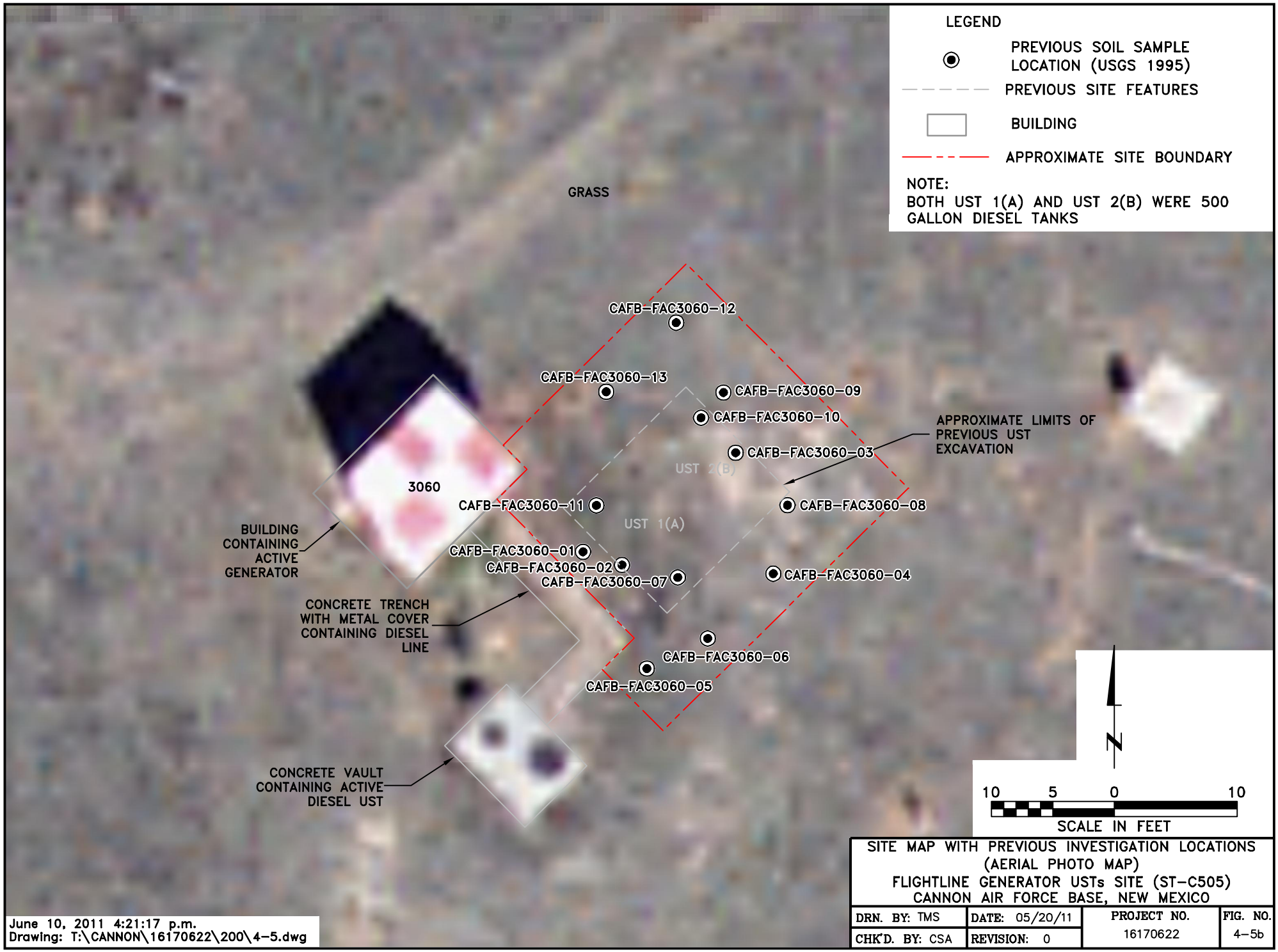
DRN. BY: TMS	DATE: 05/19/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	4-4b



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
FLIGHTLINE GENERATOR USTs SITE (ST-C505)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO. 16170622	FIG. NO. 4-5a
CHK'D. BY: CSA	REVISION: 0		

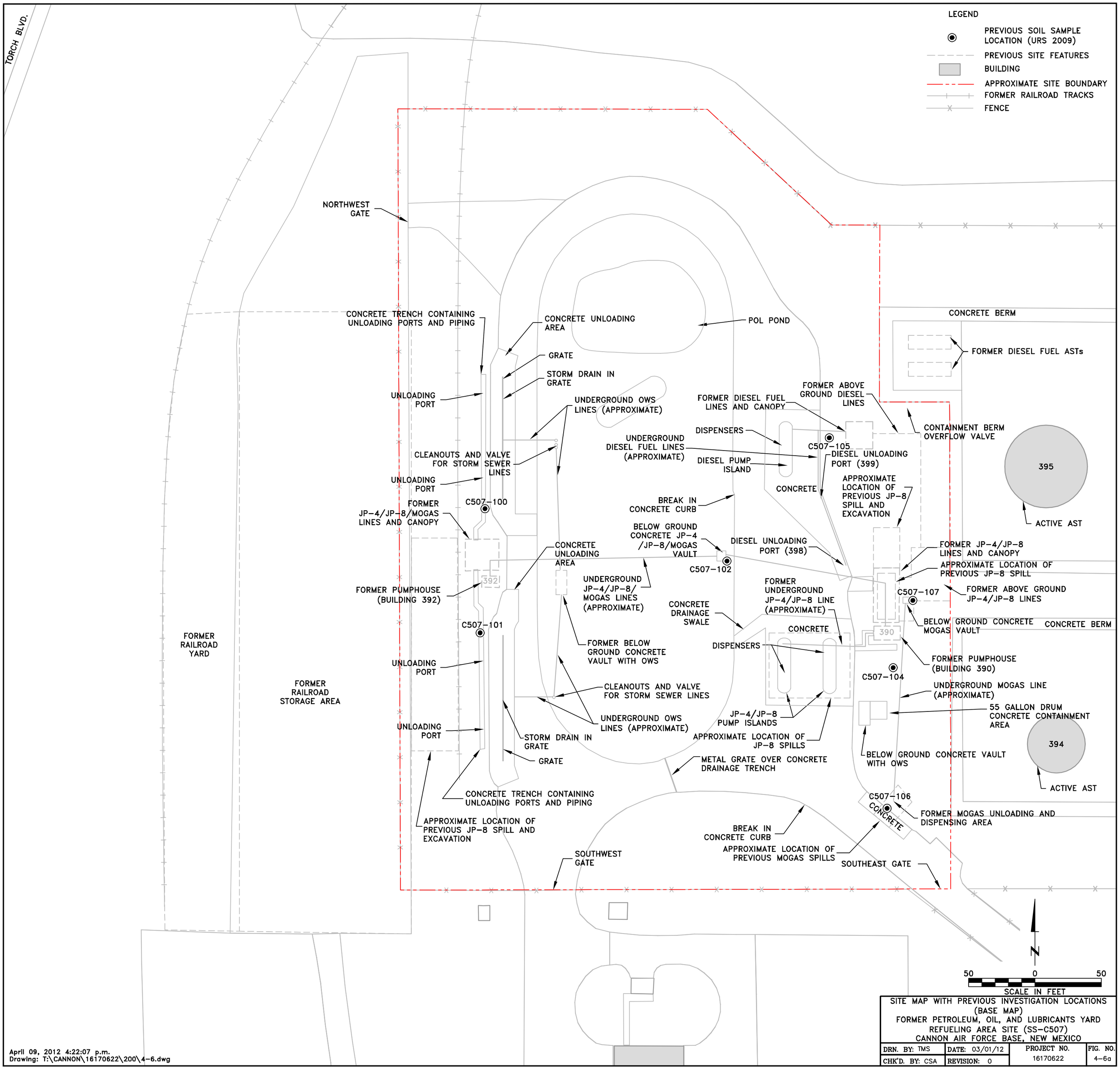
June 10, 2011 4:20:51 p.m.
Drawing: T:\CANNON\16170622\200\4-5.dwg



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
FLIGHTLINE GENERATOR USTs SITE (ST-C505)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	4-5b

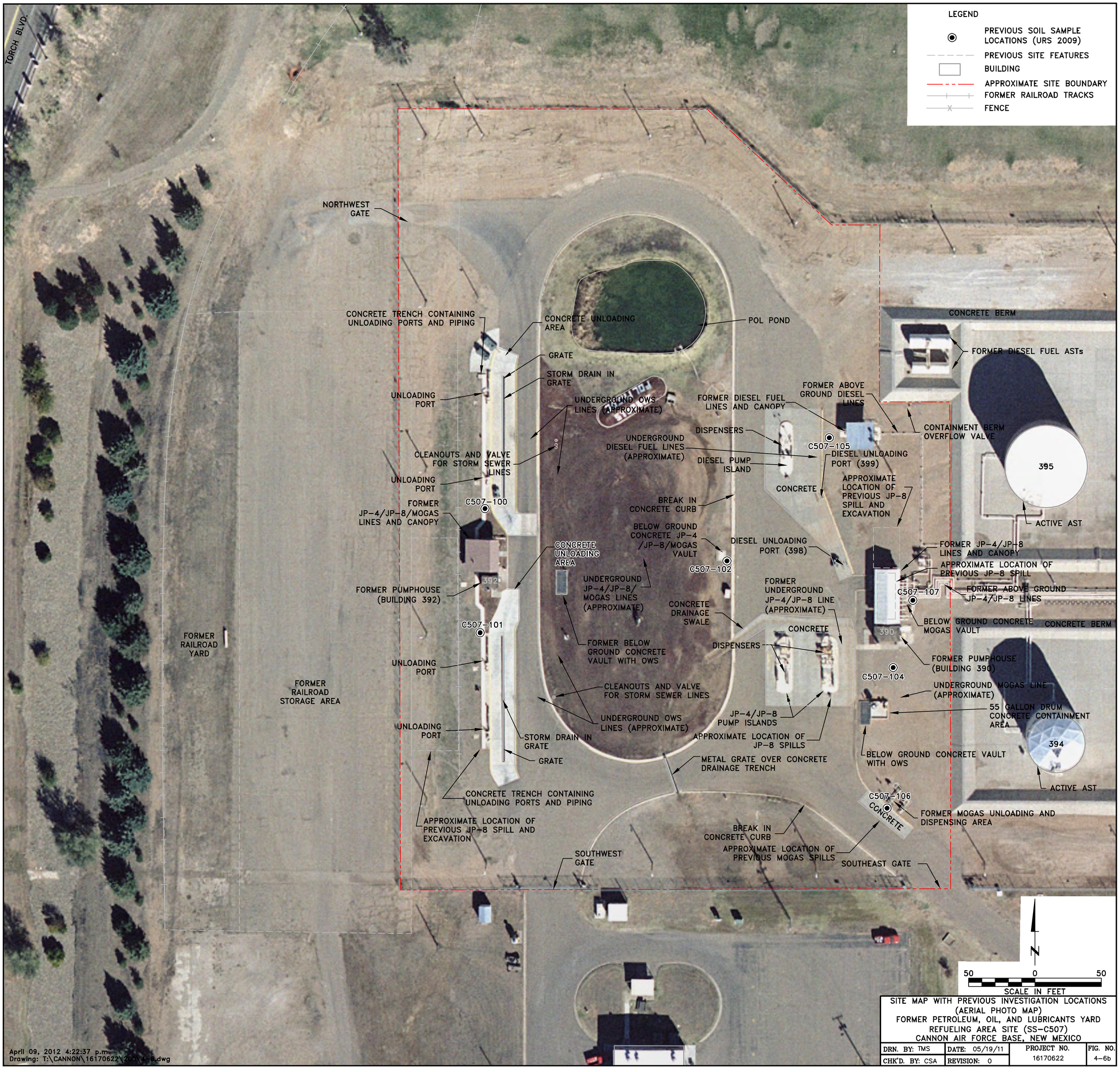
June 10, 2011 4:21:17 p.m.
Drawing: T:\CANNON\16170622\200\4-5.dwg



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
FORMER PETROLEUM, OIL, AND LUBRICANTS YARD REFUELING AREA SITE (SS-C507)
CANNON AIR FORCE BASE, NEW MEXICO

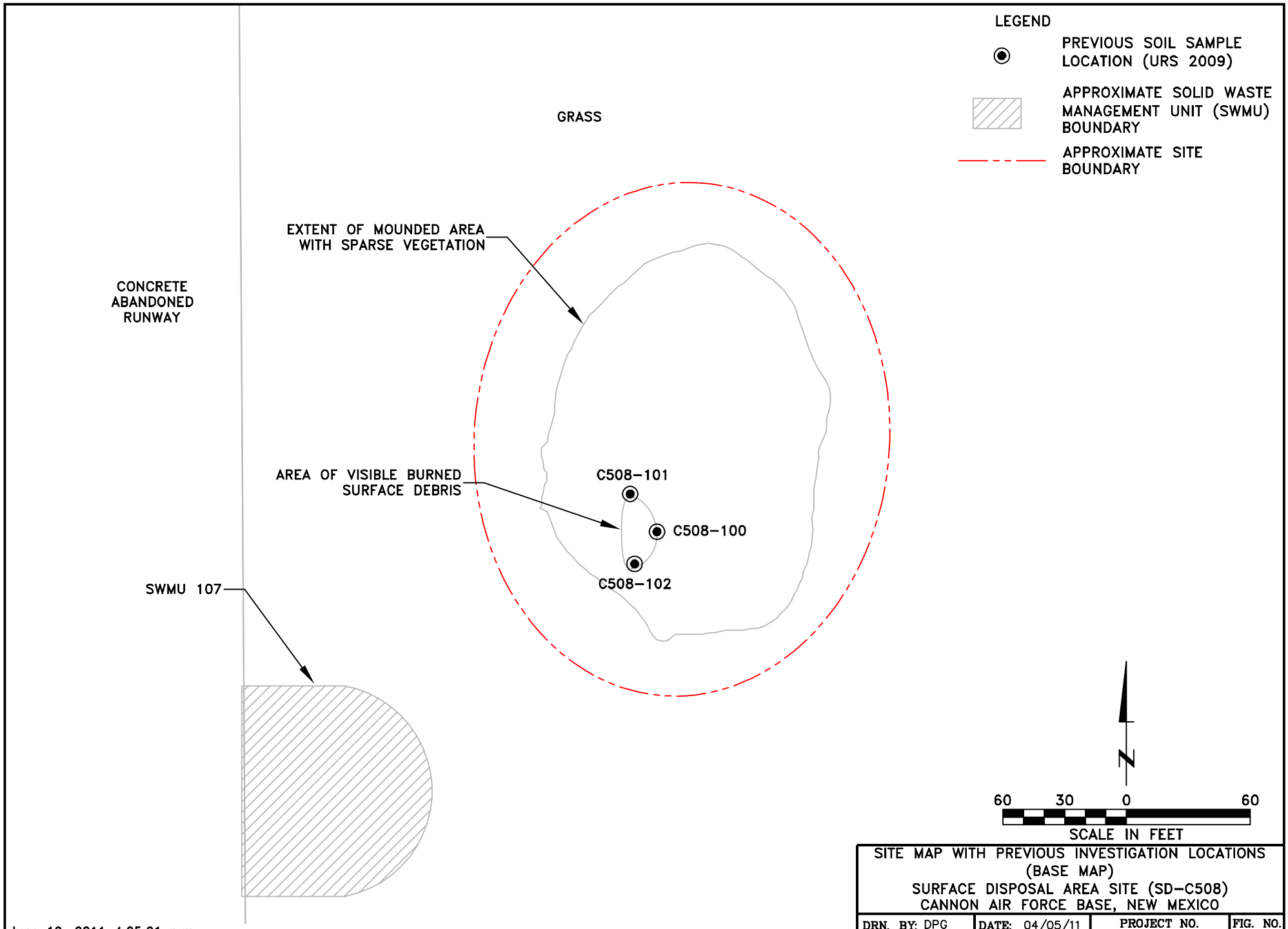
DRN. BY: TMS	DATE: 03/01/12	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	4-6a

April 09, 2012 4:22:07 p.m.
Drawing: T:\CANNON\16170622\200\4-6.dwg



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
FORMER PETROLEUM, OIL, AND LUBRICANTS YARD
REFUELING AREA SITE (SS-C507)
CANNON AIR FORCE BASE, NEW MEXICO

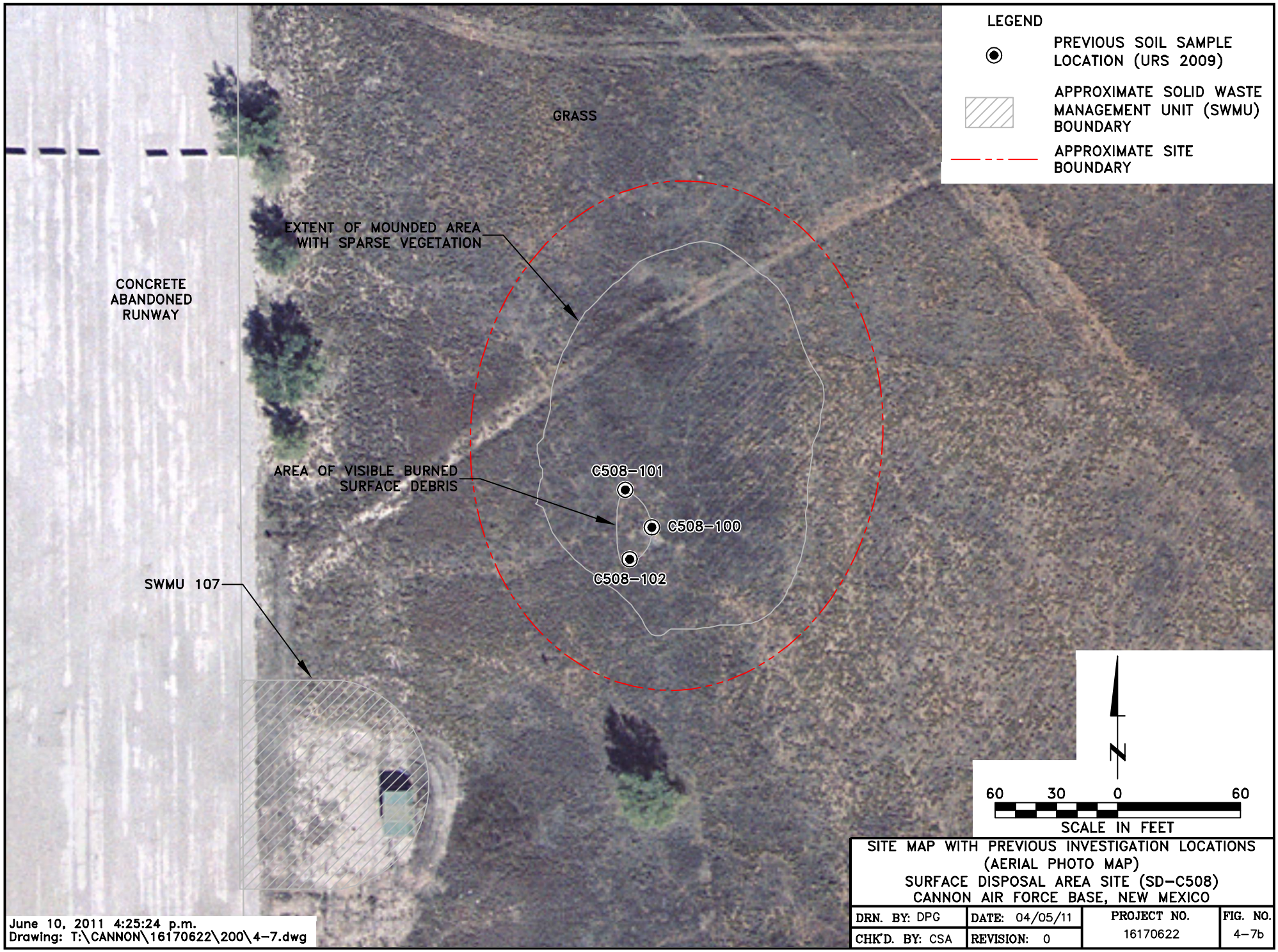
DRN. BY: TMS	DATE: 05/19/11	PROJECT NO. 16170622	FIG. NO. 4-6b
CHK'D. BY: CSA	REVISION: 0		



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/05/11	PROJECT NO. 16170622	FIG. NO. 4-7a
CHK'D. BY: CSA	REVISION: 0		

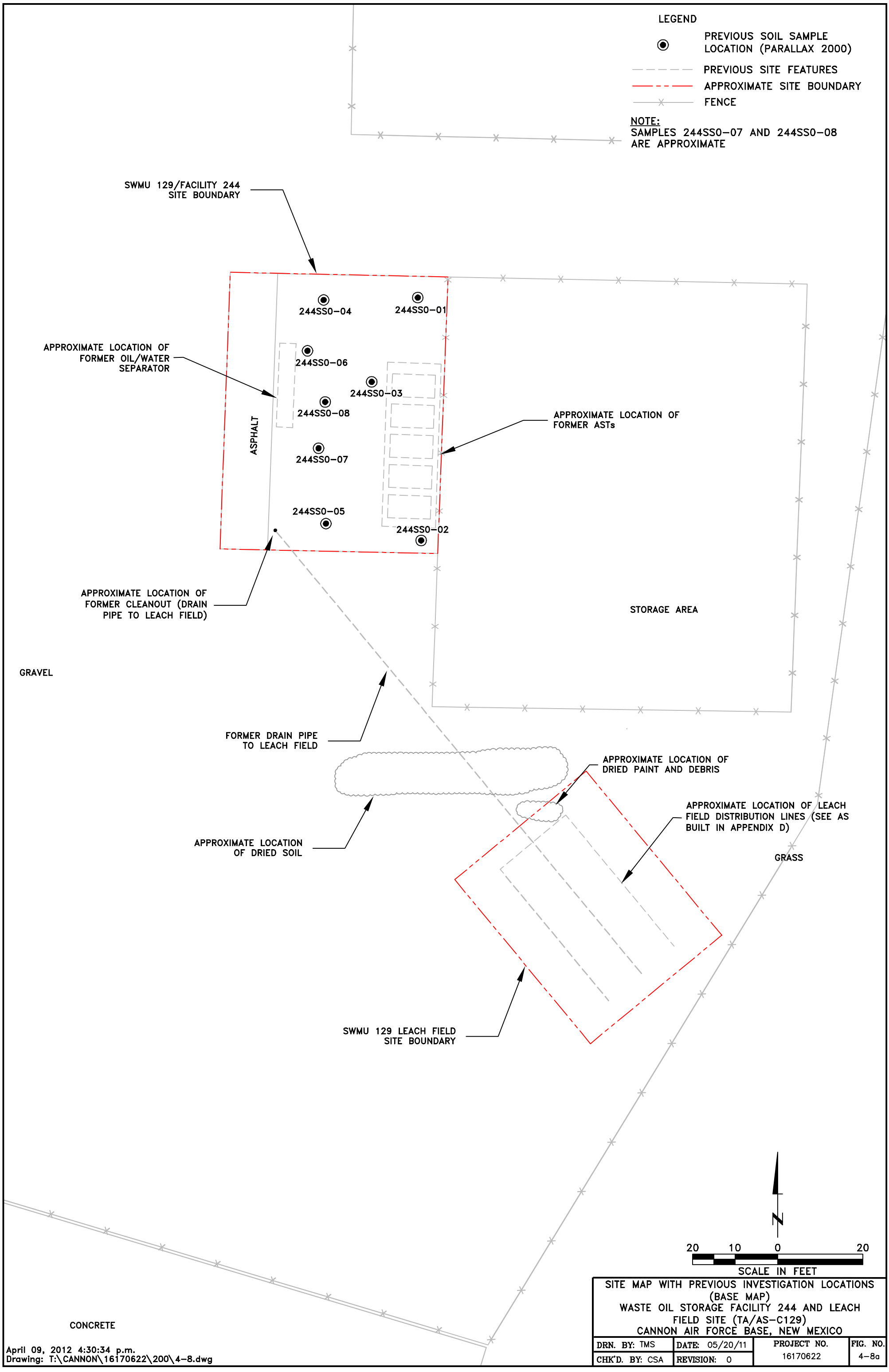
June 10, 2011 4:25:01 p.m.
Drawing: T:\CANNON\16170622\200\4-7.dwg



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/05/11	PROJECT NO. 16170622	FIG. NO. 4-7b
CHK'D. BY: CSA	REVISION: 0		

June 10, 2011 4:25:24 p.m.
Drawing: T:\CANNON\16170622\200\4-7.dwg


LEGEND
PREVIOUS SOIL SAMPLE LOCATION (PARALLAX 2000)
PREVIOUS SITE FEATURES
APPROXIMATE SITE BOUNDARY
FENCE
NOTE:
SAMPLES 244SS0-07 AND 244SS0-08 ARE APPROXIMATE
SWMU 129/FACILITY 244 SITE BOUNDARY
244SS0-04
244SS0-01
APPROXIMATE LOCATION OF FORMER OIL/WATER SEPARATOR
244SS0-06
244SS0-03
244SS0-08
ASPHALT
APPROXIMATE LOCATION OF FORMER ASTs
244SS0-07
244SS0-05
244SS0-02
APPROXIMATE LOCATION OF FORMER CLEANOUT (DRAIN PIPE TO LEACH FIELD)
STORAGE AREA
GRAVEL
FORMER DRAIN PIPE TO LEACH FIELD
APPROXIMATE LOCATION OF DRIED PAINT AND DEBRIS
APPROXIMATE LOCATION OF LEACH FIELD DISTRIBUTION LINES (SEE AS BUILT IN APPENDIX D)
APPROXIMATE LOCATION OF DRIED SOIL
GRASS
SWMU 129 LEACH FIELD SITE BOUNDARY
N
20 10 0 20
SCALE IN FEET
CONCRETE
April 09, 2012 4:30:34 p.m.
Drawing: T:\CANNON\16170622\200\4-8.dwg
SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AIR FORCE BASE, NEW MEXICO
DRN. BY: TMS
DATE: 05/20/11
PROJECT NO. 16170622
FIG. NO. 4-8a
CHK'D. BY: CSA
REVISION: 0

SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (AERIAL PHOTO MAP)
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO. 16170622	FIG. NO. 4-8b
CHK'D. BY: CSA	REVISION: 0		

This section provides an overview of the planned field activities for eight sites at Cannon AFB. Planned soil sampling locations, sample depths, analytical parameters, QC and matrix spike/matrix spike duplicate (MS/MSD) sampling locations, and technical rationale are summarized for each site in **Tables 5-1** through **5-8**. Final soil sampling depths will be based on previous sampling results, field observations (e.g., color and odor), and headspace analysis. QC and MS/MSD samples will be collected at a 10 percent frequency. Planned soil sampling locations are shown for each site on **Figures 5-1a** through **5-8b**. Based on the data collected from each site, additional to be determined (TBD) soil borings will be completed at locations to help further define the horizontal and vertical extent of potential contamination at each site. Additional TBD borings may also be used to advance planned borings to deeper depths in order to help define the vertical extent of contamination. Additional TBD borings with sample quantities are provided for each site in **Tables 5-1** through **5-8**.

The initial portion of this FSP describes the general investigative approach and protocols that will be followed during the soil sampling event. Following the general FSP sections, site-specific sampling locations and supporting rationale are provided on a site-by-site basis. Field investigation activities will be completed in accordance with the procedures detailed in this FSP.

5.1 MOBILIZATION

Mobilization of equipment and personnel will be completed prior to the start of field activities. The mobilization activities will include, but are not limited to, the tasks described in the following sections.

5.1.1 Acquire Base Passes

Field personnel and subcontractors will coordinate with the Cannon AFB RPM to acquire passes that will allow entry onto Cannon AFB to complete the planned activities.

5.1.1.1 Contractor Identification

Prior to the initiation of each field investigation, URS personnel and all subcontractors on-site will be identified to appropriate personnel within the 27th Civil Engineer Squadron's Environmental Flight (27 CES/CEV). 27 CES/CEV will make all arrangements to notify base personnel and security of the pending field investigation. It is likely that on-site URS personnel and subcontractors will be issued base visitor passes, which they will be required to have with them at all times while on base. In addition, all URS personnel and URS subcontractors may be required to attend a safety briefing provided by the base.

5.1.1.2 Vehicle Passes

All vehicles that enter the base must be registered at the Main Gate, and obtain and display a vehicle permit tag from base security. The vehicle registration applicant will need to furnish proof of insurance, rental agreement (if applicable), a valid driver's license, and the contract

number to register a vehicle. The tag shall be displayed in the lower driver's side corner of the windshield.

5.1.2 Facility Safety Requirements

URS will take preventative measures required for safe work activities at Cannon AFB. URS will follow all procedures necessary to ensure that the safe practices employed comply with Occupational Safety and Health Administration (OSHA), American National Standards Institute (ANSI), and Cannon AFB regulations.

URS will provide an SSO at all times during completion of the investigations. The SSO, as well as all project personnel, will observe the safety procedures to provide a safe work environment.

Prior to the start of field activities, a site walk will be completed at each site to identify possible safety concerns. Possible safety concerns may include physical hazards (e.g., underground/overhead utilities, holes, or uneven terrain), biological hazards, or explosives hazards (e.g., unexploded ordinance [UXO]). Although UXO is not anticipated during the execution of the project, URS field personnel will contact Cannon AFB EOD personnel to verify there is no possibility of UXO at the sites (primarily the Surface Disposal Area Site [SD-C508]). If UXO is encountered during this or any phase of work at Cannon AFB, all work will stop and the URS PM, Health and Safety Representative, and the UXO Corporate Safety Manager (Mac Reed, 615-224-2148) will immediately be notified. Cannon AFB and AFCEE will immediately be notified by the URS PM. In general, the following MEC safety protocol will be followed:

- DO NOT touch or move any ordnance items regardless of the markings or apparent condition.
- DO NOT be misled by markings on the MEC item stating “practice bomb,” “dummy,” or “inert.” Even practice bombs have explosive charges that are used to mark and/or spot the point of impact; or the item could be marked incorrectly.
- The age or condition of a MEC item does not decrease the effectiveness. MEC that has been exposed to the elements for an extended period of time becomes more sensitive to shock, movement, and friction because the stabilizing agent in the explosives may be degraded.
- Consider MEC that has been exposed to fire as extremely hazardous. Chemical and physical changes to the contents may have occurred that render it more sensitive than it was in its original state.
- DO NOT use radio or cellular phones in the vicinity of suspect MEC items.
- DO NOT drive vehicles into a suspected MEC area; use clearly marked lanes.
- DO NOT carry matches, cigarettes, lighters or other flame-producing devices into a MEC site.
- Always assume MEC items contain a live charge until determined otherwise.

5.1.3 Locate Utilities

URS will obtain utility clearances prior to the start of any intrusive activities. Utility locates will be coordinated with the Cannon AFB RPM. The utility clearances will be requested sufficiently in advance and will be completed by 27th Special Operations, Civil Engineering Squadron (27 SOCES). All underground utilities identified will be marked with flagging, stakes, and/or paint. All utility location tasks will be documented in the field logbook to aid in subsequent work. No intrusive work using heavy equipment will be completed within 5 feet of an active utility.

Digging permits will be obtained for all subsurface activities prior to initiating the work. Digging permits will be obtained through the appropriate United States Air Force (USAF) representative. When any intrusive work is being performed in the vicinity of utility and/or communication cables/lines, Civil Engineering and/or Communication monitoring personnel, as required, will be present. If a utility and/or communication line is damaged, the designated representative of the USAF shall be notified immediately for further directions.

Notice will be given to the monitoring personnel no later than 24 hours prior to work. No work shall start if the required monitoring personnel are not present.

5.1.4 Surveying of Soil Borings

Soil borings will be located in the field using predetermined survey coordinates loaded into a hand held GPS unit. The GPS unit will have sub-meter accuracy. The horizontal survey coordinates will reference the North American Datum of 1983 (NAD83) State Plane Coordinate System (i.e., New Mexico East, Federal Information Processing Standard [FIPS] 3001 [in survey feet]). Prior to the start of field activities, the GPS unit will be calibrated to a known reference point located at Cannon AFB. The results of the calibration will be recorded in the field logbook. Final sampling locations may be adjusted slightly in the field based on site conditions (i.e., underground/overhead utilities, access restrictions, permanent site features, etc.). At the completion of field activities, all final soil boring locations will be surveyed at once, along with a known reference point at Cannon AFB.

5.2 SURFACE SOIL SAMPLE COLLECTION

Surface soil samples (identified as SS) will be collected to determine if potential contamination exists in the upper 0 to 0.5 feet bgs. Surface soil samples will be collected by hand using either stainless-steel hand utensils or hand auger. Surface soil sample collection methods are provided in the following sections.

5.2.1 Surface Soil Sampling Using Hand Utensils

This method of soil sample collection is to be used at Cannon AFB in situations where conditions will not permit the use of auger or drilling methods. Soil samples will be collected from 0 to 0.5 feet bgs using a stainless steel spoon and stainless steel bowl. Before the sampling

begins, vegetation or surface debris such as rock, will be cleared as necessary. When collecting surface soil samples, if additional soil is necessary to fill sample jars, the sample area will be expanded without increasing depth.

5.2.2 Surface Soil Sampling Using a Hand Auger

This method of soil sample collection is to be used at Cannon AFB in situations where conditions will not permit the use of hand utensils or drilling methods. Hand auger samples will be collected at the specified depth using a stainless steel hand auger with a minimum 3-inch outer diameter (OD) bucket. Before the augering activities, vegetation and any surface debris such as rocks will be cleared, as necessary. When collecting surface soil samples, if additional soil is necessary to fill sample jars, an additional borehole will be advanced adjacent to the initial borehole, without increasing depth.

5.2.3 Surface Soil Analytical Sample Collection

Surface soil sample collection will begin by recording the boring location on a site map and in the field logbook. Once the sample has been collected at the specified depths, the recovery will be measured and the soil classified. The sample will be handled quickly, especially if it is loose or crumbling, to avoid losing volatile contaminants. VOCs and BETX+naphthalene will be collected using TerraCore® samplers. The TerraCore® sampler is a single use device and cannot be cleaned and/or reused. The TerraCore® sampler is designed to sample and momentarily hold soil before dispensing soil into sample container. Three separate 5-gram soil plugs from the TerraCore® sampler will be placed in three separate pre-weighed VOA vials. One VOA will contain methanol, and the other two VOA vials will contain organic free water. VOC and BETX+naphthalene samples will be collected in place to minimize the potential for a disturbed sample. Soil to be analyzed for other parameters will be composited by thoroughly mixing the soil from the sampler or auger bucket in a clean stainless steel bowl with a stainless steel spoon. Any required SVOC samples will then be immediately collected from the composited soil. The remaining composited soil will then be transferred to the appropriate laboratory-provided sample containers. Laboratory samples will be placed on ice in a cooler immediately following collection, in order to attain a temperature of 4°C. Site-specific analytical parameters will be selected from the following: TPH-DRO, TPH-GRO, TPH-oil range organics (TPH-ORO), BTEX+napthalene, VOCs, site-related semivolatile organic compounds (SVOCs), SVOCs, pesticides, RCRA metals, lead, PCBs, and dioxins/furans.

Samples will be analyzed using the following methods:

- TPH-DRO by USEPA Method 8015C
- TPH-GRO by USEPA Method 8015C
- TPH-ORO by USEPA Method 8015C
- BTEX+naphthalene by USEPA Method 8260B
- Target Compound List (TCL) VOCs by USEPA Method 8260B

- Site-related SVOCs by USEPA Method 8270D
- TCL SVOCs by USEPA Method 8270D
- TCL pesticides 8081B
- RCRA metals USEPA Method 6020A
- Mercury USEPA Method 7471B
- PCBs by USEPA Method 8082A
- Explosives by USEPA Method 8330
- Dioxins/Furans by USEPA Method 8290

At sites or at locations within a site where petroleum-related contaminants are known to be the main COPCs (e.g., UST site), surface soil samples will be analyzed for BTEX+naphthalene and site-related SVOCs in lieu of TCL VOCs and TCL SVOCs. This will allow for more efficient screenings of petroleum release sites while protecting human health and the environment. The site-related SVOC list is derived from Table 3 of the NMED TPH Screening Guideline (NMED 2006) and includes the following analytes: 2-Methyl naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. A complete list of analytes included in each of the analyte groups listed above is provided in the UFP-QAPP (**Appendix A**) Worksheets 15 and 17.

Surface soil samples will be submitted to EMAX, located at 1835 West 205th Street, Torrance CA 90501, via FedEx. Surface soil samples submitted to EMAX will be extracted and analyzed for analytical parameters within maximum hold times. A complete list of maximum hold times for each analyte is provided in the UFP–QAPP (**Appendix A**) Worksheet 19.

Final surface soil sampling locations will be photographed and located using a hand held GPS. Surface soil sample locations will be backfilled with soil. Surface soil samples will be collected at selected sites, as described in the site specific sampling objectives provided in **Sections 5.9** through **5.16**, and in **Tables 5-1** through **5-8**.

5.3 SUBSURFACE DRILLING AND SOIL SAMPLING

Subsurface drilling will be completed using direct push technology. At subsurface sample locations where pavement is present, a core machine with a diamond-tipped core barrel will be used to access the subsurface. Soil borings will be continuously sampled and each boring will be logged by the URS field geologist. Direct push technology was selected as the preferred sampling methodology in lieu of hollow stem auger, based on URS' previous drilling and sampling experience at Cannon AFB. It is also URS' experience that direct push technology is approved by NMED for subsurface soil sampling. PES, Salina Kansas, will complete the direct push sampling with oversight by the URS field manager. If direct push methods are unable to reach required sample depths, then a drilling rig with hollow stem auger and air-rotary capabilities will be used to advance the boring through the caliche layer in order to obtain

samples from the required depths. Talon/LPE of Amarillo, Texas, will complete the drill rig sampling, with oversight by the URS Field Manager.

Subsurface soil samples (identified as SB) will be collected to determine if potential contamination exists in the subsurface and to help further define the extent of known contamination in the subsurface. Subsurface soil samples will be collected using the Geoprobe Macro-Core sampler with 1.5-inch diameter, 5-foot-long, clear acetate liners. If hollow stem auger methods are employed, then samples will be collected continuously using a 2-foot-long, 2-inch diameter stainless steel, split-barrel sampler. As a last resort, air-rotary drilling methods will be employed in order to advance borings through the caliche layer. Subsurface drilling and soil sampling will be completed using the equipment and field procedures described in the following sub-sections.

5.3.1 Direct Push Sampling Procedures

Direct push sampling will be used to collect continuous or discrete soil samples. Direct push technology involves the use of probing tools that are advanced using a combination of the static weight of the carrier vehicle and hydraulic hammer percussion. Continuous soil samples will be collected with a Dual Tube soil sampler or a Macro-Core® sampler (closed-piston system) or equivalent. Discrete soil samples will be collected with a Macro-Core® sampler or equivalent. Direct push soil sample will be collected in clear acetate liners. Sample collection methods will be determined by site-specific geological conditions.

5.3.2 Drill Rig Sampling Procedures

If direct push methods are unable to reach required sample depths, then a drilling rig with hollow stem auger and air-rotary capabilities will be used to advance the boring through the caliche layer in order to obtain samples from the required depths. Hollow stem auger drilling will be accomplished using machine-driven hollow stem flight augers (HSA) with a 4.25-inch minimum inside diameter to accommodate a 2-inch outside diameter stainless-steel split spoon sampler. Where necessary for sample recovery, the sampler will also be equipped with a sample retainer.

As a last resort, air-rotary drilling methods will be employed in order to advance borings through the caliche layer. Air-rotary drilling will be accomplished using a 9-inch diameter wing bit and 4-inch outside diameter rods.

5.3.3 Subsurface Soil Analytical Sample Collection

Analytical soil samples will be collected using continuous sampling methods. Subsurface soil sample collection will begin by recording the boring location on a site map and in the field logbook. Once the sample has been collected at the specified depths, the recovery will be measured and the soil classified. VOC and BTEX+ naphthalene soil samples will be collected immediately after the acetate liner is cut, using the TerraCore® sampling methods (as previously described in **Section 5.2.3**). If the soil consistency precludes use of these samplers, then a 4-ounce glass jar will be used. Soil to be analyzed for other parameters will be composited by thoroughly mixing the soil from the acetate liner in a clean stainless steel bowl with a stainless steel spoon. Any required SVOC samples will then be immediately collected from the

composited soil. The remaining composited soil will then be transferred to the appropriate laboratory provided sample containers. Laboratory samples will be placed on ice in a cooler immediately following collection, in order to attain a temperature of 4°C.

Site specific analytical parameters will be selected from the following: TPH-DRO, TPH-GRO, TPH-ORO, BTEX+naphthalene, VOCs, site-related SVOCs, SVOCs, pesticides, RCRA metals, lead, PCBs, and dioxins/furans. Analytical methods and rationale for analyzing BTEX+naphthalene and site-related SVOCs in lieu of TCL VOCs and TCL SVOCs at petroleum release sites is the the same for subsurface soil samples as presented previously in **Section 5.2**. Samples submitted for laboratory analysis will generally be selected based on the results of field screening, as summarized below:

- If PID field screening results from a particular interval within a 5-foot-long sample are elevated, then the sample will be collected from that interval and the exact interval will be documented.
- If no elevated PID readings are obtained from a 5-foot interval, then the sample will be collected based on visual observations (if possible), and the exact interval will be documented.
- If no elevated PID readings are obtained and no visual evidence of possible contamination is encountered, then the sample for VOC analysis will be taken from the top 1-foot interval, and the sample for the remaining analytical parameters will be a composite sample comprised of several aliquots of soil collected from the entire 5-foot interval.

Subsurface soil samples will be sent to EMAX, located at 1835 West 205th Street, Torrance CA 90501, via FedEx. Subsurface soil samples submitted to EMAX will be extracted and analyzed for analytical parameters within maximum hold times. A complete list of maximum hold times for each analyte is provided in the UFP–QAPP (**Appendix A**) Worksheet 19.

Final subsurface soil sampling locations will be photographed and located using a hand held GPS. Subsurface soil sample locations will be abandoned by backfilling the boreholes with hydrated bentonite. Subsurface soil samples will be collected at selected sites, as described in the site specific sampling objectives provided in **Sections 5.9** through **5.16**, and in **Tables 5-1** through **5-8**.

5.4 FIELD SCREENING AND HEADSPACE ANALYSIS

Subsurface soil samples collected in 5-foot-long clear acetate lines will be field screened with a MiniRae 2000 PID (or equivalent) for signs of potential contamination. Field screening will involve placing a small portion of soil from the liner or split-barrel sampler into a plastic sample bag for headspace analysis. The plastic bag containing the headspace sample will be sealed and shaken to expose the soil to air trapped in the bag. After a minimum of 5 minutes, a headspace reading will be taken by inserting the probe of the instrument into the bag through a small opening. The highest reading obtained for each 5-foot interval (and the depth at which the reading was obtained) will be recorded on the boring log and in the field logbook. In addition to the field screening with a PID, any odor or discoloration (from potential contamination) will be

noted in the boring log. Final soil sample depths will be determined in the field based on headspace results and any odors or discoloration observed.

Headspace analysis will also be completed for every surface and subsurface soil sample collected. The results of field screening and headspace analysis will be recorded on the boring logs and in the field logbook.

5.5 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

The following sections briefly describe sample management procedures to be used for the work described in this plan.

5.5.1 Field Documentation

Documentation of observations and data acquired in the field will be of sufficient detail to provide information on the sample acquisition and provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound, weatherproof field logbook with consecutively numbered pages.

5.5.1.1 Field Logbook Modifications and Signatures

Sufficient information will be recorded to allow the sampling event to be reconstructed without relying on the collector's memory. The person making the entry will sign each page in the field book at the end of the day. Changes or deletions in the field logbook will be lined out with a single strike mark and will remain legible. Changes/entries made in another person's field book will be sign and dated.

5.5.1.2 Boring Logs

Boring logs will be completed for each boring by qualified personnel (geologist, geological engineer, or geotechnical engineer). Boring logs will include boring location, boring identification, drilling equipment and method, date started and completed, completion depth, logger, description of lithologies (using Unified Soil Classification System), blow counts (if appropriate), samples collected for laboratory analysis by depth, sample recovery, field screening results, origin of the lithologies (e.g., fill, loess, glacial till, glacial outwash, alluvium or colluvium, etc.), and other remarks or observations.

5.5.1.3 Sample Collection Field Sheets

As part of the field documentation, Sample Collection Field Sheets (SCFSs) will be generated for all soil samples collected for this project. The SCFS will summarize the sample collection data (i.e., parameters), sample identification, time and date collected, container type(s), QA/QC samples, physical description, and name of sampler(s). A copy of the soil SCFS for this project is provided in **Appendix C**.

5.5.1.4 Sample Chain of Custody

During field sampling activities, sample tracking will be maintained from the time the samples are collected until the time at which the laboratory data are issued. Initial information concerning collection of the sample(s) will be recorded in the field logbook as described above. Information on the custody, transfer, handling, and shipping of samples to an off-site laboratory will be recorded on a chain of custody (CoC) form.

The sampler will be responsible for initiating and filling out the CoC form. The person responsible for packaging samples for delivery to the off-site laboratory will sign the CoC form, retain the last copy of the three-part form, document the method of shipment, and send the original and the second copy of the CoC form with the samples. A custody seal will be placed on each sample cooler prior to transfer of the cooler to the delivery company (i.e., FedEx) or the laboratory. Upon receipt of the cooler by the laboratory, the person receiving the samples will sign the CoC form and return the second copy. A copy of the CoC for this project is provided in **Appendix C**.

5.5.2 Sample Identification

Samples collected during site activities will have discrete sample identification numbers. These numbers are necessary to identify and track each of the samples collected for analysis during this project. In addition, the sample identification numbers will be used to identify and retrieve the analytical results received from the laboratory.

Each sample will be identified by a unique code that generally indicates the site, sampling location, sample type, and either sampling event or sampling depth. The sample designation for each analytical and QA/QC sample is a three-letter and seven-digit/letter unique identification (CA###-YYYY-ZZZ). "CA-###" is the facility and site identifier, with "CA" for Cannon AFB and "###" representing the number identifying this site. The sample designation for ST-C502 will start as "CA502-."

The next four characters (YYYY) identify the sampling method and specific sampled locations. The first two characters will present the method of sampling. "SB" for soil boring will be used as the first two characters. The last two characters will identify the sample location. Samples from the second soil boring at ST-C502 would be identified as "CA502-SB02-."

The last set of three numbers (ZZZ) is the sample identifier. The first number indicates the type of sample:

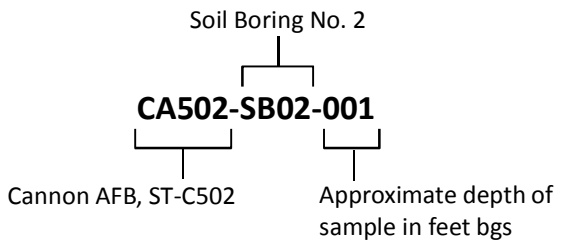
- 0 for a soil (analytical) sample
- 1 for a soil MS/MSD
- 2 for a field duplicate

The last two numbers correspond to the depth of the sample in feet bgs for all soil samples. Multiple soil samples may be collected from the same boring. The last two digits differentiate

among these multiple samples and represent the approximate depth (rounded up to the nearest foot) at which the sample was collected.

The MS/MSD should also be labeled the same as the original sample but will have "MS/MSD" written on the label.

The following is an example of an identification number:



5.5.3 Sample Labeling and Handling

All sample labels will be filled out using waterproof ink, and each label will contain the following information: sampler's initials, project name, sample identification, date and time of sample collection, method of preservation used, and sample matrix. Samples for VOCs and BTEX+naphthalene will be collected using the TerraCore® sampling method, which is described in **Section 5.2.3**. Samples for other constituents will be thoroughly homogenized and transferred to the appropriate sampling containers in accordance with the methods described in **Section 5.2.3**. The analytical laboratory will provide commercially cleaned containers. After collection, samples will be labeled as described above and placed into iced coolers. Coolers will be sealed with a custody seal and shipped to the contract laboratory. CoC forms will be maintained to document sample handling between the field and the laboratory. UFP-QAPP Worksheet #19 (**Appendix A**) summarizes the appropriate sample containers, preservation and holding times for the planned samples to be analyzed by the designated laboratory.

5.6 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

QA/QC samples will be collected according to the following schedule, as presented in the project UFP-QAPP:

- QC blind field duplicates will be collected at a frequency of about 10 percent of the total field samples. These samples will be submitted to the contract laboratory.
- MS/MSD field samples will be collected at a frequency of about 10 percent and will be submitted to the contract laboratory.
- Proficiency evaluation (PE) samples will be obtained from a certified provider and submitted to the contract laboratory as a one-time event. PE samples will be obtained and submitted for the full analyte list presented previously. Additional information regarding PE samples is provided in the UFP-QAPP (**Appendix A**).

The anticipated distribution of the QA/QC samples to be collected is listed in **Tables 5-1** through **5-8**.

5.7 EQUIPMENT AND PERSONNEL DECONTAMINATION

All sampling equipment will be decontaminated before starting work and after the collection of each individual sample. Sampling equipment decontamination will be done at the site.

The overall objective of a multimedia sampling program is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminants can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g. using sampling equipment that is not properly or fully decontaminated). Trace quantities of contaminants can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., all non-disposable equipment that will come in direct contact with samples) and field support equipment (e.g., drill rigs, vehicles) is, therefore, required prior to, between, and after uses at Cannon AFB to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

The following sections present equipment decontamination procedures.

5.7.1 Sampling Equipment

The following steps will be used to decontaminate sampling equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure.
- Gross contamination on equipment will be scraped off at the sampling or construction site.
- Equipment that cannot be damaged by water will be placed in a wash tub containing Alconox or low-sudsing non-phosphate detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub followed by a de-ionized water rinse.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and rinsed with de-ionized water. Care will be taken to prevent equipment damage.
- All reusable sampling equipment that comes in contact with the sample will receive a final rinse with isopropanol.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with contaminated soil. If the equipment is not used immediately after decontamination, the equipment will be covered or wrapped in plastic sheeting, foil, or heavy-duty trash bags to minimize potential contact with contaminants.

5.7.2 Drilling and Heavy Equipment

Drilling rigs and excavating equipment will be decontaminated at the decontamination station located near the staging area. Mobile decontamination trailers may be used to decontaminate heavy equipment at each site. The following steps will be used to decontaminate drilling and heavy equipment:

- Personnel will dress in suitable PPE to reduce personal exposure.
- Personnel will scrape equipment showing gross contamination or having caked-on drill cuttings with a flat-bladed scraper at the sampling or construction site.
- Personnel will wash equipment that cannot be damaged by water, such as drill rigs, augers, drill bits, and shovels, with a hot water, high-pressure sprayer then rinse with potable water. Care will be taken to clean the insides of the HSAs.

Following decontamination, drilling equipment will be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it should be stored in a designated clean area.

5.7.3 Equipment Leaving the Site

Vehicles used for activities in non-contaminated areas will be cleaned on an as-needed basis, as determined by the SSO, using soap and water on the outside and vacuuming the inside. On-site cleaning will be required for very dirty vehicles leaving the area. Construction equipment such as trucks, drilling rigs, trailers, etc., will be pressure washed before the equipment is removed from the site to limit exposure of off-site personnel to potential contaminants.

5.7.4 Decontamination Solutions

A decontamination solution should be capable of removing, or converting to a harmless substance, the contaminant of concern without harming the object being decontaminated. The preferred solution is a mixture of detergent and water, which is a relatively safe option compared to chemical decontaminants. A solution recommended for decontaminating consists of 1 to 1.5 tablespoons of Alconox per gallon of warm water. Skin surfaces will be decontaminated by washing with hand soap and water. The decontamination solution will be changed when it no longer foams or when it becomes extremely dirty. Rinse water will be changed when it becomes discolored, begins to foam, or when the decontamination solution cannot be removed.

5.7.5 Responsible Authority

Decontamination operations at each hazardous waste site will be supervised by the SSO. The SSO is responsible for ensuring that all personnel follow decontamination procedures and that all contaminated equipment is adequately decontaminated. The SSO is also responsible for maintaining the decontamination zone and managing the wastes generated from the decontamination process.

Site activities will be conducted with the general goal of preventing the contamination of people and equipment. Using remote sampling techniques, bagging monitoring instruments, avoiding contact with obvious contamination, and employing dust suppression methods that would reduce the probability of becoming contaminated and, therefore, reduce the need and extent of decontamination. However, some type of decontamination will always be required on site.

OSHA requires that proper PPE be worn when operating steam or pressure washing equipment. A rain suit, boots, hard hat, and a face shield are recommended. All personnel must be kept out of the path of steam or water spray.

5.7.6 Wastewater

Liquid wastewater from decontamination will be containerized and analyzed using a PID as described in **Section 5.8**.

5.7.7 Documentation

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination should include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination observations
- Weather conditions
- IDW handling

Personnel decontamination is not anticipated due to the nature of the planned soil sample collection activities. It is anticipated that field sampling members will don appropriate personal protective equipment (PPE) during surface soil sampling activities. Level D PPE is anticipated during this investigation, which includes hard hat, safety glasses, steel-toed boots, ear protection, and work gloves and/or chemical-resistant gloves.

5.8 INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) is expected to include soil, decontamination fluids, and PPE. In general, soil will be containerized and properly disposed of on the base, as long as the analytical results demonstrate the waste is nonhazardous by applying the “20 Times Rule” (i.e., none of the total analytical results exceed the corresponding Toxicity Characteristic Leaching Procedure [TCLP] limit by more than 20 times). Decontamination fluids will be field-screened visually and with a PID. Decontamination fluids containing no evidence of contaminants will be discharged either to the ground or to the sanitary sewer system. PPE will be disposed of on the base as a solid waste. If IDW storage is required, storage locations will be identified by the 27 SOCES, Asset Management Flight personnel.

5.9 FORMER AGE DISPATCH FACILITY SPILLS SITE (SS-C501)

5.9.1 Sampling Objectives and Rationale (SS-C501)

The general sampling objectives at SS-C501 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels. At SS-C501, subsurface soil samples will be collected in the vicinity of the former location of two diesel fuel spills (60 gallons each). Because the entire site is paved, surface soil is not considered a potential exposure pathway, and ecological receptors will not be considered for screening purposes at SS-C501.

5.9.2 Sampling Locations, Frequencies and Analysis (SS-C501)

The following site-specific activities will be completed at SS-C501 to meet the FSP objectives. COPCs for this site are based on its past use as a dispatch facility where fuel spills reportedly occurred and a variety of chemicals were used. The analyte list for SS-C501 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, VOCs, SVOCs, RCRA metals, and PCBs. Planned soil sample locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for SS-C501 in **Table 5-1**. Sample locations are shown on **Figures 5-1a** and **5-1b**.

5.9.2.1 Subsurface Soil Sampling (SS-C501)

Eleven planned subsurface soil borings will be completed at SS-C501 in order to satisfy the objectives of this investigation. Three additional soil borings (TBD borings) will be completed at SS-C501 based on data collected (PID readings and visual observations) from the first 11 planned borings. These three additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at SS-C501.

At both the northern and southern spill locations, five subsurface soil borings will be completed within the limits of each spill area. The two subsurface soil borings in the center of the spill areas will be completed to a depth of approximately 15 feet bgs while the other eight borings will be completed to approximately 10 feet bgs. One additional subsurface soil boring will be completed directly between the two spill areas, and will be completed to approximately 10 feet bgs. Subsurface soil samples at SS-C501 will be collected on 5-foot intervals beginning directly below the asphalt pavement.

5.10 FORMER GAS STATION SITE (ST-C502)

5.10.1 Sampling Objectives (ST-C502)

The general sampling objectives at ST-C502 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels, and to determine if other COPCs are present in subsurface soil at concentrations above screening levels at the

previously identified potential source areas and other potential source areas not previously investigated. At ST-C502, subsurface soil samples will be collected in the vicinity of the former location of the pump islands, the UST excavation area, and the vehicle service station area formerly containing two hydraulic lifts. Because the majority of the site is paved, surface soil is not considered a potential exposure pathway, and ecological receptors will not be considered for screening purposes at ST-C502. There is a small grassed landscaped area present to the northwest of Building 368 that was added to the site following the closing of the gas station and removal of USTs. The grassed landscaped area is elevated above the concrete curb and asphalt pavement, indicating that this area has been reworked and is likely fill material.

5.10.2 Sampling Locations, Frequencies, and Analysis (ST-C502)

The following site-specific activities will be completed at ST-C502 to meet the FSP objectives. COPCs for this site are based on its past use as a gas station, where a variety of chemicals were used. The analyte list for the UST excavation area and the pump islands at ST-C502 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, BTEX+naphthalene, site-related SVOCs, and lead. The analyte list for the vehicle service station area at ST-C502 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, VOCs, SVOCs, RCRA metals, and PCBs. Planned soil sample locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for ST-C502 in **Table 5-2**. Planned soil sampling locations are shown on **Figures 5-2a** and **5-2b**.

5.10.2.1 Subsurface Soil Sampling (ST-C502)

Thirteen planned subsurface soil borings will be completed at ST-C502 in order to satisfy the objectives of this investigation. Three additional soil borings (TBD borings) will be completed at ST-C502 based on data collected (PID readings and visual observations) from the first 13 planned borings. These three additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at ST-C502.

At the former pump islands area, seven soil borings will be completed within and adjacent to the former location of the two pump islands containing the fuel dispensers. Soil boring CA502-SB11 will be completed at the same location as previous soil boring CAFB-FAC0368-10. Results of the 1995 USGS investigation indicated that a release previously occurred at this location. Soil boring CA502-SB11 will be completed in order to confirm the vertical extent of contamination in this area (previously detected at approximately 30 feet bgs). This boring will be advanced to approximately 40 feet bgs. Based on the previous maximum concentration of TPH-GRO identified at 24 to 25 feet bgs, the additional soil borings at the pump island area will extend to approximately 30 feet bgs. Soil samples at the former pump island area will be collected on 5-foot intervals from directly below the asphalt pavement.

At the former UST excavation area, four soil borings will be completed within the limits of the former UST excavation, to depths of approximately 30 feet bgs. Although the bases of the three USTs at this site were 12 feet bgs, borings will be sampled on 5-foot intervals beginning at 1 foot bgs in order to ascertain the condition of the backfill placed within the excavation.

In the former vehicle service area, two soil borings will be advanced to depths of approximately 15 feet bgs in the approximate location of the former northeastern service bay containing a hydraulic lift. Based on the current configuration of the Cannon Federal Credit Union building, it is assumed that the location of the former southwestern service bay containing a hydraulic lift is within the building; therefore, it will not be investigated. Soil samples at the former vehicle service area will be collected on 5-foot intervals beginning directly below the asphalt pavement.

5.11 BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)

5.11.1 Sampling Objectives and Rationale (ST-C503)

The general sampling objectives at ST-C503 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels. At ST-C503, subsurface soil samples will be collected within the limits of the previous UST removal excavation. Based on the fact that the primary source of contamination at this site was previously detected at approximately 7 feet bgs (from a leaking UST as described in **Section 4.2**), and the UST excavation was backfilled with clean soil and the ground surface reworked following the UST removal, it is assumed that any potential surface soil contamination has been removed. Therefore, surface soil is not is not considered a likely exposure pathway and ecological receptors will not be considered for screening purposes at ST-C503.

5.11.2 Sampling Locations, Frequencies and Analysis (ST-C503)

The following site-specific activities will be completed at ST-C503 to meet the FSP objectives. COPCs for this site are based on the former presence of a diesel fuel UST used to power a generator. The analyte list for ST-C503 includes the following: TPH-DRO, TPH-ORO, BTEX+naphthalene, and site-related SVOCs. Planned soil sampling locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for ST-C503 in **Table 5-3**. Planned soil sampling locations are shown on **Figures 5-3a** and **5-3b**.

5.11.2.1 Subsurface Soil Sampling (ST-C503)

Seven planned subsurface soil borings will be completed at ST-C503 in order to satisfy the objectives of this investigation. Two additional soil borings (TBD borings) will be completed at ST-C503 based on data collected (PID readings and visual observations) from the first seven planned borings. These two additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at ST-C503.

The seven subsurface soil borings will be completed within the limits of the former UST excavation to depths of approximately 25 feet bgs. Soil boring CA503-SB03 will be completed at the same location as former soil sample location CAFB-FAC0600-03 to confirm the vertical extent of contamination in this area (previously detected from approximately 10 to 21 feet bgs). Soil boring CA503-SB05 will be completed at the same location as former soil sample location

CAFB-FAC0600-05 to confirm the vertical extent of contamination in this area (previously detected from approximately 10 to 21 feet bgs). Soil boring CA503-SB07 will be advanced between 10 and 25 feet bgs at the same location as soil sample location SES-UST-EX in order to quantify previously detected contamination in the area (previously detected from 11 feet bgs). The reported depth to the base of the UST was 7 feet bgs and the bottom of the excavation was 9 feet bgs. In order to ascertain the condition of the backfill placed within the excavation, borings will be sampled on 5-foot intervals beginning at the ground surface.

5.12 HOSPITAL ABANDONED UST SITE (ST-C504)

5.12.1 UST Location (ST-C504)

Prior to laying out sample locations at this site, the exact location of the abandoned UST will be determined. A reliable location for the UST has not been determined due to inconsistencies between previously constructed site maps and aerial photos (both historical and current). If Cannon AFB utility locating personnel cannot sufficiently locate the abandoned UST, then geo-magnetic methods will be employed in an attempt to accurately determine the abandoned UST's location. It is anticipated that a subcontracted locating service will perform the work using a Noggin PLUS Smart Cart system with 250 MHz antenna, or equivalent. Proposed sample locations will be adjusted based on the actual location of the abandoned UST.

5.12.2 Sampling Objectives (ST-C504)

The general sampling objectives at ST-C504 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soils at concentrations above screening levels. At ST-C504, subsurface soil samples will be collected within the vicinity of the abandoned UST. This site is used for industrial purposes and contains cooling towers, a paved access road, four concrete pads and three pad-mounted transformers. Vegetation is sparse on the grassed area. Because the primary source of contamination at this site was located approximately 18 feet bgs (from a leaking UST as described in **Section 4.4**), and based on current land use, surface soil is not considered a likely exposure pathway and ecological receptors are not considered for screening purposes.

5.12.3 Sampling Locations, Frequencies and Analysis (ST-C504)

The following site-specific activities will be completed at ST-C504 to meet the FSP objectives. COPCs for this site are based on the presence of a UST previously containing diesel fuel used to power a generator. The analyte list for ST-C504 includes the following: TPH-DRO, TPH-ORO, BTEX+naphthalene, and site-related SVOCs. Planned soil sample locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for ST-C504 in **Table 5-4**. Planned soil sampling locations are shown on **Figures 5-4a** and **5-4b**.

5.12.3.1 Subsurface Soil Sampling (ST-C504)

Eleven planned subsurface soil borings will be completed at ST-C504 in order to satisfy the objectives of this investigation. Three additional subsurface soil borings (TBD borings) will be completed at ST-C504 based on data collected (PID readings and visual observations) from the first 11 planned borings. These three additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at ST-C504.

At ST-C504, results of the 1995 USGS investigation indicated that the most contaminated area identified at this site was at CAFB-FAC1400-03. Planned soil boring CA504-SB01 will be completed at the former location of CAFB-FAC1400-03 in order to confirm the vertical extent of contamination in this area (previously detected from 18 to 75 feet bgs). This boring will be advanced to approximately 85 feet bgs. Three planned soil borings will be completed to the northwest, northeast, and southeast of previous soil boring CAFB-FAC1400-03. These three borings will be sampled to approximately 50 feet bgs (based on the previous maximum concentration of TPH-DRO identified from 49.5 to 50.5 feet bgs at CAFB-FAC1400-03). The final seven planned soil borings will be completed at step out locations to the northeast and southeast, and around the southwest end of the abandoned UST. These seven planned soil borings will be completed to approximately 25 feet bgs to ensure vertical delineation below the base of the abandoned UST (base at approximately 18 feet bgs). Subsurface soil samples at ST-C504 will be collected on 5-foot intervals beginning at either the ground surface or directly below the asphalt/concrete pavement.

5.13 FLIGHTLINE GENERATOR UNDERGROUND STORAGE TANKS SITE (ST-C505)

5.13.1 Sampling Objectives (ST-C505)

The general sampling objectives at ST-C505 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels. At ST-C505, subsurface soil samples will be collected within and outside the approximate limits of the previous UST removal excavation. The presence of fill versus natural material will be examined in the field to help better define the horizontal limits of the former UST excavation at this site. Soil borings may be moved slightly in the field based on the actual limits of the UST excavation at ST-C505.

Based on the fact that the primary source of contamination at this site was previously detected at approximately 9 feet bgs (from a leaking UST as described in **Section 4.5**), and the UST excavation was backfilled with clean soil and the ground surface reworked following the UST removal, it is assumed that any potential surface soil contamination has been removed. Therefore, surface soil is not is not considered a likely exposure pathway and ecological receptors will not be considered for screening purposes at ST-C505.

5.13.2 Sampling Locations, Frequencies and Analysis (ST-C505)

The following site-specific activities will be completed at ST-C505 to meet the FSP objectives. COPCs for this site are based on the former presence of a diesel fuel UST used to power a generator. The analyte list for ST-C505 includes the following: TPH-DRO, TPH-ORO, BTEX+naphthalene, and site-related VOCs. Planned soil sampling locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for ST-C505 in **Table 5-5**. Planned soil sampling locations are shown on **Figures 5-5a** and **5-5b**.

5.13.2.1 Subsurface Soil Sampling (ST-C505)

Ten planned subsurface soil borings will be completed at ST-C505 in order to satisfy the objectives of this investigation. Two additional soil borings (TBD borings) will be completed at ST-C505 based on data collected (PID readings and visual observations) from the first 10 planned borings. These two additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at ST-C505.

At ST-C505, seven planned subsurface soil borings will be completed within the limits of the previous UST excavation. Based on the results of the 1995 USGS investigation, the most contaminated areas identified at this site were at previous soil borings CAFB-FAC3060-03 and CAFB-FAC3060-02. Soil borings CA505-SB03 and CA505-SB01 will be completed at the same locations as former soil sample locations CAFB-FAC3060-02 and CAFB-FAC3060-03, respectively. These two borings and CA505-SB02 will be completed to a depth of 30 feet bgs to confirm the vertical extent of contamination in this area (previously detected from approximately 10 to 21 feet bgs). Four other subsurface soil boings will be completed near the corners of the former UST excavation, and will be completed to a depth of 25 feet bgs. Although the reported depth to the base of the UST and bottom of the excavation were both 9 feet bgs, soil samples collected from inside the former UST excavation limits will be collected on 5-foot intervals beginning at ground surface in order to ascertain the condition of the backfill placed within the excavation.

Outside the former UST excavation, three subsurface soil borings will be completed to a depth of 25 feet bgs to help define the horizontal extent of potential contamination. Subsurface soil samples collected outside the former UST excavation limits will be collected on 5-foot intervals beginning at the ground surface.

5.14 FORMER POL YARD REFUELING AREA SITE (SS-C507)

5.14.1 Sampling Objectives (SS-C507)

The general sampling objective at SS-C507 is to determine if COPCs are present in surface and subsurface soil at concentrations above screening levels at potential source areas at the site. Potential sources of contamination at this site include former fuel dispensers, tank filling areas, aboveground pipes, and surface spills. At the location of the two surface spills that were

previously excavated and backfilled, the presence of fill versus natural material will be examined in the field to better define the horizontal and vertical limits of the surface spill excavations. Based on the presence of large unpaved and grassed areas on the north and west parts of the site, surface soil is considered a potential exposure pathway, and preliminary screening for ecological receptors will be conducted.

5.14.2 Sampling Locations, Frequencies and Analysis (SS-C507)

The following site-specific activities will be completed to meet the FSP objectives. COPCs for this site are based on its past use as a POL yard refueling area and the results of a previous investigation that identified a PCB at one location (URS 2009). The analyte list for SS-C507 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, BTEX+naphthalene, site-related SVOCs, PCBs, and lead. Planned soil sample locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for SS-C507 in **Table 5-6**. Planned soil sampling locations are shown on **Figures 5-6a** and **5-6b**.

5.14.2.1 Surface Soil Sampling (SS-C507)

Because the potential sources of contamination at this site include former fuel dispensers, tank filling areas, aboveground pipes, and surface spills, it is possible that surface soil contamination may exist at several locations at this site. Surface samples will be taken at unpaved locations where the potential source was above ground. A total of 40 planned and eight additional (TBD) surface soil samples will be collected at SS-C507. Surface soil sampling locations are provided in **Table 5-6**.

5.14.2.2 Subsurface Soil Sampling (SS-C507)

Sixty-three planned subsurface soil borings will be completed at SS-C507 in order to satisfy the objectives of this investigation. Eight additional soil borings (TBD borings) will be completed at SS-C507 based on data collected (PID readings and visual observations) from the first 63 planned borings. These eight additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at SS-C507.

Depths and number of borings per potential source area were determined based on whether possible releases would have been likely to be above ground or underground, contained or uncontained, and relatively large or relatively small. Additional details concerning subsurface soil sampling at this site are included in the technical rationale provided in **Table 5-6**. The number of soil borings at each potential source area is listed below:

- Previous 400-gallon JP-8 fuel spill and excavation location to the west and south of Building 392 – three borings (SB01-03)
- Area west of the north JP-4/JP-8/MOGAS unloading ports - two borings (SB38 and 39)
- Fuel unloading ports (west-central part of site) – four borings (one per port) (SB04-07)

- Former pump house (Building 392) and associated JP-4/JP-8 fuel lines in the former canopy area – two borings (SB08 and 09)
- Fuel unloading area storm drains – two borings (one per drain) (SB10 and 11)
- Former OWS vault – two borings (SB12 and 13)
- Diesel fuel line canopy area and aboveground diesel fuel lines and elbows – four borings (SB14 and 49–51)
- Former diesel fuel pump island and underground diesel fuel lines – five borings (SB15, 16, and 46–48)
- Diesel fuel unloading ports (398 and 399) – two borings (one per port) (SB17 and 18)
- Previous JP-8 fuel spill to the north of the former canopy north of Building 390 – three borings (SB20, 21, and 52)
- Former pump house (Building 390) and associated JP-4/JP-8 fuel lines in the former canopy area – four borings (SB22–25)
- Underground JP-4/JP-8/MOGAS vault – one boring (SB26)
- Former JP-4/JP-8 pump islands and adjacent paved area – eight borings (two per pump island and one per side) (SB27–30 and 53–56)
- OWS vault and drum storage area – three borings (SB32–34)
- Former MOGAS unloading and dispensing area – five borings (SB35 and 57–60)
- Areas where runoff pools (e.g., breaks in curbs, low-lying areas downstream of potential source areas) – seven borings (SB19, 31, 36, 37, and 61–63)
- Underground JP-4/JP-8/MOGAS lines between Buildings 392 and 390 – four borings (SB40–43)
- Underground OWS elbows in west part of site – two borings (SB44 and 45)

Subsurface soil samples at SS-C507 will be collected on 5-foot intervals beginning at either 0.5 feet bgs or directly below the asphalt/concrete pavement.

5.15 SURFACE DISPOSAL AREA SITE (SD-C508)

5.15.1 Sampling Objectives (SD-C508)

The general sampling objectives at SD-C508 are to further define the horizontal and vertical extent of potential surface and subsurface soil contamination at the previously identified surface disposal area, to determine if other COPCs are present in surface and subsurface soil at concentrations above screening levels at the previously identified disposal area, and to determine if COPCs exist in surface or subsurface soil at concentrations above screening levels within the expanded site boundary not previously investigated. Because this area is generally unused,

vegetated land, surface soil is considered a potential exposure pathway, and preliminary screening for ecological receptors will be conducted.

5.15.2 Sampling Locations, Frequencies and Analysis (SD-C508)

The following site-specific activities will be completed to meet the FSP objectives. COPCs for this site are based on its inferred past use as a surface disposal area for various debris and burned material. The analyte list for SD-C508 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, VOCs, SVOCs, pesticides, RCRA metals, PCBs, explosives, and dioxins/furans. Planned soil sampling locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for SD-C508 in **Table 5-7**. Planned soil sampling locations are shown on **Figures 5-7a** and **5-7b**. Anticipated sample depth intervals for each boring are shown on **Table 5-7**.

5.15.2.1 Surface Soil Sampling (SD-C508)

Because the potential source of contamination at this site is debris on or near the surface of the ground, a surface soil sample will be taken at each boring location. Nine planned and two additional (TBD) surface soil samples will be collected at SD-C508. Surface soil sampling locations are provided in **Table 5-7**.

5.15.2.2 Subsurface Soil Sampling (SD-C508)

Nine soil borings will be completed at SD-C508 to satisfy the objectives of this investigation. Two additional soil borings (TBD borings) will be completed at SD-C508 based on data collected (PID readings and visual observations) from the first nine planned borings. These two additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at SD-C508.

One soil boring will be completed directly within the previously identified visible surface debris. This soil boring will be completed to approximately 20 feet bgs. Four other soil borings will be completed within the expanded site boundary not previously investigated, specifically within the mounded area with visibly different vegetation at the surface (describe in **Section 4.7**). These four borings will be completed to approximately 15 feet bgs. Four final soil boings will be completed outside the mounded area, but within the expanded site boundary. These four soil borings will be completed to approximately 10 feet bgs. Subsurface soil samples at SD-C508 will be collected on 5-foot intervals beginning at 0.5 feet bgs.

5.16 WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)

5.16.1 Sampling Objectives (TA/AS-C129)

The overall sampling objective at TA/AS-C129 is to determine if COPCs are present at concentrations above screening levels in the previously uninvestigated leach field area. Because the potential contamination at this site is from an underground source (the perforated pipes are

buried approximately 2.5 feet bgs), surface soil is not considered a potential exposure pathway and ecological receptors are not considered for screening purposes.

5.16.2 Sampling Locations, Frequencies and Analysis (TA/AS-C129)

The following site-specific activities will be completed to meet FSP objectives. COPCs for this site are based on its past use as a leach field connected to an OWS where waste oil and a variety of other chemicals may have been disposed. The analyte list for TA/AS-C129 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, VOCs, SVOCs, RCRA metals, PCBs, and pesticides. Planned soil sample locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for TA/AS-C129 in **Table 5-8**. Planned soil sampling locations are shown on **Figures 5-8a** and **5-8b**.

5.16.2.1 Surface Soil Sampling (TA/AS-C129)

Surface soil samples will be collected in the area covered by dried soil, and in the area containing metal debris and dried paint to assess the potential impacts to soils from the various types of waste dumped in these areas. Two surface soil samples will be collected in these areas. Surface soil sampling locations are provided in **Table 5-8**.

5.16.2.2 Subsurface Soil Sampling (TA/AS-C129)

Six planned subsurface soil borings will be completed at the former leach field, including one boring at the intersection of the drain pipe and the leach field (i.e., distribution box), in order to satisfy the objectives of the investigation. Additionally, one boring will be completed at the former cleanout/pipe to leach field, and one boring will be completed at the center of the drain pipe between the former location of the OWS and the leach field. Shallow borings (0 to 5 feet bgs) will also be advanced in the area covered by dried soil and in the area containing metal debris and dried paint. Two additional soil borings (TBD borings) will be completed at TA/AS-C129 based on data collected (PID readings and visual observations) from the first five planned borings. These two additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at TA/AS-C129.

Soil borings advanced at this site will be completed to approximately 15 feet bgs. Subsurface soil samples at TA/AS-C129 will be collected on 5-foot intervals beginning at the ground surface.

TABLE 5-1
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER AGE DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	VOCs[5]	SVOCs[6]	RCRA Metals[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA501-SB01	1-5	1236498.948	847068.969	X	X	X	X	X	X	X			Boring will be advanced on the north corner of the north diesel fuel spill area.
	5-10			X	X	X	X	X	X	X		X	
CA501-SB02	1-5	1236447.195	847022.305	X	X	X	X	X	X	X			Boring will be advanced on the west corner of the north diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
CA501-SB03	1-5	1236454.590	847065.820	X	X	X	X	X	X	X	X		Boring will be advanced in the center of the north diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA501-SB04	1-5	1236458.969	847110.366	X	X	X	X	X	X	X			Boring will be advanced on the east corner of the north diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
CA501-SB05	1-5	1236409.667	847058.708	X	X	X	X	X	X	X			Boring will be advanced on the south corner of the north diesel fuel spill area.
	5-10			X	X	X	X	X	X	X		X	
CA501-SB06	1-5	1236390.298	847002.840	X	X	X	X	X	X	X			Boring will be advanced in the center of the site, between the two fuel spill areas.
	5-10			X	X	X	X	X	X	X		X	
CA501-SB07	1-5	1236371.638	846945.002	X	X	X	X	X	X	X			Boring will be advanced on the north corner of the south diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
CA501-SB08	1-5	1236320.295	846893.792	X	X	X	X	X	X	X			Boring will be advanced on the west corner of the south diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
CA501-SB09	1-5	1236326.005	846939.860	X	X	X	X	X	X	X	X		Boring will be advanced in the center of the south diesel fuel spill area.
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
CA501-SB10	1-5	1236331.600	846982.943	X	X	X	X	X	X	X			Boring will be advanced on the east corner of the south diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
CA501-SB11	1-5	1236280.915	846933.763	X	X	X	X	X	X	X			Boring will be advanced on the south corner of the south diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			

TABLE 5-1
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER AGE DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]	Analytical Parameters									Technical Rationale
			TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	VOCs[5]	SVOCs[6]	RCRA Metals[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA501-SB12	1-5	To be determined	X	X	X	X	X	X	X	X		Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10		X	X	X	X	X	X	X			
	10-15		X	X	X	X	X	X	X			
CA501-SB13	1-5		X	X	X	X	X	X	X		X	
	5-10		X	X	X	X	X	X	X			
	10-15		X	X	X	X	X	X	X			
CA501-SB14	1-5		X	X	X	X	X	X	X			
	5-10		X	X	X	X	X	X	X			
	10-15		X	X	X	X	X	X	X			
		Totals	**33**	**33**	**33**	**33**	**33**	**33**	**33**	**4**	**4**	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-GRO analysis via USEPA Method 8015C

[4]TPH-ORO analysis via USEPA Method 8015C

[5]VOCs analysis via USEPA Method 8260B

[6]SVOCs analysis via USEPA Method 8270D

[7]Metals analysis via USEPA Method 6020A and USEPA Method 7471B (Mercury)

[8]PCBs analysis via USEPA Method 8082A

[9]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

[10]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface

MS/MSD = matrix spike/matrix spike duplicate

PCB = polychlorinated biphenyl

RCRA = Resource Conservation and Recovery Act

SVOC = semivolatile organic compound

TPH-DRO = total petroleum hydrocarbons-diesel range organics

TPH-GRO = total petroleum hydrocarbons-gasoline range organics

TPH-ORO = total petroleum hydrocarbons-oil range organics

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

TABLE 5-2
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters												Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX+Naphthalene[5]	VOCs[6]	Site-Related SVOCs[7]	SVOCs[8]	Lead[9]	RCRA Metals[10]	PCBs[11]	Field Duplicate Samples[12]	MS/MSD Samples[13]	
CA502-SB01	1-5	1237662.658	846524.522	X	X	X	X		X		X					Boring will be advanced in the north quadrant of the previously excavated UST pit (approximately 13 feet south of the north corner of the previously excavated UST pit) to determine if contamination is present from potential UST leaks.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X					
	25-30			X	X	X	X		X		X				X	
CA502-SB02	1-5	1237650.332	846537.105	X	X	X	X		X		X					Boring will be advanced in the east quadrant of the previously excavated UST pit (approximately 13 feet west of the east corner of the previously excavated UST pit) to determine if contamination is present from potential UST leaks.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X					
	25-30			X	X	X	X		X		X				X	
CA502-SB03	1-5	1237637.748	846524.779	X	X	X	X		X		X					Boring will be advanced in the south quadrant of the previously excavated UST pit (approximately 13 feet north of the south corner of the previously excavated UST pit) to determine if contamination is present from potential UST leaks.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X					
	25-30			X	X	X	X		X		X				X	
CA502-SB04	1-5	1237650.075	846512.195	X	X	X	X		X		X					Boring will be advanced in the west quadrant of the previously excavated UST pit (approximately 13 feet east of the west corner of the previously excavated UST pit) to determine if contamination is present from potential UST leaks.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X					
	25-30			X	X	X	X		X		X				X	
CA502-SB05	0-5	1237733.460	846519.618	X	X	X	X		X		X			X		Boring will be advanced on the northeast end of the northwest pump island (at the approximate location of the former fuel dispenser) to determine if contamination is present from potential leaking underground piping or potential surface spills.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X					
	25-30			X	X	X	X		X		X				X	

TABLE 5-2
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters												Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX+Naphthalene[5]	VOCs[6]	Site-Related SVOCs[7]	SVOCs[8]	Lead[9]	RCRA Metals[10]	PCBs[11]	Field Duplicate Samples[12]	MS/MSD Samples[13]	
CA502-SB06	1-5	1237728.478	846508.404	X	X	X	X		X		X					Boring will be advanced approximately 5 feet northwest of the northwest pump island to determine if contamination is present from potential surface spills.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X					
	25-30			X	X	X	X		X		X				X	
CA502-SB07	1-5	1237718.577	846505.194	X	X	X	X		X		X			X		Boring will be advanced on the southwest end of the northwest pump island (at the approximate location of the former fuel dispenser) to determine if contamination is present from potential leaking underground piping or potential surface spills.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X					
	25-30			X	X	X	X		X		X					
CA502-SB08	1-5	1237720.429	846518.221	X	X	X	X		X		X					Boring will be advanced approximately 8 feet southeast of the northwest pump island to determine if contamination is present from potential surface spills.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X					
	25-30			X	X	X	X		X		X					
CA502-SB09	1-5	1237701.813	846522.319	X	X	X	X		X		X					Boring will be advanced on the southwest end of the southeast pump island (at the approximate location of the former fuel dispenser) to determine if contamination is present from potential leaking underground piping or potential surface spills.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X			X		
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X			X		
	25-30			X	X	X	X		X		X					
CA502-SB10	1-5	1237704.465	846536.664	X	X	X	X		X		X					Boring will be advanced approximately 8 feet southeast of the southeast pump island to determine if contamination is present from potential surface spills.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X					
	25-30			X	X	X	X		X		X					

TABLE 5-2
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters												Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX+Naphthalene[5]	VOCs[6]	Site-Related SVOCs[7]	SVOCs[8]	Lead[9]	RCRA Metals[10]	PCBs[11]	Field Duplicate Samples[12]	MS/MSD Samples[13]	
CA502-SB11	0-5	1237716.992	846536.552	X	X	X	X		X		X					Boring will be advanced at the previous location of CAFB-FAC0368-10 (located in the primary source of contamination - on the northeast end of the southeastern pump island) in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-GRO (1,000 mg/kg) at 24-25 feet bgs.
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X			X		
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X			X		
	25-30			X	X	X	X		X		X					
	30-35			X	X	X	X		X		X					
	35-40			X	X	X	X		X		X					
CA502-SB12	1-5	1237713.652	846579.557	X	X	X		X		X		X	X	X		Boring will be advanced within the vicinity of the formerly present northeastern hydraulic lift in order to determine if contamination is present due to potential leaking hydraulic fuel lines, tanks or potential petroleum hydrocarbon surface spills.
	5-10			X	X	X		X		X		X	X			
	10-15			X	X	X		X		X		X	X			
CA502-SB13	1-5	1237705.838	846588.537	X	X	X		X		X		X	X			
	5-10			X	X	X		X		X		X	X			
	10-15			X	X	X		X		X		X	X		X	
CA502-SB14	1-5	To be determined		X	X	X	X		X		X			X		Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X				X	
CA502-SB15	1-5	To be determined		X	X	X	X		X		X				X	Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X			X		
CA502-SB16	1-5	To be determined		X	X	X	X		X		X					Boring location to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X		X		X					
	10-15			X	X	X	X		X		X					
	15-20			X	X	X	X		X		X					
	20-25			X	X	X	X		X		X					
			Totals	**87**	**87**	**87**	**81**	**6**	**81**	**6**	**81**	**6**	**6**	**9**	**9**	

TABLE 5-2
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]	Analytical Parameters												Technical Rationale
			TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX+Naphthalene[5]	VOCs[6]	Site-Related SVOCs[7]	SVOCs[8]	Lead[9]	RCRA Metals[10]	PCBs[11]	Field Duplicate Samples[12]	MS/MSD Samples[13]	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-GRO analysis via USEPA Method 8015C

[4]TPH-ORO analysis via USEPA Method 8015C

[5]BTEX+naphthalene analysis via USEPA Method 8260B

[6]VOCs analysis via USEPA Method 8260B

[7]Site-related SVOCs analysis via USEPA Method 8270D

[8]SVOCs analysis via USEPA Method 8270D

[9]Lead analysis via USEPA Method 6020A

[10]Metals analysis via USEPA Method 6020A and USEPA Method 7471B (Mercury)

[11]PCBs analysis via USEPA Method 8082A

[12]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

[13]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface

mg/kg = milligrams per kilogram

MS/MSD = matrix spike/matrix spike duplicate

SVOC = semivolatile organic compound

TPH-DRO = total petroleum hydrocarbons-diesel range organics

TPH-GRO = total petroleum hydrocarbons-gasoline range organics

TPH-ORO = total petroleum hydrocarbons-oil range organics

USEPA = United States Environmental Protection Agency

UST = underground storage tank

VOC = volatile organic compound

TABLE 5-3
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	SiteRelated SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA503-SB01	0-5	1235819.371	845220.667	X	X	X	X			Boring will be advanced in the center of the north quadrant of the previously excavated UST pit to determine if contamination is present from previous leaking UST.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA503-SB02	0-5	1235810.863	845212.870	X	X	X	X			Boring will be advanced in the center of the west quadrant of the previously excavated UST pit to determine if contamination is present from previous leaking UST.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA503-SB03	0-5	1235811.868	845227.384	X	X	X	X			Boring will be advanced at previous sample location CAFB-FAC0600-03 in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-DRO (3,500 mg/kg) at 14-16 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X	X		
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA503-SB04	0-5	1235812.390	845235.075	X	X	X	X			Boring will be advanced in the east corner of the previously excavated UST pit in order to determine if contamination is present at this location (and to assist in delineating any contamination present at CA503-SB03).
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA503-SB05	0-5	1235807.27	845219.06	X	X	X	X			Boring will be advanced at previous sample location CAFB-FAC0600-05 in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-DRO (820 mg/kg) at 10-12 feet bgs.
	5-10			X	X	X	X	X		
	10-15			X	X	X	X	X		
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA503-SB06	0-5	1235803.540	845219.918	X	X	X	X			Boring will be advanced in the center of the south quadrant of the previously excavated UST pit to determine if contamination is present from previous leaking UST.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	

TABLE 5-3
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	SiteRelated SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA503-SB07	10-15	1235805.05	845226.5	X	X	X	X	X		Boring will be advanced at the location of SES-UST-EX in order to quantify the previously detected contamination at this location. Previously, TPH detected at 1,370 mg/kg at 11 feet bgs.
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA503-SB08	0-5	To be determined		X	X	X	X		X	Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA503-SB09	0-5	To be determined		X	X	X	X			Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X			
	10-15			X	X	X	X	X		
	15-20			X	X	X	X			
	20-25			X	X	X	X			
			Totals	**43**	**43**	**43**	**43**	**5**	**5**	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-ORO analysis via USEPA Method 8015C

[4]BTEX + naphthalene analysis via USEPA Method 8260B

[5]Site-related SVOCs analysis via USEPA Method 8270D

[6]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

[7]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface

mg/kg = milligrams per kilogram

MS/MSD = matrix spike/matrix spike duplicate

SVOC = semivolatile organic compound

TPH-DRO = total petroleum hydrocarbons-diesel range organics

TPH-GRO = total petroleum hydrocarbons-gasoline range organics

TPH-ORO = total petroleum hydrocarbons-oil range organics

USEPA = United States Environmental Protection Agency

UST = underground storage tank

VOC = volatile organic compound

TABLE 5-4
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA504-SB01	0-5	1238826.411	844711.958	X	X	X	X			Boring will be advanced at the former location of CAFB-FAC1400-03 (located near the primary source of contamination - approximately 10 feet north of the center of the UST) in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-DRO (11,000 mg/kg) at 49.5-50.5 feet bgs. Concentrations of TPH-DRO previously detected to 75.0 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X	X		
	25-30			X	X	X	X			
	30-35			X	X	X	X			
	35-40			X	X	X	X			
	40-45			X	X	X	X			
	45-50			X	X	X	X	X		
	50-55			X	X	X	X			
	55-60			X	X	X	X			
	60-65			X	X	X	X	X		
	65-70			X	X	X	X			
	70-75			X	X	X	X			
	75-80			X	X	X	X	X		
	80-85			X	X	X	X			
CA504-SB02	0-5	1238833.919	844725.561	X	X	X	X			Boring will be advanced near the northeastern end of the UST in order to further define the vertical extent of contamination at this location. Adjacent soil boring CAFB-FAC1400-04 had detections of TPH-DRO (2,500 mg/kg) at 22.0 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X	X		
	25-30			X	X	X	X			
	30-35			X	X	X	X			
	35-40			X	X	X	X			
	40-45			X	X	X	X			
	45-50			X	X	X	X			

TABLE 5-4
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA504-SB03	0-5	1238812.773	844716.847	X	X	X	X			Boring will be advanced approximately 6 feet to the southeast of the center of the UST in order to further define the vertical extent of contamination at this location. Adjacent soil boring CAFB-FAC1400-02 had detections of TPH-DRO (6,200 mg/kg) at 20.0 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X	X		
	25-30			X	X	X	X			
	30-35			X	X	X	X			
	35-40			X	X	X	X	X		
	40-45			X	X	X	X			
	45-50			X	X	X	X			
CA504-SB04	1-5	1238833.944	844706.581	X	X	X	X			Boring will be advanced at the former location of CAFB-FAC1400-09 (approximately 8 feet northeast and 11 feet northwest of the center of the UST) in order to further define the vertical extent of contamination at this location. Maximum previously detected concentration of TPH-DRO (890 mg/kg) at 25-26 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
	25-30			X	X	X	X	X		
	30-35			X	X	X	X			
	35-40			X	X	X	X			
	40-45			X	X	X	X			
	45-50			X	X	X	X		X	
CA504-SB05	1-5	1238805.116	844722.614	X	X	X	X			Boring will be advanced approximately 16 feet to the southeast of the center of the UST in order to further define the horizontal extent of contamination to the southeast.
	5-10			X	X	X	X			
	10-15			X	X	X	X		X	
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	

TABLE 5-4
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA504-SB06	1-5	1238820.126	844724.676	X	X	X	X	X		Boring will be advanced southeast of the northeastern end of the UST in order to further define the horizontal extent of known contamination near the northeast end of the UST.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB07	1-5	1238839.785	844733.631	X	X	X	X		X	Boring will be advanced approximately 13 feet northeast of the northeast end of the UST in order to further define the horizontal extent of known contamination between the northeast end of the UST and previous soil boring CAFB-FAC1400-08 (previously nondetect).
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB08	0-5	1238813.282	844699.084	X	X	X	X		X	Borings will be advanced near the southwestern end of the UST in order to determine if contamination is present in this area (previously interpreted as unimpacted).
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB09	1-5	1238802.392	844697.022	X	X	X	X		X	
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB10	0-5	1238804.902	844708.038	X	X	X	X		X	
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			

TABLE 5-4
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA504-SB11	1-5	1238795.628	844689.323	X	X	X	X			Borings will be advanced near the southwestern end of the UST in order to determine if contamination is present in this area (previously interpreted as unimpacted).
	5-10			X	X	X	X		X	
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA504-SB12	0-5	To be determined		X	X	X	X	X		Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB13	0-5			X	X	X	X		X	
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB14	0-5			X	X	X	X			
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
			Totals	**97**	**97**	**97**	**97**	**10**	**10**	

TABLE 5-4
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]	Analytical Parameters						Technical Rationale
			TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-ORO analysis via USEPA Method 8015C

[4]BTEX + naphthalene analysis via USEPA Method 8260B

[5]Site-related SVOCs analysis via USEPA Method 8270D

[6]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

[7]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface

mg/kg = milligrams per kilogram

MS/MSD = matrix spike/matrix spike duplicate

RCRA = Resource Conservation and Recovery Act

SVOC = semivolatile organic compound

TPH-DRO = total petroleum hydrocarbons-diesel range organics

TPH-ORO = total petroleum hydrocarbons-oil range organics

USEPA = United States Environmental Protection Agency

UST = underground storage tank

VOC = volatile organic compound

TABLE 5-5
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA505-SB01	0-5	1239206.862	850901.345	X	X	X	X	X		Boring will be advanced at previous sample location CAFB-FAC3060-03 (located in the primary source area - on the northeast side of the approximate UST excavation) in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-DRO (5,300 mg/kg) at 9-11 feet bgs.
	5-10			X	X	X	X	X		
	10-15			X	X	X	X	X		
	15-20			X	X	X	X			
	20-25			X	X	X	X			
	25-30			X	X	X	X			
CA505-SB02	0-5	1239203.332	850896.899	X	X	X	X	X		Boring will be advanced in the center of the approximate UST excavation in order to further define the horizontal extent of contamination between the two areas of known contamination.
	5-10			X	X	X	X	X		
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
	25-30			X	X	X	X			
CA505-SB03	0-5	1239198.967	850891.773	X	X	X	X			Boring will be advanced at previous sample location CAFB-FAC3060-02 (located on the southwest side of the approximate UST excavation) in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-DRO (1,300 mg/kg) at 9-11 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X	X		
	15-20			X	X	X	X			
	20-25			X	X	X	X			
	25-30			X	X	X	X			
CA505-SB04	0-5	1239210.978	850897.247	X	X	X	X		X	Boring will be advanced in the north corner of the approximate UST excavation in order to further define the horizontal and vertical extent of known contamination near CAFB-FAC3060-03.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA505-SB05	0-5	1239202.764	850888.729	X	X	X	X			Boring will be advanced in the west corner of the approximate UST excavation in order to further define the horizontal and vertical extent of known contamination near CAFB-FAC3060-02.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	

TABLE 5-5
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA505-SB06	0-5	1239195.716	850896.050	X	X	X	X			Boring will be advanced in the south corner of the approximate UST excavation in order to further define the horizontal and vertical extent of known contamination near CAFB-FAC3060-02.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA505-SB07	0-5	1239204.021	850904.657	X	X	X	X			Boring will be advanced in the east corner of the approximate UST excavation in order to further define the horizontal and vertical extent of known contamination near CAFB-FAC3060-03.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA505-SB08	0-5	1239210.308	850890.937	X	X	X	X			Borings will be advanced in order to further define the horizontal and vertical extent of potential contamination outside the UST excavation.
	5-10			X	X	X	X			
	10-15			X	X	X	X		X	
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA505-SB09	0-5	1239210.843	850904.266	X	X	X	X			
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA505-SB10	0-5	1239197.370	850902.384	X	X	X	X		X	
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			

TABLE 5-5
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]	Analytical Parameters						Technical Rationale
			TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA505-SB11	0-5	To be determined	X	X	X	X			Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10		X	X	X	X			
	10-15		X	X	X	X	X		
	15-20		X	X	X	X			
	20-25		X	X	X	X			
CA505-SB12	0-5		X	X	X	X		X	
	5-10		X	X	X	X			
	10-15		X	X	X	X			
	15-20		X	X	X	X			
	20-25		X	X	X	X			
		Totals	**63**	**63**	**63**	**63**	**7**	**7**	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-ORO analysis via USEPA Method 8015C

[4]BTEX + naphthalene analysis via USEPA Method 8260B

[5]Site-related SVOCs analysis via USEPA Method 8270D

[6]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

[7]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, Californa.

bgs = below ground surface
mg/kg = milligrams per kilogram
MS/MSD = matrix spike/matrix spike duplicate
SVOC = semivolatile organic compound
TPH-DRO = total petroleum hydrocarbons-diesel range organics
TPH-ORO = total petroleum hydrocarbons-oil range organics
USEPA = United States Environmental Protection Agency
UST = underground storage tank
VOC = volatile organic compound

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS01	0-0.5	1239270.938	847748.733	X	X	X	X	X	X	X			Borings will be advanced at unpaved locations within the central part of the possible spill and excavation site (west and south of former pumphouse (Building 392) to determine if contamination is present in this area.
CA507-SB01	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS02	0-0.5	1239224.095	847752.463	X	X	X	X	X	X	X			
CA507-SB02	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
CA507-SS03	0-0.5	1239164.876	847750.996	X	X	X	X	X	X	X			
CA507-SS03	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS04	0-0.5	1239407.946	847791.334	X	X	X	X	X	X	X	X		Borings will be advanced at unpaved locations adjacent to fuel unloading ports to determine if contamination is present due to potential surface spills at these locations.
CA507-SS04	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS05	0-0.5	1239344.349	847791.342	X	X	X	X	X	X	X			
CA507-SS05	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS06	0-0.5	1239206.208	847791.977	X	X	X	X	X	X	X			
CA507-SS06	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS07	0-0.5	1239153.947	847790.784	X	X	X	X	X	X	X			Borings will be advanced at unpaved locations adjacent to fuel unloading ports to determine if contamination is present due to potential surface spills at these locations.
CA507-SS07	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS08	0-0.5	1239288.341	847792.399	X	X	X	X	X	X	X			Boring will be advanced to the north of the former location of Building 392, in the area formerly containing aboveground fuel lines, to determine if contamination is present in this area.
CA507-SS08	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS09	0-0.5	1239270.930	847797.460	X	X	X	X	X	X	X			Boring will be advanced in the area formerly occupied by Building 392 to determine if contamination is present in this area.
CA507-SS09	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SB10	1-5	1239379.193	847809.921	X	X	X	X	X	X	X			Borings will be located adjacent to storm drains under the grates in the concrete trench in the fuel unloading area on the west side of the site to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB11	1-5	1239179.853	847809.589	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS12	0-0.5	1239276.571	847851.895	X	X	X	X	X	X	X			Borings will be advanced on both ends of the area formerly occupied by an OWS within a concrete vault to determine if contamination is present in this area.
CA507-SB12	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SS13	0-0.5	1239253.817	847852.134	X	X	X	X	X	X	X			Borings will be advanced on both ends of the area formerly occupied by an OWS within a concrete vault to determine if contamination is present in this area.
CA507-SB13	0-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SS14	0-0.5	1239376.390	848074.957	X	X	X	X	X	X	X			Boring will be advanced in the area formerly containing aboveground diesel fuel lines (on the northeast part of the site) to determine if contamination is present in this area.
CA507-SB14	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SB15	1-5	1239376.390	848027.026	X	X	X	X	X	X	X			Borings will be advanced in paved areas near the ends of the former diesel pump island to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SB16	1-5	1239348.217	848012.174	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SB17	1-5	1239323.775	848046.505	X	X	X	X	X	X	X			Borings will be advanced in paved areas adjacent to the former diesel fuel unloading ports (398 and 399) to determine if contamination is present at these locations.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB18	1-5	1239270.773	848067.555	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS19	0-0.5	1239331.202	847980.726	X	X	X	X	X	X	X			Boring will be advanced in the unpaved area adjacent to a break in the concrete curb to the west of the diesel fuel pump island to determine if contamination is present in this area.
CA507-SB19	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
CA507-SS20	0-0.5	1239301.409	848095.815	X	X	X	X	X	X	X			Borings will be advanced within the approximate location of the previous 400-gallon JP-8 spill and excavation on the east part of the site and north of former Building 390, to determine if contamination is present in this area.
CA507-SB20	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS21	0-0.5	1239281.442	848094.934	X	X	X	X	X	X	X			
CA507-SB21	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS22	0-0.5	1239266.807	848095.354	X	X	X	X	X	X	X	X		Borings will be advanced in the area formerly occupied by aboveground fuel lines in the vicinity of the former pumphouse (Building 390) to determine if contamination is present in this area.
CA507-SB22	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS23	0-0.5	1239241.133	848096.836	X	X	X	X	X	X	X			Borings will be advanced in the area formerly occupied by aboveground fuel lines in the vicinity of the former pumphouse (Building 390) to determine if contamination is present in this area.
CA507-SB23	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS24	0-0.5	1239264.174	848130.424	X	X	X	X	X	X	X	X		Borings will be advanced in the area formerly occupied by aboveground fuel lines in the vicinity of the former pumphouse (Building 390) to determine if contamination is present in this area.
CA507-SB24	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS25	0-0.5	1239226.329	848095.825	X	X	X	X	X	X	X			Boring will be advanced in the center of the area formerly occupied by the pumphouse (Building 390) to determine if contamination is present in this area.
CA507-SB25	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS26	0-0.5	1239286.292	847974.296	X	X	X	X	X	X	X			Boring will be advanced adjacent to an underground vault constructed at the low point in the JP-4/JP-8/MOGAS lines to determine if contamination is present in this area.
CA507-SB26	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SB27	1-5	1239211.998	848026.333	X	X	X	X	X	X	X			Borings will be advanced in paved areas near the ends of the former JP-4/JP-8 pump islands to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB28	1-5	1239215.959	848061.431	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SB29	1-5	1239187.666	848011.473	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB30	1-5	1239187.666	848045.155	X	X	X	X	X	X	X			Borings will be advanced in paved areas near the ends of the former JP-4/JP-8 pump islands to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS31	0-0.5	1239211.490	847973.858	X	X	X	X	X	X	X			Boring will be advanced at the end of the concrete drainage swale to the west of the JP-4/JP-8 pump islands to determine if contamination is present in this area.
CA507-SB31	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS32	0-0.5	1239179.097	848078.400	X	X	X	X	X	X	X		X	Borings will be advanced on both ends of the concrete OWS vault to determine if contamination is present in this area.
CA507-SB32	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SS33	0-0.5	1239154.585	848078.400	X	X	X	X	X	X	X		X	Borings will be advanced on both ends of the concrete OWS vault to determine if contamination is present in this area.
CA507-SB33	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SS34	0-0.5	1239165.347	848107.707	X	X	X	X	X	X	X			Boring will be advanced to the east of the 55 gallon drum containment area (in the vicinity of an underground MOGAS line) to determine if contamination is present in this area.
CA507-SB34	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
CA507-SS35	0-0.5	1239093.834	848103.406	X	X	X	X	X	X	X			Boring will be advanced in an unpaved area at the former MOGAS unloading and dispensing area to determine if contamination is present in this area (potential surface spill area).
CA507-SB35	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SS36	0-0.5	1239101.725	847940.234	X	X	X	X	X	X	X			Boring will be advanced at the end of the concrete drainage trench on the south part of the site to determine if contamination from runoff is present in this area.
CA507-SB36	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
CA507-SS37	0-0.5	1239095.988	848033.386	X	X	X	X	X	X	X			Boring will be advanced at a break in the curb to the west of the former MOGAS unloading and dispensing area to determine if contamination from runoff is present in this area.
CA507-SB37	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
CA507-SS38	0-0.5	1239384.971	847749.958	X	X	X	X	X	X	X			Borings will be advanced at equally spaced locations to the west of the JP-4/JP-8/MOGAS unloading ports (northwest part of the site) to determine if surface spills occurred in this area.
CA507-SB38	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
CA507-SS39	0-0.5	1239329.62	847751.094	X	X	X	X	X	X	X			
CA507-SB39	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SB40	5-10	1239285.58	847828.987	X	X	X	X	X	X	X	X		Borings will be advanced adjacent to the multiple underground fuel lines that run from Building 392 to Building 390 (central part of the site).
	10-15			X	X	X	X	X	X	X			
CA507-SB41	5-10	1239288.079	847894.552	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB42	5-10	1239288.357	847949.961	X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
CA507-SB43	5-10	1239278.019	848032.848	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB44	5-10	1239368.714	847853.203	X	X	X	X	X	X	X		X	Boring will be advanced adjacent to the underground OWS elbows (west part of the site).
	10-15			X	X	X	X	X	X	X			
CA507-SB45	5-10	1239175.823	847850.435	X	X	X	X	X	X	X		X	
	10-15			X	X	X	X	X	X	X			
CA507-SB46	5-10	1239378.437	848044.477	X	X	X	X	X	X	X		X	Boring will be advanced adjacent to an underground diesel fuel line that runs from the former diesel fuel unloading port to the dispensers and diesel fuel line canopy (northeast part of the site). (May be adjusted based on utility locate.)
	10-15			X	X	X	X	X	X	X			
CA507-SB47	5-10	1239348.017	848044.283	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB48	1-5	1239327.642	848002.317	X	X	X	X	X	X	X			Boring will be advanced on the southwest corner of the concrete pad underneath the former diesel fuel island (east-central part of the site).
	5-10			X	X	X	X	X	X	X		X	
CA507-SS49	0-0.5	1239376.512	848121.52	X	X	X	X	X	X	X			Borings will be advanced at former elbow locations in the above-ground diesel fuel lines (east-central part of the site) to determine if surface spills occurred in this area. Boring CA507-SS/SB-50 will also be used to determine if contamination is present to the east of the previous 400-gallon JP-8 spill and excavation located north of Building 390.
CA507-SB49	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS50	0-0.5	1239290.974	848121.512	X	X	X	X	X	X	X			
CA507-SB50	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS51	0-0.5	1239290.974	848140.583	X	X	X	X	X	X	X			Borings will be advanced at former elbow locations in the aboveground diesel fuel lines (east-central part of the site) to determine if surface spills occurred in this area. Boring CA507-SS/SB-50 will also be used to determine if contamination is present to the east of the previous 400-gallon JP-8 spill and excavation located north of Building 390.
CA507-SB51	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS52	0-0.5	1239291.432	848081.844	X	X	X	X	X	X	X			Boring will be advanced to the west of the previous 400-gallon JP-8 spill and excavation located north of Building 390 to determine if contamination is present in this area.
CA507-SB52	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB53	1-5	1239243.073	848032.956	X	X	X	X	X	X	X			Borings will be advanced at paved and unpaved locations adjacent to the concrete pad underneath the former JP-4/JP-8 pump islands to determine if contamination is present due to potential surface spills at these locations (southeast part of the site).
	5-10			X	X	X	X	X	X	X			
CA507-SB54	1-5	1239204.948	847999.035	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X		X	
CA507-SB55	1-5	1239167.392	848033.261	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
CA507-SS56	0-0.5	1239210.117	848083.001	X	X	X	X	X	X	X			
CA507-SB56	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
CA507-SS57	0-0.5	1239104.723	848094.68	X	X	X	X	X	X	X			Borings will be advanced at equally spaced locations around the former MOGAS unloading and dispensing area.
CA507-SB57	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
CA507-SS58	0-0.5	1239083.14	848089.147	X	X	X	X	X	X	X			
CA507-SB58	1-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
CA507-SS59	0-0.5	1239086.108	848110.874	X	X	X	X	X	X	X			
CA507-SB59	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
CA507-SS60	0-0.5	1239105.398	848115.598	X	X	X	X	X	X	X			Borings will be advanced at equally spaced locations around the former MOGAS unloading and dispensing area.
CA507-SB60	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS61	0-0.5	1239138.666	847924.552	X	X	X	X	X	X	X			Boring will be advanced north of the concrete drainage trench on the south part of the site.
CA507-SB61	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X		X	
CA507-SS62	0-0.5	1239054.269	848034.947	X	X	X	X	X	X	X			Borings will be advanced at the discolored low points where surface runoff may have pooled.
CA507-SB62	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X		X	
CA507-SS63	0-0.5	1239042.143	847991.517	X	X	X	X	X	X	X			
CA507-SB63	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X		X	
CA507-SS64	0-0.5	To be determined		X	X	X	X	X	X	X	X		Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
CA507-SB64	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS65	0-0.5			X	X	X	X	X	X	X			
CA507-SB65	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS66	0-0.5			X	X	X	X	X	X	X			
CA507-SB66	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS67	0-0.5			X	X	X	X	X	X	X		X	
CA507-SB67	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS68	0-0.5			X	X	X	X	X	X	X			
CA507-SB68	0.5-5			X	X	X	X	X	X	X		X	
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]	Analytical Parameters									Technical Rationale
			TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS69	0-0.5	To be determined	X	X	X	X	X	X	X			Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
CA507-SB69	0.5-5		X	X	X	X	X	X	X			
	5-10		X	X	X	X	X	X	X			
	10-15		X	X	X	X	X	X	X		X	
CA507-SS70	0-0.5		X	X	X	X	X	X	X			
CA507-SB70	0.5-5		X	X	X	X	X	X	X			
	5-10		X	X	X	X	X	X	X			
CA507-SS71	0-0.5		X	X	X	X	X	X	X			
CA507-SB71	0.5-5		X	X	X	X	X	X	X			
	5-10		X	X	X	X	X	X	X			
		Totals	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**24**	**24**	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-GRO analysis via USEPA Method 8015C

[4]TPH-ORO analysis via USEPA Method 8015C

[5]BTEX + naphthalene analysis via USEPA Method 8260B

[6]Site-related SVOCs analysis via USEPA Method 8270D

[7]Lead analysis via USEPA Method 6020A.

[8]PCBs analysis via USEPA Method 8082A

[9]Field duplicate samples will be collected at a rate of 10 percent (1 per 10 samples collected) for laboratory analysis.

[10]MS/MSD samples will be collected at a rate of 10 percent (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface
EPA = Environmental Protection Agency
JP = jet propellant
MOGAS = motor gasoline
MS/MSD = matrix spike/matrix spike duplicate
OWS = oil/water separator
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SVOC = semivolatile organic compound
TPH-DRO = total petroleum hydrocarbons-diesel range organics
TPH-GRO = total petroleum hydrocarbons-gasoline range organics
TPH-ORO = total petroleum hydrocarbons-oil range organics
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

TABLE 5-7
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
SURFACE DISPOSAL AREA (SD-C508)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates[1] (Northing, Easting)[2]		Analytical Parameters												Technical Rationale
				TPH-DRO[3]	TPH-GRO[4]	TPH-ORO[5]	VOCs[6]	SVOCs[7]	Pesticides[8]	RCRA Metals[9]	PCBs[10]	Explosives[11]	Dioxins/Furans[12]	Field Duplicate Samples[13]	MS/MSD Samples[14]	
CA508-SS01	0-0.5	1228507.228	851294.596	X	X	X	X	X	X	X	X	X	X	X		Boring will be advanced in the area of visible burned surface debris (on the southwest part of the site) to determine if contamination is present in this area.
CA508-SB01	0.5-5			X	X	X	X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X	X	X			
CA508-SS02	0-0.5	1228620.071	851326.052	X	X	X	X	X	X	X	X	X	X			Boring will be advanced near the middle of the northern part of the site to determine if contamination is present in this area.
CA508-SB02	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X		X	
CA508-SS03	0-0.5	1228568.421	851372.417	X	X	X	X	X	X	X	X	X	X	X		Boring will be advanced near the middle of the eastern part of the site to determine if contamination is present in this area.
CA508-SB03	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X			
CA508-SS04	0-0.5	1228552.155	851273.669	X	X	X	X	X	X	X	X	X	X			Boring will be advanced near the middle of the western part of the site to determine if contamination is present in this area.
CA508-SB04	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X			
CA508-SS05	0-0.5	1228490.066	851350.786	X	X	X	X	X	X	X	X	X	X	X		Boring will be advanced near the middle of the southeastern quarter of the site to determine if contamination is present in this area.
CA508-SB05	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X			

TABLE 5-7
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
SURFACE DISPOSAL AREA (SD-C508)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates[1] (Northing, Easting)[2]		Analytical Parameters												Technical Rationale
				TPH-DRO[3]	TPH-GRO[4]	TPH-ORO[5]	VOCs[6]	SVOCs[7]	Pesticides[8]	RCRA Metals[9]	PCBs[10]	Explosives[11]	Dioxins/Furans[12]	Field Duplicate Samples[13]	MS/MSD Samples[14]	
CA508-SS06	0-0.5	1228664.916	851322.587	X	X	X	X	X	X	X	X	X	X			Borings will be advanced approximately 20 feet outside the perimeter of the mounded area with sparse vegetation to determine if contamination extends outside of the mounded area.
CA508-SB06	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X		X	
CA508-SS07	0-0.5	1228570.901	851234.753	X	X	X	X	X	X	X	X	X	X			
CA508-SB07	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
CA508-SS08	0-0.5	1228530.525	851398.286	X	X	X	X	X	X	X	X	X	X			
CA508-SB08	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X		X	
CA508-SS09	0-0.5	1228459.083	851267.988	X	X	X	X	X	X	X	X	X	X			
CA508-SB09	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X		X	
CA508-SS10	0-0.5	To be determined		X	X	X	X	X	X	X	X	X	X			Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
CA508-SB10	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X		X	
CA508-SS11	0-0.5			X	X	X	X	X	X	X	X	X	X			
CA508-SB11	0.5-5			X	X	X	X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X			
			Totals	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**5**	**5**	

TABLE 5-7
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
SURFACE DISPOSAL AREA (SD-C508)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates[1] (Northing, Easting)[2]	Analytical Parameters												Technical Rationale
			TPH-DRO[3]	TPH-GRO[4]	TPH-ORO[5]	VOCs[6]	SVOCs[7]	Pesticides[8]	RCRA Metals[9]	PCBs[10]	Explosives[11]	Dioxins/Furans[12]	Field Duplicate Samples[13]	MS/MSD Samples[14]	

Notes:
[1]Boring locations may be adjusted based on visible surface debris observed during field activities.
[2]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.
[3]TPH-DRO analysis via USEPA Method 8015C
[4]TPH-GRO analysis via USEPA Method 8015C
[5]TPH-ORO analysis via USEPA Method 8015C
[6]VOCs analysis via USEPA Method 8260B
[7]SVOCs analysis via USEPA Method 8270D
[8]Pesticides analysis via Method 8081B
[9]Metals analysis via USEPA Method 6020A and USEPA Method 7471B (Mercury)
[10]PCBs analysis via USEPA Method 8082A
[11]Explosives analysis via USEPA Method 8330
[12]Dioxins/furans analysis via USEPA Method 8290
[13]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.
[14]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.
Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface
MS/MSD = matrix spike/matrix spike duplicate
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SVOC = semivolatile organic compound
TPH-DRO = total petroleum hydrocarbons-diesel range organics
TPH-GRO = total petroleum hydrocarbons-gasoline range organics
TPH-ORO = total petroleum hydrocarbons-oil range organics
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

TABLE 5-8
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters										Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	VOCs[5]	SVOCs[6]	Pesticides[7]	RCRA Metals[8]	PCBs[9]	Field Duplicate Samples[10]	MS/MSD Samples[11]	
CA129-SB01	0-5	1238544.526	849438.747	X	X	X	X	X	X	X	X			Boring will be advanced in the northern part of the leach field to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X		X	
CA129-SB02	0-5	1238556.616	849454.608	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X		X	
CA129-SB03	0-5	1238539.115	849456.368	X	X	X	X	X	X	X	X	X		Boring will be advanced near the center of the leach field to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
	20-25			X	X	X	X	X	X	X	X		X	
CA129-SB04	0-5	1238511.501	849457.072	X	X	X	X	X	X	X	X	X		Boring will be advanced in the south corners of the leach field to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
CA129-SB05	0-5	1238533.662	849483.994	X	X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
CA129-SB06	0-5	1238554.72	849443.36	X	X	X	X	X	X	X	X			Boring will be advanced near the intersection of the drain pipe and the leach field (i.e., distribution box) to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
CA129-SB07	0-5	1235891.47	849413.23	X	X	X	X	X	X	X	X			Boring will be completed near the center of the drain pipe between the former location of the leach field and the cleanout to determine if the drain pipe leaked.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X		X	

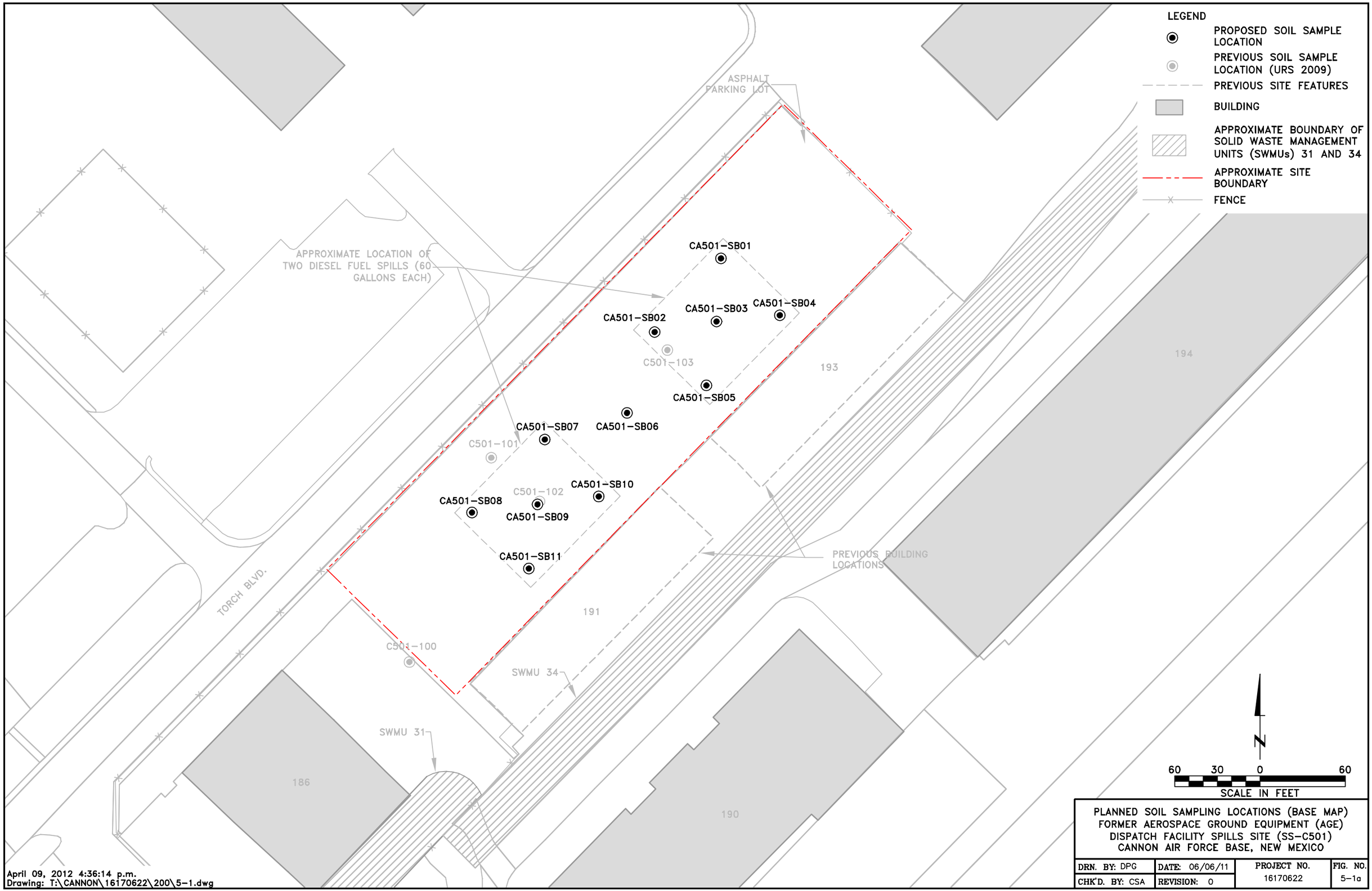
TABLE 5-8
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters										Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	VOCs[5]	SVOCs[6]	Pesticides[7]	RCRA Metals[8]	PCBs[9]	Field Duplicate Samples[10]	MS/MSD Samples[11]	
CA129-SB08	0-5	1238628.03	849382.88	X	X	X	X	X	X	X	X			Boring will be completed near the former location of the cleanout to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
CA129-SS09	0-5	1238571.72	849432.15	X	X	X	X	X	X	X	X			Surface soil samples collected to assess the potential impacts to soils from various types of waste dumped in these areas.
CA129-SS10	0-5	1238562.06	849445.04	X	X	X	X	X	X	X	X			
CA129-SB11	0-5	To be determined		X	X	X	X	X	X	X	X	X		Boring locations to be determined based on the results of field screening at the above locations.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
CA129-SB12	0-5	To be determined		X	X	X	X	X	X	X	X			Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X		X	
			Totals	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**5**	**5**	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.
[2]TPH-DRO analysis via USEPA Method 8015C
[3]TPH-GRO analysis via USEPA Method 8015C
[4]TPH-ORO analysis via USEPA Method 8015C
[5]VOCs analysis via USEPA Method 8260B
[6]SVOCs analysis via USEPA Method 8270D
[7]Pesticides analysis via Method 8081B
[8]Metals analysis via USEPA Method 6020A and USEPA Method 7471B (Mercury)
[9]PCBs analysis via USEPA Method 8082A
[10]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.
[11]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.
Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface
MS/MSD = matrix spike/matrix spike duplicate
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SVOC = semivolatile organic compound
TPH-DRO = total petroleum hydrocarbons-diesel range organics
TPH-GRO = total petroleum hydrocarbons-gasoline range organics
TPH-ORO = total petroleum hydrocarbons-oil range organics
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
FORMER AEROSPACE GROUND EQUIPMENT (AGE)
DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AIR FORCE BASE, NEW MEXICO

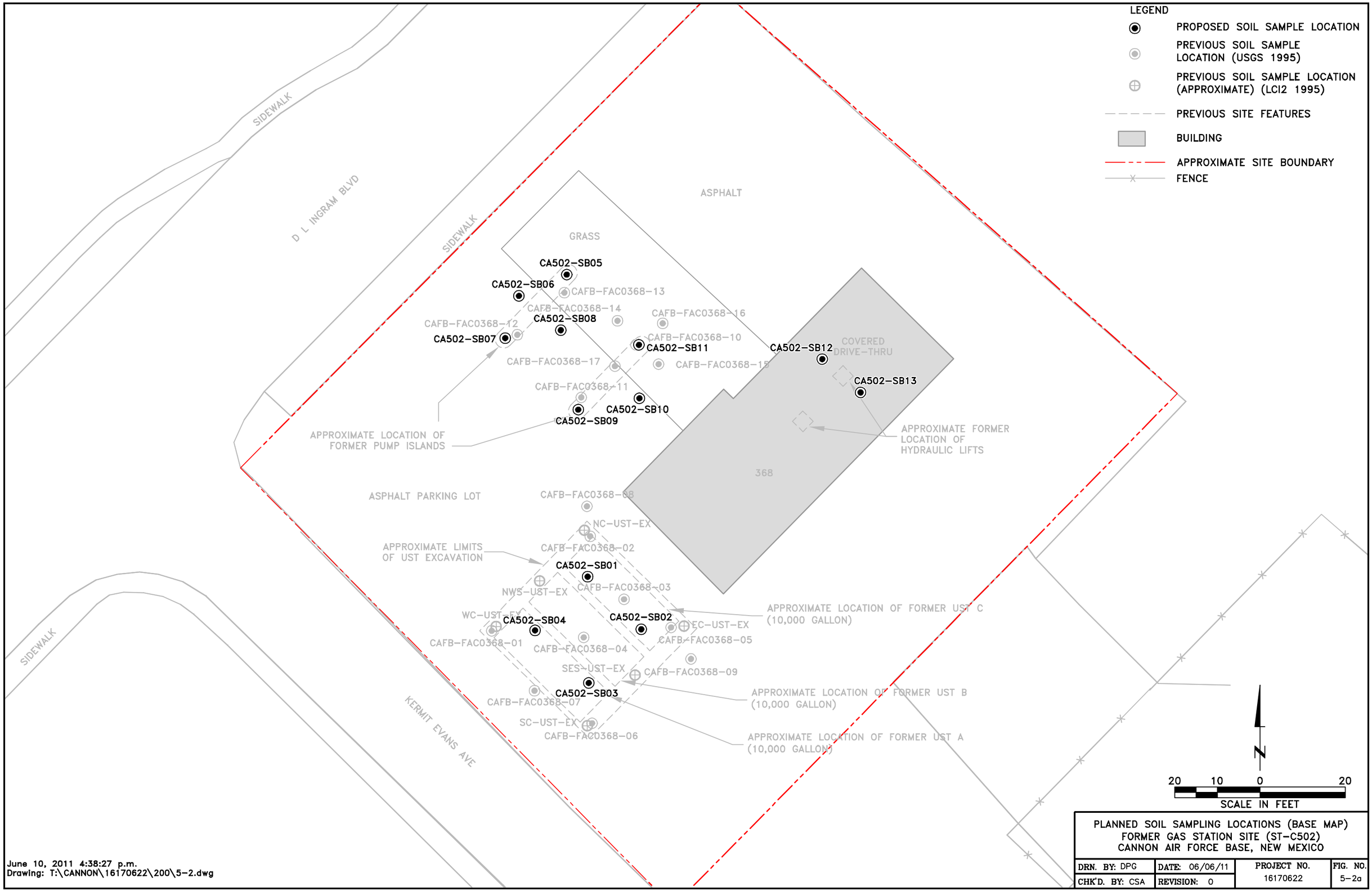
DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-1a
CHK'D. BY: CSA	REVISION: 0		

April 09, 2012 4:36:14 p.m.
Drawing: T:\CANNON\16170622\200\5-1.dwg

PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
FORMER AEROSPACE GROUND EQUIPMENT (AGE)
DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-1b
CHK'D. BY: CSA	REVISION: 0		

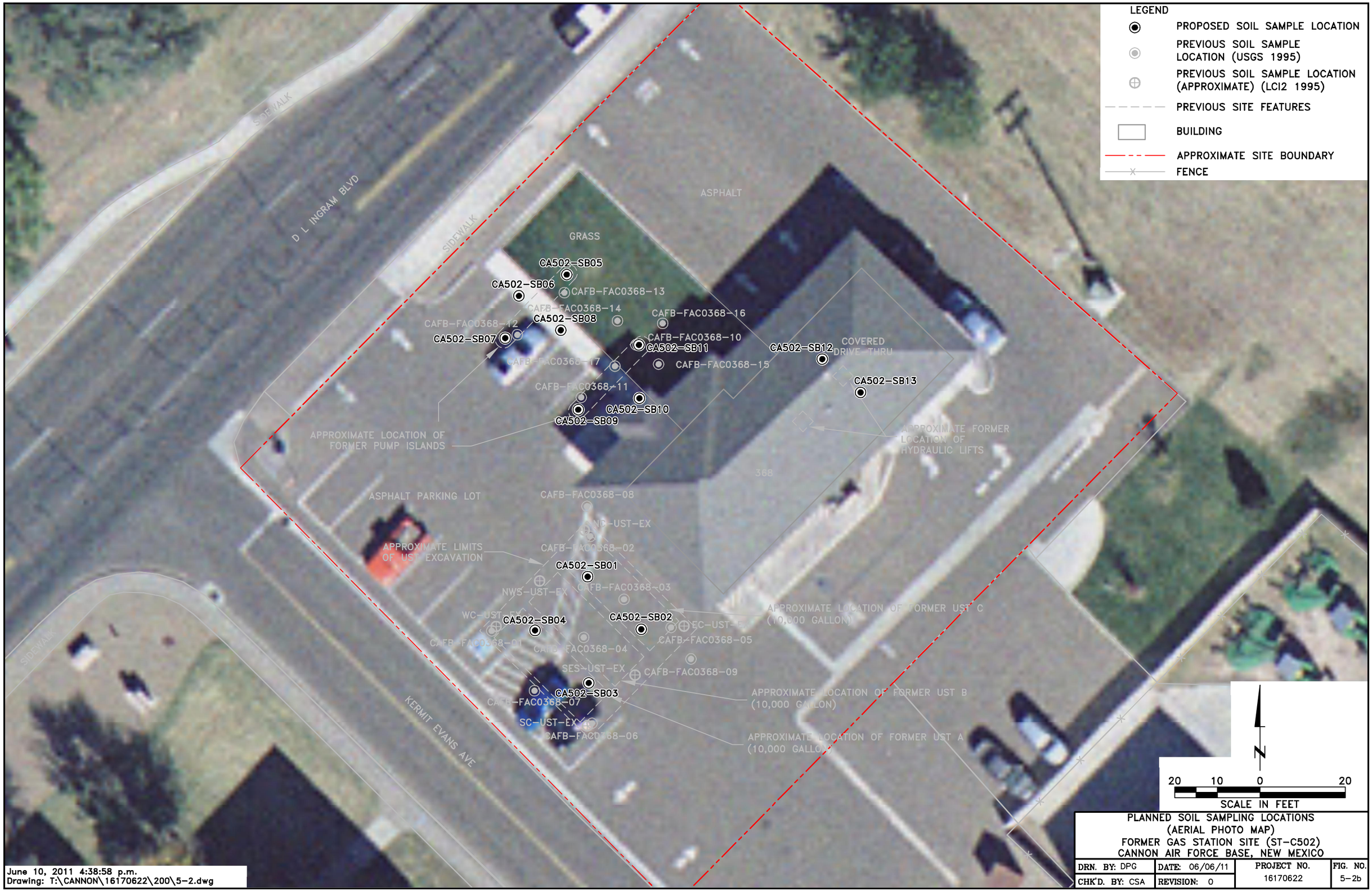
April 09, 2012 4:36:37 p.m.
Drawing: T:\CANNON\16170622\200\5-1.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
FORMER GAS STATION SITE (ST-C502)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-2a
CHK'D. BY: CSA	REVISION: 0		

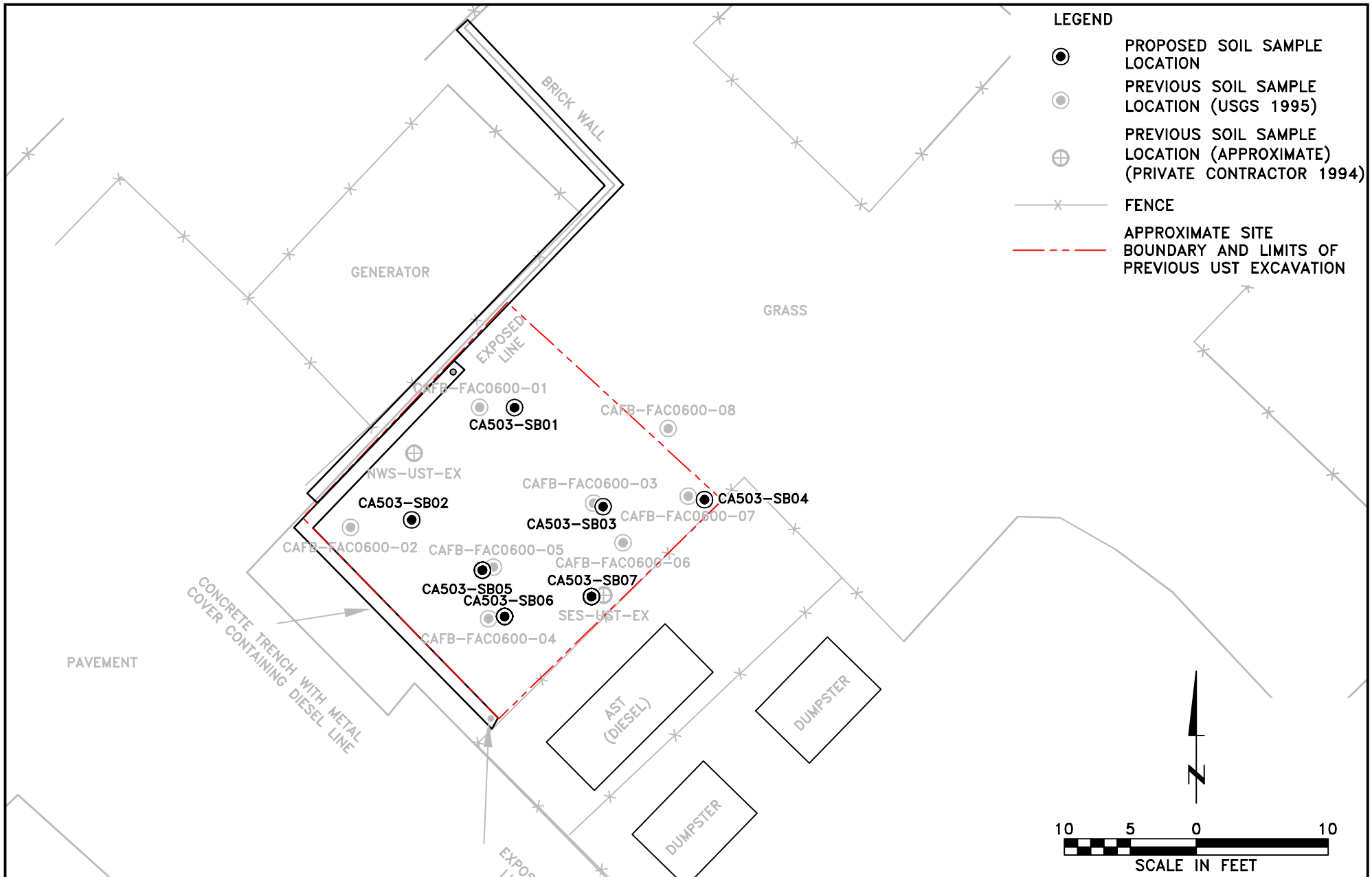
June 10, 2011 4:38:27 p.m.
Drawing: T:\CANNON\16170622\200\5-2.dwg



PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
FORMER GAS STATION SITE (ST-C502)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-2b
CHK'D. BY: CSA	REVISION: 0		

June 10, 2011 4:38:58 p.m.
Drawing: T:\CANNON\16170622\200\5-2.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AIR FORCE BASE, NEW MEXICO

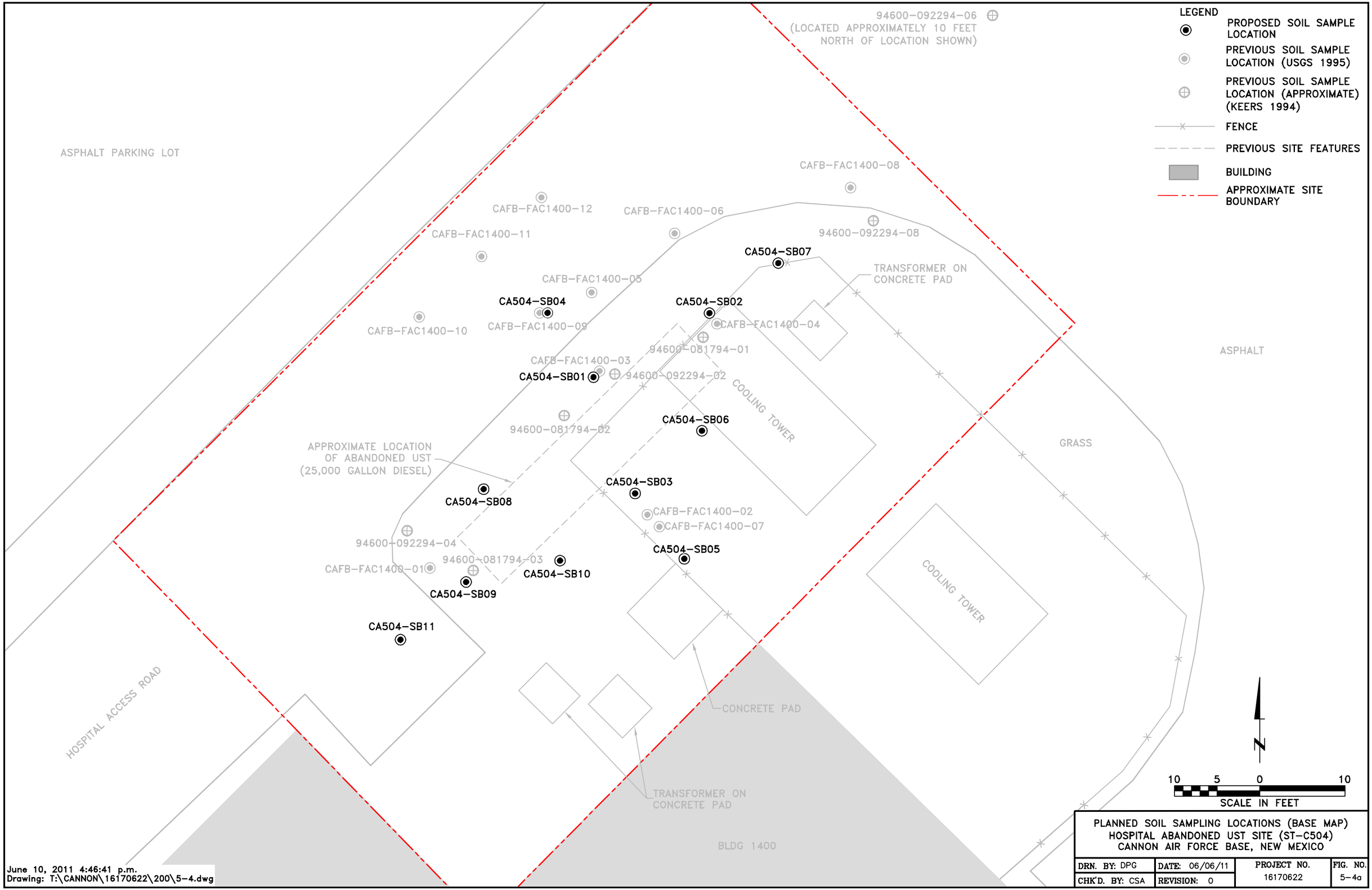
DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-3a
CHK'D. BY: CSA	REVISION: 0		

April 09, 2012 4:42:00 p.m.
Drawing: T:\CANNON\16170622\200\5-3.dwg

PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-3b

April 09, 2012 4:42:23 p.m.
Drawing: T:\CANNON\16170622\200\5-3.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AIR FORCE BASE, NEW MEXICO

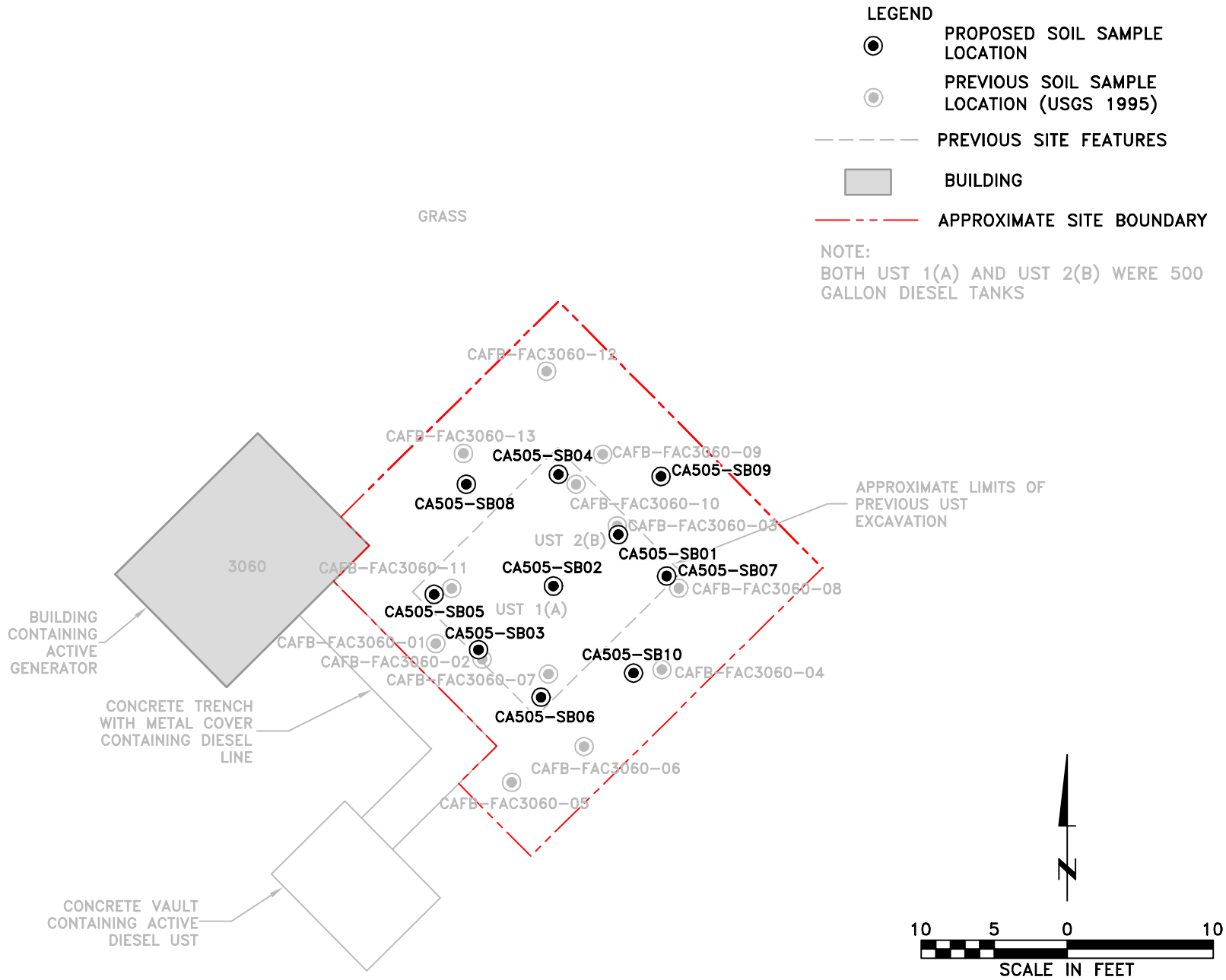
DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-4a

June 10, 2011 4:46:41 p.m.
Drawing: T:\CANNON\16170622\200\5-4.dwg

PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-4b

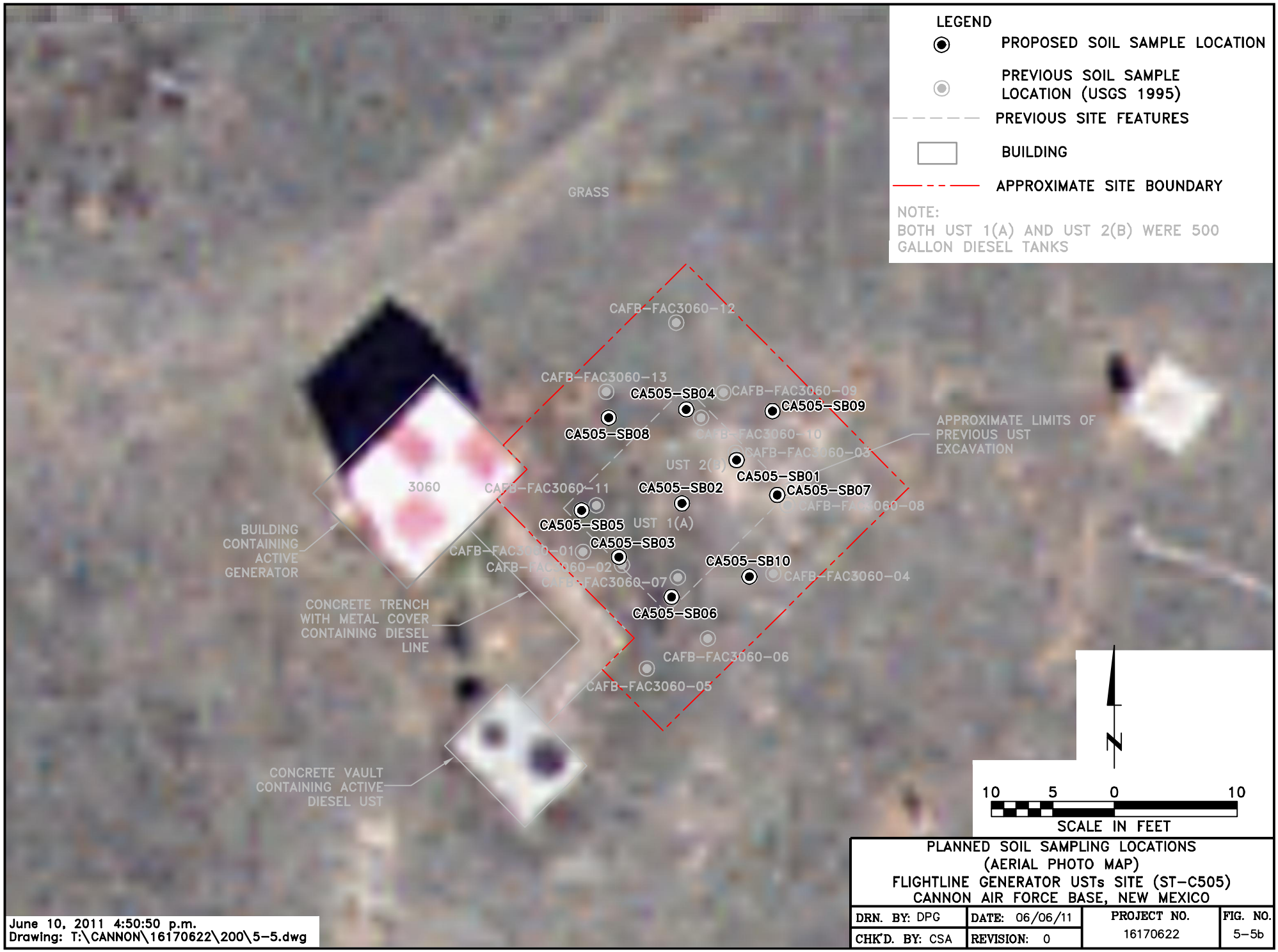
June 10, 2011 4:47:04 p.m.
Drawing: T:\CANNON\16170622\200\5-4.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
FLIGHTLINE GENERATOR USTs SITE (ST-C505)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-5a
CHK'D. BY: CSA	REVISION: 0		

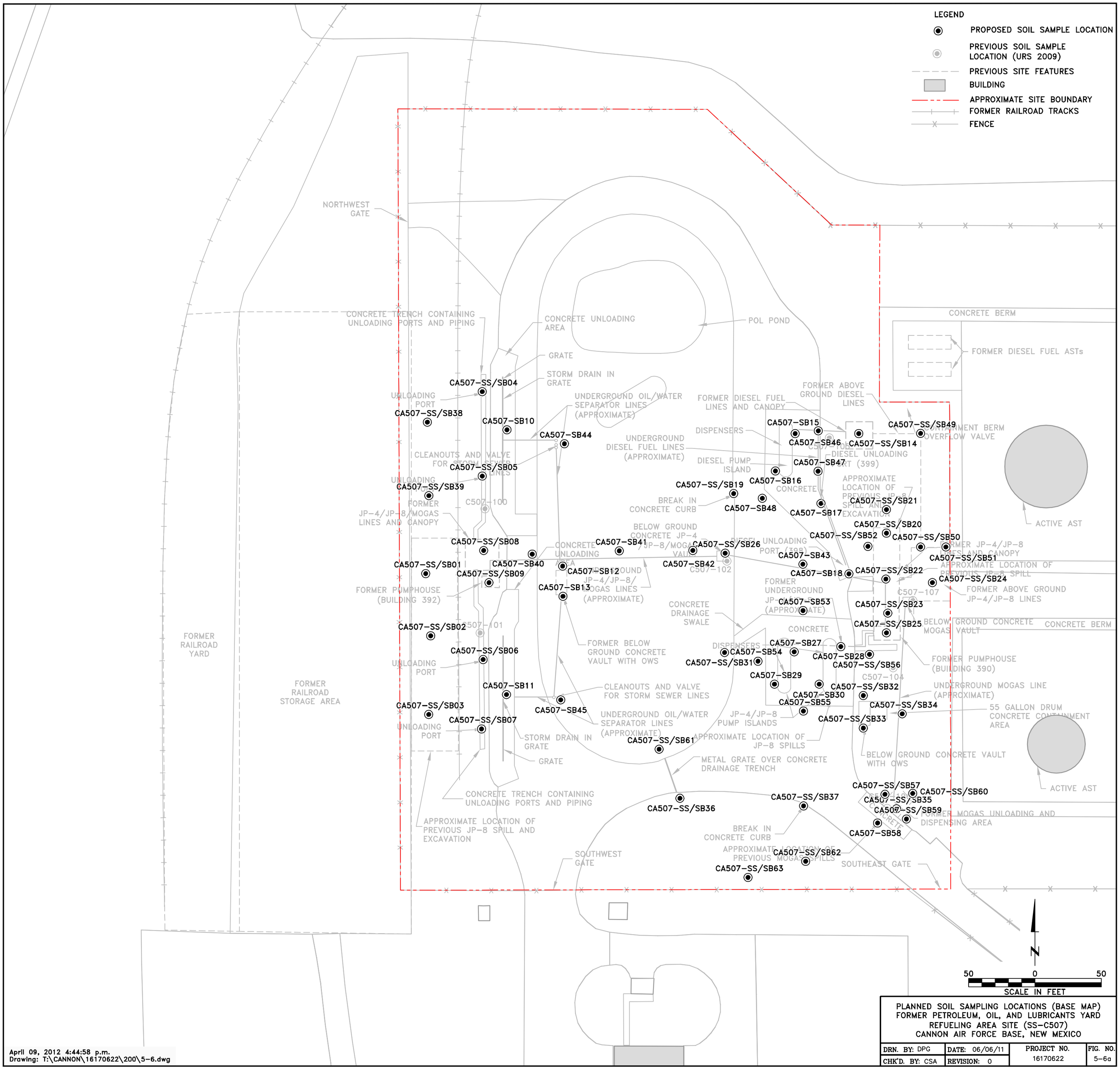
June 10, 2011 4:50:28 p.m.
Drawing: T:\CANNON\16170622\200\5-5.dwg



PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
FLIGHTLINE GENERATOR USTs SITE (ST-C505)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-5b
CHK'D. BY: CSA	REVISION: 0		

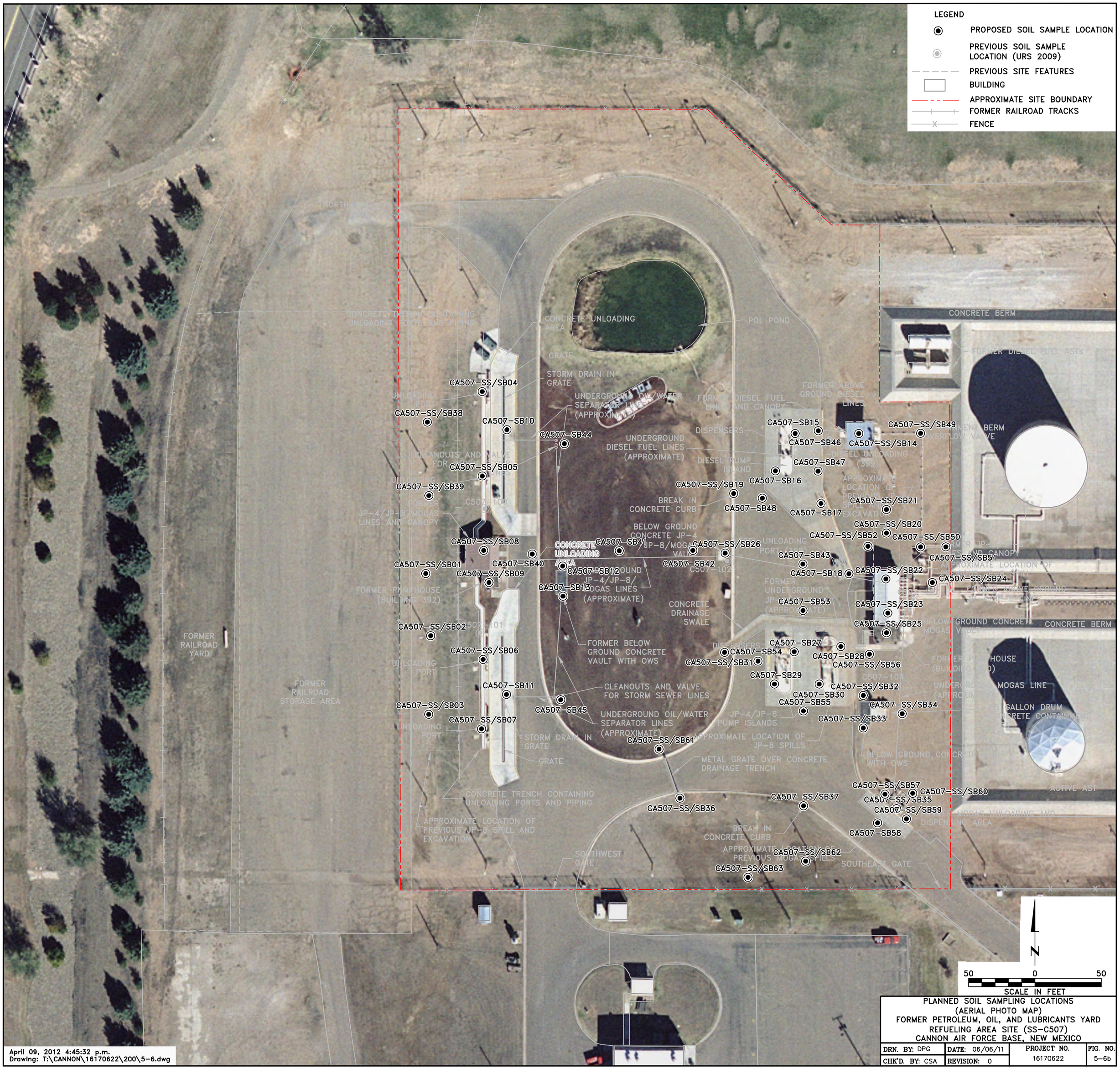
June 10, 2011 4:50:50 p.m.
Drawing: T:\CANNON\16170622\200\5-5.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
FORMER PETROLEUM, OIL, AND LUBRICANTS YARD
REFUELING AREA SITE (SS-C507)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-6a

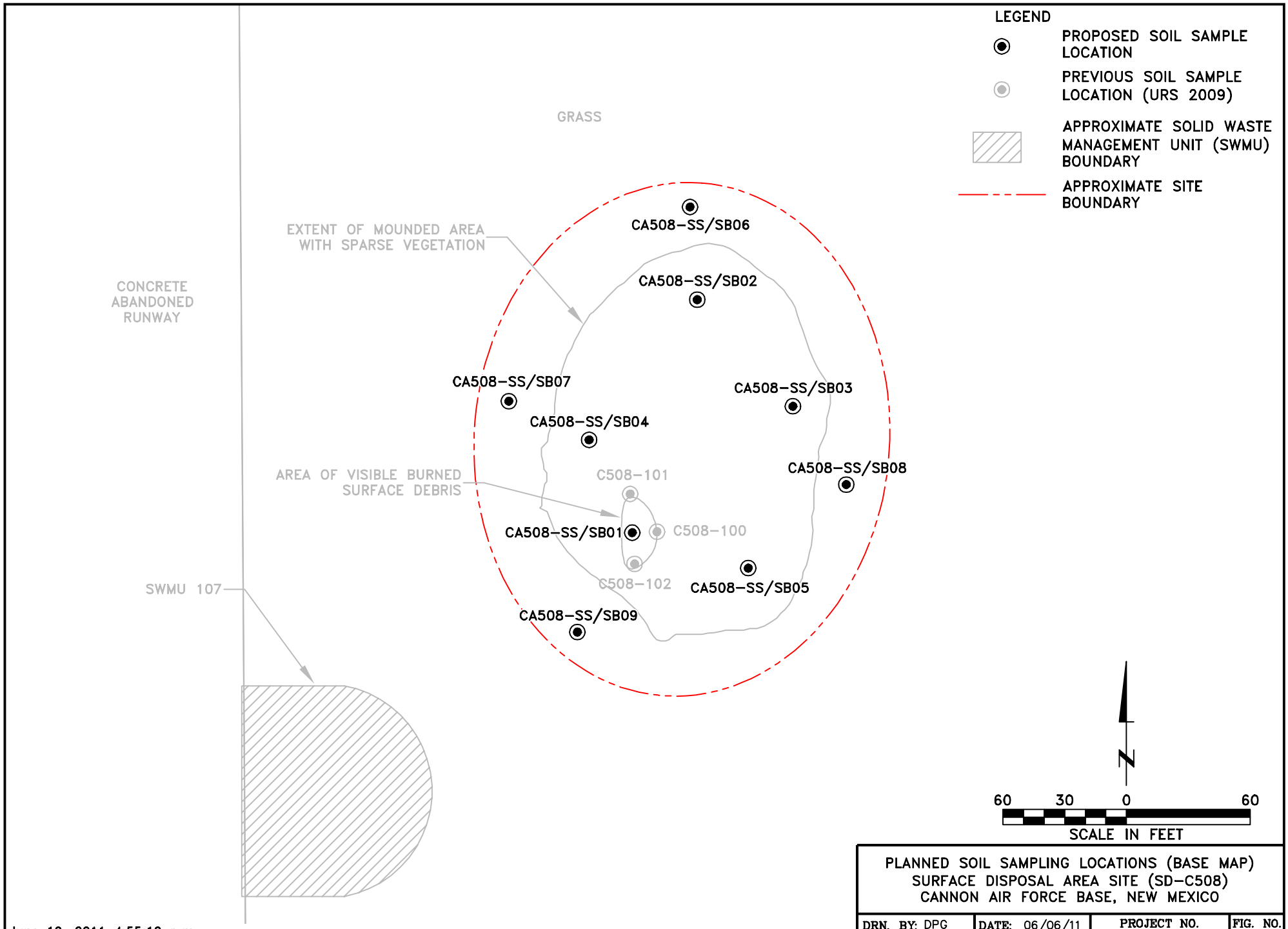
April 09, 2012 4:44:58 p.m.
Drawing: T:\CANNON\16170622\200\5-6.dwg



PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
FORMER PETROLEUM, OIL, AND LUBRICANTS YARD
REFUELING AREA SITE (SS-C507)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-6b

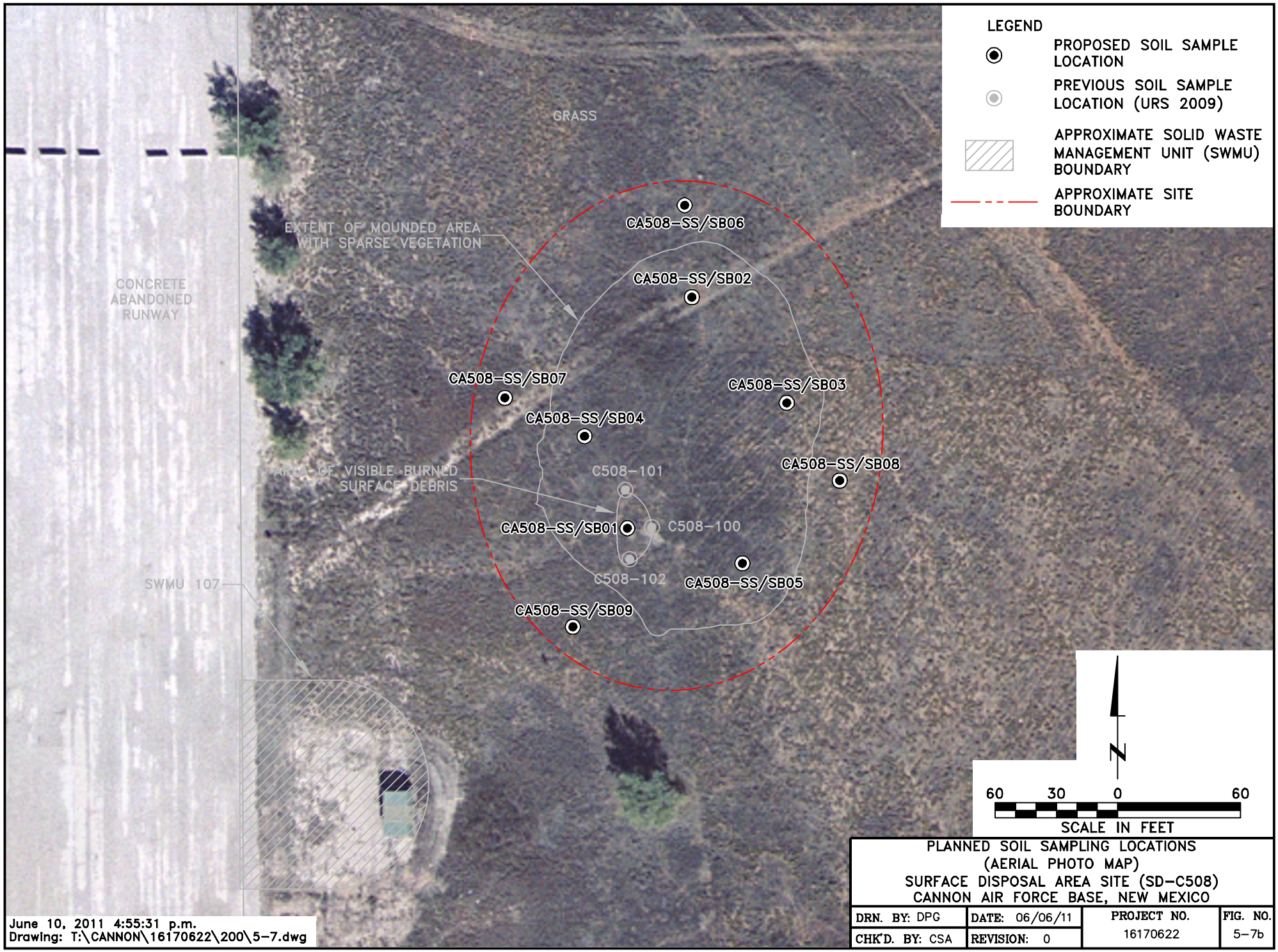
April 09, 2012 4:45:32 p.m.
Drawing: T:\CANNON\16170622\200\5-6.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-7a
CHK'D. BY: CSA	REVISION: 0		

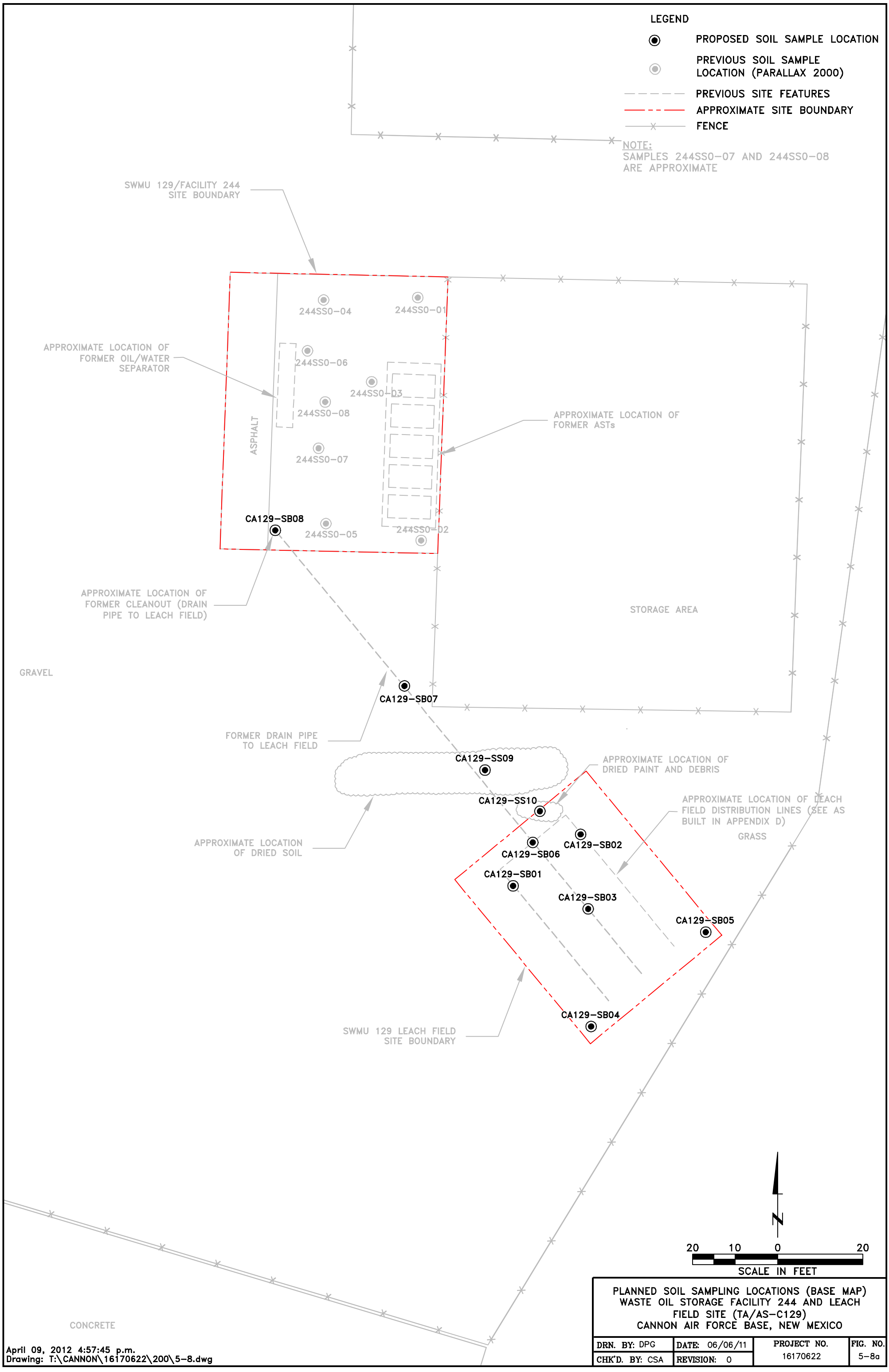
June 10, 2011 4:55:10 p.m.
Drawing: T:\CANNON\16170622\200\5-7.dwg



PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-7b

June 10, 2011 4:55:31 p.m.
Drawing: T:\CANNON\16170622\200\5-7.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-8a

PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-8b

This section presents the project documentation and reporting for the SI at eight sites project.

6.1 PROJECT MONITORING

The SI at eight sites project will be monitored continuously through a variety of mechanisms. URS will maintain open lines of communication with AFCEE and Cannon AFB to report progress and to quickly and accurately respond to items requiring clarification. URS will prepare monthly CPSMRs (AFCEE CDRL B005) to evaluate the overall progress of the project, along with any existing or potential problem areas. The monthly CPSMR will include a current project schedule (i.e., PPC [AFCEE CDRL B002]) that will be updated monthly to include actual document review times and field sampling event durations. The CPSMR will also provide field sampling progress during periods of on-going field sampling activities. The CPSMRs may be supplemented with periodic photographic documentation to help document the project's current field sampling status. The CPSMRs will also identify all testing and other QC activities that occurred during the reporting period, along with the QC test results. Examples include sample collection and CoC forms, laboratory test reports, survey data, and disposal records.

Monthly CPSMRs, with attachments, will provide a complete record of all activities completed during the SI at eight sites and will be sufficiently detailed to re-create each sampling, analytical testing, and monitoring event. The CPSMRs will be submitted monthly to AFCEE and Cannon AFB. Project execution documentation provided in the monthly CPSMRs may be used in a future site closure report.

Monthly FMERs (AFCEE CDRL C001) will be completed to correlate the status of expensed funds and man hours against the progress of the work completed and the negotiated budget.

6.2 FIELD FORM MANAGEMENT

All field forms completed during SI field activities will be submitted, via fax or as an email attachment, to the URS Omaha Office for detail checking to ensure all required information has been collected during site activities.

All field forms will be maintained in a central project file located in the URS Omaha Office and will be accessible to all project employees. Electronic scanned copies of all field forms will be maintained in the electronic project file.

6.3 SI AT EIGHT SITES REPORT

The SI Report or RCRA Facility Investigation Report (for TA/AS-C129) will include an Executive Summary, current and previous sampling results for the eight sites, a human health and ecological risk screen (where applicable), revised preliminary SCEMs, conclusions, and recommendations. At a minimum, this technical report will also include the following:

- Copies of all permits obtained to complete the work (e.g., dig permit) (AFCEE CDRL A015)

- Analytical data report package
- Field generated paperwork (i.e., SCFS and boring logs)
- Photographic documentation (AFCEE CDRL B005)
- Computer-aided design and drafting (CADD) drawings
- Draft, draft final, and final versions

In addition, this technical report will include all necessary digital files that are compatible with the existing Cannon AFB Geobase System, and will be suitable for submitting to NMED.

6.4 PROJECT FILE

The Project File for the SI at eight sites project will be maintained at the URS Omaha Office. Information or documents within the project file may be submitted to AFCEE or Cannon AFB upon request. The project file will contain, but not be limited to the following:

- All project-related proposals and SOWs
- Award documents
- Emails with government entities
- Phone call logs or meeting minutes
- Correspondence
- Presentation materials
- Site visit notes
- Site background information for each of the eight sites
- Monthly status and cost reports (i.e., CPSMRs)
- Monthly expenditure reports (i.e., FMER)
- Project schedule (i.e., PPC)
- Other written information pertaining to the execution of the task order
- Documents (draft, draft final, and final)
- Data files
- Environmental Resources Program Information Management Systems (ERPIMS) packages
- Complete populated database
- Comment resolution forms
- Sign-in sheets

Air Force Center for Engineering and the Environment (AFCEE). 2010. Statement of Work for Investigation of Oil Water Separators to Determine Defense Environmental Restoration Account Eligibility at Various Installations. June.

Efroymson, R.A., M.E. Will, G.W. Suter and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory. ES/ER/TN-85/R3. November.

Freeze, R.A. and J.A. Cherry. 1979. Groundwater. Prentice-Hall, Inc. Englewood Cliffs, NJ.

Gutentag, Edwin D., F.J. Heimes, N.C. Krothe, R.R. Luckey, and J.B. Weeks. 1984. Geohydrology of the High Plains Aquifer in Parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. USGS Professional Paper 1400-B.

Harza Engineering Company (Harza). 1997. Decision Document, JP-4 Fuel Spill. AOC B/IRP No. 22-18. Cannon AFB. January.

Lee Wan Associates, Inc. (Lee Wan). 1990. RCRA Facility Investigation Work Plan, Field Sampling Plan, and Program Management Plan. Alexandria, Virginia. June.

Los Alamos National Laboratory (LANL). 2010. Ecological Screening Levels (ESLs) in the LANL ECORISK Database, Version 2.5. October.

LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM. http://lanl.gov/environment/cleanup/ecorisk.shtml.

New Mexico Environmental Department (NMED). 2004. Letter from Mr. Glen von Gonten, Cannon AFB Project Leader, NMED, to Colonel Yates, Commander, 27th Fighter Wing. 12 January.

NMED. 2006. NMED TPH Screening Guidelines. October.

NMED. 2012. NMED Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation. February.

Office of the Deputy Under Secretary of Defense. 2009. Defense Environmental Restoration Program Manual, Draft. June.

Parallax, Inc. 2000. Closeout Report/Contamination Assessment, SWMU 129-Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, Final. July.

Radian Corp. 1986. Installation Restoration Program, Phase II – Confirmation/Qualification, Stage I. Cannon AFB. September.

Sposito, G. and A.L. Page. 1984. Cycling of Metal Ions in the Soil Environment. Metal Ions in Biological Systems, Volume 18. Circulation of Metals in the Environment. H. Sigel, ed. Marcel Dekker, Inc., New York.

Technical Cooperation Program (TTCP). 2009. Environmental Fate and Effects of Energetic Materials. The Technical Cooperation Program. http://www.em-guidelines.org/ecot.htm.

URS Group, Inc. (URS). 2005a. Work Plan. Includes: Quality Assurance Project Plan and Site Safety and Health Plan. Supplemental Assessment of Areas of Concern A, B, & C. Cannon AFB, New Mexico. Final Report. December.

URS. 2005b. Supplemental Assessment of Areas of Concern A, B, & C. Cannon AFB, New Mexico. Final. February.

URS. 2009. Final Evaluation Report. Cannon Air Force Base. Air Force Compliance Clean-up Site, Identification and Evaluation of DERA Eligibility for AFCEE, Multiple Locations. Prepared for the United States Army Corps of Engineers, Tulsa District. August.

United States Air Force. 2010. Air Force Environmental Restoration Programming Matrix. 20 April.

United States Environmental Protection Agency (USEPA). 1991. Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals). Interim. Office of Emergency and Remedial Response. Publication No. 9285.7-01B. December.

USEPA. 1994. Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. Office of Solid Waste and Emergency Response. Washington, D.C. July.

USEPA. 1999. Interim Final Lead-Based Paint Guidelines for Disposal of Department of Defense Residential Real Property – A Field Guide. December.

USEPA. 2001. USEPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review. Final. OSWER 9240.1-34. EPA 540-R-00-006. June.

USEPA. 2003. Ecological Screening Levels (ESLs) USEPA Region 5, RCRA. http://epa.gov/region05/waste/cars/pdfs/ecological-screening-levels-200308.pdf.

USEPA. 2004. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. Final. OSWER 9240.1-45. EPA 540-R-04-004. October.

USEPA. 2005-2007. Ecological Soil Screening Levels (ESSLs) Guidance Documents. OSWER Directive 9285.7. http://www.epa.gov/ecotox/ecossl/.

USEPA. 2010. Ecological Soil Screening Levels. October.United States Geological Survey (USGS). 1984. Professional Paper 1270. Element Concentrations in Soil and Other Surficial Materials in the Conterminous United States. By H.T. Shacklette and J.G. Borengen.

USGS. 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico. Volume I.

William Matotan and Associates. 1985. Water Well Master Plan Survey. Prepared for Department of the Air Force, Cannon Air Force Base, New Mexico.

Woodward-Clyde (W-C). 1991. Field Sampling Plan. Remedial Investigation. Phase I (18 SWMUs). Cannon AFB; Clovis, New Mexico.

W-C. 1995a. Appendix II SWMUs RCRA Facility Investigation. Final Report.

W-C. 1995b. Appendix III SWMUs RCRA Facility Investigation. Final Report.

W-C. 1997. Naturally Occurring Concentrations of Inorganics and Background Concentrations of Pesticides at Cannon Air Force Base, New Mexico. Final Report. September.

UNIFORM FEDERAL POLICY
QUALITY ASSURANCE PROJECT PLAN

SITE INVESTIGATION AT EIGHT SITES

CANNON AIR FORCE BASE

April 2012

Contract No. FA8903-08-D-8783
Task Order 0169

Prepared for:

Air Force Special
Operations Command

27th Special
Operations Wing

Under Contract to

Air Force Center for Engineering and the Environment

Prepared by:

URS

12120 Shamrock Plaza, Ste 300
Omaha, NE 68154

16170622

THIS PAGE INTENTIONALLY BLANK

TABLE OF CONTENTS

Introduction....1

Section 1 QAPP Worksheet #1 – Title and Approval Page....1-1

Section 2 QAPP Worksheet #2 – QAPP Identifying Information....2-1

Section 3 QAPP Worksheet #3 – Distribution List....3-1

Section 4 QAPP Worksheet #4 – Project Personnel Sign-Off Sheet....4-1

Section 5 QAPP Worksheet #5 – Project Organizational Chart....5-1

Section 6 QAPP Worksheet #6 – Communication Pathways....6-1

Section 7 QAPP Worksheet #7 – Personnel Responsibilities and Qualifications Table....7-1

Section 8 QAPP Worksheet #8 – Special Personnel Training Requirements Table....8-1

Section 9 QAPP Worksheet #9 – Project Scoping Session Participants Worksheet....9-1

Section 10 QAPP Worksheet #10 – Problem Definition....10-1

Section 11 QAPP Worksheet #11 – Project Quality Objectives/Systematic Planning Process Statements....11-1

Section 12 QAPP Worksheet #12 – Measurement Performance Criteria Table....12-1

Section 13 QAPP Worksheet #13 – Secondary Data Criteria and Limitations Table....13-1

Section 14 QAPP Worksheet #14 – Summary of Project Tasks....14-1

Section 15 QAPP Worksheet #15 – Reference Limits and Evaluation Table....15-1

Section 16 QAPP Worksheet #16 – Project Schedule / Timeline Table....16-1

Section 17 QAPP Worksheet #17 – Sampling Design and Rationale....17-1

Section 18 QAPP Worksheet #18 -- Sampling Locations and Methods/SOP Requirements Table....18-1

Section 19 QAPP Worksheet #19 – Analytical SOP Requirements Table....19-1

TABLE OF CONTENTS

Section 20 QAPP Worksheet #20 – Field Quality Control Sample Summary Table 20-1

Section 21 QAPP Worksheet #21 – Project Sampling SOP References Tables 21-1

Section 22 QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing, and Inspection Table 22-1

Section 23 QAPP Worksheet #23 – Analytical SOP References Table 23-1

Section 24 QAPP Worksheet #24 – Analytical Instrument Calibration Table 24-1

Section 25 QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table 25-1

Section 26 QAPP Worksheet #26 – Sample Handling System 26-1

Section 27 QAPP Worksheet #27 – Sample Custody Requirements Table 27-1

Section 28 QAPP Worksheet #28 – QC Samples Table 28-1

Section 29 QAPP Worksheet #29 – Project Documents and Records Table 29-1

Section 30 QAPP Worksheet #30 – Analytical Services Table 30-1

Section 31 QAPP Worksheet #31 – Planned Project Assessments Table 31-2

Section 32 QAPP Worksheet #32 – Assessment Findings and Corrective Action Responses 32-1

Section 33 QAPP Worksheet #33 – QA Management Reports Table 33-1

Section 34 QAPP Worksheet #34 – Verification (Step 1) Process Table 34-1

Section 35 QAPP Worksheet #35 – Validation (Steps IIa and IIb) Process Table 35-1

Section 36 QAPP Worksheet #36 – Validation (Steps IIa and IIb) Summary Table 36-1

Section 37 QAPP Worksheet #37 – Usability Assessment 37-1

Section 38 References 38-1

TABLE OF CONTENTS

List of Attachments

Attachment A Laboratory Standard Operating Procedures

Attachment B Laboratory Certifications

List of Tables

Table 12-1 Accuracy and Precision Criteria for VOC Analysis

Table 12-2 Accuracy and Precision Criteria for SVOC Analysis

Table 12-3 Accuracy and Precision Criteria for Organochlorine Pesticides Analysis

Table 12-4 Accuracy and Precision Criteria for PCB Analysis

Table 12-5 Accuracy and Precision Criteria for TPH-DRO, TPH-ORO and TPH-GRO Analysis

Table 12-6 Accuracy and Precision Criteria for Metals Analysis

Table 12-7 Accuracy and Precision Criteria for Dioxins/Furans Analysis

Table 12-8 Accuracy and Precision Criteria for Explosives

Table 12-9 Surrogate Compound Accuracy Criteria

Table 12-10 Calibration and QC Procedures for USEPA Methods SW8260B and SW8270D

Table 12-11 Calibration and QC Procedures for USEPA Methods SW8015C, SW8081B, SW8082A and SW8330A

Table 12-12 Calibration and QC Procedures for USEPA Methods SW6020A and SW7471B

Table 12-13 Calibration and QC Procedures for USEPA Method SW8290

TABLE OF CONTENTS

Acronyms and Abbreviations

°C	degrees Celsius
%D	percent difference
%R	percent recovery
AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
AST	Aboveground Storage Tank
BTEX	benzene, toluene, ethylbenzene, toluene and xylenes
bgs	below ground surface
BRA	Baseline Risk Assessment
B.S.	Bachelor of Science
CA	Corrective Action
CAC	corrective action complete
CAS	Chemical Abstracts Service
CAS	Columbia Analytical Services
CCB	continuing calibration blank
CCC	calibration check compounds
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CD	compact disc
CFR	Code of Federal Regulations
CIH	certified industrial hygienist
COC	chain of custody
COD	coefficient of determination
COPC	chemical of potential concern
CPR	cardiopulmonary resuscitation
CCV	continuing calibration verification
CVAA	cold vapor atomic absorption
DFTPP	decafluorotriphenylphosphine
DL	detection limit
DoD	Department of Defense
DQI	Data Quality Indicator

TABLE OF CONTENTS

DQO	data quality objective
DRO	diesel range organic
E	external
EDL	estimated detection limit
ELAP	Environmental Laboratory Accreditation Program
EMAX	EMAX Laboratories, Inc.
ERA	Ecological Risk Assessment
ESL	Ecological Screening Level
ESSL	Ecological Soil Screening Level
ERPIMS	Environmental Resources Program Information Management Systems
FS	Feasibility Study
GC	gas chromatography
GPS	global positioning system
GRO	gasoline range organics
g	gram
HRGC/HRMS	high resolution gas chromatography/high resolution mass spectrometry
I	internal
ICAL	initial calibration
ICP	inductively coupled plasma
ICP-AE	inductively coupled plasma – atomic emission
ICS	interference check sample
ICV	internal calibration verification
IDL	instrument detection limit
IS	internal standard
J	estimated
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
MB	method blank
mg/kg	milligrams per kilogram
MS	matrix spike
MSD	matrix spike duplicate
MD	matrix duplicate

TABLE OF CONTENTS

N/A	not applicable
NAD	North American Datum
NMED	New Mexico Environment Department
No	number
ORO	oil range organics
oz	ounce
P & P	Policies and Procedures
PAWP	Project Activities Work Plan
PCB	polychlorinated biphenyl
PDS	post digestion spike
PFTBA	perfluorotributylamine
PG	Professional Geologist
pH	hydrion ion exponent
PID	photoionization detector
PM	Project Manager
POL	petroleum, oil, and lubricants
ppm	parts per million
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
r	correlation coefficient
R	rejected
RCRA	Resource Conservation and Recovery Act
RF	response factor
RPD	relative percent difference
RSD	relative standard deviation
RSL	regional screening level
RT	retention time
SAP	Sampling and Analysis Plan
SCFS	sample collection field sheet
SOP	standard operating procedure
SB	subsurface soil
SSL	soil screening level

TABLE OF CONTENTS

SVOC	semivolatile organic compound
TBD	to be determined
TPH	total petroleum hydrocarbon
U	nondetect
UFP-QAPP	Uniform Federal Policy–Quality Assurance Project Plan
UJ	estimated nondetect
URS	URS Group, Inc.
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
UTL	upper tolerance limit
Ver	version
VOC	volatile organic compound

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY BLANK

INTRODUCTION

This Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) has been prepared in support of the Site Investigation (SI) at eight sites at Cannon Air Force Base (AFB), New Mexico. The eight sites include SS-C501, ST-C502, ST-C503, ST-C504, ST-C505, SS-C507, SD-C508, and TA/AS-C129 (SWMU 129). It provides completed worksheets prepared in accordance with Part 1 of the UFP-QAPP (the UFP-QAPP Manual).

This compilation of worksheets is intended to meet the requirements of the Sampling and Analysis Plan (SAP) and the Quality Assurance Project Plan (QAPP) and supplements the Project Activities Work Plan (PAWP). Each worksheet addresses specific requirements of the UFP-QAPP. The ultimate success of an environmental program or project depends on the quality of the environmental data that is collected and used in decision-making, and this depends significantly on the adequacy of the QAPP and its effective implementation.

The Former AGE Dispatch Facility Spills (SS-C501) site includes the area northeast of Building 186 where at least two diesel fuel spills (up to 60 gallons each) have historically occurred. The area has recently been repaved with asphalt.

The Former Gas Station underground storage tanks (USTs) (ST-C502) site formerly contained three 10,000-gallon gasoline USTs. In July 1995, the gasoline pump islands were added to the scope of the field investigation at this site. The USTs were removed in January 1995. Currently, the area includes the Cannon Federal Credit Union building and parking lot. An actual date of release cannot be determined; however, it is believed to have occurred during the service life of the tanks (USGS 1995).

The Base Support/Operations Generator Former UST (ST-C503) site formerly contained a 500-gallon diesel UST associated with an emergency generator located to the south of Building 600. The base of the tank was approximately seven feet below ground surface (bgs). The UST and some contaminated soil were removed in October 1994. The former UST was located between an aboveground storage tank (AST) and a brick wall that surrounds a generator and cooling towers (USGS 1995).

The Hospital Abandoned UST (ST-C504) site includes an abandoned 25,000-gallon diesel UST associated with an emergency generator at the Cannon AFB Hospital, Building 1400. The tank is constructed of steel, and its base is approximately 18 feet bgs (USGS 1995).

The Flightline Generator USTs (ST-C505) site formerly contained two 500-gallon diesel USTs associated with the emergency generator at Building 3060. The USTs were removed in December 1994 and January 1995.

INTRODUCTION

The petroleum, oil, and lubricants (POL) Yard Refueling Area (SS-C507) site includes historical spills associated with refueling stations, pumps, ASTs and piping at the POL Yard, which was closed in June/July 2009.

A surface disposal area (SD-C508) site identified in 2009 includes an area containing a variety of debris (some burned), including an ammunition can lid, metal slag, and mechanical parts. The surface disposal area is located east of the former north-south runway and north of SWMU 107.

The TA/AS-C129 site is located within SWMU 129. Facility 244 was originally built in 1991 to store waste petroleum products generated during routine maintenance of aircraft and service vehicles. The facility was used infrequently due to design and operational problems. Historically, lubricating oils, hydraulic fluids, and solvents were reportedly stored in tanks at this site. Fuels were reportedly never stored at this site (Parallax, Inc. [Parallax] 2000).

Additional site descriptions, site background and information about previous investigations are presented in Section 4 of the SI for eight sites PAWP (URS 2011).

QAPP Worksheet #1 (UFP-QAPP Manual Section 2.1) -- Title and Approval Page

Site Investigation at Eight Sites
Document Title

Air Force Center for Engineering and the Environment
Lead Organization

Tony Sedlacek, URS
Preparer's Name and Organizational Affiliation

12120 Shamrock Plaza, Suite 300 Omaha, NE 68154 (402-334-8181),
tony_sedlacek@urscorp.com
Preparer's Address, Telephone Number, and E-mail Address

4/20/2011
Preparation Date (Month/Day/Year)

Investigative Organization's Project Manager: Corey Anderson, URS Project Manager
Printed Name/Title

Signature/Date

Investigative Organization's Project QA Officer: Juan Szymanski, URS Quality Assurance Officer
Printed Name/Title

Signature/Date

Lead Organization's Project Manager: Eliud Burgos, AFCEE Project Manager
Printed Name/Title

Signature/Date

Primary Laboratory QA Manager: Kenette Pimentel / EMAX QA Manager
Printed Name/Title

Signature/Date

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) -- QAPP Identifying Information

Site Number/Code: SS-C501, ST-502, ST-C503, ST-C504, ST-C505, SS-C507, SD-C508 and TA/AS-C129 (SWMU 129)

Operable Unit: Not applicable (N/A)

Contractor Name: URS Group, Inc. (URS)

Contractor Number: FA8903-08-D-8783

Contract Title: Site Investigation at Eight Sites

Work Assignment Number: Task Order 0169

1. Identify guidance used to prepare Quality Assurance Project Plan (QAPP):

   Uniform Federal Policy for Quality Assurance Project Plans
   Department of Defense Quality Systems Manual, Version 4.2

2. Identify regulatory program:

   Resource Conservation and Recovery Act (RCRA) Hazardous Waste Permit 72124454) (No. NM7572124454)

3. Identify approval entity:

   Air Force Center for Engineering and the Environment (AFCEE)

4. This is a project-specific QAPP.

5. List dates of scoping sessions that were held:

   The project scoping session was completed during a site visit on April 19 and 20, 2011.

6. List dates and titles of QAPP documents written for previous site work, if applicable:

   Final Evaluation Report. Cannon AFB. Air Force Compliance Clean-up Site, Identification and Evaluation of Defense Environmental Restoration Account (DERA) Eligibility for AFCEE, Multiple Locations. August, 2009

   USGS. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico. Volume I. 1995

   Final Closeout Report/Contamination Assessment, SWMU 129-Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, Final. July, 2000

7. List organizational partners (stakeholders) and connection with lead organization:

   NMED – regulator

8. List data users:

   AFCEE, NMED, Cannon AFB and URS

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below:

   Not applicable

QAPP Worksheet #3 (UFP-QAPP Manual Section 2.3.1) -- Distribution List

QAPP Recipients	Title	Organization / Address	Telephone Number	E-mail Address	Document Control Number
Eliud Burgos	AFCEE Project Manager	AFCEE (EX) ATTN: Eliud Burgos 2261 Hughes Avenue, Suite 155 Lackland, TX 78236-9854	(210) 395-8626	Eliud.Burgos@us.af.mil	COPY 1
John Kieling	New Mexico Environment Department Program Manager	NMED – Hazardous Waste Bureau 2905 Rodeo Park Dr. East, Building 1 Santa Fe, NM 87505-6303	(505) 476-6000	To be determined (TBD)	COPY 2
Matthew Higginbotham	Cannon AFB Remedial Project Manager	27 SOCES/CEAN, 506 North DL Ingram Blvd Cannon AFB, New Mexico 88103-5003	(575)748-1092	Matthew.Higginbotham@cannon.af.mil	COPY 3
Kenette Pimentel	QA Manager	EMAX Laboratories, Inc. 1835 West 205th St Torrance, CA 90501	(301) 618-8889	Kpimentel@emaxlabs.com	COPY 4
Stephen Jacobson	URS Field Team Leader	URS 12120 Shamrock Plaza, Suite (STE) 300 Omaha, NE 68154	(402) 952-2544	stephen.jacobson@urs.com	COPY 5

QAPP Worksheet #4 (UFP-QAPP Manual Section 2.3.2) -- Project Personnel Sign-Off Sheet

Organization: Air Force Center for Engineering and the Environment

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
Eliud Burgos	AFCEE PM	(210) 395-8626		

Organization: Cannon Air Force Base

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
Matthew Higginbotham	Cannon AFB Remedial PM	(575) 784-1092		

Organization: URS

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
Corey Anderson	Project Manager	(402) 952-2551		
Tony Sedlacek	Project Chemist	(402) 952-2532		
Stephen Jacobson	URS Field Team Leader	(402) 952-2544		
Dennis Day	Health and Safety Officer	(402) 952-2525		

Organization: EMAX Laboratories, Inc. (EMAX)

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
Molly Nguyen	Project Manager	(310) 618-8889		
Kenette Pimentel	QA Manager	(310) 618-8889		

QAPP Worksheet #5 (UFP-QAPP Manual Section 2.4.1) -- Project Organizational Chart

See Figure 2-1 of the Site Investigation at eight sites PAWP

QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) -- Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Point of contact with AFCEE	AFCEE PM	Eliud Burgos	(210) 395-8626	Eliud Burgos is the liaison to Cannon AFB and URS.
Point of contact with Cannon AFB	Cannon AFB Remedial Project Manager	Matthew Higginbotham	(575) 784-1092	Matthew Higginbotham is the liaison to URS for technical matters. Will be notified by Corey Anderson if analytical data irregularities are observed or problems with analytical data are encountered.
Manage all URS Project Phases	URS Project Manager (PM)	Corey Anderson	(402) 952-2551	Corey Anderson is the URS point of contact to AFCEE.
QAPP Changes in the Field	URS Field Team Leader	Stephen Jacobson	(402) 952-2544	Notify Corey Anderson immediately by phone of changes to QAPP made in the field and the reason.
Reporting Lab Data Quality Issues	EMAX QA Manager	Kenette Pimentel	(310) 618-8889	All quality assurance/quality control (QA/QC) issues with project field samples will be reported by Kinette Pimentel to Tony Sedlacek immediately via email. Tony Sedlacek will communicate data quality issues to Corey Anderson.
Analytical Corrective Actions	URS Chemist	Tony Sedlacek	(402) 952-2532	The need for corrective action for analytical issues will be determined by Tony Sedlacek.
Release of Analytical Data	URS Chemist	Tony Sedlacek	(402) 952-2532	No analytical data can be released until an acceptable data package has been received, validation is completed, and Tony Sedlacek has approved the release.
QAPP Amendments	AFCEE PM	Eliud Burgos	(210) 395-8626	Any major changes to the QAPP must be approved by Eliud Burgos before they can be implemented.

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) -- Personnel Responsibilities and Qualifications Table

Name	Title	Organization	Responsibilities	Education and Experience Qualifications
Eliud Burgos	AFCEE PM	AFCEE	Oversees administrative aspects of project	TBD
Matthew Higginbotham	Remedial PM	Cannon AFB	Oversees project - communications and review activities with URS	TBD
Corey Anderson	URS PM	URS	Manages project – coordinates with lead agency	Professional Geologist (PG), Bachelor of Science (B.S.), Environmental Geololgy, 14 year's experience .
Tony Sedlacek	URS Project Chemist	URS	Analytical laboratory oversight	B.S. Chemistry, 6 years exp.
Stephen Jacobson	URS Field Team Leader	URS	Supervises and performs field sampling and coordinates on site field activities	PG, B.S. Geology, 9 years exp.
Dennis Day	Health and Safety Officer	URS	Oversees Health and Safety for field activities	CIH >15 years exp.
Molly Nguyen	Laboratory Project Manager	EMAX	Manages analytical laboratory	B.S. Chemistry, 10 years exp.
Kenette Pimentel	Laboratory QA Manager	EMAX	Performs lab QA oversight	B.S. Chemical Engineering, 25 years exp.

QAPP Worksheet #8 (UFP-QAPP Manual Section 2.4.4) -- Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates[1]
Field geology and sampling	Health and Safety Training/Refresher per 29 Code of Federal Regulation (CFR) 1910.120 Tailgate meeting to discuss sampling plan and procedures	URS	March 2012 Start of fieldwork	Field Team Leader and Project Field Team Project Field Team just prior to the start of field activities	Field Team Leader and Project Field Team, URS	URS, Omaha Office Certificates available on request Field Logbook Daily Safety Forms
	First Aid Training/Cardiopulmonary resuscitation (CPR)	Omaha First Aid Training	Various	Field Team Leader and Project Field Team	Field Team Leader and Project Field Team, URS	URS, Omaha office Certificates available on request

[1] If training records and/or certificates are on file elsewhere, document their location in this column. If training records and/or certificates do not exist or are not available, then this should be noted. A record of the tailgate meeting will be made in the Field Log Book.

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) -- Project Scoping Session Participants Sheet

Project Name: Site Investigation at 8 Sites **Projected Date(s) of Sampling:** Spring and Summer 2012 **Project Manager:** Corey Anderson	**Site Name:** SS-C501, ST-502, ST-C503, ST-C504, ST-C505, SS-C507, SD-C508, and TA/AS-C129 (SWMU 129) **Site Location:** Cannon AFB
Date of Session: The project scoping session was completed during a site visit on April 19 and 20, 2011. **Scoping Session Purpose:** The purpose of the scoping session was to conduct site walkovers, to determine site boundaries, to gather historical site information and to refine the project scope. Detailed site plans were obtained, when possible, to assist in identifying source areas and choosing areas for soil sampling. Additional scoping session details are summarized in the April 2011 site visit notes presented in Appendix D of the PAWP.	

QAPP Worksheet #10 (UFP-QAPP Manual Section 2.5.2) -- Problem Definition

Problem Definition:

Additional analytical data is required to further define the horizontal and vertical extent of known chemicals of potential concern (COPCs) and to determine the presence or absence of various COPCs at the eight sites where potential soil contamination was previously identified.

The investigative approach at the eight sites is designed to provide soil data of sufficient quality and quantity to evaluate whether a release has occurred that could pose a risk to human health or the environment and to evaluate the need for further evaluation, such as collection of additional data, completion of a Baseline Risk Assessment (BRA), or completion of a Feasibility Study (FS).

Project Description:

The primary objective of this project is to complete a Site Investigation that will include collection of surface and subsurface soil samples that will be used to provide the information necessary to further define the horizontal and vertical extent of known COPCs and to determine the presence or absence of chemical contamination, which may pose an unacceptable risk to human health or the environment at these eight sites.

Project Decision Condition:

The soils investigation decision process is designed to identify appropriate actions for each of the eight sites based on three recommendations: corrective action complete (CAC) without controls, CAC with controls, or further investigation and evaluation. Site-specific recommendations for the selection of an appropriate action will depend on whether COPCs are detected in soils at each site, at levels that may pose an unacceptable risk to human health or the environment. The recommendations will be made on the following basis:

- If the horizontal and vertical extent of contamination has been defined and no threat to human health exists based on comparison of maximum concentrations (excluding metals/pesticides below background and field/laboratory contaminants) to NMED residential soil screening levels (SSLs) (NMED 2012) or United States Environmental Protection Agency (USEPA) Residential Regional Screening Levels (RSLs) (USEPA 2011), and no potential threat to the environment is apparent, then CAC without

QAPP Worksheet #10 (UFP-QAPP Manual Section 2.5.2) -- Problem Definition

controls will be recommended. Note: Maximum concentrations will be compared to USEPA RSLs if NMED SSLs are unavailable.

- If one or more COPCs exceed residential SSLs, but not other relevant SSLs, and the horizontal and vertical extent of contamination has been defined, and no potential threat to the environment is apparent, then CAC with controls will be recommended.
- If there is a potential significant threat to human health based on the presence of COPCs with concentrations exceeding NMED SSLs or USEPA RSLs, further investigation will be recommended for the site. Further investigation may include additional field investigation and/or a BRA.

Preliminary ecological screening levels for any detected COPCs will also be used to determine whether further investigation at two of the sites (SS-C507 and SD-C508) is necessary, since these sites are considered potential habitat for ecological receptors. Ecological screening levels will be selected from the following sources in order of priority:

1) USEPA (2005-2007) Ecological Soil Screening Levels (ESSLs); the lowest of plant, soil invertebrate, bird and mammal ESSLs;
2) The lower of:
   a. Technical Cooperation Program – Energetic Material (TTCP);
   b. Los Alamos National Laboratory Ecological Screening Levels (ESLs) (LANL 2011)
3) USEPA Region 5 ESLs (USEA 2003);
4) Other published literature (for example, Efroymson et al 1997).

Due to the small size and developed nature of six of the eight sites, these six sites do not support suitable habitat for ecologically sensitive species and, therefore, do not support suitable habitat for ecological receptors.

All detected analytes will be compared to screening levels presented in Worksheet #15.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) -- Project Quality Objectives/Systematic Planning Process Statements

Who will use the data?

Data will be used by AFCEE, URS and Cannon AFB to evaluate the need for further evaluation, CAC with controls, or CAC without controls at the eight sites.

What will the data be used for?

The data should result in sufficient information to determine the need for further evaluation, such as collection of additional data, completion of BRA, or possible completion of FS.

What types of data are needed?

Discrete surface and subsurface soil samples will be collected continuously using direct push technology from each site and analyzed for selected COPCs. COPCs will be selected from the following: total petroleum hydrocarbon–diesel range organics (TPH-DRO); TPH-gasoline range organics (GRO); TPH-oil range organics (ORO); volatile organic compounds (VOCs); benzene, toluene, ethylbenzene, and xylene (BTEX)+naphthalene; semivolatile organic compounds (SVOCs); site-related SVOCs; pesticides; RCRA metals; lead; polychlorinated biphenyls (PCBs); dioxins/furans; and explosives. Soil samples from each site will be analyzed for the COPCs considered likely to be present based on the site's background.

Planned soil sampling locations, depths, analytical parameters, and technical rationale for each soil boring are provided for each site in Tables 5-1 through 5-8 of the PAWP. Final soil sampling depths will be based on previous sampling results, field observations (e.g., color and odor), and headspace analysis. The sampling efforts described here are discussed in greater detail in **Worksheet #17**.

Also, soil lithological data will be collected to characterize site stratigraphy. Sampling locations and site boundaries will also be surveyed using global positioning system (GPS) survey methods. Horizontal coordinates will be surveyed using the North American

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) -- Project Quality Objectives/Systematic Planning Process Statements

Datum of 1983 (NAD83). Each sample location will be photographed and the appropriate field documentation will be completed.
How much data are needed? Samples that will be collected at each site are presented in Tables 5-1 through 5-8 of the PAWP.
How good does the data need to be? Laboratory analytical data (generated by a Department of Defense [DoD] Environmental Laboratory Accreditation Program [ELAP] accredited laboratories using USEPA test methods) will be used to determine the presence or absence of various COPCs and define horizontal and vertical extent of known COPCs at the eight sites. Investigative samples will be duplicated in the field at a rate of 10 percent and analyzed by EMAX to assess field and laboratory precision.
When will data be collected? Data are anticipated to be collected in the spring and summer of 2012.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-10 and do not replace the appropriate DoD QSM Version (Ver) 4.2 Appendix F Table F-4.			
Analytical Group	Volatile Organic Compounds				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8260B / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-1 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-10 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-4.			
Analytical Group	Semivolatile Organic Compounds				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8270D / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-2 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-11 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-2.			
Analytical Group	Organochlorine Pesticides				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8081B / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-3 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-11 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-2.			
Analytical Group	Polychlorinated Biphenyls				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8082A / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-4 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-11 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-2.			
Analytical Group	TPH-DRO/TPH-ORO/TPH-GRO				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8015C / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-5 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-11 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-2.			
Analytical Group	Explosives				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8330A / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-8 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-12 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-7.			
Analytical Group	Metals				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 6020A and 7471B / N/A	Precision – Lab	RPD < 20%	Matrix duplicate (MD) and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field and Laboratory (matrix) Duplicates	S&A
		Accuracy/Bias	See Table 12-6	LCS and MS recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-13 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-6.			
Analytical Group	Dioxins/Furans				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8290 / N/A	Precision – Lab	RPD < 20%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Table 12-7	LCS/LCSD and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

TABLE 12-1
ACCURACY AND PRECISION CRITERIA FOR VOC ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
1,1,1,2-Tetrachloroethane	75-125	30
1,1,1-Trichloroethane	70-135	30
1,1,2,2-Tetrachloroethane	55-130	30
1,1,2-Trichloroethane	60-125	30
1,1-Dichloroethane	75-125	30
1,1-Dichloroethene	65-135	30
1,1-Dichloropropene	70-135	30
1,2,3-Trichlorobenzene	60-135	30
1,2,3-Trichloropropane	65-130	30
1,2,4-Trichlorobenzene	65-130	30
1,2,4-Trimethylbenzene	65-135	30
1,2-Dibromo-3-chloropropane	40-135	30
1,2-Dibromoethane	70-125	30
1,2-Dichlorobenzene	75-120	30
1,2-Dichloroethane	70-135	30
1,2-Dichloropropane	70-120	30
1,3,5-Trimethylbenzene	65-135	30
1,3-Dichlorobenzene	70-125	30
1,3-Dichloropropane	75-125	30
1,4-Dichlorobenzene	70-125	30
2,2-Dichloropropane	65-135	30
2-Butanone	30-160	30
2-Chlorotoluene	70-130	30
2-Hexanone	45-145	30
4-Chlorotoluene	75-125	30
4-Methyl-2-pentanone	45-145	30
Acetone	20-160	30
Benzene	75-125	30
Bromobenzene	65-120	30
Bromochloromethane	70-125	30
Bromodichloromethane	70-130	30
Bromoform	55-135	30
Bromomethane	30-160	30
Carbon disulfide	45-160	30
Carbon tetrachloride	65-135	30
Chlorobenzene	75-125	30
Chlorodibromomethane	65-130	30
Chloroethane	40-155	30
Chloroform	70-125	30
Chloromethane	50-130	30
cis-1,2-Dichloroethene	65-125	30
cis-1,3-Dichloropropene	70-125	30
Dibromomethane	75-130	30
Dichlorodifluoromethane	35-135	30
Ethylbenzene	75-125	30
Hexachlorobutadiene	55-140	30
Isopropylbenzene	75-130	30

TABLE 12-1
ACCURACY AND PRECISION CRITERIA FOR VOC ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
m,p-Xylene	80-125	30
Methylene chloride	55-140	30
Naphthalene	40-125	30
n-Butylbenzene	65-140	30
n-Propylbenzene	65-135	30
o-Xylene	75-125	30
p-Isopropyltoluene	75-135	30
sec-Butylbenzene	65-130	30
Styrene	75-125	30
tert-Butylbenzene	65-130	30
Tetrachloroethene	65-140	30
Toluene	70-125	30
trans-1,2-Dichloroethene	65-135	30
trans-1,3-Dichloropropene	65-125	30
Trichloroethene	75-125	30
Trichlorofluoromethane	25-185	30
Vinyl chloride	60-125	30

Notes:

Accuracy evaluation criteria are from Table G-5 and precision evaluation criteria are from Table F-4 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

VOC = Volatile Organic Compond

TABLE 12-2
ACCURACY AND PRECISION CRITERIA FOR SVOC ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
1,2,4-Trichlorobenzene	45-110	30
1,2-Dichlorobenzene	45-100	30
1,3-Dichlorobenzene	40-100	30
1,4-Dichlorobenzene	35-105	30
2,4,5-Trichlorophenol	50-110	30
2,4,6-Trichlorophenol	45-110	30
2,4-Dichlorophenol	45-110	30
2,4-Dimethylphenol	30-105	30
2,4-Dinitrophenol	15-130	30
2,4-Dinitrotoluene	50-115	30
2,6-Dinitrotoluene	50-110	30
2-Chloronaphthalene	45-105	30
2-Chlorophenol	45-105	30
2-Methylnaphthalene	45-105	30
2-Methylphenol	40-105	30
2-Nitroaniline	45-120	30
2-Nitrophenol	40-110	30
4-Nitrophenol	15-140	30
3 & 4-Methylphenol	40-105	30
3-Nitroaniline	25-110	30
4,6-Dinitro-2-methylphenol	30-135	30
4-Bromophenyl-phenyl ether	45-115	30
4-Chloro-3-methylphenol	45-115	30
4-Chlorophenyl-phenyl ether	45-110	30
4-Nitroaniline	35-115	30
Acenaphthene	45-110	30
Acenaphthylene	45-105	30
Anthracene	55-105	30
Benzo(a)anthracene	50-110	30
Benzo(a)pyrene	50-110	30
Benzo(b)fluoranthene	45-115	30
Benzo(g,h,i)perylene	40-125	30
Benzo(k)fluoranthene	45-125	30
Benzyl alcohol	20-125	30
Bis(2-chloroethoxy)methane	45-110	30
Bis(2-chloroethyl)ether	40-105	30
Bis(2-chloroisopropyl)ether	20-115	30
Bis(2-ethylhexyl)phthalate	45-125	30
Butylbenzylphthalate	50-125	30
Carbazole	45-115	30
Chrysene	55-110	30
Di-n-butylphthalate	55-110	30
Di-n-octylphthalate	40-130	30
Dibenz(a,h)anthracene	40-125	30
Dibenzofuran	50-105	30
Diethylphthalate	50-115	30
Dimethylphthalate	50-110	30

TABLE 12-2
ACCURACY AND PRECISION CRITERIA FOR SVOC ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
Fluoranthene	55-115	30
Fluorene	50-110	30
Hexachlorobenzene	45-120	30
Hexachlorobutadiene	40-115	30
Hexachloroethane	35-110	30
Indeno(1,2,3-cd)pyrene	40-120	30
Isophorone	45-110	30
N-Nitroso-di-n-propylamine	40-115	30
N-Nitrosodimethylamine	20-115	30
N-Nitrosodiphenylamine	50-115	30
Naphthalene	40-105	30
Nitrobenzene	40-115	30
Pentachlorophenol	25-120	30
Phenanthrene	50-110	30
Phenol	40-100	30
Pyrene	45-125	30

Notes:

Accuracy evaluation criteria are from Table G-7 and precision evaluation criteria are from Table F-4 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

SVOC = Semi-volatile organic compound

TABLE 12-3
ACCURACY AND PRECISION CRITERIA FOR ORGANOCHLORINE PESTICIDE ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
4,4'-DDD	30-135	30
4,4'-DDE	70-125	30
4,4'-DDT	45-140	30
Aldrin	45-140	30
alpha-BHC	60-125	30
alpha-Chlordane	65-120	30
beta-BHC	60-125	30
delta-BHC	55-130	30
Dieldrin	65-125	30
Endosulfan I	15-135	30
Endosulfan II	35-140	30
Endosulfan sulfate	60-135	30
Endrin	60-135	30
Endrin aldehyde	35-145	30
Endrin ketone	65-135	30
gamma-BHC	60-125	30
gamma-Chlordane	65-125	30
Heptachlor	50-140	30
Heptachlor epoxide	65-130	30
Methoxychlor	55-145	30

Notes:
Accuracy evaluation criteria are from Table G-15 and precision evaluation criteria are from Table F-2 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

BHC = Hexachlorocyclohexane

DDD = Dichlorodiphenyldichloroethane

DDE = Dichlorodiphenyldichloroethylene

DDT = Dichlorodiphenyltrichloroethane

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

TABLE 12-4
ACCURACY AND PRECISION CRITERIA FOR PCB ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
Aroclor 1016	40-140	30
Aroclor 1260	60-130	30

Notes:

Accuracy evaluation criteria are from Table G-17 and precision evaluation criteria are from Table F-2 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

TABLE 12-5
ACCURACY AND PRECISION CRITERIA FOR TPH-DRO, TPH-ORO AND TPH-GRO ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
TPH-DRO	60-150	30
TPH-ORO	50-150	30
TPH-GRO	50-150	30

Notes:

Accuracy evaluation criteria are from EMAX in-house limits and precision evaluation criteria are from Table F-2 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics

TPH-GRO = Total Petroleum Hydrocarbons - Gasoline Range Organics

TPH-ORO = Total Petroleum Hydrocarbons - Oil Range Organics

TABLE 12-6
ACCURACY AND PRECISION CRITERIA FOR METALS ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
Arsenic	80-120	20
Barium	80-120	20
Cadmium	80-120	20
Chromium	80-120	20
Lead	80-120	20
Mercury	80-120	20
Selenium	80-120	20
Silver	75-120	20

Notes:

Accuracy evaluation criteria are from Table G-19 and precision evaluation criteria are from Tables F-7 and F-8 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

TABLE 12-7
ACCURACY AND PRECISION FOR DIOXINS/FURANS ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

	Accuracy (%R)	Precision (RPD)
Spiking Compound	**Soil**	**Soil**
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	75-117	20
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	72-118	20
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	58-120	20
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	67-121	20
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	62-122	20
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	74-119	20
1,2,3,4,6,7,8,9-Heptachlorodibenzo-p-dioxin (OCDD)	62-137	20
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	79-120	20
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	73-112	20
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	61-131	20
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	75-126	20
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	48-123	20
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	68-111	20
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	62-121	20
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	66-112	20
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	69-135	20
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	64-135	20

Notes:
to Columbia Analytical Services (CAS) of Houston.
Accuracy and precision evaluation criteria are CAS in-house limits.
The accuracy and precision values are applicable to MS/MSD and LCS/LCSD samples.
%R = Percent recovery
LCS/LCSD = Laboratory control sample/Laboratoy control sample duplicate
MS/MSD = Matrix spike/matrix spike duplicate
RPD = Relative percent difference

TABLE 12-8
ACCURACY AND PRECISION FOR EXPLOSIVES ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

	Accuracy (%R)	Precision (RPD)
Spiking Compound	**Soil**	**Soil**
1,3,5-Trinitrobenzene	75-125	30
1,3-Dinitrobenzene	80-125	30
2,4,6-Trinitrotoluene	55-140	30
2,4-Dinitrotoluene	80-125	30
2,6-Dinitrotoluene	80-120	30
2-Amino,4,6-Dinitrotoluene	80-125	30
2-Nitrotoluene	80-125	30
3-Nitrotoluene	75-120	30
4-Amino-2,6-Dinitrotoluene	80-125	30
4-Nitrotoluene	75-125	30
HMX	75-125	30
Nitrobenzene	75-125	30
RDX	70-135	30
Tetryl	10-150	30

Notes:
The accuracy and precision values are applicable to MS/MSD and LCS/LCSD samples.
%R = Percent recovery
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
LCS/LCSD = Laboratory control sample/Laboratoy control sample duplicate
MS/MSD = Matrix spike/matrix spike duplicate
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine
RPD = Relative percent difference

TABLE 12-9
SURROGATE COMPOUND ACCURACY CRITERIA
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Analysis	Spiking Compound	Accuracy (%R) Soil
Volatile Organic Compounds	4-Bromofluorobenzene	85-120
	Toluene-d_8	85-115
Semivolatile Organic Compounds	2,4,6-Tribromophenol	35-125
	2-Fluorobiphenyl	45-105
	2-Fluorophenol	35-105
	Nitrobenzene-d_5	35-100
	Phenol-d_6	40-100
	Terphenyl -d_{14}	30-125
Diesel Range Organics / Oil Range Organics	Bromobenzene	50-150
	Hexacosane	50-150
Gasoline Range Organics	Bromofluorobenzene	50-150
	1,1,1-Trifluorotoluene	50-150
Organochlorine Pesticides	Tetrachloro-m-xylene	70-125
	Decachlorobiphenyl	55-130
Polychlorinated Biphenyls	Decachlorobiphenyl	60-125
Explosives	3,4-Dinitrotoluene	70-130

Notes:
Accuracy evaluation criteria for VOCs, SVOCs, PCBs and Pesticides are from Table G-3 of the DoD QSM, Version 4.2 and accuracy evaluation criteria for GRO, DRO, ORO and Explosives are EMAX in-house control limits.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

PCBs = Polychlorinated Biphenyls

SVOCs = semivolatile organic compounds

UFP-QAPP = Uniform Federal Policy - Quality Assurance Project Plan

VOCs = volatile organic compounds

TABLE 12-10
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8260B AND SW8270D

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
LOD determination and verification	At initial set-up and verified quarterly. If multiple instruments are used, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Apply **R**-flag to data without a valid LOD
LOQ establishment and verification	At initial setup and quarterly: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If LOQ is not set at the lowest calibration standard, must be verified with each batch. If multiple instruments are used, the LOQ must be verified on each.	The LOQ must meet the control limits of the LCS found in QAPP **Tables 12-1** and **12-2**.	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the LCS control limits in QAPP **Tables 12-1** and **12-2**.	Apply **R**-flag to data without a valid LOQ
Holding time	Every sample	Soil VOCs: 48 hours until frozen by laboratory (< -7°C), 14 days to analysis. Soil SVOCs: 14 days to extract, 40 days to analysis.	Contact URS as to additional measures to be taken.	VOCs and SVOCs: Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.
Sample temperature	Every cooler	4 ± 2 °C	Contact URS as to additional measures to be taken.	VOCs and SVOCs: Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to nondetects. VOCs and SVOCs: Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to nondetects.
Mass Tuning	VOCs and SVOCs: Prior to initial calibration and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Apply **R**-flag to data without a valid tune.

TABLE 12-10
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8260B AND SW8270D

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Breakdown check (DDT Method 8270C only)	At the beginning of each 12-hour period, prior to analysis of samples	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat breakdown check	Apply **R**-flag to data analyzed if DDT degradation is not met.
Minimum five point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis	1. Average response factor (RF) for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform and 1,1-dichloroethane. SVOCs ≥ 0.050 2. RSD for RFs for CCCs: VOCs and SVOCs ≤ 30% and one option below: Option 1: RSD for each analyte ≤ 15% Option 2: linear least squares regression r ≥ 0.995 Option 3: non-linear regression: coefficient of determination (COD) r^2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat ICAL	Apply **R**-flag to data without a valid ICAL
Second source calibration verification (ICV)	Once after each ICAL	All project analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.

TABLE 12-10
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8260B AND SW8270D

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Continuing calibration verification (CCV)	Daily before sample analysis and every 12 hours of sampling time.	1. Average RF for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform and 1,1-dichloroethane. SVOCs ≥ 0.050 2. % Difference/Drift for all target compounds and surrogates: VOCs and SVOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration.	Correct problem then repeat CCV. If that fails, then repeat initial calibration and reanalyze all samples since last successful calibration verification	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.
Method blank	One per preparatory batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Apply **U**-flag to analytes detected in field samples < 5X blank contamination (< 10X for common laboratory contaminants).
LCS containing all analytes to be reported, including surrogates.	One per preparatory batch	QC acceptance criteria specified in QAPP **Tables 12-1 and 12-2**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30% or 1/2 the lower limit): Apply **J**-flag to detects and **R**-flag to nondetects.
Internal standards verification	Every field sample, standard and QC sample.	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.

TABLE 12-10
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8260B AND SW8270D

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Surrogate spike	All field and QC samples	QC acceptance criteria specified in QAPP **Table 12-8**.	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to nondetects.
Matrix spike/matrix spike duplicate (MS/MSD)	One per preparatory batch per matrix	QC acceptance criteria specified in QAPP **Tables 12-1 and 12-2**.	Examine the project-specific DQOs. Contact URS as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects and **UJ**-flag to nondetects if acceptance criteria are not met. No qualification if concentration is > 4X the spiking amount.
Field Duplicate	One per 10 field samples	If both the parent and duplicate values are > 5X the LOQ, then 30% RPD for aqueous samples and 50% RPD for soil samples. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	N/A	Apply **J**-flag to detects and **UJ**-flag to nondetects
Professional Judgment	As determined by URS Chemist	Common laboratory contaminants detected at levels > 2X the LOQ.	N/A	Apply **U**-flag to analytes detected in field samples.

Notes:

Data evaluation criteria are from Table F-4 of the DoD QSM, Version 4.2. Industry standard was used when flagging criteria was not specified in the DoD QSM, Version 4.2.

TABLE 12-11
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8015C, SW8081B, SW8082A AND SW8330A
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
LOD determination and verification	At initial set-up and verified quarterly. If multiple instruments are used, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Apply **R**-flag to data without a valid LOD
LOQ establishment and verification	At initial setup: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If LOQ is not set at the lowest calibration standard, must be verified with each batch. If multiple instruments are used, the LOQ must be verified on each.	The LOQ must meet the control limits of the LCS found in QAPP **Tables 12-3, 12-4, 12-5** and **12-8**.	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the LCS control limits in QAPP **Tables 12-3, 12-4, 12-5** and **12-8**.	Apply **R**-flag to data without a valid LOQ
Holding time	Every sample	GRO Soil samples: 48 hours until frozen by laboratory (< -7°C), 14 days to analysis. DRO, ORO, Pesticides, PCB and Explosives Soil samples: 14 days to extract, 40 days to analysis.	Contact URS as to additional measures to be taken.	GRO samples: Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria. DRO, ORO, Pesticides, PCB and Explosives soil samples: Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.

TABLE 12-11
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8015C, SW8081B, SW8082A AND SW8330A
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Sample temperature	Every cooler	4 ± 2 °C	Contact URS as to additional measures to be taken.	Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to nondetects. Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to nondetects.
Breakdown Check (Endrin / DDT Method 8081 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 15% for both DDT and Endrin.	Correct problem then repeat breakdown check.	Apply R-flag to data analyzed if Endrin / DDT degradation is not met.
Minimum five point ICAL for all analytes (DRO/ORO/GRO/Pesticides/PCBs/ Explosives)	ICAL prior to sample analysis	One of the options below: Option 1: RSD for each analyte ≤ 20% Option 2: linear least squares regression r ≥ 0.995 Option 3: non-linear regression: COD r^2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration	Apply **R**-flag to data without a valid ICAL
Second source calibration verification (ICV) (DRO/ORO/GRO/Pesticides/PCBs)	Immediately following ICAL.	All project analytes within established retention time windows. All project analytes within ± 20% of expected value from the ICAL.	Correct problem, then rerun ICV. If that fails, repeat ICAL.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.
Explosives		All project analytes within ± 15% of expected value from the ICAL.		

TABLE 12-11
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8015C, SW8081B, SW8082A AND SW8330A
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Continuing calibration verification (CCV) (DRO/ORO/GRO/Pesticides/PCBs)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes within established retention time windows. All project analytes within ± 20% of expected value from the ICAL.	Correct problem then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and R-flag to nondetects.
Explosives		All project analytes within ± 15% of expected value from the ICAL.		
Method blank	One per preparatory batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Apply **U**-flag to analytes detected in field samples < 5X blank contamination.
LCS containing all analytes to be reported, including surrogates.	One per preparatory batch	QC acceptance criteria specified in QAPP **Tables 12-3, 12-4, 12-5** and **12-8**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30% or 1/2 the lower limit): Apply **J**-flag to detects and **R**-flag to nondetects.
Surrogate spike	All field and QC samples	QC acceptance criteria specified in QAPP **Table 12-9**.	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to nondetects.
Confirmation of positive results (second column or second detector)	All positive results must be confirmed (with the exception of Method 8015).	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	Use project-specific reporting requirements if available; otherwise, use method reporting requirements; otherwise, report the result from the primary column.	Apply **J**-flag if RPD >40%. Apply **U**-flag if primary result not confirmed.

TABLE 12-11
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8015C, SW8081B, SW8082A AND SW8330A
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Matrix spike/matrix spike duplicate (MS/MSD)	One per preparatory batch per matrix	QC acceptance criteria specified in QAPP **Tables 12-3, 12-4, 12-5** and **12-8**.	Examine the project-specific DQOs. Contact URS as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data. No qualification if concentration is > 4X the spiking amount.
Field Duplicate	One per 10 field samples	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil samples and 30% RPD for aqueous samples. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	N/A	Apply **J**-flag to detects and **UJ**-flag to nondetects

Notes:
Data evaluation criteria are from Table F-2 of the DoD QSM, Version 4.2. Industry standard was used when flagging criteria was not specified in the DoD QSM, Version 4.2.

TABLE 12-12
CALIBRATION AND QC PROCEDURES FOR
USEPA METHOD SW6020A AND SW7471B
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
LOD determination and verification	At initial set-up and verified quarterly. If multiple instruments are used, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Apply **R**-flag to data without a valid LOD
LOQ establishment and verification	At initial setup: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If LOQ is not set at the lowest calibration standard, must be verified with each batch. If multiple instruments are used, the LOQ must be verified on each.	The LOQ must meet the control limits of the LCS found in QAPP **Table 12-6**.	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the LCS control limits in QAPP **Table 12-6.**	Apply **R**-flag to data without a valid LOQ
Instrument detection limit (IDL) study	At initial set-up	IDLs shall be ≤ LOD.		Apply **R**-flag to data without a valid IDL.
Holding time	Every sample	Metals: 6 months (mercury 28 days)	Contact URS as to additional measures to be taken.	Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.
Sample temperature	Every cooler	None (mercury 4 ± 2 °C)	Contact URS as to additional measures to be taken.	Mercury samples arriving at temperatures > 6 °C, apply **J**-flag to detects and **UJ**-flag to nondetects.
Tuning	Prior to ICAL	Mass calibration ≤ 0.1 amu from the true value; Resolution < 0.9 amu full width at 10% peak height; For stability, RSD ≤ 5% for at least four replicate analyses.	Corect problem, then repeat ICAL.	Apply **R**-flag to data without a valid ICAL.

TABLE 12-12
CALIBRATION AND QC PROCEDURES FOR USEPA METHOD SW6020A AND SW7471B
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Initial calibration for all analytes (ICAL) **ICP: minimum of two standards and a blank** **CVAA: minimum 5 standards and a blank**	Daily ICAL prior to sample analysis	$r \geq 0.995$	Correct problem then repeat initial calibration	Apply **R**-flag to data without a valid ICAL
Second source calibration verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analyte(s) within ± 10% of true value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat initial calibration.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.
Continuing calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence.	ICP: All analytes within ± 10% of true value. CVAA: within ± 20% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.
Method blanks	One per preparatory batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Apply **U**-flag to analytes detected in field samples < 5X blank contamination.
Calibration blanks	Before beginnin a sample run, after 10 samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. If required, reprep and reanalyze calibration blank and all samples following the last acceptable calibration blank mus tbe reanalyzed.	Apply **U**-flag to analytes detected in field samples < 5X blank contamination.
LCS containing all analytes to be reported.	One per preparatory batch	QC acceptance criteria specified in QAPP **Table 12-6**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<40%): Apply **J**-flag to detects and **R**-flag to nondetects.

TABLE 12-12
CALIBRATION AND QC PROCEDURES FOR USEPA METHOD SW6020A AND SW7471B
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Matrix spike (MS)	One per preparatory batch per matrix	QC acceptance criteria specified in QAPP **Table 12-6**.	Examine the project-specific DQOs. If the matrix spike falls outside criteria, additional quality control tests are required to evaluate matrix effects.	For the lead in the parent sample. High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<40%): Apply **J**-flag to detects and **R**-flag to nondetects. No qualification if native concentration is > 4X the spiking amount.
Matrix duplicate (MD)	One per preparatory batch per matrix.	RPD < 20% (sample and sample duplicate)	Examine the project-specific DQOs. Contact URS as to additional measures to be taken.	Data shall be evaluated to determine the source of difference. Apply **J**-flag to detects if acceptance criteria are not met.
Interference check solutions (ICS) (ICP only)	At the beginning of an analytical run and every 12 hours	ICS-A: Absolute value of concentration for all non-spiked analytes <LOD (unless they are a verified trace impurity from one of the spiked analytes) ICS-AB: Within ± 20% of true value	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects.
Dilution Test (ICP only)	One per preparatory batch	Five-fold dilution must agree within ± 10% of the original measurement	Perform post digestion spike addition	If the metal(s) outside criteria in parent sample were detected at levels > 50x the LOQ and the PDS fails. Apply **J**-flag to detects in parent sample.
Post-digestion spike (PDS) addition (ICP only)	When dilution test fails or analyte concentration in all samples < 50x LOD	Recovery within 75-125%	None	For the specific analyte(s) in the parent sample. Apply **J**-flag to detects.
Internal standards (IS)	Every sample.	IS intensity within 30-120% of intensity of the IS in the ICAL.	Reanalyze sample at 5-fold dilution with addition of appropriate amounts of internal standards.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects.
Field Duplicate	One per 10 field samples	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil samples. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	N/A	Apply **J**-flag to detects and **UJ**-flag to nondetects

Notes:
Data verification criteria are from Tables F-7 and F-8 of the DoD QSM, Version 4.2. Industry standard was used when flagging criteria was not specified in the DoD QSM, Version 4.2.

TABLE 12-13
CALIBRATION AND QC PROCEDURES FOR
USEPA METHOD SW8290
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
LOD determination and verification	At initial set-up and verified quarterly. If multiple instruments are used, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Apply **R**-flag to data without a valid LOD
LOQ establishment and verification	At initial setup and quarterly: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If LOQ is not set at the lowest calibration standard, must be verified with each batch. If multiple instruments are used, the LOQ must be verified on each.	The LOQ must meet the control limits of the LCS found in QAPP **Table 12-7**.	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the LCS control limits in QAPP **Table 12-7**.	Apply **R**-flag to data without a valid LOQ
Holding time	Every sample	Soil : 30 days to extract, 45 days to analysis.	Contact URS as to additional measures to be taken.	Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.
Sample temperature	Every cooler	4 ± 2 °C	Contact URS as to additional measures to be taken.	Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to nondetects. Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to nondetects.
Initial calibration (ICAL) for all analytes	ICAL prior to sample analysis, as needed by the failure of calibration verification standard, and when a new lot is used as standard source for HRCC-3, sample fortification or recovery solutions.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and S/N ratio ≥ 10 for all target analyte ions; RSD ≤ 20% for the response factors (RF) for all 17 unlabeled standards and RSD ≤ 20% for the RFs for the 9 labeled IS.	Correct problem then repeat initial calibration. Calibration may not be forced through origin.	Apply **R**-flag to data without a valid ICAL

TABLE 12-13
CALIBRATION AND QC PROCEDURES FOR
USEPA METHOD SW8290
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Continuing calibration verification (CCV)	At the beginning of each 12 hour period, and at the end of the anlaytical sequence.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and For unlabeled standards, RF within ± 20% D of RF established in ICAL; For labeled standards, RF within ± 30% D of RF established in ICAL.	Correct problem, repeat calibration verification standard. If that fails, then repeat ICAL and reanalyze all samples analyzed since the last successful CCV. End-of-run CCV: If the RF for unlabeled standards ≤ 25% RPD and the RF for labeled standards ≤ 35% RPD (relative to the RF established in the ICAL), the mean RF from the two daily CCVs must be used for quantitation of impacted samples instead of the ICAL mean RF value. If the starting and ending CCV RFs differ more than > 25% RPD for unlabeled compounds or 35% RPD for labeled compounds, the sample may be quantitated against a new initial calibration if it is analyzed within two hours. Otherwise reanalyze samples with positive detections if necessary.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.
Method blank	One per preparatory batch, run after calibration standards and before samples.	Use project-specific criteria, if available. Otherwise, no analytes detected ≥ LOD for the analyte or ≥ 5% of the associated regulatory limit for the analyte or ≥ 5% of the sample result for the analyte, whichever is greater, per method.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Apply **U**-flag to analytes detected in field samples < 5X blank contamination.
LCS (or fortified field blank)	One per preparatory batch	QC acceptance criteria specified in QAPP **Table 12-7**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30% or 1/2 the lower limit): Apply **J**-flag to detects and **R**-flag to nondetects.
Sample duplicate	One per preparatory batch	RPD ≤ 25% (between sample and sample duplicate), per method	Examine the project-specific DQOs. Contacnt URS as to additional measures to be taken.	Apply **J**-flag to detects and **UJ**-flag to nondetects

TABLE 12-13
CALIBRATION AND QC PROCEDURES FOR
USEPA METHOD SW8290
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Internal standards	Every field sample, standard and QC sample.	%R recovery for each IS in the original sample (prior to dilutions) must be within 40-135% per method.	Correct problem, then reprep and reanalyze the sample(s) with failed IS.	Apply **J**-flag to detects and **UJ**-flag to nondetects
Matrix spike/matrix spike duplicate (MS/MSD)	One per preparatory batch per matrix	QC acceptance criteria specified in QAPP **Table 12-7**.	Examine the project-specific DQOs. Contact URS as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects and **UJ**-flag to nondetects if acceptance criteria are not met. No qualification if concentration is > 4X the spiking amount.
Field Duplicate	One per 10 field samples	If both the parent and duplicate values are > 5X the LOQ, then 30% RPD for aqueous samples and 50% RPD for soil samples. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	N/A	Apply **J**-flag to detects and **UJ**-flag to nondetects

Notes:

Data evaluation criteria are from Table F-6 of the DoD QSM, Version 4.2. Industry standard was used when flagging criteria was not specified in the DoD QSM, Version 4.2.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) -- Secondary Data Criteria and Limitations Table

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Report that includes the descriptions, finding and results of previous investigations completed at sites SS-C501, SS-C507 and SD-C508	Final Evaluation Report. Cannon AFB. Air Force Compliance Clean-up Site, Identification and Evaluation of Defense Environmental Restoration Account (DERA) Eligibility for AFCEE, Multiple Locations. August, 2009	URS, analytical results from soil borings, boring logs.	Utilize analytical results of previous investigations at sites SS-C501, SS-C507 and SD-C508 to determine sample quantities, locations and initial depths.	None
Report that includes the descriptions, finding and results of previous investigations completed at sites ST-C502, ST-C503, ST-C504 and ST-C505	USGS. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico. Volume I. 1995	USGS, analytical results from soil borings	Utilize analytical results of previous investigations at sites ST-C502, ST-C503, ST-C504 and ST-C505 to determine sample quantities, locations and initial depths.	None
Report that includes the descriptions, finding and results of previous investigations completed at site TA/AS-C129.	Final Closeout Report/Contamination Assessment, SWMU 129-Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, Final. July, 2000	Parallax, Inc. analytical results from soil borings	Utilize analytical results of previous investigations at site TA/AS-C129 to determine sample quantities, locations and initial depths.	None

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) -- Summary of Project Tasks

Project Tasks:

1. Discrete surface and subsurface soil samples will be collected from the eight sites. Discussion of the sampling approach and sampling design and rationale is provided in **Worksheet #17**.

2. Samples will be collected using the URS PAWP.

Analysis Tasks:

1. EMAX will analyze all surface and subsurface soil samples for TPH-DRO, TPH-GRO, TPH-ORO, VOCs, BTEX+naphthalene, SVOCs, site-related SVOCs, pesticides, metals, lead, PCBs and explosives using USEPA SW-846 Methods 8015C, 8260B, 8270D, 8081B, 6020A/7471B, 8082A and 8330A.

2. EMAX will subcontract analysis of all surface and subsurface soil samples for dioxins/furans to Columbia Analytical Services (CAS) – Houston. Dioxins/Furans will be analyzed using USEPA SW-846 Method 8290.

Quality Control Tasks:

1. Matrix spike/matrix spike duplicates (MS/MSD) will be collected at an approximate frequency of 10 percent.

2. Investigative samples will be duplicated in the field at a rate of 10 percent to assess field and laboratory precision.

Secondary Data:

Previously collected information will be used. See **Worksheet #13**.

Data Management Tasks:

Data will be placed in the Environmental Resources Program Information Management System (ERPIMS) database after data review has been performed and data qualifiers have been added. The data in the ERPIMS database will also be submitted to AFCEE in the form of an ERPIMS data submittal.

Documentation and Records:

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) -- Summary of Project Tasks

1. All samples collected will have coordinate locations documented, locations photographed, records of each sample collected in field logbooks, and all field measurements documented in field logbooks.

Documentation and Records continued:

2. Sample collection field sheets (SCFS) will be completed for each investigative sample. Sample identification (ID), sample depth, sample parameters, QA/QC information soil lithologic data, and data collected will be recorded on the SCFS.
3. Chain of Custody (COC) forms and airbills will be prepared and retained for each sample shipment.
4. Copies of the finalized documents, photpgraphs, and technical project documents (including but not limited to the UFP-QAPP, Site Safety and Health Plan [SSHP] and PAWP) will be retained in a central project file for a minimum of 10 years. Other project-related files, such as contract documents, employee benefits, and other information will be retained in accordance with URS policy as stated in URS Policies and Procedures (P & P) Number 070.040JDE.

Data Packages:

EMAX and CAS-Houston will complete analytical Level IV data packages in accordance with the DoD QSM. EMAX and CAS-Houston will provide ERPIMS lab submission files.

Assessment/Audit Tasks:

Field Sample Collection and Documentation Audits: A field audit will be completed at the beginning of the investigation. A laboratory audit of EMAX will be completed if the proficiency evaluation samples do not pass evaluation criteria. Proficiency evaluation samples will be purchased from a certified vendor. Proficiency evaluation samples will be collected in sample containers supplied by the laboratory and submitted blind to the laboratory and analyzed for the project analytical parameters.

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) -- Summary of Project Tasks

Data Review Tasks:

1. EMAX and CAS-Houston will verify that all data are complete for samples received. All data package deliverable requirements will be met. Data will be 100% reviewed by URS using the analytical data summary package. Also, the criteria listed in **Tables 12-1** through **Tables 12-9,** in accordance with DoD QSM Version 4.2 will be utilized. A data review report will be produced by URS for each sample delivery group.

2. Reviewed data and all related field logbooks/notes/records will be reviewed to assess total measurement error and determine overall usability of the data for project purposes. Data limitations will be determined and data will be compared to Project Quality Objectives. Corrective action will be initiated as necessary. Final data are placed in an ERPIMS database, with any necessary qualifiers and tables.

3. Comparison of laboratory proficiency evaluation sample results to proficiency evaluation evaluation criteria.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
1,1,1,2-Tetrachloroethane	630-20-6	2.91E+01	SSL	1.00+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1,1-Trichloroethane	71-55-6	1.56E+04	SSL	2.60E+02	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1,2,2-Tetrachloroethane	79-34-5	8.02E+00	SSL	1.27E-01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1,2-Trichloroethane	79-00-5	2.81E+00	SSL	2.86E+01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1-Dichloroethane	75-34-3	6.45E+01	SSL	2.10E+02	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1-Dichloroethene	75-35-4	4.49E+02	SSL	1.10E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1-Dichloropropene	563-58-6	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2,3-Trichlorobenzene	87-61-6	4.90E+01	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2,3-Trichloropropane	96-18-4	4.97E-02	SSL	3.36E+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2,4-Trichlorobenzene	120-82-1	7.30E+01	SSL	2.70E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2,4-Trimethylbenzene	95-63-6	6.20E+01	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2-Dibromo-3-chloropropane	96-12-8	1.86E+00	SSL	3.50E-02	USEPA Region 5 ESLs	1.00E-02	2.00E-03	5.00E-03	1.00E-02
1,2-Dibromoethane	106-93-4	5.88E-01	SSL	1.23E+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2-Dichlorobenzene	95-50-1	2.31E+03	SSL	9.20E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2-Dichloroethane	107-06-2	7.89E+00	SSL	8.50E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2-Dichloropropane	78-87-5	1.52E+01	SSL	3.27E+01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,3,5-Trimethylbenzene	108-67-8	7.80E+02	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,3-Dichlorobenzene	541-73-1	-	-	7.30E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
1,3-Dichloropropane	142-28-9	1.60E+03	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,4-Dichlorobenzene	106-46-7	3.17E+01	SSL	8.80E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
2,2-Dichloropropane	594-20-7	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
2-Butanone	78-93-3	3.71E+04	SSL	3.60E+02	LANL 2011	1.00E-02	5.00E-03	5.00E-03	1.00E-02
2-Chlorotoluene	95-49-8	1.56E+03	SSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
2-Hexanone	591-78-6	2.10E+02	RSL	3.60E-01	LANL 2011	2.00E-02	5.00E-03	1.00E-02	2.00E-02
4-Chlorotoluene	106-43-4	1.60E+03	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
4-Methyl-2-pentanone	108-10-1	5.82E+03	SSL	9.80E+00	LANL 2011	2.00E-02	5.00E-03	1.00E-02	2.00E-02
Acetone	67-64-1	6.66E+04	SSL	1.20E+00	LANL 2011	1.00E-02	5.00E-03	5.00E-03	1.00E-02
Benzene	71-43-2	1.54E+01	SSL	2.40E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Bromobenzene	108-86-1	3.00E+02	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Bromochloromethane	74-97-5	1.60E+02	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Bromodichloromethane	75-27-4	5.41E+00	SSL	5.40E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Bromoform	75-25-2	6.20E+01	RSL	1.59E+01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Bromomethane	74-83-9	1.65E+01	SSL	2.35E-01	USEPA Region 5 ESLs	1.00E-02	2.00E-03	5.00E-03	1.00E-02
Carbon disulfide	75-15-0	1.53E+03	SSL	8.20E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Carbon tetrachloride	56-23-5	1.08E+01	SSL	2.98E+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Chlorobenzene	108-90-7	3.76E+02	SSL	2.40E+00	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Chlorodibromomethane	124-48-1	1.21E+01	SSL	2.05E+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
Chloroethane	75-00-3	2.98E+04	SSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Chloroform	67-66-3	5.86E+00	SSL	8.00E+00	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Chloromethane	74-87-3	2.75E+02	SSL	1.04E+01	USEPA Region 5 ESLs	1.00E-02	2.00E-03	3.00E-03	1.00E-02
cis-1,2-Dichloroethene	156-59-2	1.56E+02	SSL	2.30E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
cis-1,3-Dichloropropene	10061-01-5	-	-	3.98E-01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Dibromomethane	74-95-3	2.50E+01	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Dichlorodifluoromethane	75-71-8	1.68E+02	SSL	3.95E+01	USEPA Region 5 ESLs	1.00E-02	2.00E-03	3.00E-03	1.00E-02
Ethylbenzene	100-41-4	6.84E+01	SSL	5.16E+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Hexachlorobutadiene	87-68-3	6.20E+00	RSL	3.98E-02	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Isopropylbenzene	98-82-8	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
m,p-Xylene	136777-61-2	7.74E+02	SSL	1.40E+00	LANL 2011	1.00E-02	2.00E-03	5.00E-03	1.00E-02
Methylene chloride	75-09-2	4.09E+02	SSL	2.60E+00	LANL 2011	1.00E-02	2.00E-03	5.00E-03	1.00E-02
Naphthalene	91-20-3	4.30E+01	SSL	2.90E+01	USEPA ESSLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
n-Butylbenzene	104-51-8	3.90E+03	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
n-Propylbenzene	103-65-1	3.40E+03	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
o-Xylene	95-47-6	8.98E+02	SSL	1.40E+00	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
p-Isopropyltoluene	99-87-6	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
sec-Butylbenzene	135-98-8	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Styrene	100-42-5	7.28E+03	SSL	1.20E+00	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
tert-Butylbenzene	98-06-6	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Tetrachloroethene	127-18-4	7.02E+00	SSL	1.80E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Toluene	108-88-3	5.27E+03	SSL	2.30E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
trans-1,2-Dichloroethene	156-60-5	2.70E+02	SSL	2.30E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
trans-1,3-Dichloropropene	10061-02-6	-	-	3.98E-01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Trichloroethene	79-01-6	8.77E+00	SSL	4.20E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Trichlorofluoromethane	75-69-4	1.41E+03	SSL	5.20E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Vinyl chloride	75-01-4	7.28E-01	SSL	1.20E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.

[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method

Undetermined values display a dash in the associated cell.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
ESLs = United States Environmental Protection Agency, Region 5, Resource Conservation and Recovery Act Ecological Screening Levels, 2003
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM.
LOD = limit of detection
LOQ = limit of quantitation
RSL = United States Environmental Protection Agency Regional Screening Levels, May 2011
SSLs = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.
USEPA = United States Environmental Protection Agency
USEPA. 2007. Ecological Soil Screening Levels (ESSLs) Guidance Documents. OSWER Directive

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Semivolatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
1,2,4-Trichlorobenzene	120-82-1	7.30E+01	SSL	2.70E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
1,2-Dichlorobenzene	95-50-1	2.31E+03	SSL	9.20E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
1,3-Dichlorobenzene	541-73-1	-	-	7.30E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
1,4-Dichlorobenzene	106-46-7	3.17E+01	SSL	8.80E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,4,5-Trichlorophenol	95-95-4	6.11E+03	SSL	1.41E+01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,4,6-Trichlorophenol	88-06-2	6.11E+01	SSL	9.94E+00	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,4-Dichlorophenol	120-83-2	1.83E+02	SSL	8.75E+00	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,4-Dimethylphenol	105-67-9	1.22E+03	SSL	1.00E+01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,4-Dinitrophenol	51-28-5	1.22E+02	SSL	6.09E-02	USEPA Region 5 ESLs	6.60E-01	1.67E-01	3.30E-01	6.60E-01
2,4-Dinitrotoluene	121-14-2	1.57E+01	SSL	2.50E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,6-Dinitrotoluene	606-20-2	6.11E+01	SSL	1.80E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2-Chloronaphthalene	91-58-7	6.26E+03	SSL	1.22E-02	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2-Chlorophenol	95-57-8	3.91E+02	SSL	3.90E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2-Methylnaphthalene	91-57-6	3.10E+02	RSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
2-Methylphenol	95-48-7	3.10E+03	RSL	6.70E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2-Nitroaniline	88-74-4	6.10E+02	RSL	5.40E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2-Nitrophenol	88-75-5	-	-	1.60E+00	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
4-Nitrophenol	100-02-7	-	-	5.12E+00	USEPA Region 5 ESLs	6.60E-01	1.67E-01	1.67E-01	6.60E-01
3 & 4-Methylphenol	106-44-5	3.10E+02	RSL	6.90E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Semivolatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
3-Nitroaniline	99-09-2	-	-	2.19E+01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
4,6-Dinitro-2-methylphenol	534-52-1	4.89E+00	SSL	-	-	6.60E-01	1.67E-01	3.30E-01	6.60E-01
4-Bromophenyl-phenyl ether	101-55-3	-	-	-	-	3.30E-01	1.67E-01	1.67E-01	3.30E-01
4-Chloro-3-methylphenol	59-50-7	6.10E+03	RSL	7.95E+00	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
4-Chlorophenyl-phenyl ether	7005-72-3	-	-	-	-	3.30E-01	1.67E-01	1.67E-01	3.30E-01
4-Nitroaniline	100-01-6	2.40E+01	RSL	2.19E+01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Acenaphthene	83-32-9	3.44E+03	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Acenaphthylene	208-96-8	-	-	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Anthracene	120-12-7	1.72E+04	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Benzo(a)anthracene	56-55-3	1.48E+00	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Benzo(a)pyrene	50-32-8	1.48E-01	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Benzo(b)fluoranthene	205-99-2	1.48E+00	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Benzo(g,h,i)perylene	191-24-2	-	-	1.10E+00	USEPA ESSLs	USEPA ESSLs	2.50E-03	5.00E-03	1.00E-02
Benzo(k)fluoranthene	207-08-9	1.48E+01	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Benzyl alcohol	100-51-6	6.10E+03	RSL	1.20E+02	LANL 2011	1.30E+01	3.30E-01	6.60E-01	1.30E+01
Bis(2-chloroethoxy)methane	111-91-1	1.80E+02	RSL	3.02E-01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Bis(2-chloroethyl)ether	111-44-4	2.68E+00	SSL	-	-	3.30E-01	1.67E-01	1.67E-01	3.30E-01

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Semivolatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
Bis(2-chloroisopropyl)ether	108-60-1	9.15E+01	SSL	-	-	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Bis(2-ethylhexyl)phthalate	117-81-7	3.47E+02	SSL	2.00E-02	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Butylbenzylphthalate	85-68-7	2.60E+02	RSL	9.00E+01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Carbazole	86-74-8	-	-	8.00E+01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Chrysene	218-01-9	1.48E+02	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Di-n-butylphthalate	84-74-2	6.11E+03	SSL	1.10E-02	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Di-n-octylphthalate	117-84-0	-	-	1.10E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Dibenz(a,h)anthracene	53-70-3	1.48E-01	SSL	1.10E+00	USEPA ESSLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Dibenzofuran	132-64-9	7.80E+01	RSL	6.10E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Diethylphthalate	84-66-2	4.89E+04	SSL	1.00E+02	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Dimethylphthalate	131-11-3	6.11E+05	SSL	1.00E+01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Fluoranthene	206-44-0	2.29E+03	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Fluorene	86-73-7	2.29E+03	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Hexachlorobenzene	118-74-1	3.04E+00	SSL	7.90E-02	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Hexachlorobutadiene	87-68-3	6.20E+00	RSL	3.98E-02	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Hexachloroethane	67-72-1	4.28E+01	SSL	5.96E-01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Indeno(1,2,3-cd)pyrene	193-39-5	1.48E+00	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Isophorone	78-59-1	5.12E+03	SSL	1.39E+02	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Semivolatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
N-Nitroso-di-n-propylamine	621-64-7	6.90E-02	RSL	-	-	3.30E-01	1.67E-01	1.67E-01	3.30E-01
N-Nitrosodimethylamine	62-75-9	2.26E-02	SSL	3.20E-04	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
N-Nitrosodiphenylamine	86-30-6	9.93E+02	SSL	5.45E-01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Naphthalene	91-20-3	4.30E+01	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Nitrobenzene	98-95-3	5.35E+01	SSL	2.20E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Pentachlorophenol	87-86-5	8.94E+00	SSL	3.60E-01	USEPA ESSLs	6.60E-01	1.75E-01	3.30E-01	6.60E-01
Phenanthrene	85-01-8	1.83E+03	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Phenol	108-95-2	1.83E+04	SSL	7.90E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Pyrene	129-00-0	1.72E+03	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
Shaded values indicate DLs exceed Screening Levels.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
ESLs = United States Environmental Protection Agency, Region 5, Resource Conservation and Recovery Act Ecological Screening Levels, 2003
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmentla Services Division, Los Alamos, NM.
LOD = limit of detection
LOQ = limit of quantitation
RSL = United States Environmental Protection Agency Regional Screening Levels, May 2011
SSL = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.USEPA. 2007. Ecological Soil Screening Levels (ESSLs) Guidance Documents. OSWER Directive

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Organochlorine Pesticides
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
4,4'-DDD	72-54-8	2.03E+01	SSL	2.10E-02	USEPA ESSLs	4.0E-03	1.20E-03	2.40E-03	4.0E-03
4,4'-DDE	72-55-9	1.43E+01	SSL	2.10E-02	USEPA ESSLs	4.0E-03	1.20E-03	2.40E-03	4.0E-03
4,4'-DDT	50-29-3	1.72E+01	SSL	2.10E-02	USEPA ESSLs	4.0E-03	1.20E-03	2.40E-03	4.0E-03
Aldrin	309-00-2	2.84E-01	SSL	3.70E-02	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
alpha-BHC	319-84-6	7.72E-01	SSL	5.80E+01	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
alpha-Chlordane	5103-71-9	-	-	2.70E-01	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
beta-BHC	319-85-7	2.70E+00	SSL	2.70E-01	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
delta-BHC	319-86-8	-	-	9.94E+00	USEPA Region 5 ESLs	2.0E-03	6.00E-04	1.20E-03	2.0E-03
Dieldrin	60-57-1	3.04E-01	SSL	4.90E-03	USEPA ESSLs	4.0E-03	1.20E-03	2.40E-03	4.0E-03
Endosulfan I	959-98-8	-	-	6.40E-01	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
Endosulfan II	33213-65-9	-	-	6.40E-01	LANL 2011	4.0E-03	1.20E-03	2.40E-03	4.0E-03
Endosulfan sulfate	1031-07-8	-	-	3.58E-02	USEPA Region 5 ESLs	4.0E-03	1.50E-03	3.0E-03	4.0E-03
Endrin	72-20-8	1.83E+01	SSL	1.40E-03	LANL 2011	4.0E-03	1.20E-03	2.40E-03	4.0E-03
Endrin aldehyde	7421-93-4	-	-	1.05E-02	USEPA Region 5 ESLs	4.0E-03	1.20E-03	2.40E-03	4.0E-03
Endrin ketone	53494-70-5	-	-	-	-	4.0E-03	1.20E-03	2.40E-03	4.0E-03
gamma-BHC	58-89-9	5.17E+00	SSL	9.40E-03	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
gamma-Chlordane	5103-74-2	-	-	2.20E+00	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
Heptachlor	76-44-8	1.08E+00	SSL	5.90E-02	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Organochlorine Pesticides
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
Heptachlor epoxide	1024-57-3	5.30E-02	RSL	1.52E-01	USEPA Region 5 ESLs	2.0E-03	6.00E-04	1.20E-03	2.0E-03
Methoxychlor	72-43-5	3.10E+02	RSL	5.00E+00	LANL 2011	2.0E-02	4.00E-03	8.0E-03	2.0E-02

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
ESLs = United States Environmental Protection Agency, Region 5, Resource Conservation and Recovery Act Ecological Screening Levels, 2003
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NMLOD = limit of detection
LOQ = limit of quantitation
RSL = United States Environmental Protection Agency Regional Screening Levels, May 2011SSLs = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.
USEPA. 2007. Ecological Soil Screening Levels (ESSLs) Guidance Documents. OSWER Directive

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Polychlorinated biphenyls
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
PCB-1016	12674-11-2	3.93E+00	SSL	1.00E+00	LANL 2011	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1221	11104-28-2	1.49E+00	SSL	-	-	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1232	11141-16-5	1.49E+00	SSL	-	-	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1242	53469-21-9	2.22E+00	SSL	4.10E-02	LANL 2011	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1248	12672-29-6	2.22E+00	SSL	7.20E-03	LANL 2011	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1254	11097-69-1	1.12E+00	SSL	4.10E-02	LANL 2011	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1260	11096-82-5	2.22E+00	SSL	1.40E-01	LANL 2011	5.00E-02	2.00E-02	3.30E-02	5.00E-02

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
Shaded values indicate DLs exceed Screening Levels.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM
LOD = limit of detection
LOQ = limit of quantitation
SSL = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: TPH-DRO/TPH-ORO/TPH-GRO
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
Diesel Range Organics	68334-30-5	1.00E+03	NMED	-	-	1.00E+01	2.50E+00	5.00E+00	1.00E+01
Oil Range Organics	N/A	1.00E+03	NMED	-	-	2.00E+01	5.00E+00	1.00E+01	2.00E+01
Gasoline Range Organics	8006-61-9	1.00E+03	NMED	-	-	1.00E+00	3.50E-02	5.00E-01	1.00E+00

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method
NMED: New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Investigations and Remediation, February 2012

mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
LOD = limit of detection
LOQ = limit of quantitation
NMED = New Mexico Environment Department

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: RCRA Metals
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
Arsenic	7440-38-2	3.90E+00	SSL	1.80E+01	USEPA ESSLs	5.00E-01	5.00E-02	1.00E-01	5.00E-01
Barium	7440-39-3	1.56E+04	SSL	3.30E+02	USEPA ESSLs	5.00E-01	7.20E-02	1.00E-01	5.00E-01
Cadmium	7440-43-9	7.03E+01	SSL	3.60E-01	USEPA ESSLs	5.00E-01	5.70E-02	1.00E-01	5.00E-01
Chromium	7440-47-3	1.17E+05	SSL	2.60E+01	USEPA ESSLs	5.00E-01	5.00E-02	1.00E-01	5.00E-01
Lead	7439-92-1	4.00E+02	SSL	1.10E+01	USEPA ESSLs	5.00E-01	5.00E-02	1.00E-01	5.00E-01
Mercury	7439-97-6	1.56E+01	SSL	1.30E-02	LANL 2011	1.00E-01	3.30E-02	3.30E-02	1.00E-01
Selenium	7782-49-2	3.91E+02	SSL	5.20E-01	USEPA ESSLs	5.00E-01	5.00E-02	1.00E-01	5.00E-01
Silver	7440-22-4	3.91E+02	SSL	4.20E+00	USEPA ESSLs	5.00E-01	5.00E-02	1.00E-01	5.00E-01

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM
LOD = limit of detection
LOQ = limit of quantitation
RSL = United States Environmental Protection Agency Regional Screening Levels, May 2011
SSL = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.
USEPA. 2007. Ecological Soil Screening Levels (ESSLs) Guidance Documents. OSWER Directive

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Dioxins/Furans
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							EDLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	4.50E-05	SSL	2.90E-07	LANL 2011	1.00E-06	5.88E-08	1.00E-07	1.00E-06
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4	-	-	-	-	2.50E-06	4.82E-08	2.5E-07	2.50E-06
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	57653-85-7	-	-	-	-	2.5E-06	4.66E-08	2.5E-07	2.5E-06
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	39227-28-6	-	-	-	-	2.5E-06	4.25E-08	2.5E-07	2.5E-06
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	19408-74-3	-	-	-	-	2.5E-06	4.47E08	2.5E-07	2.5E-06
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	35822-46-9	-	-	-	-	2.5E-06	4.79E-08	7.5E-07	2.5E-06
1,2,3,4,6,7,8,9-Heptachlorodibenzo-p-dioxin (OCDD)	3268-87-9	-	-	-	-	5.0E-06	6.95E-08	1.50E-06	5.0E-06
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9	4.50E-04	SSL	-	-	1.00E-06	5.62E-08	1.00E-07	1.00E-06
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6	-	-	-	-	2.5E-06	3.96E-08	2.5E-07	2.5E-06

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Dioxins/Furans
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							EDLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4	-	-	-	-	2.5E-06	3.88E-08	2.5E-07	2.5E-06
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	72918-21-9	-	-	-	-	2.5E-06	3.35E-08	2.5E-07	2.5E-06
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	70648-26-9	-	-	-	-	2.5E-06	4.18E-08	2.5E-07	2.5E-06
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9	-	-	-	-	2.5E-06	3.40E-08	2.5E-07	2.5E-06
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5	-	-	-	-	2.5E-06	3.67E-08	2.5E-07	2.5E-06
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4	-	-	-	-	2.5E-06	3.77E-08	2.5E-07	2.5E-06
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7	-	-	-	-	2.5E-06	5.00E-08	2.5E-07	2.5E-06
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-0	-	-	-	-	5.00E-06	6.44E-08	5.00E-07	5.00E-06

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
EDL = estimated detection limit
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM
LOD = limit of detection
LOQ = limit of quantitation
SSL = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Explosives
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
1,3,5-Trinitrobenzene	99-35-4	2.20E+03	RSL	6.60E+00	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
1,3-Dinitrobenzene	99-65-0	6.10E+00	RSL	7.30E-02	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
2,4,6-Trinitrotoluene	118-96-7	3.91E+01	SSL	6.40E+00	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
2,4-Dinitrotoluene	121-14-2	1.57E+01	SSL	2.50E+00	LANL 2011	2.00E-01	5.50E-02	1.00E-01	2.00E-01
2,6-Dinitrotoluene	606-20-2	6.11E+01	SSL	1.80E+00	LANL 2011	2.00E-01	5.60E-02	1.00E-01	2.00E-01
2-Amino-4,6-Dinitrotoluene	35572-78-2	1.50E+02	RSL	1.00E+01	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
2-Nitrotoluene	88-72-2	2.91E+01	SSL	9.90E+00	LANL 2011	2.00E-01	7.60E-02	1.00E-01	2.00E-01
3-Nitrotoluene	99-08-4	7.82E+00	SSL	1.20E+01	LANL 2011	2.00E-01	9.50E-02	1.00E-01	2.00E-01
4-Amino-2,6-Dinitrotoluene	19406-51-0	1.50E+02	RSL	3.60E+00	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
4-Nitrotoluene	99-99-0	2.44E+02	SSL	2.20E+01	LANL 2011	2.00E-01	9.90E-02	1.00E-01	2.00E-01
HMX	2691-41-0	3.91E+03	SSL	1.70E+01	TTCP 2009	2.00E-01	5.00E-02	1.00E-01	2.00E-01
Nitrobenzene	98-95-3	5.35E+01	SSL	2.20E+00	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
RDX	121-82-4	5.82E+01	SSL	7.50E+00	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
Tetryl	479-45-8	2.44E+02	SSL	9.90E-01	LANL 2011	2.00E-01	5.70E-02	1.00E-01	2.00E-01

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service

DL = detection limit
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM.
LOD = limit of detection
LOQ = limit of quantitation
RSL = United States Environmental Protection Agency Regional Screening Levels, May 2011
SSL = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.
TTCP. 2009. Environmental Fate and Effects of Energetic Materials. The Technical Cooperation Program. Available at: http://www.em-guidelines.org/ecot.htm.

QAPP Worksheet #16 (UFP-QAPP Manual Section 2.8.2) -- Project Schedule / Timeline Table

See Figure 1-7 of the Site Investigation at Eight Sites PAWP.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Sampling Approach:

Surface and subsurface soil samples will be collected to further define the horizontal and vertical extent of known contamination and to determine the presence or absence of chemical contamination, which may pose an unacceptable risk to human health or the environment at these eight sites. Results from this investigation will be included in the Site Investigation for Eight Sites Report.

The analytical data will be screened against NMED residential soil SSL (NMED 2012) or USEPA residential RSLs (USEPA 2011) and Cannon AFB background levels (W-C 1997) presented in Worksheet #15. Ecological screening levels will be selected from the following sources in order of priority:

1) USEPA (2005-2007) Ecological Soil Screening Levels (ESSLs); the lowest of plant, soil invertebrate, bird and mammal ESSLs;
2) The lower of:
   a. Technical Cooperation Program – Energetic Material (TTCP);
   b. Los Alamos National Laboratory Ecological Screening Levels (ESLs) (LANL 2011)
3) USEPA Region 5 ESLs (USEA 2003);
4) Other published literature (for example, Efroymson et al 1997).

Sampling Design and Rationale

The sampling design has been created to further define the horizontal and vertical extent of potential surface and/or subsurface soil contamination above screening levels and to determine if other COPCs are present in surface and/or subsurface soil at concentrations above screenings levels.

The planned surface and subsurface soil sampling locations, location coordinates, analytical parameters, and QA/QC sample locations are provided in Tables 5-1 through 5-8 of the PAWP. Planned surface and subsurface soil sampling locations are shown on Figures 5-1a through 5-8b of the PAWP. Soil samples will be collected from various depths and were identifed using previous sampling results.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Former AGE Dispatch Facility Spills Site (SS-C501)

The general sampling objectives at SS-C501 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels.

Samples will be analyzed for TPH-DRO, TPH-ORO and TPH-GRO (USEPA Method 8015C), VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270D), RCRA metals (USEPA Methods 6020A/7471B), and PCBs (USEPA Method 8082A). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for SS-C501 in Table 5-1 of the PAWP. Sample locations are shown on Figures 5-1a and 5-1b of the PAWP.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Former Gas Station Site (ST-C502)

The general sampling objectives at ST-C502 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels at the previously identified potential source areas and other potential source areas not previously investigated.

Samples will be analyzed for TPH-DRO, TPH-ORO, and TPH-GRO (USEPA Method 8015C), VOCs or BTEX+naphthalene (USEPA Method 8260B), SVOCs or site-related SVOCs (USEPA Method 8270D) and RCRA metals or lead (USEPA Methods 6020A/7471B). Samples may also be analyzed for PCBs (USEPA Method 8082A). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for ST-C502 in Table 5-2 of the PAWP. Planned soil sampling locations are shown on Figures 5-2a and 5-2b of the PAWP.

Base Support/Operations Generator Former UST Site (ST-C503)

The general sampling objectives at ST-C503 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels.

Samples will be analyzed for TPH-DRO, TPH-ORO (USEPA Method 8015C), BTEX+naphthalene (USEPA Method 8260B), site-related SVOCs (USEPA Method 8270D). Note: Site-related SVOCs will consist of 2-Methyl naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. The site-related SVOC analyte list is derived from Table 3 of the NMED TPH Screening Guidelines (NMED 2006). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for ST-C503 in Table 5-3 of the PAWP. Planned soil sampling locations are shown on Figures 5-3a and 5-3b of the PAWP.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Hospital Abandoned UST Site (ST-C504)

The general sampling objectives at ST-C504 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels.

Samples will be analyzed for TPH-DRO, TPH-ORO (USEPA Method 8015C), BTEX+naphthalene (USEPA Method 8260B), site-related SVOCs (USEPA Method 8270D). Note: Site-related SVOCs will consist of 2-Methyl naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. The site-related SVOC analyte list is derived from Table 3 of the NMED TPH Screening Guidelines (NMED 2006). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for ST-C504 in Table 5-4 of the PAWP. Planned soil sampling locations are shown on Figures 5-4a and 5-4b of the PAWP.

Flightline Generator USTs Site (ST-C505)

The general sampling objectives at ST-C505 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels.

Samples will be analyzed for TPH-DRO, TPH-ORO (USEPA Method 8015C), BTEX+naphthalene (USEPA Method 8260B), site-related SVOCs (USEPA Method 8270D). Note: Site-related SVOCs will consist of 2-Methyl naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. The site-related SVOC analyte list is derived from Table 3 of the NMED TPH Screening Guidelines (NMED 2006). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for ST-C505 in Table 5-5 of the PAWP. Planned soil sampling locations are shown on Figures 5-5a and 5-5b of the PAWP.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Former POL Yard Refueling Area Site (SS-C507)

The general sampling objective at SS-C507 is to determine if COPCs are present at concentrations above screening levels at potential source areas at the site.

Samples will be analyzed for TPH-DRO, TPH-ORO, TPH-GRO (USEPA Method 8015C), BTEX+naphthalene (USEPA Method 8260B), site-related (USEPA Method 8270D), PCBs (USEPA Method 8082A) and lead (USEPA Methods 6020A). Note: Site-related SVOCs will consist of 2-Methyl naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. The site-related SVOC analyte list is derived from Table 3 of the NMED TPH Screening Guidelines (NMED 2006). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for SS-C507 in Table 5-6 of the PAWP. Planned soil sampling locations are shown on Figures 5-6a and 5-6b of the PAWP.

Surface Disposal Area Site (SD-C508)

The general sampling objectives at SD-C508 are to further define the horizontal and vertical extent of potential surface and subsurface soil contamination at the previously identified surface disposal area, to determine if other COPCs are present in surface and subsurface soil at concentrations above screening levels at the previously identified disposal area, and to determine if COPCs exist in surface and subsurface soil at concentrations above screening levels within the expanded site boundary not previously investigated.

Samples will be analyzed for TPH-DRO, TPH-ORO, TPH-GRO (USEPA Method 8015C), VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270D), PCBs (USEPA Method 8082A), RCRA metals (USEPA Methods 6020A/7471B), organochlorine pesticides USEPA Method 8081B), dioxins/furans (USEPA Method 8290) and explosives (USEPA Method 8330A). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for SD-C508 in Table 5-7 of the PAWP. Planned soil sampling locations are shown on Figures 5-7a and 5-7b of the PAWP. Anticipated sample depth intervals for each boring are shown on Table 5-7 of the PAWP.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129)

The overall sampling objective at TA/AS-C129 is to determine if COPCs are present at concentrations above screening levels in the previously uninvestigated leach field area.

Samples will be analyzed for TPH-DRO, TPH-ORO, TPH-GRO (USEPA Method 8015C), VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270D), PCBs (USEPA Method 8082A), RCRA metals (USEPA Methods 6020A/7471B), and organochlorine pesticides USEPA Method 8081B). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for TA/AS-C129 in Table 5-8 of the PAWP. Planned soil sampling locations are shown on Figures 5-8a and 5-8b of the PAWP.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) -- Sampling Locations and Methods Requirements Table

Sampling Location	Matrix	Depth (feet)	Analytical Group	Concentration Level	Number of Samples	Sampling Reference[1]	Rationale for Sampling Location
CA501-SBXX-XXX	Soil	1-15	VOCs, SVOCs, TPH-DRO, TPH-ORO, TPH-GRO, PCBs, RCRA Metals	Low to nondetect	33 samples 4 duplicates	See PAWP	See Worksheet #17
CA502-SBXX-XXX	Soil	0-40	VOCs or BTEX+ naphthalene, SVOCs or site-related SVOCs, TPH-DRO, TPH-ORO, TPH-GRO, RCRA Metals or Lead, PCBs (at select locations)	Low to nondetect	87 samples 9 duplicates	See PAWP	See Worksheet #17
CA503-SBXX-XXX	Soil	0-25	BTEX+naphthalene, site-related SVOCs, TPH-DRO, TPH-ORO	Low to nondetect	42 samples 5 duplicates	See PAWP	See Worksheet #17
CA504-SBXX-XXX	Soil	1-85	BTEX+naphthalene, site-related SVOCs, TPH-DRO, TPH-ORO	Low to nondetect	97 samples 10 duplicates	See PAWP	See Worksheet #17
CA505-SBXX-XXX	Soil	0-30	BTEX+naphthalene, site-related SVOCs, TPH-DRO, TPH-ORO	Low to nondetect	63 samples 7 duplicates	See PAWP	See Worksheet #17
CA507-SBXX-XXX	Soil	1-20	BTEX+naphthalene, site-related SVOCs, TPH-DRO, TPH-ORO, TPH-GRO, PCBs, Lead	Low to nondetect	239 samples 24 duplicates	See PAWP	See Worksheet #17

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) -- Sampling Locations and Methods Requirements Table

Sampling Location	Matrix	Depth (feet)	Analytical Group	Concentration Level	Number of Samples	Sampling Reference[1]	Rationale for Sampling Location
CA508-SBXX-XXX	Soil	0-20	VOCs, SVOCs, TPH-DRO, TPH-ORO, TPH-GRO, Pesticides, PCBs, RCRA Metals, Dioxins/Furans, Explosives	Low to nondetect	41 samples 5 duplicates	See PAWP	See Worksheet #17
CA129-SBXX-XXX	Soil	0-25	VOCs, SVOCs, TPH-DRO, TPH-ORO, TPH-GRO, Pesticides, PCBs, RCRA Metals	Low to nondetect	43 samples 5 duplicates	See PAWP	See Worksheet #17

Note: Specific information for sample locations, sample depths and analytical parameters is presented in Tables 5-1 through 5-8 in the Work Plan.

[1] Detailed sampling procedures are provided in Section 5 of the PAWP.

XX = Sample location identification
XXX = Sample depth identification

QAPP Worksheet #19 (UFP-QAPP Manual Section 3.1.1) -- Analytical Requirements Table

Matrix	Analytical Group	Concentration Level	Preparation and Analytical Method Reference	Sample Volume	Containers	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation, analysis)
Soil	VOCs or BTEX+naphthalene	Low	USEPA 8260B	5 grams	3 x 40 mL	4°C ± 2°C, two vials reagent water with sodium bisulfate, one vial methanol	48 hours until frozen by laboratory (< -7°C), 14 days to analysis
Soil	SVOCs or site-related SVOCs	Low	USEPA 8270D	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis
Soil	TPH-DRO	Low	USEPA 8015C	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis
Soil	TPH-ORO	Low	USEPA 8015C	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis
Soil	TPH-GRO	Low	USEPA 8015C	5 grams	3 x 40 mL	4°C ± 2°C, two vials reagent water with sodium bisulfate, one vial methanol	48 hours until frozen by laboratory (< -7°C), 14 days to analysis
Soil	Pesticides	Low	USEPA 8081B	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis
Soil	PCBs	Low	USEPA 8082A	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis
Soil	RCRA Metals	Low	USEPA 3050B and 6020A	8 oz	1 x 8 oz glass jar	None	6 months, 28 days mercury
Soil	Lead	Low	USEPA 3050B and 6020A	8 oz	1 x 8 oz glass jar	None	6 months
Soil	Dioxins/Furans	Low	USEPA 8290	8 oz	1 x 8 oz glass jar	4° C, in the dark	30 days to extraction, 45 days to analysis
Soil	Explosives	Low	USEPA 8330A	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis

oz = ounce
USEPA = United States Environmental Protection Agency

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) -- Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Conc. Level	Preparation and Analytical SOP[1]	No. of Investigative Samples[2]	No. of Field Duplicate Samples	No. of MS/ MSD	Total No. of Samples[3]
Former AGE Dispatch Facility Spills (SS-C501)	Soil	VOCs	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	SVOCs	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	TPH-DRO	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	TPH-ORO	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	TPH-GRO	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	PCBs	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	RCRA Metals	Low to nondetect	N/A	33	4	4	37
Former Gas Station (ST-C502)	Soil	VOCs or BTEX+naphthalene	Low to nondetect	N/A	87	9	9	96
Former Gas Station (ST-C502)	Soil	SVOCs or Site-Related SVOCs	Low to nondetect	N/A	87	9	9	96
Former Gas Station (ST-C502)	Soil	TPH-DRO	Low to nondetect	N/A	87	9	9	96

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) -- Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Conc. Level	Preparation and Analytical SOP[1]	No. of Investigative Samples[2]	No. of Field Duplicate Samples	No. of MS/ MSD	Total No. of Samples[3]
Former Gas Station (ST-C502)	Soil	TPH-ORO	Low to nondetect	N/A	87	9	9	96
Former Gas Station (ST-C502)	Soil	TPH-GRO	Low to nondetect	N/A	87	9	9	96
Former Gas Station (ST-C502)	Soil	RCRA Metals or Lead	Low to nondetect	N/A	87	9	9	96
Former Gas Station (ST-C502)	Soil	PCBs	Low to nondetect	N/A	6	1	1	7
Base Support/ Operations Generator Former UST (ST-C503)	Soil	BTEX+naphathalene	Low to nondetect	N/A	42	5	5	47
Base Support/Operations Generator Former UST (ST-C503)	Soil	Site-Related SVOCs	Low to nondetect	N/A	42	5	5	47
Base Support/Operations Generator Former UST (ST-C503)	Soil	TPH-DRO	Low to nondetect	N/A	42	5	5	47
Base Support/Operations Generator Former UST (ST-C503)	Soil	TPH-ORO	Low to nondetect	N/A	42	5	5	47
Hospital Abandoned UST (ST-C504)	Soil	BTEX+naphathalene	Low to nondetect	N/A	97	10	10	107
Hospital Abandoned UST (ST-C504)	Soil	Site-Related SVOCs	Low to nondetect	N/A	97	10	10	107

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) -- Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Conc. Level	Preparation and Analytical SOP[1]	No. of Investigative Samples[2]	No. of Field Duplicate Samples	No. of MS/ MSD	Total No. of Samples[3]
Hospital Abandoned UST (ST-C504)	Soil	TPH-DRO	Low to nondetect	N/A	97	10	10	107
Hospital Abandoned UST (ST-C504)	Soil	TPH-ORO	Low to nondetect	N/A	97	10	10	107
Flightline Generator USTs (ST-C505)	Soil	BTEX+naphathalene	Low to nondetect	N/A	63	7	7	70
Flightline Generator USTs (ST-C505)	Soil	Site-Related SVOCs	Low to nondetect	N/A	63	7	7	70
Flightline Generator USTs (ST-C505)	Soil	TPH-DRO	Low to nondetect	N/A	63	7	7	70
Flightline Generator USTs (ST-C505)	Soil	TPH-ORO	Low to nondetect	N/A	63	7	7	70
POL Yard Refueling Area (SS-C507)	Soil	BTEX+naphathalene	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	Site-Related SVOCs	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	TPH-DRO	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	TPH-ORO	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	TPH-GRO	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	PCBs	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	Lead	Low to nondetect	N/A	239	24	24	263

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) -- Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Conc. Level	Preparation and Analytical SOP[1]	No. of Investigative Samples[2]	No. of Field Duplicate Samples	No. of MS/ MSD	Total No. of Samples[3]
Surface disposal area (SD-C508)	Soil	VOCs	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	SVOCs	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	TPH-DRO	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	TPH-ORO	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	TPH-GRO	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	PCBs	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	RCRA Metals	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	Pesticides	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	Dioxins/Furans	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	Explosives	Low to nondetect	N/A	41	5	5	46
TA/AS-C129 (SWMU 129)	Soil	VOCs	Low to nondetect	N/A	43	5	5	48

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) -- Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Conc. Level	Preparation and Analytical SOP[1]	No. of Investigative Samples[2]	No. of Field Duplicate Samples	No. of MS/ MSD	Total No. of Samples[3]
TA/AS-C129 (SWMU 129)	Soil	SVOCs	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	TPH-DRO	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	TPH-ORO	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	TPH-GRO	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	PCBs	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	Pesticides	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	RCRA Metals	Low to nondetect	N/A	43	5	5	48

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).
[2] If samples will be collected at different depths at the same location, count each discrete sampling depth as a separate sampling location or station.
[3] MS/MSD samples are not included in the total number of samples.
SOP = Standard operating procedure

All laboratory SOPs were removed from this document at the request of NMED.

QAPP Worksheet #21 (UFP-QAPP Manual Section 3.1.2) -- Project Sampling SOP References Table

See PAWP.

Reference Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
See PAWP	N/A	N/A	N/A	N/A	N/A

All reference to sampling SOPs were removed from this document at the request of NMED. Detailed sampling procedures are provided in Section 5 of the PAWP.

QAPP Worksheet #22 (UFP-QAPP Manual Section 3.1.2.4) -- Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maint. Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person
Photoionization detector (PID)	Calibrated to 100 ppm using 100 ppm isobutylene	Clean unit weekly	Check response with marking pen	Observe pump and PID response	Daily	Within 3%	Clean lamp	Field personnel

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) -- Analytical SOP References Table

Laboratory SOPs are located in Attachment A

SOP Reference Number [1]	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
N/A	N/A	N/A	N/A	N/A	N/A	N/A

All laboratory SOPs were removed from this document at the request of NMED.

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
ICP-MS (Method 6020A)	Establish instrument detection limits (IDLs)	At initial set-up and after significant change in instrument type, personnel, test method, or sample matrix.	IDL shall be ≤ LOD.	NA	NA	N/A
ICP-MS (Method 6020A)	Calibrate using multi-point standard calibration	Daily prior to analysis of sample	Correlation coefficient ≥ 0.995	Correct problem then repeat initial calibration	Analyst or certified instrument technician	N/A
ICP-MS (Method 6020A)	Establish linear dynamic range	Once every six months.	The calculated value should be within ± 10% of the true value	NA	Analyst or certified instrument technician	N/A
ICP-MS (Method 6020A)	Run interference check solution	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes. ICS-AB: Within ± 20% of its true value	Correct problem then repeat the calibration process, reanalyze all samples	Analyst or certified instrument technician	N/A
ICP-MS (Method 6020A)	Second source calibration verification (ICV)	Once after each ICAL, prior to beginning a sample run.	± 10% of its true value	Correct problem then repeat the calibration process	Analyst or certified instrument technician	N/A
ICP-MS (Method 6020A)	Continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	± 10% of its true value	Terminate analysis; recalibrate and reanalyze the samples	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
ICP-MS (Method 6020A)	Continuing calibration blank (CCB)	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Terminate analysis; recalibrate and reanalyze the samples	Analyst or certified instrument technician	N/A
CVAA (Method 7471B)	Initial Calibration (ICAL) for all analytes. Minimum 5 standards and a calibration blank	Daily ICAL prior to analyzing samples	Correlation coefficient is ≥ 0.995	Correct problem then repeat the calibration process	Analyst or certified instrument technician	N/A
CVAA (Method 7471B)	Second source calibration verification (ICV)	Once after 5-point standard calibration, prior to sample run	± 10% of its true value	Correct problem then repeat the calibration process	Analyst or certified instrument technician	N/A
CVAA (Method 7471B)	Continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	± 20% of its true value	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
CVAA (Method 7471B)	Calibration blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Reprep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst or certified instrument technician	N/A
GC-MS (Methods 8260B/8270D)	MS tuning check	Prior to ICAL and at the beginning of each 12-hour period	The manufacture's specifications for DFTPP, PFTBA, or other specified compound shall be used. Mass assignments should be within ± 0.1 mass units of target values.	Retune instrument and verify. Rerun affected samples.	Analyst or certified instrument technician	N/A
GC-MS (Method 8270D)	Breakdown check (8270D only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤20% for DDT. No visible peak tailing for Benzidine or Pentachlorophenol and should not exceed a tailing factor of 2.	Correct problem then repeat performacen check.	Analyst certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
GC-MS (Methods 8260B/8270D)	Minimum five-point initial calibration (ICAL) for all analytes.	Prior to sample analysis	Average response factor (RF) for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1- dichloroethane. PAHs ≥ 0.050. RSD for RFs for CCCs: VOCs and PAHs ≤ 30% and one option below: RSD for each analyte ≤ 15% or least square regression ≥ 0.995	Correct problem then repeat ICAL	Analyst or certified instrument technician	N/A
GC-MS (Methods 8260B/8270D)	Second source calibration verification	After ICAL All analytes within ± 20% of expected value	Correct problem and verify second source standard.	Rerun second source verification. If that fail, correct problem and repeat initial calibration	Analyst or certified instrument technician	N/A
GC-MS (Methods 8260B/8270D)	RT window position for each analyte and surrogate	Once per ICAL	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
GC-MS (Methods 8260B/8270D)	Relative RT (RRT)	With each sample	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then reanalyze all samples analyzed since the last RT check; If that fails then rerun ICAL and samples.	Analyst or certified instrument technician	N/A
GC-MS (Methods 8260B/8270D)	CCV	Daily, before sample analysis and every 12 hours of analysis time.	Average RF for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2- tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1- dichloroethane. SVOCs ≥ 0.050 %Difference (%D)/Drift for all target compounds and surrogates: VOCs and PAHs ≤ 20%D	Correct problem, rerun CCV. Reanalyze all samples since last successful calibration verification. If that fails, repeat initial calibration.	Analyst or certified instrument technician	N/A
GC-MS (Methods 8260B/8270D)	Internal Standards (IS)	Every field sample, standard, and QC sample.	RT ± 30 seconds from RT of the midpoint standard in the ICAL; EICP area within -50% to + 100% of ICAL midpoint standard	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed during failure is mandatory.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
GC-FID (Methods 8015C/8015C)	Minimum five point ICAL for all analytes (DRO/ORO/GRO)	ICAL prior to sample analysis	One of the options below: Option 1: RSD for each analyte $\leq$ 20% Option 2: linear least squares regression r $\geq$ 0.995 Option 3: non-linear regression: COD $r^2 \geq 0.99$ (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration	Analyst or certified instrument technician	N/A
GC-FID (Methods 8015C/8015C)	Second source calibration verification (ICV) (DRO/ORO/GRO)	Immediately following ICAL.	All project analytes within established retention time windows. All project analytes within $\pm$ 20% of expected value from the ICAL.	Correct problem, then rerun ICV. If that fails, repeat ICAL.	Analyst or certified instrument technician	N/A
GC-FID (Methods 8015C/8015C)	Continuing calibration verification (CCV) (DRO/ORO/GRO)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes within established retention time windows. All project analytes within $\pm$ 20% of expected value from the ICAL.	Correct problem then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
GC-ECD (Methods 8081B/8082A)	Minimum five point ICAL for all analytes (DRO/ORO/GRO)	ICAL prior to sample analysis	One of the options below: Option 1: RSD for each analyte $\leq$ 20% Option 2: linear least squares regression r $\geq$ 0.995 Option 3: non-linear regression: COD $r^2 \geq 0.99$ (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration	Analyst or certified instrument technician	N/A
GC-ECD (Methods 8081B/8082A)	Second source calibration verification (ICV) (DRO/ORO/GRO)	Immediately following ICAL.	All project analytes within established retention time windows. All project analytes within $\pm$ 20% of expected value from the ICAL.	Correct problem, then rerun ICV. If that fails, repeat ICAL.	Analyst or certified instrument technician	N/A
GC-ECD (Methods 8081B/8082A)	Continuing calibration verification (CCV) (DRO/ORO/GRO)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes within established retention time windows. All project analytes within $\pm$ 20% of expected value from the ICAL.	Correct problem then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
HPLC	Initial multipoint calibration for all analytes (minimum five standards) (ICAL)	Initial calibration prior to sample analysis	*Option 1*: RSD for each analyte ≤ 20% *Option 2* Linear least squares regression r > 0.995 *Option 3:* Non-linear regression: coefficient of determination r_2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration.	Analyst or certified instrument technician	N/A
HPLC	Second-source Calibration verification	Once per ICAL	All analytes within ± 15% of expected value.	Correct problem, then rerun second source. If that fails, repeat ICAL.	Analyst or certified instrument technician	N/A
HPLC	Retention time window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical shift	Position shall be set using the midpoint standard of the initial calibration curve or the value in the CCV run at the beginning of the analytical shift.	N/A	Analyst or certified instrument technician	N/A
HPLC	Retention time window verified for each analyte	Each calibration verification standard	Analyte within established window	Correct problem then reanalyze all samples analyzed since the last retention time check. If they fail, redo ICAL and reset retention time window.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
HPLC	Calibration verification Initial ICV and continuing CCV	ICV: Daily, before sample analysis CCV: After every 10 field samples and at the end of the analysis sequence	All analytes within ± 15% of expected value from the ICAL.	ICV: Correct problem then rerun ICV. If that fails, repeat initial calibration. CCV: Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification.	Analyst or certified instrument technician	N/A
HRGC/HRMS (Method 8290)	Initial calibration (ICAL) for all analytes	ICAL prior to sample analysis, as needed by the failure of calibration verification standard, and when a new lot is used as standard source for HRCC-3, sample fortification or recovery solutions.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and S/N ratio $\geq$ 10 for all target analyte ions; RSD $\leq$ 20% for the response factors (RF) for all 17 unlabeled standards and RSD $\leq$ 20% for the RFs for the 9 labeled IS.	Correct problem then repeat initial calibration. Calibration may not be forced through origin.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
HRGC/HRMS (Method 8290)	Continuing calibration verification (CCV)	At the beginning of each 12 hour period, and at the end of the anlaytical sequence.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and For unlabeled standards, RF within ± 20% D of RF established in ICAL; For labeled standards, RF within ± 30% D of RF established in ICAL.	Correct problem, repeat calibration verification standard. If that fails, then repeat ICAL and reanalyze all samples analyzed since the last successful CCV. End-of-run CCV: If the RF for unlabeled standards ≤ 25% RPD and the RF for labeled standards ≤ 35% RPD (relative to the RF established in the ICAL), the mean RF	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
HRGC/HRMS (Method 8290)	Continuing calibration verification (CCV) (Continued)	At the beginning of each 12 hour period, and at the end of the anlaytical sequence.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and For unlabeled standards, RF within ± 20% D of RF established in ICAL; For labeled standards, RF within ± 30% D of RF established in ICAL.	from the two daily CCVs must be used for quantitation of impacted samples instead of the ICAL mean RF value. If the starting and ending CCV RFs differ more than > 25% RPD for unlabeled compounds or 35% RPD for labeled compounds, the sample may be quantitated against a new initial calibration if it is analyzed within two hours. Otherwise reanalyze samples with positive detections if necessary.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
HRGC/HRMS (Method 8290)	Internal standards	Every field sample, standard and QC sample.	%R recovery for each IS in the original sample (prior to dilutions) must be within 40-135% per method.	%R recovery for each IS in the original sample (prior to dilutions) must be within 40-135% per method.	Analyst or certified instrument technician	N/A

[1] The Analytical SOP References table is found on Worksheet #23.

QAPP Worksheet #25 (UFP-QAPP Manual Section 3.2.3) -- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP[1]
ICP-MS	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
CVAA	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
GC-MS	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
GC-ECD	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
GC-FID	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
HPLC	Maintenance specified in lab Equipment Maintenance SOP	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
HRGC/HRMS	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A

QAPP Worksheet #26 (UFP-QAPP Manual Appendix A) -- Sample Handling System

Sample Collection, Packaging, and Shipment

Sample Collection (Personnel/Organization): Project Field Team, URS

Sample Packaging (Personnel/Organization): Project Field Team, URS

Coordination of Shipment (Personnel/Organization): Project Field Team, URS

Type of Shipment/Carrier: Overnight/FedEx

Sample Receipt and Analysis

Sample Receipt (Personnel/Organization): TBD by Molly Nguyen/EMAX

Sample Custody and Storage (Personnel/Organization): TBD by Molly Nguyen/EMAX

Sample Preparation (Personnel/Organization): TBD by Molly Nguyen/EMAX

Sample Determinative Analysis (Personnel/Organization): TBD by Molly Nguyen/EMAX

Sample Archiving

Field Sample Storage (No. of days from sample collection): 30 days

Sample Extract/Digestate Storage (No. of days from extraction/digestion): 90 days

Biological Sample Storage (No. of days from sample collection): N/A

Sample Disposal

Personnel/Organization: TBD by Molly Nguyen/EMAX

Number of Days from Analysis: 30 days

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) – Sample Custody Requirements Table

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

See PAWP

Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal):

See the following SOPs

N/A

Sample Identification Procedures:

See PAWP

Chain of Custody Procedures:

See PAWP

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	VOCs
Analytical Method Reference	USEPA SW-846 Method 8260B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-1	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-10
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-1	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-10

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	VOCs
Analytical Method Reference	USEPA SW-846 Method 8260B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-10

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	SVOCs
Analytical Method Reference	USEPA SW-846 Method 8270D

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-2	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-10
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-2	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-10

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	SVOCs
Analytical Method Reference	USEPA SW-846 Method 8270D

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-10

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	TPH-DRO,TPH-ORO,TPH-GRO
Analytical Method Reference	USEPA SW-846 Method 8015C

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-5	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-5	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	TPH-DRO,TPH-ORO,TPH-GRO
Analytical Method Reference	USEPA SW-846 Method 8015C

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	Organochlorine Pesticides
Analytical Method Reference	USEPA SW-846 Method 8081B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-3	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-3	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	Organochlorine Pesticides
Analytical Method Reference	USEPA SW-846 Method 8081B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	PCBs
Analytical Method Reference	USEPA SW-846 Method 8082A

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-4	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-4	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	PCBs
Analytical Method Reference	USEPA SW-846 Method 8082A

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	Explosives
Analytical Method Reference	USEPA SW-846 Method 8330A

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-8	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-8	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	Explosives
Analytical Method Reference	USEPA SW-846 Method 8330A

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	RCRA Metals
Analytical Method Reference	USEPA SW-846 Method 6020A / 7471B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-6	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-12
Matrix Spike (MS)	One per preparation/analytical batch	See Table 12-6	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-12

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	RCRA Metals
Analytical Method Reference	USEPA SW-846 Method 6020A / 7471B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Sample duplicate	One sample duplicate per preparatory batch per matrix	See Table 12-6	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-12

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	Dioxins/Furans
Analytical Method Reference	USEPA SW-846 Method 8290

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparatory batch, run after calibration standards and before samples.	Use project-specific criteria, if available. Otherwise, no analytes detected ≥ LOD for the analyte or ≥ 5% of the associated regulatory limit for the analyte or ≥ 5% of the sample result for the analyte, whichever is greater, per method.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS) or fortified field blank)	One per preparation/analytical batch	See Table 12-7	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-13
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-7	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-13

QAPP Worksheet #29 (UFP-QAPP Manual Section 3.5.1) -- Project Documents and Records Table

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field Logbook	Sample Receipt, Custody, and Tracking Records	Sample Receipt, Custody, and Tracking Records	Data Validation Reports	
Chain of Custody Records	Corrective Action Forms	Standard Traceability Logs	Corrective Action Forms	
Air Bills	Reported Field Sample Results	Sample Prep Logs		
Custody Seals	Sample Disposal Records	Equipment Maintenance, Testing, and Inspection Logs		
Corrective Action Forms		Corrective Action Forms		
		Reported Field Sample Results		
		Reported Results for Standards, QC Checks, and QC Samples		
		Data Package Completeness Checklist		
		Sample Disposal Records		
		Extraction/Cleanup-up Records		
		Raw Data (stored on disk CD-R)		

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) -- Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ID Number	Analytical SOP	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)
Soil	VOCs	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX Laboratories, Inc. 1835 West 205th St Torrance, CA 90501 Attn: Molly Nguyen (310) 618-8889
Soil	SVOCs	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	TPH-DRO/TPH-ORO	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	TPH-GRO	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	Organochlorine Pesticides	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	PCBs	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	RCRA Metals	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	Explosives	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) -- Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ID Number	Analytical SOP	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)
Soil	Dioxins/Furans	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	Columbia Analytical Services – Houston 19408 Park Row Dr.; Suite 320 Houston, TX 77084 Note: EMAX will be contact for Columbia Analytical Services

All laboratory SOPs were removed from this document at the request of NMED.

QAPP Worksheet #31 (UFP-QAPP Manual Section 4.1.1) -- Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Review Field Logbooks and Chain of Custody forms	As work progresses	Internal	URS	Corey Anderson and/or Tony Sedlacek, URS	Stephen Jacobson, Field Team Leader, URS	Stephen Jacobson, Field Team Leader, URS	Stephen Jacobson, Field Team Leader, URS

QAPP Worksheet #32 (UFP-QAPP Manual Section 4.1.2) -- Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Review Field Logbooks and Chain of Custody forms	Marked up copy of document	Corey Anderson, PM, URS	Within 24 hours of finding deficiency	Review of corrected documentation	Stephen Jacobson, Field Team Leader, URS	24 hours after notification

QAPP Worksheet #33 (UFP QAPP Manual Section 4.2) -- QA Management Reports Table

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Site Investigation at Eight Sites Report	One report after all field data collected.	TBD	Corey Anderson, PM, URS	Eliud Burgos, AFCEE John Kieling, NMED Matthew Higginbotham,Cannon AFB

QAPP Worksheet #34 (UFP-QAPP Manual Section 5.2.1) -- Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Chain of custody and shipping forms	Chain of custody (COC) forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the COC should be initialed by the reviewer, a copy of the COC retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	I	Stephen Jacobson, Field Team Leader, URS
Laboratory Sample Receipt Reports	Laboratory report listing all samples received condition of receipt and analyses requested. Signed copy of COC included.	I	Tony Sedlacek, URS
Field Logbooks	Field logbooks will be reviewed internally and placed in the project file.	I	Corey Anderson, URS
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	I	Kenette Pimentel, EMAX
	All received data packages will be verified externally according to the data validation procedures specified in Worksheet #35.	E	Tony Sedlacek, URS

QAPP Worksheet #35 (UFP-QAPP Manual Section 5.2.2) -- Validation (Steps IIa and IIb) Process Table

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	PAWP	Ensure that all sampling procedures were followed	Tony Sedlacek, URS
IIb	Documentation of QC Sample Results	Establish that all required QC samples were analyzed and met evaluation criteria.	Tony Sedlacek, URS
IIb	Project Quantitation Limits	Verify that sample results met the quantitation limits specified in the QAPP	Tony Sedlacek, URS

QAPP Worksheet #36 (UFP-QAPP Manual Section 5.2.2) -- Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa	Soil	VOCs, SVOCs, TPH-DRO,TPH-ORO, TPH-GRO, Organochlorine Pesticides, PCBs, RCRA Metals, Dioxins/Furans, Explosives	Low	DoD QSM Version 4.2	Tony Sedlacek, URS
IIa	Soil	VOCs, SVOCs, TPH-DRO,TPH-ORO, TPH-GRO, Organochlorine Pesticides, PCBs, RCRA Metals, Dioxins/Furans, Explosives	Low	QAPP Worksheets 12, 15 and 24. QAPP Tables 12-1 through 12-13	Tony Sedlacek, URS

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) -- Usability Assessment

The Data Usability Assessment will be performed by URS personnel. Corey Anderson, URS PM, will be responsible for information in the Usability Assessment. He will also be responsible for assigning task work to the individual task members who will be supporting the Data Usability Assessment. Note that the Data Usability Assessment will be conducted on reviewed data. After the Data Usability Assessment has been performed, data deemed appropriate for decision-making purposes will be used to determine the extent of contamination of the eight sites. The results of the Data Usability Assessment will be presented in the Site Investigation of Eight Sites Report. The following items will be assessed and conclusions drawn based on their results.

Precision – Results of field duplicates will be presented separately in tabular format for the sample pair. For the field duplicate pair, the results will be assessed as stated in Tables 12-10 through 12-13. MS/MSD RPDs are calculated by the laboratory and those with RPDs outside the criteria established in Tables 12-1 through 12-8 will be listed in tabular form in the Site Investigation of Eight Sites Report. A discussion will follow summarizing the results of the laboratory precision. Any conclusions about the precision of the analyses will be drawn and any limitations on the use of the data will be described.

Accuracy/Bias Contamination – Results for all laboratory method blanks will be evaluated and analytes detected in these blanks will be listed in tabular form in the data review report. Laboratory data will be qualified based on the criteria listed in Tables 12-10 through 12-13. A discussion will follow summarizing the results of the laboratory accuracy/bias. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be described.

Overall Accuracy/Bias – Results for all LCS, surrogate and MS/MSD recoveries that are outside evaluation criteria will be presented in tabular format in the Site Investigation of Eight Sites Report. The results will be checked versus those listed in Tables 12-1 through 12-9. A discussion will follow summarizing the overall accuracy/bias. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be described.

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) -- Usability Assessment

Sensitivity – Results for the sensitivity check standard will be provided by the laboratory for all analyses. The results for each analyte will be checked against the performance criteria presented on Worksheet #12 and cross checked against the quantitation limits presented on Worksheet #15. Results for analytes that exceed criteria will be identified on the tables. A discussion will follow summarizing the results of the laboratory sensitivity. Any conclusions about the sensitivity of the analyses will be drawn and any limitations on the use of the data will be described.

Representativeness – A measure of representativeness will be provided by assessing if the proper analytical procedures, appropriate methods, holding times and field duplicate procedures were followed. Any conclusions about the representativeness of the analyses will be drawn and any limitations on the use of the data will be described.

Comparability – The results will be compared to any previous sampling results (if available). Comparability is also achieved by using standard sampling and analysis procedures that can be reproduced.

Completeness – A completeness check will be performed on all data generated by the laboratory. Completeness criteria are presented on Worksheet #12. Completeness will be calculated as the number of data points for each analyte that is deemed useable (not rejected) divided by the total number of data points for each analyte. A discussion will follow summarizing the results of the calculation of data completeness. Any conclusions about the completeness of the data will be drawn and any limitations on the use of the data will be described.

Graphics – Figures will be constructed showing each sampling location.

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) -- Usability Assessment

Reconciliation – Each of the measurement performance criteria listed in Worksheet #12 will be examined to determine if the objective was met. Each analysis will be evaluated separately in terms of the major impacts observed from the data review, data quality indicators and measurement performance criteria assessments. Based on the results of these assessments, the quality of the data will be determined. Usability of the data will be based on the quality assessment. After establishing the usability of the data, it will be determined if the DQO was met and if project action limits were met. The final report will include a summary of all points that comprised the reconciliation of each objective. Any conclusions or limitations on the usability of any of the data will be described.

REFERENCES

Intergovernmental Data Quality Task Force. 2005. Uniform Federal Policy for Quality Assurance Project Plans. March.

Los Alamos National Laboratory (LANL). 2011. Exorisk Database Release. Los Alamos Natinoal Laboratory, Environmental Programs Directorate Waste and Environmental Services Division, Los Alamos, NM. October

New Mexico Environment Department (NMED). 2006. TPH Screening Guidelines. October.

NMED. 2012. Risk Assessment Guidance for Investigations and Remediation, Volume 1. February.

Parallax, Inc. 2000. Closeout Report/Contamination Assessment, SWMU 129-Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, Final. July.

The Technical Cooperation Program (TTCP). 2009. Environmental Fate and Effects of Energetic Materials. Available at http://www.em-guidelines.org/ecot.htm.

URS Group, Inc. 2009. Final Evaluation Report. Cannon Air Force Base. Air Force Compliance Clean-up Site, Identification and Evaluation of DERA Eligibility for AFCEE, Multiple Locations. Prepared for the United States Army Corps of Engineers, Tulsa District. August.

U. S. Department of Defense, Environmental Data Quality Workgroup. 2010. Quality Systems Manual (QSM) for Environmental Laboratories, Version 4.2. October.

United States Environmental Protection Agency (USEPA). 2003. Region 5 RCRA, Ecological Screening Levels, August.

USEPA. 2007. Ecological Soil Screening Levels, August.

USEPA. 2011. Regional Screening Levels. November.

United States Geological Survey (USGS). 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico. Volume I.

Woodward-Clyde (W-C). 1997. "Naturally Occurring Concentrations of Inorganics and Background Concentrations of Pesticides at Cannon Air Force Base, New Mexico." Final Report. September.

REFERENCES

THIS PAGE INTENTIONALLY BLANK

ATTACHMENT A
LABORATORY STANDARD OPERATING PROCEDURES

((Included electronically as PDF only))

THIS PAGE INTENTIONALLY BLANK

STANDARD OPERATING PROCEDURE

ACID DIGESTION, TOTAL METALS FOR SOLIDS

SOP No.:	EMAX-3050	Revision No.	4	Date:	24-Aug-10
Prepared By:	Mary Jane Mendoza			Date:	08-24-10
Approved By:	Kenette Pimentel QA Manager			Date:	08.24.10
Approved By:	Caspar Pang Laboratory Director			Date:	08-24-10.

Control Number: 3050-04-

1.0 SCOPE AND APPLICATION

1.1. This method describes the acid digestion for soils, sludge, sediments and other related substances that are solid in nature, in preparation for metals analysis by ICP analytical technique. This SOP adopts the same acid strength as SW846 Method 3050B. A comparative study of this modified procedure vis-à-vis the reference method show better recoveries for some elements particularly antimony.

2.0 SUMMARY OF METHOD

2.1. Metal analytes are acid digested from a pre-measured sample. Hydrochloric acid is added to the sample and heated to initialize digestion. Nitric acid is added to the digestate and is further oxidized with 30% peroxide. Hydrochloric acid is again added to complete acid digestion.

2.2. **Interferences**

2.2.1. Sludge samples can contain diverse matrix types, which may present analytical challenge.

2.2.2. Samples having high concentrations may cause memory effect on the digestion vessels. Treating the vessels with 1:1 v/v of HCL and HNO3 will decontaminate the digestion vessels.

3.0 DETECTION LIMITS

3.1. Refer to applicable analytical procedure

4.0 DYNAMIC RANGE

4.1. Refer to applicable analytical procedure.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Holding Time**

5.1.1. All samples shall be digested within 180 days from sampling date.

5.2. **Preservation**

5.2.1. All samples shall be stored at the condition specified by the project.

6.0 ASSOCIATED SOP

6.1. EMAX-QC04 Balance Calibration

6.2.	EMAX-QC06	Calibration of Micropipettes
6.3.	EMAX-QC07	Glassware Cleaning
6.4.	EMAX-SM04	Analytical and QC Labeling
6.5.	EMAX-6010	ICP Emission Spectrometric Method for Trace Metal Analyses

7.0 SAFETY

7.1. Read the MSDS of all chemicals listed in this SOP.

7.2. All reagents, standards and samples shall be treated as potential hazard. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves, shall be worn at all times when performing this procedure.

7.3. All wastes generated during digestion, i.e., filter papers, paper towels, etc., and/or any solid material contaminated with acid, shall be placed in the wastes containers under the fume hoods. These wastes shall be labeled acidic wastes and shall be given to the waste management unit for proper disposal. NO ACIDIC WASTE SHALL BE DISPOSED IN THE TRASH CAN.

7.4. All acidic rinsate (pH ≤ 2) shall be labeled acidic water and shall be given to the waste management unit for proper disposal. NO ACID WASTE SHALL BE DISPOSED IN THE SINK.

7.5. If for any reason, acid and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with copious amount of tap water. If irritations or any other discomfort related to the incident persist, inform your supervisor immediately, so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS & REAGENTS

8.1. **Instruments & Supplies**

Balance	Sartorius LC 620 S or equivalent
Spatula	Stainless steel or equivalent
Digestion vessel	50-mL, 100-mL digestion vessel
Pipet	1-mL, 0.100-mL
Digestion block	Aluminum blocks or equivalent
Thermometer	Range 0 – 110°C
Watch Glass	Killdee Conical Watch glass or equivalent
Filter	Whatman #41 or equivalent
Digestate Container	125-mL Polyethylene bottle, Graduated

8.2. **Chemicals & Reagents**

Reagent water	ASTM Type II Water
Nitric Acid	NX0407-2 EM Science or equivalent
Hydrochloric Acid	HX0607-2 EM Science or equivalent
Hydrogen Peroxide	VW3690-5 VWR or equivalent

9.0 STANDARD

9.1. ICP Matrix Spike and Laboratory Control Solution

ICP MATRIX SPIKE AND LCS STANDARD 1	
PARAMETER	CONCENTRATION (mg/L)
Arsenic Barium Beryllium Cadmium Chromium Cobalt Copper Lead Manganese Nickel Selenium Silver Thallium Vanadium Zinc	100
Aluminum Iron	1000

ICP MATRIX SPIKE AND LCS STANDARD 2	
PARAMETER	CONCENTRATION (mg/L)
Antimony	500
Bismuth Boron Molybdenum Strontium Tin Titanium	100

ICP MATRIX SPIKE AND LCS STANDARD 3	
PARAMETER	CONCENTRATION (mg/L)
Calcium Magnesium Potassium Sodium	5000

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Sample Handling

10.1.1.1. Based from the work order, determine the samples to form a preparative batch (not to exceed 20 field samples). Withdraw the sample(s) from the sample control room designated for metals analysis (passing # 10 sieve) and bring them to the weighing area. Allow the samples to equilibrate at room temperature.

Note: Sample homogeneity is crucial in metals analysis. If no sample was designated for metals analysis, and it is apparent that sample particles contain > #10 sieve, inform the Supervisor for further instruction.

10.1.1.2. Take digestion vessels and label each one corresponding to the samples withdrawn. Take four more vessels and label them as preparation blank, LCS, matrix spike and matrix spike duplicate.

10.1.1.3. Check project sub-sampling requirement. If multi-incremental sub-sampling (MIS) is required, refer to EMAX-SM01, section 5.13.2 for details. Otherwise follow the steps described in EMAX-SM01, section 5.13.1.

10.1.1.4. Scoop 1-2-g sub-sample and transfer into a properly labeled digestion vessel. Record the weight to the nearest 0.01-g.

10.1.2. Pre-heating the Digestion Block

10.1.2.1. Place a digestion vessel with reagent water and a temperature monitoring thermometer on the digestion block.

10.1.2.2. Turn the digestion block on and set the thermostat to ~95°C or to a predetermined

temperature to obtain approximately 95°C once the digestion vessel is covered with a watch glass.

10.1.2.3. When the temperature reading is about 95°C ± 5°C, the digestion block is now ready for digestion.

10.1.3. Standard Addition.

10.1.3.1. Call for a witness for standard addition. Have the witness verify the setting of the micropippet and the expiration dates of the spike standards.

10.1.3.2. Add 0.5-ml of ICP Spike 1 and 2 and 1.0-mL of ICP spike 3 (Sec. 9.1) to LCS and matrix spike samples.

10.1.4. Acid Digestion

10.1.4.1. Add 10-mL of regent water and 5-ml of concentrated HCL[1] into each vessel, swirl the vessel to mix the acid and the sample. Add same amount of acid into a clean and empty vessel and designate it as blank. Insert the vessels in the digestion block(s). Cap the vessels with conical watch glass.

10.1.4.2. Check the temperature of the digestion block (95°C ± 5°C), adjust if necessary. If temperature happens to be ≥ 100°C, adjust the thermostat and wait until temperature falls within 95°C ± 5°C. Record the temperature reading in the digestion log.

10.1.4.3. Place the digestion vessels on the digestion block and reflux for 15 minutes without boiling.

10.1.4.4. Transfer the vessels into unheated digestion block and allow the vessels to cool down for at least 5 minutes. Lift the watch glass and add 10-mL of concentrated HNO_3. Place the watch glass back before working on the next vessel.

10.1.4.5. Return the vessels to the digestion block and reflux for another 15 minutes.

10.1.4.6. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes. Lift the water glass and add 10-mL 1:1 HNO3. Place the water glass back before working on the next vessel.

10.1.4.7. Return the vessels to the digestion block and reflux for another 15 minutes.

10.1.4.8. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes.

10.1.4.9. Add 2-mL of reagent water. Then add 3-mL of 30% hydrogen peroxide (H_2O_2) to each vessel, swirling each one of them after every addition to initiate peroxide reaction. Continue to add H_2O_2 until the amount added reaches 10-mL.

10.1.4.10. Return the vessels to the heated digestion block. Care must be taken to ensure that losses do not occur due to excessive effervescence.

10.1.4.11. Continue to reflux the mixture at 95°C ± 5°C for 15 minutes. Remove the digestion vessels from the digestion block.

10.1.4.12. Lift the watch glass, add 5-mL of concentrated HCl. Swirl the vessel until added

[1] Addition of 5-ml HCl is a modification from Method 3050B to enhance recovery of antimony. Refer to Appendix 2 for the comparative study done on ICP.

reagents are properly mixed with the solution. Place the watch glass before working on the next vessel. Return the vessels into the heated digestion block. Reflux for additional 15 minutes. Subsequently, remove the digestion vessels from the digestion block and allow the vessels to cool down and dilute to 100-mL final volume with reagent water.

10.1.4.13. Let the digestate settle and centrifuge or filter with Whatman #41 (see 10.1.5) if necessary otherwise digestates are now ready for analysis.

10.1.5. Digestate Filtration

10.1.5.1. Place Whatman #41 filter paper into each funnel resting on holders. Rinse the filter papers with reagent water.

10.1.5.2. Place a pre-labeled digestate container under each funnel making sure that the labels are visible.

10.1.5.3. Check the labels to make sure that they agree. Pour the digestate into the filter.

10.1.5.4. Filter and collect the digestates in the labeled container. The digestates are now ready for analysis.

10.2. **Instrument Parameters**

10.2.1. Take a digestion vessel filled halfway with tap water and insert a thermometer to serve as a temperature monitoring vessel. Place the temperature monitoring vessel on the digestion block together with the samples being digested. Check the temperature reading from time to time to ensure that it delivers heat at about 95°C ± 5°C.

10.3. **Calibration**

10.3.1. Balance calibration shall be carried out as described by EMAX-QC04.

10.3.2. Thermometer calibration shall be carried out as described by EMAX-QC05.

10.3.3. Pipette calibration shall be carried out as described by EMAX-QC06.

10.3.4. Check acid dispenser monthly using a class “A” graduated cylinder for accuracy prior to acid digestion. Adjust the dispenser stopper if necessary. Document the dispenser calibration on the digestion log.

10.3.5. **Volumetric Containers Calibration**

10.3.5.1. Perform calibration of digestion vessels per lot.

10.3.5.2. Randomly select 3 vessels from the lot.

10.3.5.3. Using a calibrated balance, tare off digestate vessel.

10.3.5.4. Fill the vessel to the 50-mL mark with reagent water and record the weight.

10.3.5.5. Fill the vessel to the 100-mL mark with reagent water and record the weight.

10.3.5.6. Repeat steps 10.3.3.2 to 10.3.3.4 on the other two vessels.

10.3.5.7. Take the temperature reading of the reagent water used. Get the density of reagent water corresponding to the reagent water at that temperature.

10.3.5.8. Calculate the actual volumes measured for each of the digestion vessel using Eq.-10.6.1.

10.3.5.9. Calculate the average volume measured from the three vessels using Eq-10.6.2.

10.3.5.10. Calculate the standard deviation using Eq-10.6.3.

10.3.5.11. Acceptance criteria shall be ± 2% of the expected value. All measurements must fall into the acceptance criteria, otherwise reject the lot.

10.4. **Analysis**

10.4.1. For ICP analytical technique refer to EMAX-6010 or EMAX-6010C.

10.5. **Data Reduction**

10.5.1. Refer to analytical procedures.

10.6. **Calculations**

10.6.1. Calculate for actual volume measured as indicated by the graduation of the vessel.

$$V = \frac{W}{D} \qquad \text{Eq-10.6.1}$$

where:

V	=	Actual volume measure
W	=	Weight of reagent water
D	=	Density of reagent water at the measured temperature

10.6.2. Calculate for average volume measured for each vessel.

$$V_{ave} = \frac{\sum V}{n} \qquad \text{Eq-10.6.2}$$

where:

ΣV	=	Summation of volume calculated from each trial
n	=	Number of measurements
V_{ave} =	=	Average volume measured

10.6.3. Calculate the Standard Deviation.

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}} \qquad \text{Eq-10.6.3}$$

where:

SD	=	Standard Deviation
$\overline{x}$	=	Mean
x_i	=	Result at i^{th} measurement
n	=	Number of measurements

10.7. **Report Generation**

10.7.1. Refer to analytical method

10.8. **Data Review**

10.8.1. Refer to analytical method

10.9. **Preventive Maintenance**

10.9.1. The digestion area in general shall be maintained clean at all times to prevent contamination

11.0 QUALITY CONTROL

11.1. The maximum number of original field samples in an analytical batch shall be 20 unless otherwise specified by the project.

11.2. Matrix spike samples shall be taken from a specified matrix spike field sample. In the absence of a specified matrix spike field sample, the analyst performing the extraction shall choose from any of the samples within the analytical batch.

11.3. A method blank, LCS, MS and MSD shall be prepared in every analytical batch, unless otherwise specified by the project. They shall be subjected to the same process that the field samples undergo as described in section 10.

11.4. In the event that there is insufficiency of sample to be used for MS/MSD, LCS duplicate shall be prepared to demonstrate precision.

11.5. All labwares to be used in the sample preparation shall be properly treated as specified in EMAX-QC07.

11.6. All reagents shall undergo quality control acceptance prior to its use.

11.7. Every lot of digestion vessels shall be checked for accuracy prior to its use. Record the verification in the Digestion Vessel QC Log (see Appendix 3).

11.8. Demonstration of proficiency is required prior to performing this procedure.

12.0 CORRECTIVE ACTION

12.1. Corrective action for each Quality Control procedure is summarized in Appendix 1 of the analytical method.

12.2. A non-conformance report (NCR) shall be filled out and attached to the analysis folder whenever the following circumstances occur. Corrective action shall be undertaken as advised below:

12.2.1. For insufficiency of sample(s), inform the Supervisor immediately for further advice.

12.2.2. Insufficient preservation of sample. If sample pH is ≥ 2, and no special instruction is provided by the analysis folder, inform your supervisor immediately for further action.

12.2.3. Breakage of sample container. Identify the sample and check for sample spare. If a spare is found replace the broken sample, if not inform your supervisor immediately for further action.

12.2.4. Sample overflow due to excessive effervescence. Identify the sample and check for sample spare. If a spare is found re-digest the sample, if none inform your supervisor immediately for further action.

12.2.5. Breakage of digestate container or sample was spilled prior to dilution to final volume. Identify the digestate. If it is a method blank or LCS, re-digest the whole analytical batch. If it is a sample, re-digest the sample with a method blank and LCS. If re-extraction is not possible, inform your supervisor for further action.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped in the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to the WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. Collect all waste generated, i.e. acidic rinsate, filter papers, etc. , into properly labeled waste containers and properly turn them over to the waste disposal unit.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch is a group of samples that are prepared and/or analyzed at the same time using the same reagent lot.

15.1.1.1. **Preparation batch** is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.2. **Analytical batch** is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.4. Matrix – is a component or form of a sample.

15.1.5. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.6. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.7. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.8. Reagent Water – is purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.9. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.10. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.11. Sample Duplicate – is a second sample aliquot of any sample (preferably the MS sample) to check matrix homogeneity and precision of method in a given matrix.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria specified in this SOP shall be applied to all projects when performing acid digestion of soil, sludge, and sediment samples for metals analysis. In the instance where there is a project or program specific requirement, the requirements given in the project shall take precedence over this SOP.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. USEPA SW846, Method 3050B

16.2. EMAX Quality Systems Manual, as updated

17.0 APPENDICES

17.1. Figures

17.1.1.	Figure 1	Acid Digestion Flow Diagram

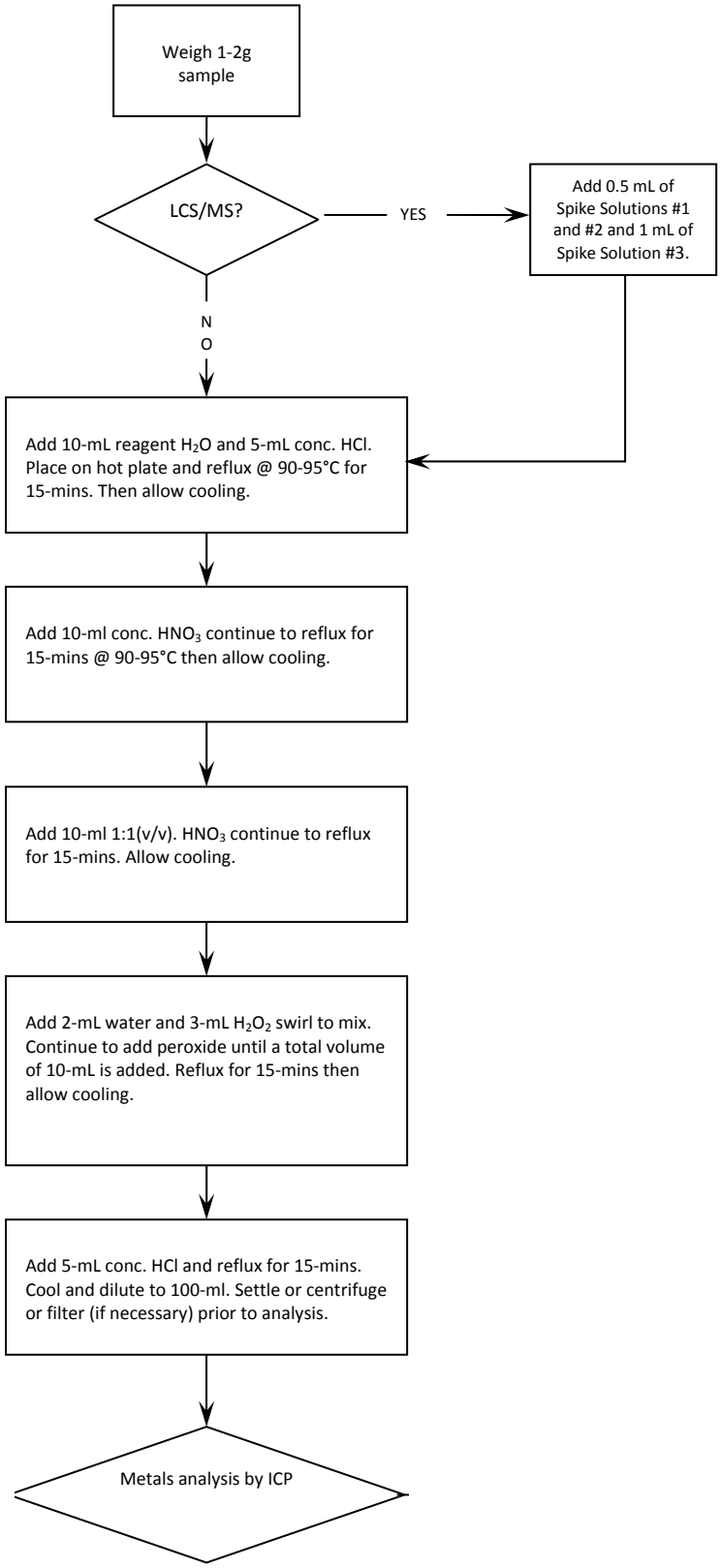
17.2. Appendices

17.2.1.	Appendix 1	Demonstration of Capability
17.2.2.	Appendix 2	Comparative Study of Modified 3050B

17.3. Forms

17.3.1.	3050FS	Digestion Log
17.3.2.	3050FC	Volumetric Containers Calibration Log

FIGURE 1: ACID DIGESTION FLOW DIAGRAM



APPENDIX 1: **DEMONSTRATION OF CAPABILITY**

ANALYTICAL METHOD: SW 6010C
PREPARATION BATCH: IPE017S
ANALYTICAL BATCH: D8E007

Preparation Date: 5/6/2010
Extracted by: M. Mendoza
Analytical Run Date: 5/7/2010
Analyzed by: T. Hoang

	Concentration (mg/Kg)				True Value (mg/Kg)	Ave. Conc. (mg/Kg)	Ave. Rec. (%)	Std. Dev.	RPD (%)	ACCEPTANCE LIMITS (% Rec)	Evaluation
	ID8E007025 IPE017SL	ID8E007026 IPE017SC	ID8E007028 IPE017SY	ID8E007045 IPE017SX							
Aluminum	528	515	512	515	500	518	104	7.141	1.4	80 - 120	PASSED
Antimony	271	263	267	266	250	267	107	3.304	1.2	80 - 120	PASSED
Arsenic	52.1	50.2	51.6	51.8	50	51.4	103	0.842	1.6	80 - 120	PASSED
Barium	51.2	49.8	50	50.1	50	50.3	101	0.629	1.3	80 - 120	PASSED
Beryllium	51.1	50	49.6	49.4	50	50	100	0.759	1.5	80 - 120	PASSED
Boron	49.4	47.9	48.9	49.3	50	48.9	98	0.685	1.4	80 - 120	PASSED
Cadmium	52.9	51.4	51.9	52.1	50	52.1	104	0.624	1.2	80 - 120	PASSED
Calcium	5400	5250	5410	5490	5000	5390	108	100.1	1.9	80 - 120	PASSED
Chromium	53.4	51.6	52.9	53.4	50	52.8	106	0.85	1.6	80 - 120	PASSED
Cobalt	51.7	50.3	50.8	51.4	50	51.1	102	0.624	1.2	80 - 120	PASSED
Copper	52.4	50.5	52.6	53.6	50	52.3	105	1.295	2.5	80 - 120	PASSED
Iron	524	507	517	519	500	517	103	7.136	1.4	80 - 120	PASSED
Lead	51.2	49.7	50	50.3	50	50.3	101	0.648	1.3	80 - 120	PASSED
Magnesium	5020	4970	4890	4830	5000	4930	99	84.21	1.7	80 - 120	PASSED
Manganese	49.8	48.7	48.3	47.9	50	48.7	97	0.818	1.7	80 - 120	PASSED
Molybdenum	55.7	54.1	54.3	54.5	50	54.7	109	0.719	1.3	80 - 120	PASSED
Nickel	54.6	53.1	53.7	54.2	50	53.9	108	0.648	1.2	80 - 120	PASSED
Potassium	5160	5040	5170	5230	5000	5150	103	79.58	1.5	80 - 120	PASSED
Selenium	50.8	49.1	50.6	51	50	50.4	101	0.866	1.7	80 - 120	PASSED
Silver	51.2	49.6	50.8	51.6	50	50.8	102	0.864	1.7	80 - 120	PASSED
Sodium	5250	5130	5250	5320	5000	5240	105	78.9	1.5	80 - 120	PASSED
Strontium	48.2	46.7	48.3	49.2	50	48.1	96	1.036	2.2	80 - 120	PASSED
Thallium	54.2	52.6	52.6	52.6	50	53	106	0.8	1.5	80 - 120	PASSED
Tin	55.2	53.6	53.6	53.4	50	54	108	0.839	1.6	80 - 120	PASSED
Titanium	52.3	51.2	51.1	50.8	50	51.4	103	0.656	1.3	80 - 120	PASSED
Vanadium	52.4	50.7	51.7	52	50	51.7	103	0.726	1.4	80 - 120	PASSED
Zinc	57.5	55.5	56	56.4	50	56.4	113	0.85	1.5	80 - 120	PASSED

APPENDIX 2: **COMPARATIVE STUDY OF MODIFIED 3050B**

ANALYTICAL METHOD: SW 6010C
PREPARATION BATCH: IPG052S - Modified Method 3050B
IPG053S - Reference Method 3050B
ANALYTICAL BATCH: D8G025
QC STANDARD: 09G281-02

Preparation Date: 7/27/2010
Extracted by: M. Mendoza
Analytical Run Date: 7/28/2010
Analyzed by: T. Hoang

COMPOUND	TRUE VALUES (mg/Kg)	ACCEPTANCE LIMITS (mg/Kg)	RECOVERY LIMITS (%)	REFERENCE METHOD 3050B				MODIFIED METHOD 3050B			
				Concentration (mg/Kg)		Recovery		Concentration (mg/Kg)		Recovery	
				D8G025063 G281-02	D8G025064 G281-02D	D8G025063 G281-02	D8G025064 G281-02D	D8G025054 G281-02	D8G025055 G281-02D	D8G025054 G281-02	D8G025055 G281-02D
Aluminum	7320	4940 - 16400	67.5 - 224	13900	13800	190%	189%	12600	12600	172%	172%
Antimony	110	11.0 - 121	10.0 - 110	22.4	20.4	20%	19%	71.5	76.7	65%	70%
Arsenic	84.2	42.8 - 92.7	50.8 - 110	67.5	68.1	80%	81%	70.1	71.7	83%	85%
Barium	247	186 - 318	75.3 - 129	246	248	100%	100%	266	261	108%	106%
Beryllium	49.0	29.0 - 53.9	59.2 - 110	39.7	39.4	81%	80%	43.8	42.5	89%	87%
Boron	130	61.8 - 149	47.5 - 115	99.8	99.8	77%	77%	108	105	83%	81%
Cadmium	76.5	48.7 - 84.4	63.7 - 110	70.6	71.6	92%	94%	77.5	76.8	101%	100%
Calcium	10200	7860 - 12900	77.1 - 126	10400	11500	102%	113%	11200	11200	110%	110%
Chromium	116	74.8 - 140	64.5 - 121	108	108	93%	93%	117	119	101%	103%
Cobalt	64.6	47.2 - 79.7	73.1 - 123	64.5	64.2	100%	99%	70	69	108%	107%
Copper	143	99.7 - 166	69.7 - 116	134	135	94%	94%	143	144	100%	101%
Iron	23300	11500 - 36200	49.4 - 155	25400	24700	109%	106%	25500	25700	109%	110%
Lead	82.0	41.9 - 90.2	51.1 - 110	62.5	63.6	76%	78%	66.4	66.2	81%	81%
Magnesium	7400	5300 - 9060	71.6 - 122	7080	7140	96%	96%	7330	7330	99%	99%
Manganese	475	428 - 724	90.1 - 152	566	581	119%	122%	618	597	130%	126%
Molybdenum	66.1	36.0 - 72.7	54.5 - 110	55.4	53.9	84%	82%	63.5	62.8	96%	95%
Nickel	144	88.8 - 158	61.7 - 110	129	131	90%	91%	142	141	99%	98%
Potassium	3740	2360 - 4990	63.1 - 133	4080	3970	109%	106%	4110	3920	110%	105%
Selenium	189	97.2 - 208	51.4 - 110	151	155	80%	82%	157	162	83%	86%
Silver	40.6	21.2 - 44.6	52.2 - 110	33.3	34.7	82%	85%	35.3	35.9	87%	88%
Sodium	200	31.4 - 324	15.7 - 162	223	214	112%	107%	199	202	100%	101%
Strontium	135	88.1 - 162	65.3 - 120	121	118	90%	87%	128	125	95%	93%
Thallium	127	73.2 - 144	57.6 - 113	108	114	85%	90%	116	110	91%	87%
Tin	250	39.5 - 275	15.8 - 110	72.1	73.5	29%	29%	85.3	86	34%	34%
Titanium	609	426 - 792	70.0 - 130	725	731	119%	120%	765	746	126%	122%
Vanadium	61.8	55.6 - 123	90.0 - 199	97.4	95.8	158%	155%	99.6	99.3	161%	161%
Zinc	208	145 - 270	69.7 - 130	227	228	109%	110%	258	244	124%	117%

** Note: Modified 3050B procedure is specified in EMAX-3050 Rev. 4*

3050FS: **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

DIGESTION LOG *for* ICP

Page 1

Sample Prep ID	Lab Sample ID	Sample Amount (g | ml)	pH	Extract Volume (ml)
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				

Book#: EIP-092

Batch:

Matrix:

SOP #	Rev.#
☐ EMAX-3005	
☐ EMAX-3010	
☐ EMAX-3050	
☐ EMAX-200.7	
☐ EMAX-	

	DATE	TIME	TEMP
START			°C
END			°C

Standards	ID	Amount Added (ml)
LCS -1		
LCS -2		
LCS -3		
MS		
Reagent	**Lot# / ID**	**Amount Added (ml)**
HNO_3		
HCl		
H_2O_2		
HNO3(1:1)		
Digestate Location		
Extract Location		

Comments:

Prepared By:

Standard Added By: Witnessed By:

Extract Rcvd By: Checked By:

Date endorsed to waste Disposal:

Accepted By:

3050FC: **VOLUMETRIC CONTAINERS CALIBRATION LOG**

EMAX LABORATORIES, INC.

VOLUMETRIC CONTAINER CALIBRATION

Page # 1

Book # QC-VC-001

Container Size _____ mL Lot#: _____

Cal. Points	Balance Readings (g)			
EV(ml)				
1				
2				
3				

Calibration Solution	DI WATER
Temperature(°C)	
Density	#N/A
Acceptance Criteria: Within (±)	2% of EV

Calibrated Date:

Checked by: Date:

Lot#: _____ Ref. No.: QC-VC-001-01-01

Cal. Points	Calculated Results (ml)			
EV				
1				
2				
3				
Average				
SD				
Criteria (±)				
Upper Limit				
Lower Limit				

Comments: @-ml EV:
@-ml EV:
@-ml EV:
@-ml EV:

Container Size _____ mL Lot#: _____

Cal. Points	Balance Readings (g)			
EV(ml)				
1				
2				
3				

Calibration Solution	DI WATER
Temperature(°C)	
Density	#N/A
Acceptance Criteria: Within (±)	2% of EV

Calibrated Date:

Checked by: Date:

Lot#: _____ Ref. No.: QC-VC-001-01-02

Cal. Points	Calculated Results (ml)			
EV				
1				
2				
3				
Average				
SD				
Criteria (±)				
Upper Limit				
Lower Limit				

Comments: @-ml EV:
@-ml EV:
@-ml EV:
@-ml EV:

Container Size _____ mL Lot#: _____

Cal. Points	Balance Readings (g)			
EV(ml)				
1				
2				
3				

Calibration Solution	DI WATER
Temperature(°C)	
Density	#N/A
Acceptance Criteria: Within (±)	2% of EV

Calibrated Date:

Checked by: Date:

Lot#: _____ Ref. No.: QC-VC-001-01-03

Cal. Points	Calculated Results (ml)			
EV				
1				
2				
3				
Average				
SD				
Criteria (±)				
Upper Limit				
Lower Limit				

Comments: @-ml EV:
@-ml EV:
@-ml EV:
@-ml EV:

TOC

STANDARD OPERATING PROCEDURE

EXTRACTION, PULSE SONICATION

SOP No.:	EMAX-3550	Revision No.	3	Effective Date:	03-Sep-10
Prepared By:	Marina Lyudmirskaya			Date:	09-03-10
Approved By:	Kenette Pimentel QA Manager			Date:	09.03.10
Approved By:	Caspar Pang Laboratory Director			Date:	09-03-10

Control Number: 3550-03-

1.0 SCOPE AND APPLICATION

1.1. This method describes the process of sample preparation, extraction, and concentration of solid samples prior to analysis. This process is applicable but not limited to soils; sediments, sludge, and other related substances that are solid in nature, requiring determination and quantification of semivolatile; pesticide; extractable hydrocarbons and other organic compounds of similar characteristic. This SOP is an adaptation of the USEPA SW846, Method 3550C.

2.0 SUMMARY OF METHOD

2.1.1. A measured amount of sample is solvent extracted, utilizing a pulse sonicator. The extract is concentrated to a volume required by the analytical method or subsequently exchanged to an appropriate solvent as prescribed by the analytical method.

2.1.2. **Interference**

2.1.2.1. Solvents, reagents, glassware, and other sample processing hardware may yield artifacts and/or interference to sample analysis. All these materials must be demonstrated to be free from interference under the conditions of the analysis by analyzing method blanks. Specific selection of reagents and purification of solvents by distillation in all-glass systems may be necessary. Refer to each method for specific guidance on quality control procedures and to EMAX-QC07 for guidance on the cleaning of glassware.

2.1.2.2. Interference co-extracted from the samples will vary considerably from source to source. If analysis of an extracted sample is prevented due to interferences, further clean-up of the sample extract may be necessary. Refer to Method 3600 for guidance on clean-up procedures.

2.1.2.3. Phthalate esters contaminate many types of products commonly found in the laboratory. Plastics, in particular, must be avoided because phthalates are commonly used as plasticizers and are easily extracted from plastic materials. Serious phthalate contamination may result at any time if consistent quality control is not practiced.

2.1.2.4. Soap residue (e.g. sodium dodecyl sulfate), which results in a basic pH on glassware surfaces, may cause degradation of certain analyte. Specifically, Aldrin, Heptachlor, and most organophosphorus pesticides will degrade in this situation. This problem is especially pronounced with glassware that may be difficult to rinse. These items should be hand-rinsed very carefully to avoid this problem.

3.0 DETECTION LIMITS

3.1. Refer to applicable analytical procedure.

4.0 DYNAMIC RANGE

4.1. Refer to applicable analytical procedure.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Holding Time**

5.1.1. All samples shall be extracted within 14 days from sampling date unless otherwise specified by the project.

5.1.2. All extracts shall be analyzed within 40 days from extraction.

5.2. **Preservation**

5.2.1. All samples and extracts shall be stored at $\leq$ 6°C.

6.0 ASSOCIATED SOPs

EMAX-QC02	Preparation of Analytical Standards
EMAX-QC04	Balance Calibration
EMAX-QC06	Calibration of Micropipettes
EMAX-QC07	Glassware Cleaning
EMAX-MCD	Moisture Content Determination
EMAX-SM04	Analytical and QC Sample Labeling
EMAX-3640	Clean-up, GPC

7.0 SAFETY

7.1. Read all MSDS for chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves at all times when performing this procedure. Perform all sample and standard handling in the fume hood.

7.3. Place all wastes generated during analytical process in the waste containers. Endorse these wastes to waste disposal section for proper disposal.

7.4. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. Instruments and Supplies

8.1.1. Standard Preparation

Balance	Sartorius
Syringe	1000 µL, gas tight, Hamilton
Volumetric Flask	10 ml, glass

8.1.2. Sample Handling

Particle size reduction	10 lb. Drop hammer and 4" ϕ steel cylinder
Sieve	No. 10 Standard Sieve
Pan	Glass, 18" x 24"
Scoop	Stainless Steel
Balance	Sartorius LC 6200 D or equivalent
Spatula	Stainless steel or equivalent
Beaker	300 ml, tall form, Kimax 14030-300 or equivalent
Vials	40 ml

8.1.3. Sample Extraction

Standard Addition	1 ml, 0.5 ml, .025 ml gas-tight syringe or equivalent
Extractor Probe ¾" & $^{1}/_{8}$"	Pulse Sonicator, 300 watts with pulsing capability
Filter	Whatman #41
Stemless funnel	75 mm, glass, Fisher 10-384B or equivalent

8.1.4. Extract Concentration

8.1.4.1. TurboVap Concentration Technique

Concentrator	TurboVap II or equivalent
Concentrator Tubes	200 ml Zymark tubes or equivalent
Pipettes	9 in, disposable glass
Volumetric Flask	1 ml, 10 ml
Graduated Cylinder	10 ml
Vials	2 ml, glass with Teflon faced septa; 20 ml, glass with Al or Teflon faced cap

Rubber Bulb	2 ml, latex

8.2. **Chemicals and Reagents**

Chemical/Reagent	Name	Source
Extraction solvent	Methylene Chloride	EM-DX0837-1 or equivalent
Exchange solvents	Hexane, Acetonitrile	EM-HX0297-1 or equivalent EM-AX0145-1 or equivalent
Drying reagent	Sodium Sulfate (baked at 400°C)	EM-SX0760E-3 or equivalent
Blank Soil	Organic free silica sand (baked at 400°C)	Ottawa Sand No. 30 or equivalent.

9.0 STANDARDS[1]

Analysis	Surrogate	Matrix Spike
Semivolatile	Spike amount – 0.4 ml	Spike amount – 0.2 ml
Semivolatile (SIM)	Spike amount – 0.1 ml	Spike amount – 0.05 ml
Chlorinated Pesticide	Spike amount – 1 ml	Spike amount – 1.0 ml
PCB	Spike amount – 1 ml	Spike amount - 0.5 ml
Polynuclear Aromatic Hydrocarbons By HPLC	Spike amount – 50 µL	Spike amount – 400 µL
Extractable TPH	Spike Amount – 1 ml	Spike Amount – 1 ml

10.0 PROCEDURES

10.1. Sample Preparation

10.1.1. Sample Handling

[1] For other methods, where this procedure is applicable, matrix spike and surrogate standards are listed in Section 9 of the specific analytical SOP.

10.1.1.1. Soil samples. Open the container and discard the top half-inch layer. Decant any water layer. Mix the sample thoroughly and discard any foreign objects, i.e., any vegetation, sticks, and rocks.

10.1.1.2. Concrete, mortar and other related samples. If sample amount is greater than 500 grams, use a clean aluminum pan to reduce the amount of sample by quartering. Return the excess sample that is in the sample container. Place the sample to be crushed in a clean 4" diameter steel mold. Position the 10-lb drop hammer vertically on top of the sample. Lift and drop the hammer until the sample is crushed to particles passing No. 10 standard sieve. Place the crushed sample in a clean and properly labeled sample container.

10.1.1.3. Perform moisture content determination as described in EMAX-MCD.

10.1.2. **Blank Soil Treatment**

10.1.2.1. Thoroughly wash the silica sand with methylene chloride.

10.1.2.2. Leave it open in a fume hood until the sand is air-dried.

10.1.2.3. Bake silica sand at 400 ^{o}C overnight and allow the sand to cool down.

10.1.2.4. Perform low level concentration extraction and have it analyzed for the intended use.

10.1.3. **Extraction - Low Level Concentration (< 20 mg/Kg)**

10.1.3.1. Weigh 30.0 g[2] of sample in a beaker and cover the beaker with aluminum foil before weighing the next sample. Use blank soil for Blank and LCS. Add sodium sulfate sufficient enough so that when mixed with the soil, the mixture shall have a free-flowing sandy texture.

10.1.3.2. Add matrix spike standard to matrix spike samples and LCS. Add surrogate standard to all samples to include blank, LCS and matrix spike samples. Refer to Section 9.0 for specific standard working solutions. Add about 80 ml of methylene chloride to each beaker.

10.1.3.3. Prepare the drying bed. Surface the stemless funnels with filter paper then pour anhydrous sodium sulfate to about 2/3 of the funnel. Rinse with methylene chloride and let it sit on properly labeled concentrator tube.

10.1.3.4. Fine-tune the pulse sonicator according to the manufacturer's operating manual to attain adequate extraction efficiency using ¾" probe. Make sure the probe is clean and rinsed with methylene chloride before using. Place the sonicator probe about 1/4 inch below the solvent. Turn on the sonicator and adjust the height of the probe so that the soil particles are free flowing with the solvent as the sonicator probe pulses without solvent spillage. Refer to 10.2.1 for pulse sonicator parameters.

10.1.3.5. Rinse the probe with methylene chloride into the beaker, and pour the extract into a drying bed.

10.1.3.6. Repeat the sonication process two times more, adding about 60 ml of fresh solvent each time. After the last extract has passed through the drying bed, rinse the beaker

[2] For TPH use 10-g unless otherwise specified by the project.

with methylene chloride wash bottle and combine the rinsate with the extract. Subsequently, rinse the drying bed with methylene chloride wash bottle. The extract is now ready for concentration.

10.1.4. **Extraction – Medium/High Concentration Levels (> 20 mg/Kg)**

10.1.4.1. Weigh 1.0 g of sample in a 40 ml vial. Wipe the rim of the each vial prior to capping them. Use blank soil for Blank and LCS.

10.1.4.2. Add matrix spike standard to matrix spike samples and LCS. Add surrogate standard to all samples to include blank, LCS and matrix spike samples. Refer to Section 9.0 for specific standard working solutions.

10.1.4.3. Add about 2 g of sodium sulfate and use a micro spatula for mixing. Pour about 20 ml of methylene chloride and stir the mixture with the spatula making sure that the soil and sodium sulfate is free flowing. Rinse the spatula with methylene chloride wash bottle.

10.1.4.4. Prepare the drying bed. Surface the stemless funnels with filter paper, containing about 5 g of anhydrous sodium sulfate. Rinse with methylene chloride and let it sit on properly labeled concentrator tube.

10.1.4.5. Sonicate the mixture for 2 minutes using $^{1}/_{8}$" probe. Rinse the probe with methylene chloride into the vial, and pour the extract into the drying bed.

10.1.4.6. Rinse the vial thoroughly. Subsequently, rinse the drying bed with methylene chloride wash bottle.

10.1.4.7. After all the rinsate has passed through the drying bed, the extract is now ready for concentration. Proceed to Section 10.1.6.

10.1.5. **Extraction – Wipe Samples**

10.1.5.1. Place a blank wipe in a 4-oz. sample jar with teflon-lined cap.

10.1.5.2. Note that samples received should be contained in a glass jar with Teflon-lined caps/septa. If not, record the sample condition as received in the extraction log and transfer the sample in a 4-oz. sample jar with Teflon-lined cap. Rinse the container with methylene chloride and pour the rinsate into the sample.

10.1.5.3. Add matrix spike standard to matrix spike samples and LCS. Add surrogate standard to all samples to include blank, LCS and matrix spike samples. Refer to Section 9.0 for specific standard working solutions.

10.1.5.4. Fill the sample container with methylene chloride until the wipe is completely submerged. Place the samples in the shaker. Turn on the shaker and shake for 1 hour.

10.1.5.5. Prepare the drying bed. Surface the stemless funnels with filter paper, and pour anhydrous sodium sulfate to about 2/3 of the funnel. Rinse with methylene chloride and let it sit on properly labeled concentrator tube.

10.1.5.6. Pour the extract into a drying bed. Rinse the sample thoroughly and pour the rinsate into the drying bed. Subsequently, rinse the drying bed with methylene chloride wash bottle.

10.1.5.7. After all the rinsate has passed through the drying bed, the extract is now ready for concentration. Proceed to 10.1.6.

10.1.6. **Concentrating Extracts**

10.1.6.1. Set the TurboVap concentrator as described in 10.2.2 and concentrate the extracts to ≤ final volume required in Table I. Refer to Table I for specific extract treatment. If solvent exchange is required, proceed to 10.1.6.2. If solvent exchange is not required, proceed to 10.1.6.3. If extract clean up is required, refer to specific clean-up SOP.

10.1.6.2. Using an appropriate solvent wash bottle, rinse the sides of the concentrator tube and swirl the tube to mix the concentrated extract with the exchange solvent. Add approximately 100 ml of exchange solvent and concentrate to ≤ final volume required in table.

10.1.6.3. Adjust the volume of the solvent according to Table I. Transfer the extract in a properly labeled and appropriate extract container.

Table 1: Specific Extract Treatment

Method	Exchange Solvent	Final Vol. (ml)	Extract Container
Semi volatile	none	2	4 ml screw cap vial with Teflon faced septa
Chlorinated Pesticides	Hexane	10	20 ml clear vial with Teflon lined cap
Polynuclear Aromatic Hydrocarbons	Acetonitrile	5	20 ml clear vial with Teflon lined cap
Extractable TPH	None	10	20 ml clear vial with Teflon lined cap

10.2. **Instrument Parameters**

10.2.1. Pulse Sonicator

Make	Duty Cycle	Intensity/Output Control	Timer (min)
Tekmar Sonic Disruptor	50%-70%	10	3
Braun-Sonic U	0.5	High	3
Branson Sonifier 450	50%-70%	10	3
Tekmar Ultrasonic Processor	Pulse on: 0.8 sec Pulse off: 0.5 sec	75%-85% 40% max. when using microtip	1 min:52 sec

10.2.2. Concentrator

10.2.2.1. TurboVap Concentrator

10.2.2.2. Set the water bath temperature at a maximum of 5°C less than the boiling point of the solvent in use, i.e., methylene chloride (BP = 40 °C). Temperature setting shall not exceed 35 °C.

10.2.2.3. Maintain the pressure of Nitrogen blowing down into the extracts at 11 psi.

10.3. **Calibration**

10.3.1. Calibrate pipettes used to dispense standards to ensure accuracy in standard addition as described in EMAX-QC06.

10.3.2. Check that the balance used for sample weighing was calibrated for the day, otherwise inform the supervisor.

10.4. **Analysis**

10.4.1. Refer to specific analytical SOP.

10.5. **Calculations**

10.5.1. Not applicable.

10.6. **Preventive Maintenance**

10.6.1. Maintain cleanliness in the extraction lab to minimize contamination uncertainties.

11.0 QUALITY CONTROL

11.1. The maximum number of original field samples in an analytical batch shall be 20 unless otherwise specified by the project.

11.2. Matrix spike samples shall be taken from a specified matrix spike field sample. In the absence of a specified matrix spike field sample, the analyst performing the extraction shall choose from any of the samples within the analytical batch.

11.3. A method blank, LCS, MS and sample duplicate shall be prepared in every analytical batch, unless otherwise specified by the project. They shall be subjected to the same process that the field samples undergo as described in Section 10.

11.4. In the event that there is insufficient amount of sample to be used for MS/MSD, LCS duplicate shall be prepared to demonstrate precision.

11.5. All labwares to be used in the sample preparation shall be properly treated as specified in EMAX-QC07.

11.6. All reagents and standards shall undergo quality control acceptance prior to its use.

12.0 CORRECTIVE ACTION

12.1. Whenever the following circumstances occur, corrective action shall be undertaken as advised below:

- Insufficient amount of sample. Check the COC and/or analytical folder for any special instruction. If none, complete the NCR and inform the supervisor immediately for further instruction.
- Breakage of sample container. Identify the sample and check for sample spare. If a spare is found, replace the broken sample. If not, inform your supervisor immediately for further action.
- Breakdown of apparatus. If the concentrator is broken (no power supply) in the middle of extraction, resolve the problem and continue to extract the samples. If the problem is beyond your means, inform your supervisor.

- Breakage of extract container or sample was spilled prior to dilution to final volume. Identify the extract. If it is a method blank or LCS, re-extract the whole analytical batch. If it is a sample, re-extract the sample with a method blank and LCS. If re-extraction is not possible, inform your supervisor for further action.

13.0 POLLUTION PREVENTION

13.1. Prevent indoor pollution by handling the solvents and extracts under the fume hoods.

13.2. Separate and properly identify all unused expired analytical standards prior to endorsing them to Waste Disposal Unit for proper disposal.

13.3. Keep extraction area clean to prevent contamination of sample.

14.0 WASTE MANAGEMENT

14.1. Collect all waste generated, i.e. extracted samples, filters, wipes, vials, etc. and properly turn them over to the waste disposal unit.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – A group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.1.1. **Preparation batch** – Composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.2. **Analytical batch –** Composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – A determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Lab Control Sample (LCS) – A target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.4. Matrix – A component or form of a sample.

15.1.5. Matrix Spike (MS) – A sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.6. Matrix Spike Duplicate (MSD) – A replicate of MS analyzed to monitor precision or recovery.

15.1.7. Method Blank – A target-analyte-free sample subjected to the entire sample preparation

and/or analytical to monitor contamination.

15.1.8. Reagent Water – Purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.9. Sample – A specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.10. Sample Duplicate – A second sample aliquot of any sample (preferably the MS sample) to check matrix homogeneity and precision of method in a given matrix.

15.1.11. Sub-sample – An aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing this analysis unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. USEPA SW846, Method 3550B

17.0 APPENDICES

17.1. Appendix

17.1.1. Appendix 1 Demonstration of Capability

17.2. Forms

17.2.1. 3550FS Extraction Log

Appendix 1: **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil / Hazardous Waste PT** **PT Study Closing Date: 3/4/2010**

Method: **SW 3550 C/SW 8270 D** **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
1	1,2,3,4-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
2	1,2,3,5-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
3	1,2,3-Trichlorobenzene	<330 ug/kg	<500	-	Acceptable
4	1,2,4,5-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
5	1,2,4-Trichlorobenzene	1000 ug/kg	1790	300-2070	Acceptable
6	1,2-Dichlorobenzene	<330 ug/kg	<300	-	Acceptable
7	1,3,5-Trichlorobenzene	<330 ug/kg	<500	-	Acceptable
8	1,3-Dichlorobenzene	<330 ug/kg	<300	-	Acceptable
9	1,4-Dichlorobenzene	1000 ug/kg	1920	300-2120	Acceptable
10	1-Chloronaphthalene	<330 ug/kg	<500	-	Acceptable
11	2,3,4,5-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
12	2,3,4,6-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
13	2,3,4-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
14	2,3,5,6-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
15	2,3,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
16	2,3,6-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
17	2,3-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
18	2,4,5-Trichlorophenol	1130 ug/kg	1900	300-2300	Acceptable
19	2,4,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
20	2,4,6-Trichlorophenol	958 ug/kg	1800	300-2240	Acceptable
21	2,4,6-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
22	2,4-Dibromophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
23	2,4-Dichlorophenol	962 ug/kg	1800	300-2260	Acceptable
24	2,4-Dichlorophenyl-3-methyl-4-nitrophenyle	<330 ug/kg	<500	-	Acceptable
25	2,4-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
26	2,4-Dimethylphenol	1080 ug/kg	3790	505-4170	Acceptable
27	2,4-Dinitrophenol	<660 ug/kg	<600	-	Acceptable
28	2,4-Dinitrotoluene	1240 ug/kg	1820	300-2570	Acceptable
29	2,5-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
30	2,6-Dichlorophenol	1160 ug/kg	2110	523-2330	Acceptable
31	2,6-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
32	2,6-Dinitrotoluene	<330 ug/kg	<300	-	Acceptable
33	2-Amino-1-methylbenzene	<330 ug/kg	<500	-	Acceptable
34	2-Chloronaphthalene	613 ug/kg	1120	200-1350	Acceptable
35	2-Chlorophenol	1190 ug/kg	2300	300-2870	Acceptable
36	2-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
37	2-Methyl-4,6-Dinitrophenol	<660 ug/kg	<600	-	Acceptable
38	2-Methylnaphthalene	961 ug/kg	1620	426-1780	Acceptable
39	2-Methylphenol	2470 ug/kg	5190	600-5710	Acceptable

Appendix 1 (cont.): **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil / Hazardous Waste PT** **PT Study Closing Date: 3/4/2010**

Method: **SW 3550 C/SW 8270 D** **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
40	2-Nitroaniline	<330 ug/kg	<500	-	Acceptable
41	2-Nitrophenol	1510 ug/kg	3630	600-3990	Acceptable
42	3,3'-Dichlorobenzidine	<330 ug/kg	<500	-	Acceptable
43	3,4,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
44	3,4-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
45	3,5-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
46	3-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
47	3-Nitroaniline	<330 ug/kg	<500	-	Acceptable
48	3-Nitrophenol	<330 ug/kg	<500	-	Acceptable
49	4-Bromophenyl-phenylether	2300 ug/kg	3040	836-3580	Acceptable
50	4-Chloro-3-methylphenol	<330 ug/kg	<300	-	Acceptable
51	4-Chloroaniline	655 ug/kg	815	0-1960	Acceptable
52	4-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
53	4-Chlorophenyl-phenylether	2370 ug/kg	3390	842-3930	Acceptable
54	4-Methylphenol (and/or 3-Methylphenol)	2400 ug/kg	4600	1200-5060	Acceptable
55	4-Nitroaniline	1200 ug/kg	1070	107-4210	Acceptable
56	4-Nitrophenol	1830 ug/kg	5500	600-6600	Acceptable
57	4-Nitrophenylphenylether	<330 ug/kg	<500	-	Acceptable
58	Acenaphthene	870 ug/kg	1420	200-1820	Acceptable
59	Acenaphthylene	863 ug/kg	1500	228-1930	Acceptable
60	Aniline	<660 ug/kg	<500	-	Acceptable
61	Anthracene	1380 ug/kg	1850	343-2420	Acceptable
62	Benzidine	<1300 ug/kg	<500	-	Acceptable
63	Benzo(a)anthracene	1240 ug/kg	1400	364-1890	Acceptable
64	Benzo(a)pyrene	1110 ug/kg	1340	319-1840	Acceptable
65	Benzo(b)fluoranthene	<330 ug/kg	<200	-	Acceptable
66	Benzo(g,h,i)perylene	<330 ug/kg	<200	-	Acceptable
67	Benzo(k)fluoranthene	1330 ug/kg	1760	444-2240	Acceptable
68	Benzoic acid	<1300 ug/kg	<500	-	Acceptable
69	Benzotrichloride	<330 ug/kg	<500	-	Acceptable
70	Benzyl alcohol	<330 ug/kg	<500	-	Acceptable
71	Benzyl chloride	<330 ug/kg	<500	-	Acceptable
72	Bis(2-chloroethoxy)methane	993 ug/kg	1710	300-2120	Acceptable
73	bis(2-Chloroethyl)ether	977 ug/kg	1840	229-2020	Acceptable
74	Bis(2-chloroisopropyl) ether	<330 ug/kg	<300	-	Acceptable
75	Bis(2-ethylhexyl)phthalate	1600 ug/kg	1690	300-2660	Acceptable
76	bis(2-methoxyethyl)phthalate	<330 ug/kg	<500	-	Acceptable
77	Butyl benzyl phthalate	1790 ug/kg	2130	446-2840	Acceptable
78	Carbazole	<330 ug/kg	<500	-	Acceptable

Appendix 1 (cont.): **DEMONSTRATION OF CAPABILITY**

PT # HW0110 Soil / Hazardous Waste PT **PT Study Closing Date: 3/4/2010**

Method: SW 3550 C/SW 8270 D **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
79	Chrysene	<330 ug/kg	<200	-	Acceptable
80	Diamylphthalate	<330 ug/kg	<500	-	Acceptable
81	Dibenzo(a,h)anthracene	1110 ug/kg	1260	200-1910	Acceptable
82	Dibenzofuran	1660 ug/kg	2520	648-2990	Acceptable
83	Dicyclohexylphthalate	<330 ug/kg	<500	-	Acceptable
84	Diethylphthalate	1200 ug/kg	1830	300-2420	Acceptable
85	Dimethylphthalate	1270 ug/kg	1970	300-2550	Acceptable
86	Di-n-butylphthalate	1530 ug/kg	1900	300-2730	Acceptable
87	Di-n-octylphthalate	1750 ug/kg	1950	300-2900	Acceptable
88	Dinonylphthalate	<330 ug/kg	<500	-	Acceptable
89	Fluoranthene	2000 ug/kg	2360	720-3040	Acceptable
90	Fluorene	1260 ug/kg	1820	349-2340	Acceptable
91	Hexachlorobenzene	<330 ug/kg	<300	-	Acceptable
92	Hexachlorobutadiene	1140 ug/kg	1900	300-2400	Acceptable
93	Hexachlorocyclohexane	<330 ug/kg	<500	-	Acceptable
94	Hexachlorocyclopentadiene	<330 ug/kg	<300	-	Acceptable
95	Hexachloroethane	895 ug/kg	1840	71.8-2050	Acceptable
96	Hexyl-2-ethylhexylphthalate	<330 ug/kg	<500	-	Acceptable
97	Indeno(1,2,3-cd)pyrene	<330 ug/kg	<200	-	Acceptable
98	Isophorone	814 ug/kg	1740	423-1920	Acceptable
99	Maleic anhydride	<330 ug/kg	<500	-	Acceptable
100	Naphthalene	1050 ug/kg	1830	218-2160	Acceptable
101	Nitrobenzene	1040 ug/kg	1920	300-2430	Acceptable
102	N-Nitrosodiethylamine	<330 ug/kg	<1500	-	Acceptable
103	N-Nitrosodimethylamine	653 ug/kg	1860	0-2040	Acceptable
104	N-Nitroso-di-n-propylamine	<330 ug/kg	<300	-	Acceptable
105	N-Nitrosodiphenylamine	1000 ug/kg	1700	422-1990	Acceptable
106	Pentachlorobenzene	<330 ug/kg	<500	-	Acceptable
107	Pentachlorohexane	<330 ug/kg	<500	-	Acceptable
108	Pentachlorophenol	2550 ug/kg	5790	600-6370	Acceptable
109	Phenanthrene	1360 ug/kg	1810	372-2330	Acceptable
110	Phenol	1930 ug/kg	3800	380-4280	Acceptable
111	Pyrene	1390 ug/kg	1720	497-2270	Acceptable
112	Pyridine	<1300 ug/kg	<500	-	Acceptable

Appendix 1 (cont.): **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil/Hazardous Waste Proficiency Testing** **PT Study Closing Date: Mar. 4, 2010**

Method: SW 3550 C / SW 8081 B Analyst: Enrico Santos

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aldrin	419	µg/Kg	412	130	-	562	Acceptable
2	alpha-BHC	428	µg/Kg	236	126	-	555	Acceptable
3	beta-BHC	156	µg/Kg	172	30.4	-	263	Acceptable
4	delta-BHC	307	µg/Kg	344	77.7	-	431	Acceptable
5	gamma-BHC (Lindane)	276	µg/Kg	299	84.6	-	412	Acceptable
6	alpha-Chlordane	200	µg/Kg	194	65.3	-	262	Acceptable
7	gamma-Chlordane	303	µg/Kg	331	139	-	428	Acceptable
8	DDD (4,4)	288	µg/Kg	324	118	-	464	Acceptable
9	DDE (4,4)	47.9	µg/Kg	57.6	11.1	-	96.4	Acceptable
10	DDT (4,4)	130	µg/Kg	181	44.4	-	276	Acceptable
11	Dieldrin	475	µg/Kg	483	190	-	653	Acceptable
12	Endosulfan I	329	µg/Kg	374	123	-	487	Acceptable
13	Endosulfan II	252	µg/Kg	265	76.1	-	361	Acceptable
14	Endosulfan Sulfate	105	µg/Kg	124	21.9	-	180	Acceptable
15	Endrin	155	µg/Kg	186	60.8	-	228	Acceptable
16	Endrin aldehyde	172	µg/Kg	371	37.1	-	409	Acceptable
17	Endrin Ketone	407	µg/Kg	459	121	-	634	Acceptable
18	Heptachlor	70.0	µg/Kg	86.4	22.9	-	118	Acceptable
19	Heptachlor Epoxide (beta)	56.2	µg/Kg	71.7	21.9	-	98.3	Acceptable
20	Methoxychlor	374	µg/Kg	392	43.4	-	601	Acceptable
21	Chlordane (total)	572	µg/Kg	652	140	-	926	Acceptable
22	Toxaphene (total)	783	µg/Kg	785	78.5	-	1130	Acceptable

Appendix 1 (cont.): **DEMONSTRATION OF CAPABILITY**

PT # WP0110 Water Pollution Proficiency Testing PT Study Closing Date: Feb. 18, 2010

Method: SW 3580 / SW 8082 A Analyst: Supakit Deesopha

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aroclor 1016	18.6	mg/Kg	30.1	4.83	-	42.0	Acceptable
4	Aroclor 1242	0	mg/Kg	0				Acceptable
6	Aroclor 1254	0	mg/Kg	0				Acceptable
7	Aroclor 1260	0	mg/Kg	0				Acceptable

PT # HW0110 Soil/Hazardous Waste Proficiency Testing PT Study Closing Date: Mar. 4, 2010

Method: SW 3550 C / SW 8081 B Analyst: Enrico Santos

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aroclor 1016	5.81	mg/kg	6.03	1.22	-	8.42	Acceptable
2	Aroclor 1221	<0.05	mg/kg	<0.2				Acceptable
3	Aroclor 1232	<0.05	mg/kg	<0.2				Acceptable
4	Aroclor 1242	<0.05	mg/kg	<0.2				Acceptable
5	Aroclor 1248	<0.05	mg/kg	<0.2				Acceptable
6	Aroclor 1254	<0.05	mg/kg	<0.2				Acceptable
7	Aroclor 1260	<0.05	mg/kg	<0.2				Acceptable
8	Total PCBs	5.81	mg/kg	6.03	1.22	-	8.42	Acceptable

3550FS: **EXTRACTION LOG**

EMAX LABORATORIES, INC.

Page 1

EXTRACTION LOG FOR TPH

SOP ☐ EMAX-3550 Rev. No.3 ☐ EMAX-3520 Rev. No.2 ☐ EMAX-LUFT E Rev. No.3 ☐ EMAX-3540 Rev. No.2 ☐ EMAX-3510Rev.No. 2 ☐ EMAX-AK102 Rev.No. 3

Matrix: Start Date: Time: End Date: Time: Book # EDS-050

PREPARATION BATCH * _____

Sample Prep ID	Lab Sample ID	Sonicator Number	Sample Amount (g | ml)	Extract Volume (ml)	Silica Gel Clean-up	Notes
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						

Standards	ID	Amount Added (ml)
Surrogate		
LCS/MS		

Reagent	Lot# / ID
CH_2Cl_2	
Na_2SO4	
HCl	
Silica Sand	
Silica Gel	

TUNING	
Sonicator #	Reading

Concentrator Water Bath Temp. (C)		
1		
2		
3		
4		
5		
6		

Comments: Test thermometer = T_1

Prepared By: Standard Added By:

Witnessed By: Checked By:

Extract Received by: Extract Location:

Disposal Date: Disposed By:

This page is checked during data review.

TOC

STANDARD OPERATING PROCEDURES

CLOSED SYSTEM PURGE AND TRAP

SOP No.:	EMAX-5035	Revision No.	2	Date:	14-May-09
Prepared By:	Souzan Greas			Date:	05-14-09
Approved By:	Kenette Pimentel QA Manager			Date:	05.14.09
Approved By:	Caspar Pang Laboratory Director			Date:	5/14/09

Control Number: **5035-02-**

1.0 SCOPE AND APPLICATION

1.1. This method describes a closed-system purge and trap process for the sample preparation and extraction for the analysis of volatile organics in a solid matrix. It applies to the gas chromatographic determination of volatile organics in sediment, soil, and waste. The low soil method (0.5 to 200 µg/kg) utilize a hermetically-sealed sample vial, the seal of which is never broken from the time of sampling to the time of sample preservation. Procedures are also included for preparing high concentration sample for purging by Method 5030C.

2.0 SUMMARY OF METHOD

2.1. Low Concentration Soil Samples (0.5-200 µg/Kg)

2.1.1. Samples collected in EnCore^{R} tube are preserved within 48 hours of sample collection by directly transferring its contents into a 40 ml vial containing sodium bisulfate as preservative, 5-ml of reagent water and a stir bar. Samples are extracted in a purge and trap closed system interfaced to a GC instrument equipped with a detector appropriate for the determinative method.

2.1.2. In the purge and trap closed, is equipped with an autosamper. The vial containing the sample is simultaneously analyzed and heated. A duplicate sample is prepared in case re-analysis is needed.

2.2. High Concentration Soil Sample and another Encore tube is extracted with 5-ml methanol in case sample dilution is necessary.

2.3. This method is an adaptation of SW846 Method 5035A.

2.4. **Interferences**

2.4.1. Impurities in the purge gas and organic compounds in the trap account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination by running method blanks. The use of non-polytetrafluoroethylene (non-PTFE) plastic coating, non-PTFE thread sealant, or flow controllers with rubber components in the purging device must be avoided. These compounds will result in interferences or false positives in the determinative step.

2.4.2. Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) during shipment or storage. A trip blank prepared from organic-free reagent water and carried through sampling and handling serves as a check on such contamination.

2.4.3. Contamination by carryover can occur whenever high-concentration and low-concentration samples are analyzed in sequence. Where practical, samples with unusually high concentrations of analytes should be followed by an analysis of organic-free reagent water to check for cross-contamination.

2.4.4. The volatile lab should be free of solvents and contamination. Special precautions must be taken to determine methylene chloride. The volatile area should be isolated from all atmospheric sources of methylene chloride, otherwise random background levels will result.

3.0 REPORTING LIMITS

3.1. Refer to specific analytical SOP.

4.0 DYNAMIC RANGE

4.1. 5.0 µg/kg to 200 µg/kg

5.0 PRESERVATION AND HOLDING TIME

5.1. Samples are preserved with sodium bisulfate or extracted with methanol within 48 hours from sampling date or as specified by the project.

5.2. Analyze preserved samples within 14 days from sampling or extracts within 14 days from extraction.

5.3. Preserved samples and extracts shall be stored at $\leq 6^{o}C$.

6.0 ASSOCIATED SOPs

6.1. All SOPs utilize purge and trap procedures for sample preparation are listed below:

6.1.1. EMAX-BTEXM Aromatic Volatile Volatiles by GC

6.1.2. EMAX-8015P Total Volatile Petroleum Hydrocarbons

6.1.3. EMAX-8260 Volatile Organics by GC/MS

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. All reagents, standards, and samples shall be treated as potential hazards. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves, shall be worn at all times when performing this procedure. All sample and standard handling shall be performed in the fume hood.

7.3. All wastes generated during the analytical process shall be placed in the wastes containers. These wastes shall be endorsed to the waste disposal section for proper disposal.

7.4. Water samples shall be neutralized to pH 7 ($\pm$ 2) prior to disposal.

7.5. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If an irritation persists, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS, AND SUPPLIES

8.1. Instruments and Supplies

8.1.1. Purge and Trap Autosampler : Archon

8.1.2. Trap: VOCARB 4000 (Supelco) or equivalent

8.1.3. Syringe: 5 ml, gas-tight with Luerlok tip

8.1.4. Microsyringe: 5, 10, 25, 50 µl (Hamilton 702N or equivalent)

8.1.5. Sparging Vessel: 40 ml vials with screw cap and Teflon-lined septum

8.1.6. Stir bars: Teflon lined

8.1.7. Archon Soil Method Program (If applicable to the method) : Internal Standard solution is added automatically by the instrument to the initial calibration standards containing all analytes of interest and surrogates, in the same fashion as used for the samples.

8.2. Chemicals and Reagents

8.2.1. Reagent Water: Organic free water, generated from active charcoal column.

8.2.2. Reagent Soil: Silica sand baked at 200°C overnight

8.2.3. Preservative: Sodium Bisulfate, Reagent grade

8.2.4. Extraction Solvent: Methanol, Ultrapure

9.0 STANDARDS

9.1. Preparation of standard is outlined in Section 9.0 of each analytical method.

9.2. Spiking Standard Solution

9.2.1. Refer to specific analytical method.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Decontamination of Reusable Labwares

10.1.1.1. Stir bars. Wash recycled stir bars with tap water until no solids are visible. Rinse with methanol and final rinse with copious amount of reagent water. Bake for a minimum of 2 hours at 120°C and allow cooling before reuse.

10.1.2. Purifying Reagent Soil

10.1.2.1. Fill a clean 1-L wide mouth glass jar with silica sand. Label the jar with the silica sand lot number for traceability purposes and bake it at 200 °C overnight.

10.1.2.2. Analyze a 5-g sample to verify that the reagent soil is organic free.

10.1.2.3. Sample result must be < RL for all target analytes, otherwise, the lot will be discarded.

10.1.2.4. Submit result to the QA Department.

10.1.3. Low Level Sample Preservation (<200µg/kg)

10.1.3.1. Remove EnCore tubes from freezer and let them warm up to room temperature. Line them up chronologically according to the sample IDs.

10.1.3.2. Label the vials and line them up in the same order as the EnCore tubes. Prepare one extra vial for preparation blank.

10.1.3.3. Add 1-g of sodium bisulfate, 5 ml of organics free water and a clean stirring bar to each of the vials. Re-cap the vial and gently mix the content.

10.1.3.4. List the samples into the preparation log on the same order as the samples are lined up.

10.1.3.5. Weigh the first vial and record the weight to the nearest 0.01-g as W_1. Open the Encore Tube envelope corresponding to the first vial and take-out one tube and re-seal the envelope.

10.1.3.6. Using the Encore tube sample extruder, remove the tube seal and quickly extrude the entire content of the EnCore tube into the vial and seal the vial with the screw cap. Record the weight to the nearest .01-g as W_2.

Note: Due to the nature of volatile compounds, minimum sample exposure must be observed during the sample transfer from the Encore tube to the vial.

10.1.3.7. Repeat the same procedures for the rest of the samples.

10.1.3.8. Duplicate the entire process suffixing the sample IDs with "R" to be used in case re-analysis is needed.

10.1.3.9. Extract another set of samples as described in 10.1.4 in case sample concentration(s) is >200 µg/kg. Prepare another preparation blank for each preparation batch.

10.1.4. Medium Level Samples (>200µg/kg)

10.1.4.1. Remove EnCore tubes from sample storage and let them warm up to room temperature. Line them up chronologically according to the sample IDs.

10.1.4.2. Label the vials and line them up in the same order as the EnCore tubes. Prepare one extra vial for extraction blank.

10.1.4.3. Add 5-ml of methanol containing 2.5 µg/ml of surrogate and matrix spikes to designated MS/MSD samples. Re-cap each vial after methanol addition.

10.1.4.4. List the samples into the extraction log on the same order as the samples are lined up.

10.1.4.5. Weigh the first vial and record the weight to the nearest 0.01-g as W_1. Open the EnCore Tube envelope corresponding to the first vial, and take-out one tube.

10.1.4.6. Using the EnCore tube sample extruder, remove the tube seal and quickly extrude the entire content of the EnCore tube into the vial and seal the vial. Record the weight to the nearest .01-g as W_2. Use 5-g of reagent soil for the extraction blank.

Note: Due to the nature of volatile compounds, minimum sample exposure must be observed during the sample transfer from the Encore tube to the vial.

10.1.4.7. Repeat the same procedures for the rest of the samples.

10.1.4.8. Store extracts at ≤ 6°C.

10.2. **Instrument Parameters**

10.2.1.	Purge Gas	:	Helium at 40 ml/min at 30 psi
10.2.2.	Desorb Time	:	4.0 ± 0.1 min.
10.2.3.	Purge Time	:	11.0 ± 0.1 min.
10.2.4.	Purge Temp.	:	40°C
10.2.5.	Desorb Temp.	:	220°C

10.2.6. Backflush Gas Flow: 20-60 ml/min.

10.3. **Calibration**

10.3.1. Refer to specific analytical method.

10.4. **Analysis**

10.4.1. Refer to specific analytical method.

10.5. **Data Reduction**

10.5.1. Refer to specific analytical method.

10.6. **Calculations**

10.6.1. Refer to specific analytical method.

10.7. **Report Generation**

10.7.1. Refer to specific analytical method.

10.8. **Data Review**

10.8.1. Refer to specific analytical method.

10.9. **Preventive Maintenance**

10.9.1. Instruments should receive routine preventive maintenance. Routine maintenance insures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction, consequently affecting results.

11.0 QUALITY CONTROL

11.1. Before processing any samples, the analyst must demonstrate through the analysis of reagent water blank that all glassware and reagents are free of interference.

11.2. The sequence of runs and quality control acceptance criteria are specified in the individual analytical methods. They include method blank, calibrations, lab control samples, and matrix spike/matrix spike duplicate.

12.0 CORRECTIVE ACTIONS

12.1. Since the performance of this method is always combined with an individual analytical method, the corrective actions are outlined in the specific methods.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped in the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to the WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to the WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. When the low concentration samples are strongly alkaline or highly calcareous in nature, the sodium bisulfate solution may not be strong enough to reduce the pH of the sample to below 2. Additional steps may be required to preserve the samples. Such steps include: addition of large amount of sodium bisulfate solution, storage of the samples at –10°C, or significantly reducing the maximum holding time for low concentration samples. Whichever steps are employed, they should be clearly described in the case narrative.

15.2. Soil samples that contain carbonate minerals may effervescence upon contact with the acidic preservative solution in low concentration sampling vial. Therefore, when samples are known or suspected to contain high levels of carbonate, sodium bisulfate should be replaced with organic free reagent water and samples should be analyzed within 48 hours of sampling.

15.3. **Application of EMAX QC Procedures**

15.3.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing purgeable volatile analyses. In instances where there is a project or program QAPP, the requirements given in the project shall take precedence over this SOP.

15.3.2. **Department of Defense (DoD) Projects**

15.3.2.1. When samples from DoD sponsored projects are analyzed for purgeable volatiles, the calibration, QC, corrective action, and data flagging requirements shall follow the specifics outlined in the DoD Quality Systems Manual for Environmental Laboratories, latest version. In the absence of a project QAPP or directive from the client project manager, DoD Quality Systems Manual latest version shall be applied.

16.0 REFERENCES

1.1. "Test Methods for Evaluating Solid Waste, Physical / Chemical Methods", EPA Publication SW-846 Update IV, Method 5035A.

1.2. EMAX Quality Systems Manual.

17.0 APPENDICES

17.1.	Table 1	Method Proficiency for Volatiles
17.2.	Appendix 1	Preservation Log for Volatiles
17.3.	Appendix 2	Extraction Log for Volatiles

METHOD PROFICIENCY

Unit: µg/kg
Sample Amount(g): 5
Sample Purge(ml): 5
Type of Sample: Encore

Date Analyzed: 04/30/09
Analyzed by: C. Mendoza

PARAMETER	VO03D38L RDB648	VO03D38C RDB649	VO03D39L RDB656	VO03D39C RDB657	TV (ug/kg)	Ave. Conc.	Ave. % Rec.	Std Dev.	RSD	QC Criteria	Comments
Acetone	187.54	191.45	174.90	178.69	200	183.14	92	7.662	4	40 - 160	Passed
Acrolein	181.46	189.98	171.92	173.74	200	179.27	90	8.247	5	50 - 150	Passed
Acrylonitrile	252.64	260.58	248.34	246.56	250	252.03	101	6.248	2	70 - 130	Passed
Benzene	51.35	51.94	49.59	52.09	50	51.24	102	1.144	2	70 - 130	Passed
Bromobenzene	49.97	53.20	54.23	52.85	50	52.56	105	1.824	3	70 - 130	Passed
Bromochloromethane	51.67	52.47	52.02	52.87	50	52.26	105	0.524	1	60 - 150	Passed
Bromodichloromethane	52.79	52.51	51.39	53.53	50	52.56	105	0.886	2	60 - 130	Passed
Bromoform	50.71	54.52	54.33	52.55	50	53.03	106	1.782	3	60 - 130	Passed
Bromomethane	48.46	50.99	44.82	44.72	50	47.25	94	3.041	6	40 - 160	Passed
tert-Butyl alcohol	238.13	253.76	253.20	249.46	250	248.64	99	7.260	3	70 - 160	Passed
2-Butanone (MEK)	194.60	203.41	195.39	187.35	200	195.18	98	6.570	3	50 - 160	Passed
n-Butylbenzene	53.62	55.67	54.09	53.14	50	54.13	108	1.099	2	50 - 150	Passed
sec-Butylbenzene	52.41	55.10	55.17	52.11	50	53.70	107	1.664	3	70 - 130	Passed
tert-Butylbenzene	50.00	53.43	54.57	50.92	50	52.23	104	2.128	4	70 - 130	Passed
Carbon disulfide	50.44	51.90	48.52	50.11	50	50.24	100	1.387	3	50 - 130	Passed
Carbon tetrachloride	52.23	52.39	50.27	52.57	50	51.86	104	1.071	2	50 - 130	Passed
Chlorobenzene	52.11	52.70	50.39	53.17	50	52.09	104	1.213	2	70 - 130	Passed
Chloroethane	48.37	52.88	45.16	44.42	50	47.71	95	3.852	8	60 - 150	Passed
Chloroform	51.33	53.33	51.87	51.78	50	52.08	104	0.869	2	70 - 130	Passed
1-Chlorohexane	52.57	52.58	49.92	52.49	50	51.89	104	1.316	3	70 - 130	Passed
Chloromethane	49.81	54.44	45.04	45.96	50	48.81	98	4.282	9	50 - 150	Passed
2-Chlorotoluene	52.34	54.06	55.06	52.31	50	53.44	107	1.354	3	70 - 130	Passed
4-Chlorotoluene	49.34	54.63	55.12	51.80	50	52.72	105	2.687	5	70 - 130	Passed
Dibromochloromethane	51.79	52.61	51.61	53.33	50	52.33	105	0.794	2	70 - 130	Passed
1,2-Dibromo-3-chloropropane	49.76	49.57	52.42	52.52	50	51.07	102	1.623	3	50 - 150	Passed
1,2-Dibromoethane	51.17	51.56	50.80	51.59	50	51.28	103	0.372	1	50 - 150	Passed
Dibromomethane	51.84	51.65	51.69	53.28	50	52.11	104	0.780	1	70 - 130	Passed
1,1-Dichloroethane	51.90	54.02	51.35	52.45	50	52.43	105	1.152	2	70 - 130	Passed
1,2-Dichloroethane	51.23	51.63	51.71	53.14	50	51.93	104	0.833	2	60 - 140	Passed
1,2-Dichlorobenzene	51.71	52.99	51.60	52.83	50	52.28	105	0.730	1	70 - 130	Passed
1,3-Dichlorobenzene	51.73	54.06	53.57	52.47	50	52.96	106	1.054	2	70 - 130	Passed
trans-1,4-Dichloro-2-Butene	49.44	53.37	51.81	50.75	50	51.34	103	1.666	3	60 - 140	Passed
1,4-Dichlorobenzene	52.08	53.21	52.52	52.73	50	52.64	105	0.467	1	70 - 130	Passed
Dichlorodifluoromethane	50.77	53.47	46.30	46.58	50	49.28	99	3.463	7	50 - 130	Passed
1,1-Dichloroethene	51.86	53.61	51.17	51.30	50	51.99	104	1.126	2	60 - 130	Passed
cis-1,2-Dichloroethene	52.35	54.74	52.08	52.76	50	52.98	106	1.205	2	70 - 130	Passed
trans-1,2-Dichloroethene	52.57	53.86	50.93	52.17	50	52.38	105	1.206	2	70 - 130	Passed
1,1-Dichloropropene	50.41	51.29	50.00	52.42	50	51.03	102	1.070	2	70 - 130	Passed
1,2-Dichloropropane	52.33	52.32	51.52	53.41	50	52.40	105	0.775	1	70 - 130	Passed
1,3-Dichloropropane	50.72	51.88	51.52	52.81	50	51.74	103	0.866	2	70 - 140	Passed
2,2-Dichloropropane	54.83	56.42	51.01	51.77	50	53.51	107	2.546	5	40 - 140	Passed
cis-1,3-Dichloropropene	52.47	52.75	51.23	53.64	50	52.52	105	0.998	2	60 - 130	Passed
trans-1,3-Dichloropropene	52.96	53.63	52.16	53.88	50	53.16	106	0.770	1	60 - 140	Passed
tert-Butyl ethyl ether (ETB	51.18	52.95	51.48	52.96	50	52.14	104	0.947	2	70 - 130	Passed
Ethyl Methacrylate	50.98	51.72	51.94	52.23	50	51.72	103	0.535	1	50 - 150	Passed
Ethylbenzene	52.75	53.33	52.20	52.67	50	52.74	105	0.461	1	70 - 130	Passed
2-Hexanone (MBK)	200.32	202.82	196.57	192.08	200	197.95	99	4.681	2	60 - 160	Passed
Hexachlorobutadiene	52.63	52.31	49.11	50.97	50	51.26	103	1.603	3	50 - 140	Passed
Iodomethane	51.81	53.99	50.43	51.44	50	51.92	104	1.500	3	40 - 150	Passed
Isopropyl ether (DIPE)	52.24	53.76	51.98	52.69	50	52.67	105	0.785	1	70 - 130	Passed
Isopropylbenzene	50.44	53.35	54.11	52.30	50	52.55	105	1.590	3	70 - 140	Passed
p-Isopropyltoluene	51.73	53.91	53.44	52.85	50	52.98	106	0.942	2	60 - 140	Passed
Methylene Chloride	47.32	49.29	47.13	47.39	50	47.78	96	1.009	2	70 - 130	Passed

PRESERVATION LOG FOR VOLATILES

SOP ☐ 5035 Revision No. 2 ☐ **Book # E02-026**

Start Date: **Time:** **End Date:** **Time:**

Lab Sample ID	W_1 (g)	W_f (g)	Notes

Standards / Reagents	ID / Lot#	Amount Added (mL)
$NaHSO_4 \cdot H_2O$		
Reagent Water		
Sand		
DISPENSER CALIBRATION		

W_1 = Weight of Vial+Stirrer+$NaHSO_4 \cdot H_2O$+Solvent

W_f = W_1+Sample

Comments: _____

Prepared By: _____

Checked By: _____

Samples Received By: _____

Sample Location _____

Disposed by: _____ Date:

EXTRACTION LOG FOR VOLATILES

SOP ☐ EMAX-5035 Rev. No.: 2 ☐ Book # E01-030

Start Date: Time: End Date: Time:

Lab Sample ID	w_1 (g)	w_f (g)	Notes

Standards / Reagents	ID / Lot#	Amount Added (ml)
Surrogate		
LCS/MS		
Sand		
Methanol/Surrogate		

W_1 - Weight of Vial+Solvent

W_f = Weight of Vial+Solvent+Sample

Comments: _____

Prepared By: _____

Standard Added By: _____

Witnessed By: _____

Checked By: _____

Extract Received By: _____

Extract Location: _____

Disposed By: _____ Date: _____

STANDARD OPERATING PROCEDURES

TRACE METALS BY ICP-MS

SOP No.:	EMAX-6020	Revision No.	6	Effective Date:	14-Feb-11
Prepared By:	Mary Jane Mendoza			Date:	02.14.11
Approved By:	Kenette Pimentel QA Manager			Date:	02.14.11
Approved By:	Caspar Pang Laboratory Director			Date:	02-14-11
				Control Number:	**6020-06**

1.0 SCOPE AND APPLICATION

1.1. This procedure is applicable for the determination of sub-µg/L concentrations of a large number of elements in drinking water, wastewater, groundwater, aqueous, extract, soil, sludge, and sediment samples using the Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) method. All matrices require proper sample preparation prior to analysis.

1.2. The elements and their corresponding isotopes are listed in Table 1.

1.3. This SOP is an adaptation of the SW846 Method 6020A.

2.0 SUMMARY OF METHOD

2.1. Metal analytes in water are acid digested from a pre-measured sample. Nitric acid and hydrochloric acid are added to the sample and heated without boiling until the volume is substantially reduced. The digestate is diluted back to its original sample volume using reagent water.

2.2. Metal analytes in soil are acid digested from a pre-measured sample. Nitric acid is added to the sample and heated to initialize digestion. It is further oxidized with 30% hydrogen peroxide and the acid used for final reflux is hydrochloric acid.

2.3. Digestates are introduced by pneumatic nebulization resulting aerosol into a high temperature argon plasma, where they are decomposed, atomized and ionized. The ions produced are extracted from the plasma via the sample and skimmer orifices in the interface region of the mass spectrometer. The extracted ions are guided by an off-axis Lens System to reduce background noise, passes through an Octopole Reaction System (ORS) where some ions require a simple reaction with H_2 or He to eliminate matrix interference prior to entering the Quadrupole Mass Filter (QMF). The QMF separates ions based on their mass-to-charge ratios and ions are counted by electron multiplier detector.

2.4. Quantitation is accomplished by comparing the response of a major ion relative to an internal standard using a calibration curve.

2.5. **Interference**

2.5.1. Isobaric Elemental Interference. Are caused by isotopes of different elements which form singly or doubly charge ions of the same nominal mass-to-charge ratio. The signal of an isotope of an interfering element is determined and subtracted from the analyte isotope signal.

2.5.2. Isobaric Polyatomic Ion Interference. Are caused by ions consisting of more than one atom which have the same nominal mass-to-charge ratio as the isotope of interest. To correct for isobaric polyatomic ion interferences, optimize the cell gas pressure on each analyte so that when the ORS employs simple reaction gases (H_2 and He) side reactions create new and unpredictable interferences. The ORS is equipped with notch filters and by using scanning voltages the created interferences are prevented from reaching the analyzer.

2.5.3. Physical Interference. Nebulization and transport processes can be affected if a matrix component causes a change in surface tension or viscosity. An internal standard can be used to correct physical interference if is carefully matched to the analyte so that the two elements are similarly affected by matrix changes. When the intensity level of the internal standard is less than 70% of the intensity of the first standard used during calibration, the sample must be diluted and re-analyzed.

2.5.4. Memory Interference. Contamination by carry-over can occur whenever high concentrations are analyzed in sequence with a low concentration sample. To reduce potential carry-over the rinse period between samples must be long enough to eliminate significant memory effect.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Established limits are shown in Table 5.

4.0 DYNAMIC RANGE

4.1. Linear Dynamic Range (LDR) is the concentration over which the instrument response remains linear.

4.2. Establish LDR of each analyte by determining the signal response from a minimum of three preferably five different concentration across the range. The upper limit should be within 10% (±10%) of the true value.

4.3. Verify the established LDR every six months or when there is a significant change in the instrument signal, whichever comes first.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. Expected sample condition when received in the lab:

- water samples in HDPE, preserved to pH <2 with HNO_3
- soil samples in glass jar or brass tubes

5.2. When water sample preservation is requested to be done in the lab, preserve the sample to pH <2 wit HNO_3 and observe at least 24 hours from the time preservative is added before sample digestion.

5.3. Store water samples in the same condition as received unless specified in the project requirement.

5.4. Store soil samples at ≤ 6°C.

5.5. **Holding Time**

5.5.1. Analyze all samples within 180 days from the collection date.

6.0 ASSOCIATED SOPs

6.1. EMAX-QA04 Method Detection Limit (MDL)

6.2. EMAX-QA08 Corrective Action

6.3. EMAX-QC01 Quality Control for Chemicals

6.4. EMAX-QC02 Analytical Standard Preparation

6.5. EMAX-QC06 Calibration of Micropipettes

6.6. EMAX-QC07 Glassware Cleaning

6.7. EMAX-SM04 Analytical and QC Labeling

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. Observe the following precautions during operation or maintenance of the instrument:

- Close the instruments hoods and panels prior to operation.
- Check the exhaust system for a positive extraction at the exhaust duct.
- Handle the solvents correctly.
- Check the drain vessels frequently.
- Make sure that the argon tank is chained.
- Wait for the instrument interface region to cool down prior to instrument maintenance.
- Observe all cautions and warnings stipulated in the Agilent 7500 ICP/MS Manuals.

7.3. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure. Observe all chemical hygiene procedures as mentioned in the Chemical Hygiene Plan.

7.4. Place all wastes generated during analytical process in a properly labeled satellite waste containers.

7.5. DO NOT DISPOSE ACIDIC WASTE IN THE TRASH CAN OR IN THE SINK.

7.6. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

8.1.1. ICP-MS: Agilent 7500CE Octopole Reaction System

8.1.2. Autosampler: CETAC ASX-520

8.1.3. Computer: IBM Compatible

8.1.4. RF Generator: Agilent RF Generators

8.1.5. Data Acquisition: Agilent Chemstation (G1834B)

8.1.6. Autosampler rack(s): 17 mm, 60 positions

8.1.7. Culture tubes: 17 mm, polypropylene

8.1.8. Volumetric Flask: 100 ml

8.1.9. Micropipets: 100 - 1000 µl

8.1.10. Pipet Tips: 100 - 1000 µl

8.1.11. Polyethylene bottles: 250, 500, 1000 ml

8.1.12. Liquid argon

8.1.13. Hydrogen, Compressed: Ultra-high purity

8.1.14. Helium, compressed: Ultra-high purity

8.1.15. Balance Sartorius LC 620 S or equivalent

8.1.16. Spatula Stainless steel or equivalent

8.1.17. Digestion vessel 50 ml, 100 ml snap seal

8.1.18. Pipette 1 ml, 0.100 ml, 5 ml

8.1.19. Digestion block Aluminum blocks or equivalent

8.1.20. Thermometer Range 0 - 110°C

8.1.21. Filter Whatman #41 or equivalent

8.1.22. Digestate Container 50 ml polyethylene vessel, 100 ml Corning snap seal or equivalent

8.1.23. Disposable watch glass

8.2. **Chemicals and Reagents**

8.2.1. DI water, ASTM Type II or equivalent

8.2.2. Nitric Acid, Trace high purity grade, concentrated

8.2.3. Hydrochloric acid, Trace high purity grade, concentrated

8.2.4. Hydrogen Peroxide, ACS grade (e.g., VW3690-5 from VWR) or equivalent

9.0 STANDARDS

9.1. **Tune Check Standard**

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
Tuning Solution	Agilent	Li, Y, Ce, Tl, Co	0.01	2% HNO_3
Tuning Check Standard	High Purity Standard	Co, In, Li, Tl	10	2% HNO_3

9.1.1. Prepare tuning check standard at concentration level suggested below.

STANDARD	Aliquot, (ml)	Final volume (ml)	Final Concentration (mg/L)
Intermediate tuning check standard	0.5	50	0.100

9.2. **Internal Standard (IS)**

9.2.1. Purchase stock internal standard as certified standard at concentration listed below or equivalent.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
IS	Agilent	Li6, Sc, Ge, Rh, In, Tb, Bi, Lu	100	10% HNO_3

9.3. **Calibration Standards**

9.3.1. Calibration Stock Standard

9.3.1.1. Purchase custom-made certified mixed stock standards as listed in the table below or equivalent.

STANDARD	SOURCE	ELEMENTS	CONC. (µg/ml)	MATRIX
SM-2208-001	High Purity	As, B, Se, Sr, Tl, Ti, V, Zn, Sb, Mo, Sn	10	2% HNO_3 and Trace HF Acid
SM-2208-002	High Purity	Ba, Be, Cd, Cr, Co, Cu, Pb, Li, Mn, Ni, Ag, U	10	2% HNO_3
SM-2208-003	High Purity	Al, Fe, K, Ca, Mg, Na	1000	4% HNO_3

9.3.2. Matrix Acid Blank (S0)

9.3.2.1 Prepare matrix acid solution by mixing 3% by volume nitric acid and 2% by volume hydrochloric acid in reagent water. Transfer into a clean HDPE bottle and identify the solution as S0.

9.3.2.2 Use this solution for standards or digestate dilutions.

9.3.3. Initial Calibration Standard

9.3.3.1 The initial calibration consists of a blank (S0) and three standards (S3, S4 and S5). Prepare the standards as suggested below. Refer to Table 3 for final concentrations for each analyte. Please note: More standard points may be added at the discretion of the analyst.

	SM-2208-001 (ml)	SM-2208-002 (ml)	SM-2208-003 (ml)	Final volume (ml)	Final Concentration (mg/L)
S1	0.025	0.025	0.025	50	0.005/0.5
S2	0.125	0.125	0.125		0.025/2.5
S4	0.250	0.250	0.250		0.05/5

9.3.4. Continuing Calibration Verification (CCV) Standard

9.3.4.1 Prepare CCV using the stock standards and S0 as suggested below. Refer to Table 3 for final concentrations for each analyte.

From Calibration Stock Standard	Aliquot (ml)	Final volume (ml)	CCV Final Concentration (mg/L)
SM-2208-001	0.125	50	0.025
SM-2208-002	0.125		0.025

From Calibration Stock Standard	Aliquot (ml)	Final volume (ml)	CCV Final Concentration (mg/L)
SM-2208-003	0.125		2.5

9.3.4.2 Prepare intermediate solution for Low Level CCV (LLCCV) using the stock standards and S0 as suggested below. Refer to Table 3 for final concentrations of each analyte.

	From Calibration Stock Standard	Aliquot (ml)	Final volume (ml)	LLCCV Final Concentration (mg/L)
MIX 7	SM-2208-001	1.0	10	1.0
	SM-2208-002	1.0		1.0
	SM-2208-003	1.0		100
Zn	Zn	0.5		10

9.4. **Secondary Source Standard**

9.4.1. Purchase secondary stock standard from a different source as certified standards or equivalent. Refer to list below.

SOURCE	STANDARD	ELEMENTS	CONC. (mg/L)	MATRIX
CPI	EMAX MIX 2	As, Ba, Be, B, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, Sr, Tl, Ti, V, Zn, Ag, Sb, Mo, Li, U, Sn	10	5% HNO_3 + Tr HF
	EMAX MIX 3	Al, Fe, Ca, Mg, K, Na	1000	5% HNO_3

9.4.2. Refer to EMAX-QC02 for detailed procedure of standard preparation and labeling.

9.5. **Initial Calibration Verification (ICV)**

9.5.1. Prepare ICV using the secondary stock standards and S0 as suggested below. Refer to Table 3 for final concentrations for each analyte.

From Stock Standard	Aliquot (ml)	Final Volume (ml)	ICV Final Concentration (mg/L)
EMAX MIX 2	0.150	50	0.030
EMAX MIX 3	0.150		3

9.6. **Interference Standards (ICSA/ICSAB)**

9.6.1. Purchase ICS stock standard as mix certified standards at concentration levels listed below.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
6020ICS-0A (ICSA)	Inorganic Ventures	Al, Ca, Fe, Mg, Na, P, K, S	1000	1.4% HNO_3
		C	2000	
		Cl	10000	
		Mo, Ti	20	

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
6020ICS-0A + EMAX MIX 2 (ICSAB)	6020ICS-0A	Al, Ca, Fe, Mg, Na, P, K, S	1000	1.4% HNO_3
		C	2000	
		Cl	10000	
		Mo, Ti	20	
	EMAX MIX 2	As, Ba, Be, B, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, Sr, Tl, Ti, V, Zn, Ag, Sb, Mo, Li, U, Sn	10	5% HNO_3 + Tr HF

9.6.2. Prepare Intermediate ICSA and ICSAB standards at concentration levels suggested below. Refer to Table 3 final concentrations.

Standard	Parent Standard	Aliquot (ml)	Final Volume (ml)	Final Concentration (mg/L)
Intermediate ICSA	6020ICS-0A	5	50	Varied
Intermediate ICSAB	6020ICS-0A	5	50	Varied
	EMAX MIX 2	0.10		

9.7. **LCS/MS Spike Standard**

9.7.1. Purchase LCS/MS standards as certified custom-mixed.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
EMAX MIX 2	CPI	B, Sr, As, Ba, Be, Ag, Cd, Cr, Co, Cu, Tl, Pb, Mn, Ni, Se, V, Zn, Ti, Sb, Mo, Li, U, Sn	10	5% HNO_3+ Tr HF
EMAX MIX 3		Al, Fe, Ca, Mg, K, Na	1000	5% HNO_3

9.8. **P/A Tuning Standard**

9.8.1. Using the calibration stock standard from 9.3.1, prepare a 50 µg/L and 100 µg/L mixed standard. These standards should also include 50 µg/L and 100 µg/L of internal standard, which can be prepared by using the internal standard stock from 9.2.1.

10.0 PROCEDURES

10.1. **Sample Preparation for Water Samples**

10.1.1. Based from the work order, determine the samples to form a preparative batch (not to exceed 20 samples per preparative batch). Withdraw the sample(s) from the sample control room and bring them to the preparation area. Allow the samples to equilibrate at room temperature.

10.1.2. Shake the sample container. Pour a small amount of sample into the sample cap and trickle just enough to wet the pH indicator strip. Compare the color of the wet strip to the indicator chart displayed in the pH indicator box. Record the pH in the digestion log. If the pH value is <2, proceed to 10.1.3. If the pH value is ≥2, check if special instruction is written on the analysis folder or in the COC. Otherwise, fill out an NCR and inform the supervisor immediately. DO NOT PROCEED WITH THE DIGESTION. WAIT FOR FURTHER INSTRUCTION.

10.1.3. Line up the samples chronologically under the hood. Check and record the lot number of the digestion vessels if it has been verified for accuracy. Take digestion vessels and label each one corresponding to the samples withdrawn and place them in front of each sample making sure that their labels agree. Take four more vessels and label them as preparation blank, LCS, matrix spike and matrix spike duplicate.

10.1.4. Mix the sample thoroughly to achieve homogeneity. Fill each digestion vessel up to the 50-ml mark. (The reduction of the volume is due to waste minimization).

10.1.5. Record the volume in the digestion log. Use reagent water for blank and LCS.

10.1.6. Take another digestion vessel; fill it with tap water to 50 ml mark. Put a thermometer inside and let it sit on the digestion block. Turn the thermostat to a pre-determined mark to deliver heat at 90°C - 95°C. Record the temperature reading in the digestion log.

10.1.7. Standard Addition

10.1.7.1. Call for a witness for standard addition. Have the witness verify the setting of the micropipette and the expiration dates of the spike standards.

10.1.7.2. Add 0.125 ml of each from EMAX MIX 2 and 3 (see Section 9.4.1) solutions to matrix spike samples and LCS.

10.1.8. Acid Digestion for Dissolved Metals

10.1.8.1. Add 0.5 ml of concentrated HNO_3 and 0.25 ml concentrated HCl to each of the digestion vessels.

10.1.8.2. Cap the digestion vessels with disposable watch glass.

10.1.8.3. Check that the temperature of the digestion block is 85°C, adjust if necessary. If temperature happens to be less than 85ºC, adjust the thermostat and wait until temperature falls at 85°C.

10.1.8.4. Place the digestion vessels on the digestion block and reduce volume of sample by continuous heating without boiling for two hours.

10.1.8.5. Reflux gently for another 15 minutes. Remove the digestion vessels from the digestion plate and allow the vessels to cool down.

10.1.8.6. Using a reagent water wash bottle, rinse the disposable watch glass collecting the rinsate on the same digestion vessel that it covered. Add 1.0 ml concentration HNO_3 and 0.25 ml concentration HCl for matrix matching.

10.1.8.7. Dilute the digestate with reagent water to the 50 ml mark of the digestion vessel. Seal the vessel and shake. If the digestate appears to be turbid, pass it through Whatman #41 filter and collect it in a new polyethylene container.

10.1.9. Acid Digestion for Total Recoverable Metals

10.1.9.1. Add 0.5 ml of concentrated HNO_3 and 0.25 ml concentrated HCl to each of the digestion vessels.

10.1.9.2. Cap the digestion vessels with disposable watch glass.

10.1.9.3. Check that the temperature of the digestion block is 85°C, adjust if necessary. If temperature happens to be less than 85°C, adjust the thermostat and wait until temperature falls at 85°C.

10.1.9.4. Place the digestion vessels on the digestion block and reduce volume of sample by continuous heating without boiling for two hours.

10.1.9.5. Reflux gently for another 15 minutes. Remove the digestion vessels from the digestion block and allow the vessels to cool down.

10.1.9.6. Using a reagent water wash bottle, rinse the disposable watch glass collecting the rinsate on the same digestion vessel that it covered. Add 1.0 ml concentration HNO_3 and 0.25 ml concentration HCl for matrix matching.

10.1.9.7. Dilute the digestate with reagent water to the 50 ml mark of the digestion vessel. Seal the vessel and shake. If the digestate appears to be turbid, pass it through Whatman #41 filter and collect it in a new polyethylene container.

10.2. **Sample Preparation for Soil Samples**

10.2.1. Sample Handling

10.2.1.1. Based from the work order, determine the samples to form a preparative batch (not to exceed 20 field samples). Withdraw the sample(s) from the sample control room designated for metals analysis (passing # 10 sieve) and bring them to the weighing area. Allow the samples to equilibrate at room temperature.

Note: Sample homogeneity is crucial in metals analysis. If no sample was designated for metals analysis, and it is apparent that sample particles contain > #10 sieve, inform the Supervisor for further instruction.

10.2.1.2. Take digestion vessels and label each one corresponding to the samples withdrawn. Take four more vessels and label them as preparation blank, LCS, matrix spike and matrix spike duplicate.

10.2.1.3. Check project sub-sampling requirement. If multi-incremental sub-sampling (MIS) is required, refer to EMAX-SM01, section 5.13.2 for details. Otherwise follow the steps described in EMAX-SM01, section 5.13.1.

10.2.1.4. Scoop 1-2 g sub-sample and transfer into a properly labeled digestion vessel. Record the weight to the nearest 0.01 g.

10.2.2. Pre-heating the Digestion Block

10.2.2.1. Place a digestion vessel with reagent water and a temperature monitoring thermometer on the digestion block.

10.2.2.2. Turn the digestion block on and set the thermostat to ~95°C or to a predetermined temperature to obtain approximately 95°C once the digestion vessel is covered with a watch glass.

10.2.2.3. When the temperature reading is about 95°C ± 5°C, the digestion block is now ready for digestion.

10.2.3. Standard Addition

10.2.3.1. Call for a witness for standard addition. Have the witness verify the setting of the micropipette and the expiration dates of the spike standards.

10.2.3.2. Add 2.5 ml of EMAX MIX 2 & 3 (Sec. 9.4.1) to LCS and matrix spike samples.

10.2.4. Acid Digestion

10.2.4.1. Add 10 ml of regent water and 5 ml of concentrated HCL[1] into each vessel, swirl the vessel to mix the acid and the sample. Add same amount of acid into a clean and empty vessel and designate it as blank. Insert the vessels in the digestion block(s). Cap the vessels with conical watch glass.

10.2.4.2. Check the temperature of the digestion block (95°C ± 5°C), adjust if necessary. If temperature happens to be ≥ 100°C, adjust the thermostat and wait until temperature falls within 95°C ± 5°C. Record the temperature reading in the digestion log.

10.2.4.3. Place the digestion vessels on the digestion block and reflux for 15 minutes without boiling.

10.2.4.4. Transfer the vessels into unheated digestion block and allow the vessels to cool down for at least 5 minutes. Lift the watch glass and add 10-mL of concentrated HNO_3. Place the watch glass back before working on the next vessel.

10.2.4.5. Return the vessels to the digestion block and reflux for another 15 minutes.

10.2.4.6. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes. Lift the water glass and add 10 ml 1:1 HNO3. Place the water glass back before working on the next vessel.

10.2.4.7. Return the vessels to the digestion block and reflux for another 15 minutes.

10.2.4.8. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes.

10.2.4.9. Add 2 ml of reagent water. Then add 3 ml of 30% hydrogen peroxide (H_2O_2) to each vessel, swirling each one of them after every addition to initiate peroxide reaction. Continue to add H_2O_2 until the amount added reaches 10 ml.

10.2.4.10. Return the vessels to the heated digestion block. Care must be taken to ensure that losses do not occur due to excessive effervescence.

10.2.4.11. Continue to reflux the mixture at 95°C ± 5°C for 15 minutes. Remove the digestion vessels from the digestion block and allow the vessel to cool down for at least 5 mins.

10.2.4.12. Lift the watch glass, add 5 ml of concentrated HCl. Swirl the vessel until added reagents are properly mixed with the solution. Place the watch glass before working on the next vessel. Return the vessels into the heated digestion block. Reflux for additional 15 minutes. Subsequently, remove the digestion vessels from the digestion block and allow the vessels to cool down and dilute to 100 ml final volume with reagent water.

10.2.4.13. Let the digestate settle and centrifuge or filter with Whatman #41 (see 10.1.5) if necessary otherwise digestates are now ready for analysis.

10.2.5. Digestate Filtration

10.2.5.1. Place Whatman #41 filter paper into each funnel resting on holders. Rinse the filter papers with reagent water.

10.2.5.2. Place a pre-labeled digestate container under each funnel making sure that the labels are visible.

[1] Addition of 5 ml HCl is a modification from Method 3050B to enhance recovery of antimony. Refer to Appendix 3 for the comparative study done on ICP-MS.

10.2.5.3. Check the labels to make sure that they agree. Pour the digestate into the filter.

10.2.5.4. Filter and collect the digestates in the labeled container. The digestates are now ready for analysis.

10.3. **Instrument Parameters**

10.3.1. Set instrument parameters as suggested below.

10.3.2. Plasma Condition

- RF Power: 1550 W
- RF Matching: 1.68 V
- Sample Depth: 8.0 mm
- Torch Height: -0.4 mm
- Torch Vertical: 0 mm
- Carrier Gas: 0.9 L/min
- Make-up Gas: 0.2 L/min Note: Total Carrier and Make-up gas not to exceed 1.1 L/min.
- Peristaltic pump: 0.1 rps
- Spray Chamber (S/C) Temp: 2°C

10.3.3. Ion Lenses

- Extract 1: 0 V
- Extract 2 : -130V
- Omega Bias-ce: -20 V
- Omega Lens-ce: -2 V
- Cell Entrance: -30 V
- QP Focus: 3 V
- Cell Exit: -30 V

10.3.4. Octopole Parameters

- Octopole RF: 190 V
- Octopole Bias: -9 V

10.3.5. Q-Pole Parameters

- AMU Gain: 127
- AMU Offset: 125
- Axis Gain: 0.9996
- Axis Offset: 0.04
- QP Bias: -3 V

10.3.6. Detector Parameters

- Discriminator: 8 mV
- Analog HV: 1630 V
- Pulse HV: 990 V

10.3.7. Reaction Cell

- H_2 Gas: 3.0 ml/min
- He Gas: 4 ml/min

10.3.8. Adjust the instrument parameters to optimize the instrument performance in conformance to the tuning requirement.

10.3.9. Print the most current instrument parameters and place in the appropriate binder for easy reference. Replaced instrument parameter set-up should be archived chronologically for future reference and historical record.

10.4. **Calibration**

10.4.1. Instrument Set-Up

10.4.1.1. Set up the ICP-MS with proper operating parameters. Refer to Section 10.3.

10.4.1.2. Ignite the plasma and allow the instrument to become thermally stable for at least 30 minutes.

10.4.1.3. Check the peristaltic pump to deliver a steady flow.

10.4.2. Tuning the Instrument

10.4.2.1. Tune the instrument according to Normal Mode, Hydrogen Mode and Helium Mode without the internal standard. Refer to Section 10.3 for parameters. On the ICP-MS main Menu, go to Instrument and click Tune and run the tuning solution without the internal standard. After about 60 seconds (making sure the solution is in the system) click start and evaluate the counts of the isotopes according to the table below.

Mode	Range		
Normal	Li6 ≥ 6400 counts	Y89 ≥ 16000 counts	Tl205 ≥ 9600 counts
Hydrogen	Ar/Ar78 < 10	Co59 ≥ 3000 counts	
Helium	V51/Co59 < 0.6	Co59 ≥ 7000 counts	ArCl-75 < 10 counts

10.4.2.2. If non-compliant, adjust parameters (e.g. Torch height, Torch vertical, Octopole Bias and QP Bias) and repeat the tune process until the required range is met.

10.4.2.3. Click Generate report for a full scan of the tune. Save all tune values to the current method.

10.4.3. Perform a P/A Factor Evaluation

10.4.3.1. Analyze the 50 µl P/A Tuning Standard.

10.4.3.2. Under "Tune," access "P/A Factor."

10.4.3.3. Select "Load masses from acquired method" and then select calcium "Ca" from the list of elements. Select "delete" to remove Ca from the P/A Factor analysis.

10.4.3.4. Select "run."

10.4.3.5. When complete accept the changes.

10.4.3.6. Print out P/A Factor and store the printout with the tuning data.

10.4.3.7. Accept the new P/A Factors.

10.4.3.8. Under "file" select "copy tune parameters" and copy the P/A Factors to both the H2 and He modes.

10.4.3.9. Save file as "norm.u".

10.4.4. Perform Tune Check

10.4.4.1. Analyze the intermediate tune check solution (9.1.1) using 4 replicates.

10.4.4.2. Evaluate the tune check so that the mass calibration differs no more than 0.1 AMU of the true value and the resolution to be less than 0.9 AMU full width.

10.4.5. Initial Calibration (ICAL)

10.4.5.1. Analyze a calibration blank (S0) and a multi-point calibration standard (Section 9.3.3.1).

10.4.5.2. Set the instrument rinse time to 90 seconds between each standard solution.

10.4.5.3. Refer to Appendix 1 for ICAL acceptance criteria and /or corrective action.

10.4.6. Initial Calibration Verification (ICV)/ Instrument Calibration Blank (ICB)

10.4.6.1. Analyze the ICV (Section 9.5.1) from a second source to verify the concentration of the ICAL.

10.4.6.2. Analyze a low-level ICV (LLICV) from the same source as the calibration standard to verify the lower limit of quantitation (RL).

10.4.6.3. Analyze an ICB after LLICV to demonstrate absence of instrument contamination.

10.4.6.4. Refer to Appendix 1 for ICV, LLICVand ICB acceptance criteria and /or corrective action.

10.4.7. Continuing Calibration Verification (CCV)/ Continuing Calibration Blank (CB)

10.4.7.1. Analyze CCV to check the validity of the ICAL every 10 samples and at the end of the analytical sequence.

10.4.7.2. Analyze low-level CCV (LLCCV) to check the system stability at low end of ICAL at the end of the analytical sequence.

10.4.7.3. Analyze a CCB every after LLCCV to demonstrate the absence of instrument contamination.

10.4.7.4. Refer to Appendix 1 for CCV, LLCCV and CCB acceptance criteria and/or corrective action.

10.4.8. ICSA and ICSAB

10.4.8.1. Analyze ICSA and ICSAB at the beginning of each analytical run and every 12 hours thereafter.

10.4.9. Establishing Instrument Detection Limit (IDL)

10.4.9.1. Analyze a minimum of seven consecutive method blanks.

10.4.9.2. Repeat the process within three non-consecutive days.

10.4.9.3. Calculate the standard deviation of each run.

10.4.9.4. The average of the standard deviation of the three runs determines the IDL for each analyte.

10.4.9.5. Establish IDL at least every 3 months.

10.4.10. Verifying Linear Dynamic Range (LDR)

10.4.10.1. Verify the LDR by preparing a standard at the upper limit of the LDR. Analyze and quantitate against the normal calibration curve. Percent recovery must be within ± 10% of expected value. If non-complaint re-establish LDR.

10.4.10.2. At a minimum perform LDR verification every six months.

10.5. **Analysis**

10.5.1. Analytical Sequence

10.5.1.1. From the main menu, go to Sequence and input the analytical sequence into the instrument using data acquisition software. Refer to Table 4.

10.5.1.2 Set QC limits on QC samples for easy verification while analytical samples are running.

10.5.1.3 Using the analytical sequence, arrange the standards and the digestates to be analyzed chronologically.

10.5.1.4 Transfer about 10 ml of its content into the autosampler tubes placing them on the autosampler rack in the same order as the analytical sequence. A dilution of x10 for soil samples is required due to the high acid content of the digestate.

10.5.1.5 Dilution Test sample is prepared at 5 times dilution. Seal the tube with Parafilm and invert the tube several times to ensure adequate mixing.

10.5.1.6 Prepare a Post Digestion Spike test sample. Using the un-spiked sample digestate (preferably the QC sample), add MS standard to maintain the same spike level as the MS sample digestate.

10.5.1.7 A 100 µg/L internal standard shall be spiked into each sample.

10.5.1.8 Set the prepared analytical samples into the auto-sampler and start the analytical run.

10.5.2. Sample Result Evaluation

10.5.2.1 Check QC parameters as soon as the data is available.

- Check the initial calibration verification (ICV, LLICV and ICB) against Appendix 1.
- Check MB, LCS against Appendix 1. Perform specified corrective action if necessary.
- Check the MS, duplicate sample, serial dilution and post digestion spike results. If matrix interference is indicated, dilute the sample and re-analyzed.
- Check intensity of internal standard on each sample.
- If any of the above checkpoints is non-compliant, perform the specified corrective action in /Appendix 1. If results indicate digestion problem, fill-up an

NCR and order re-digestion for the affected sample(s). If unresolved, consult the Supervisor for further action.

10.5.2.2 Check the sample rack to ensure that the Autosampler did not skip any sample.

10.5.2.3 Check concentration of target analytes. If the response exceeds LDR, dilute and reanalyze the sample at a concentration within the LDR.

10.5.2.4 Check other QC requirements like ICSA, ICSAB, CCV, LLCCV, CCB against Appendix 1.

10.6. **Calculations**

10.6.1. The computer software is designed to calculate the concentrations in the digestates, based on the assumption that the initial calibration is linear through the origin. Thus, for aqueous samples, the computer-produced results represent the concentration of the sample.

10.6.2. For water samples, if the initial sample taken was V_s, different from 50 mL, then calculate the concentration using the following equation:

$$C_s = C_i\left(\frac{V_e}{V_s}\right)DF \qquad \text{Eq-10.6.2}$$

where:

C_s	-	concentration in the sample, µg/L
C_i	-	concentration in the digestate, µg/L
V_s	-	volume of sample taken, mL
V_e	-	volume of digestate, mL
DF	-	dilution factor

10.6.3. For solids, use the following equation to calculate the concentration.

$$Cs = C_i\left(\frac{V_e}{W_s}\right)\left(\frac{100}{100 - \%H_2O}\right)DF \qquad \text{Eq-10.6.3}$$

Where:

C_s	–	concentration in the sample, µg/L
C_I	–	concentration in the digestate (computer generated), µg/L
W_s	–	sample amount taken, g
V_e	–	volume of digestate, mL
$\% H_2O$	–	percent moisture of the sample
DF	–	dilution factor

10.6.4. <u>Calculate the percent recovery (%R)</u>

$$\%\ Recovery = \frac{Cf - C}{Cs} * 100 \qquad \text{Eq-10.6.4}$$

where:

C_f	–	concentration found, µg/ L
C	–	concentration of sample, µg/L
C_s	–	concentration of spike, µg/L

10.6.5. Relative Percent Difference (%RPD)

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$ Eq-10.6.5

Where:

RPD = Relative Percent Difference

C_1 = Measured concentration of the first sample aliquot

C_2 = Measured concentration of the second sample aliquot

10.7. **Data Reduction**

10.7.1. Make a copy of the analytical run log and highlight the data to be reported.

10.7.2. Collate the reportable raw data separating the QC results from sample results.

10.7.3. Keep all other data generated with the analytical folder marked with "For record only" for traceability purpose.

10.8. **Report Generation**

10.8.1. Print the summary of the analytical run, perform a data transfer into a disk, and convert the instrument electronic output file into an ASCII file format.

10.8.2. Run the ICPCHK.exe program for calibration check.

10.8.3. Identify samples that need to be re-analyzed, if any, and report all samples that met the analytical requirements.

10.8.4. Generate the report using the following in-house reporting program:

Executable Files	Required Support Files	Output
WDBX[2].exe	Login File (requires network), project.pln, seq_name.sq, seq_name.ckv, seq_name.ckb, seq_name.csv, seq_name.qck, EXCLCMP.LST	Method.txt [this file integrates the login sample information and the analytical sample information]
IF1VX.exe	method.txt, method.met, method.crf, project.pln, project code.txt, qcell.txt	Sample Results (Form1)
IQCICP.exe	method.txt, method.crf, method.qc, project.pln, project code.txt, qcell.txt	QC Summary for LCS and MS (Form 3)
QCX.exe	method.txt, method.crf, method.qc, project.pln, qcell.txt	Summary for Dilution Test (Form 3)
LABCHRNX.exe	method.txt	Lab Chronicle

X[2] – latest program version

Executable Files	Required Support Files	Output
CN2.exe	Login File, method.txt, Form 1, Form 3	Case Narrative

10.7.4. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated and re-analyses.

- Sample Results
- LCS Summary
- MS Summary
- Duplicate Summary
- CCV Summary
- ICV Summary
- ICAL Summary

10.7.5. Generate the case narrative using CN2.exe.

10.7.6. Submit the analysis package for secondary review.

10.8. **Data Review**

10.8.1. Perform a 100% data review in accordance to EMAX-DM01 and the PSR.

- Review the ICPCHK.exe output file to ensure that it agrees with the instrument output. Check Project Specific Requirement (PSR) or Appendix 1 for acceptance criteria.
- Check frequency of calibration verification. Verify results to be within acceptance limits.
- Check of target analytes concentration to be within linear range.
- Verify interference check results to be within acceptance limits.

10.8.2. If any of the above checkpoints is non-compliant, re-analysis is required.

10.9. **Preventive Maintenance**

10.9.1. Instruments shall receive routine preventive maintenance that is properly recorded in the instrument-specific maintenance logs. The list of maintenance is summarized in Form 6020FM. The practice ensures optimum operating condition of the equipment thus reducing the possibility of frequent instrument malfunction.

11.0 QUALITY CONTROL

11.1. **Sample Preparation QC**

11.1.1. A preparative batch consists of 20 or fewer samples of the same matrix that are prepared for analysis simultaneously or sequentially, using the same lots of all reagents.

11.1.2. Every preparative batch shall have at least one method blank, one LCS and a set of MS/MSD unless otherwise specified by the project. These QC samples shall be digested together with the field samples.

11.1.3. All reagents shall be subjected to QC check prior to its use. Refer to EMAX-QC01 for details.

11.2. **Sample Analysis QC**

11.2.1. Perform a tune check before every analytical run, an initial calibration and initial calibration verification (ICV / LLICV). Obtain the ICV standard from a different source from that of the initial calibration and LLICV from the same source as the ICAL. Analyze an instrument calibration blank (ICB) after the LLICV. No further analysis shall be valid unless acceptance criteria are met.

11.2.2. Monitor the intensities of all internal standards for every analysis. Refer to Appendix 1 for acceptance criteria.

11.2.3. Verify inter-element and background correction factors with ICSA and ICSAB standards after ICB every 12 hours.

11.2.4. Verify calibration with continuing calibration verification (CCV) standard and continuing calibration blank (CCB) after every ten samples and at the end of the analytical run. Also verify LLCCV at the end of the analytical run.

11.2.5. Evaluate results of MS/MSD to document matrix interference.

11.2.6. Perform Post Digestion Spike whenever recoveries for MS/MSD failed.

11.2.7. Evaluate Dilution Test result if post digestion spike result failed to meet the acceptance criteria. Failure typically happens when analyte concentrations are high.

11.2.8. Refer to Appendix 1 for acceptance criteria.

11.3. **Method QC**

11.3.1. Establish a Method Detection Limit Study before the analytical procedure can be used.

11.3.2. Establish Method proficiency before the analytical procedure can be used.

11.3.3. Establish demonstration of proficiency for all analysts conducting this analysis.

11.3.4. Perform dynamic range study at least every six months or whenever there is a significant change in instrument response unless otherwise specified by the project.

12.0 CORRECTIVE ACTION

12.1. Quality control procedures and corresponding corrective actions are summarized in Appendix 1.

12.2. If tune is non-compliant, consider the following suggestions to correct the problem:

- Check the instrument settings and make sure that the instrument parameters are properly set up.
- Check argon gas flow.
- Perform auto tune or visual optimization
- If the problem persists, inform the Supervisor.

12.3. If correlation coefficient (R) of ICAL is non-compliant, consider the following suggestions to help you correct the problem:

- Check the calibration points for possible presence of out-lier. If out-lier is present, prepare a fresh standard and repeat the calibration.
- Check the connections and make sure that they are air-tight. Perform maintenance as needed.
  - Presence of bubbles is indicative of poor connection between the sipper and the nebulizer.
  - Poor precision to inability to light the plasma is a symptom of a poor drain tube connection
  - Poor precision and carry-over problems are indicative of a dirty spray chamber.
  - Relative increase in the sensitivity ratio of the higher: lower atomic number elements are indicative of stretched pump tubing. The sample flow rate decreases as the tubing stretches.
- Check the argon gas flow. Loss of signal is indicative of low or no argon gas flow.
- Poor precision and a gradual loss of signal is indicative of "salting-out" in the nebulizer and/or spray chamber due to samples with high dissolved or suspended solids. This problem will necessitate nebulizer and spray chamber cleaning.
- If the problem persists, inform the Supervisor.

12.4. If ICV is non-compliant, consider the following suggestions to help you correct the problem:

- If the RSD is high it is indicative that the carry-over might be present in the spray chamber.
- If result is bias high, prepare a fresh standards and repeat calibration.
- If the problem persists, inform the Supervisor.

12.5. If ICB/CCB is non-compliant, consider the following suggestions to correct the problem:

- Prepare a fresh calibration blank solution. Perform instrument rinsing and repeat the ICB/CCB prior to re-analysis of associated sample(s).
- Carry-over problem is indicative of dirty spray chamber, nebulizer and/or torch. Perform instrument maintenance and repeat the calibration.
- If the problem persists, inform the Supervisor.

12.6. If CCV or LLICV or LLCCV is non-compliant, consider the following suggestions to correct the problem:

- Check the connections prior to re-running the ICAL. Refer to Section 12.3.
- Prepare a new standard and repeat the ICAL.

12.7. If the intensity of the Internal Standard is non-compliant, consider the following suggestions to correct the problem:

- Check for drift occurrence by observing the internal standard intensities in the calibration blank.
- If drift has occurred, terminate the analysis, recalibrate, verify the new calibration and reanalyze the affected samples.
- If drift has not occurred, dilute affected samples five fold and reanalyze with the addition of appropriate amounts of internal standards.

12.8. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

- Rule-out instrument contamination by checking the CCBs. Refer to Section 12.5.

- Rule-out reagent contamination by testing each reagent as described in EMAX-QC01.
- Rule-out digestate vessel contamination by adding verified reagents heating the vessels prior to testing.
  - Common environmental contaminants – Ca, Si, Fe, Na, Mg, K, Tl, Cu, Mn, can be minimized by maintaining the lab clean.
- Other sources of contamination:
  - Sweat contains Ca, Mg, Pb, K, NH_4^+ , SO_4^{-2}, PO_4^{-3}, and Cd (for those who smoke).
  - Cosmetics can contain high concentrations of Al, Be, Ca, Cu, Cr, K, Fe, Mn, Ti, and Zn.
  - Some hair dyes contain $Pb(OAC)_2$.
  - Dandruff shampoo can contain significant levels of Se.
  - Eye make-up may contain Hg as a preservative.
  - Calamine lotion is almost pure ZnO.
  - Watches and jewelry contain an assortment of elements and should not be worn in the laboratory.
- Re-digest MB and the associated samples with reagents free of contamination or with newly opened reagents.
- If the problem persists, inform the Supervisor.

12.9. If LCS is non-compliant, consider the following suggestions to correct the problem:

- If result is bias-high, check the LCS standard by analyzing at the spike level.

  If the LCS check is within 80-120 % of the expected value, check the calibration of the micropipette use for spiking. Re-digest and re-analyze the LCS and the associated samples.

  If the LCS check is not within 80-120%, prepare a fresh LCS standard, re-digest and re-analyze LCS and the associated samples.
- Common Problems with Ag, As, Ba, Pb, and Cr, indicating stock standard degradation, are as follows:

  Low Silver (Ag) recovery is indicative of Chloride contamination causing AgCl precipitation

  Low Arsenic (As) recovery is indicative of loss during sample preparation as volatile oxides (AsO_3) or precipitation as $AsCl_3$

  Low Barium (Ba) recovery is indicative of SO_4or CrO_4 contamination. Barium will form precipitates with HF and H_2SO_4.

  High Lead (Pb) recovery is indicative of environmental contamination.

12.10. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.10.1. Corrective action needs the function of other department; e.g., the sample needs to be re-digested. Refer to EMAX-QA08 for details of completing an NCR.

12.10.2. Corrective action needs the assistance of the Project Manager; e.g., sample passed the holding time, insufficient amount of sample, etc.

12.10.3. Corrective action prescribed in the IQC Summary does not correct the problem.

12.11. For other problems encountered, inform the supervisor immediately for further instruction.

13.0 POLLUTION PREVENTION

13.1. Unused samples, digestates and instrument wastes are very acidic and are very corrosive. Endorse the wastes to the Waste Management Unit for proper treatment or disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process endorsed to WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

Preparation batch is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

Analytical batch is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – is defined as an instrument response per unit measure. It is an experimental value by measuring the response of an instrument per unit target analyte under the method specific condition. A determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.4. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.5. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.6. Matrix – is a physical state of a sample. Most of environmental samples are classified as water, soil or air.

15.1.7. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.8. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.9. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical procedure to monitor contamination.

15.1.10. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.11. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.12. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria specified in this SOP shall be applied to all projects when performing metals analysis. In the instance where there is a project or program specific requirement, the requirements given in the project shall take precedence over this SOP.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluating Solid Waste, Physical / Chemical Methods", EPA Publication SW-846 Update IV, Method 6020A.

16.2. Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry, Method 200.8 Rev. 5.4 EMMC Version.

16.3. USEPA SW846, Method 3050B.

16.4. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Tables**

17.1.1.	Table 1	ICP-MS Elements & Isotopes
17.1.2.	Table 2	Initial Calibration Standard Preparation Method
17.1.3.	Table 3	Calibration Standards Concentration and Reporting Limit
17.1.4.	Table 4	ICP-MS Analytical Sequence
17.1.5.	Table 5	MDL and Linear Range Concentration Levels

17.2. **Figures**

17.2.1. Figure 1 Typical Sample Report

17.2.2. Figure 2 Typical LCS/LCD Summary

17.2.3. Figure 3 Typical MS/MSD Summary

17.2.4. Figure 4 Typical Case Narrative

17.3. **Appendices**

17.3.1. Appendix 1 Summary of In-House Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.3.3. Appendix 3 Comparative Study of Modified 3050B

17.4. **Forms**

17.4.1. 6020FA Analytical Run Log

17.4.2. 6020FS Sample Preparation Log

17.4.3. 6020FM Instrument Maintenance Log

Table 1: ICP-MS ELEMENTS & ISOTOPES

ELEMENT	SYMBOL	MASS	Tune Mode	Internal Standard
Aluminum	Al	27	3	Sc45
Antimony	Sb	121	3	In115
Arsenic	As	75	2	Ge72
Barium	Ba	137	3	In115
Beryllium	Be	9	3	Li6
Boron	B	11	3	Li6
Cadmium	Cd	111	3	In115
Calcium	Ca	43	1	Sc45
Chromium	Cr	53	2	Sc45
Cobalt	Co	59	3	Sc45
Copper	Cu	63	2	Sc45
Iron	Fe	57	1	Sc45
Lead	Pb	208	3	Tb159
Lithium	Li	7	3	Li6
Magnesium	Mg	24	3	Sc45
Manganese	Mn	55	3	Sc45
Molybdenum	Mo	95	3	In115
Nickel	Ni	60	2	Sc45
Potassium	K	39	3	Sc45
Selenium	Se	82	1	Ge72
Silicon	Si	28	1	Sc45
Silver	Ag	107	3	In115
Sodium	Na	23	1	Sc45
Strontium	Sr	88	3	Y89
Thallium	Tl	205	3	Tb159
Tin	Sn	118	3	In115
Titanium	Ti	47	3	Sc45
Uranium	U	238	3	Tb159
Vanadium	V	50	2	Sc45
Zinc	Zn	66	3	Ge72

Tune Mode: 1=Reaction H_2 Mode; 2=Collision He Mode; 3= Normal Mode

Table 2 : CALIBRATION STANDARD AND VERIFICATION PREPARATION

Standard #	Mixed Standard Name	Conc. (µg/mL)	Source	Preparation		
				Aliquot (mL)	Final Vol. (mL)	Final Conc. (µg/mL)
S1	SM-2208-01	10	High Purity	0.025	50	0.005
	SM-2208-02	10		0.025		0.005
	SM-2208-03	1000		0.025		0.5
S2	SM-2208-01	10	High Purity	0.125	50	0.025
	SM-2208-02	10		0.125		0.025
	SM-2208-03	1000		0.125		2.5
S4	SM-2208-01	10	High Purity	0.250	50	0.05
	SM-2208-02	10		0.250		0.05
	SM-2208-03	1000		0.250		5
ICV	EMAX MIX 2	10	CPI	0.150	50	0.03
	EMAX MIX 3	1000		0.150		3
CCV	SM-2208-01	10	High Purity	0.125	50	0.025
	SM-2208-02	10		0.125		0.025
	SM-2208-03	1000		0.125		2.5
LLICV / LLCCV (water)	Mix 7	1/100	High Purity	0.05	50	0.001 / 0.1
	Zn	10		0.045		0.01
LLICV / LLCCV (soil)	Mix 7	1/100	High Purity	0.025	50	0.0005/ 0.05
	Zn	10		0.0025		0.001

Table 3: CALIBRATION STANDARDS CONCENTRATION AND REPORTING LIMIT

ELEMENT	ICAL (mg/L)			ICV / CCV (mg/L)	ICSA (mg/L)	ICSAB (mg/L)	LLICV,LLCCV, LOQ (Water) (µg/L)	LLICV,LLCCV, LOQ (Soil) (mg/Kg)
	S1	S2	S4					
Aluminum	0.5	2.5	5	6	100	100	100	100
Antimony	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Arsenic	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Barium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Beryllium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Boron	0.005	0.025	0.05	0.06	0	0.2	10	10
Cadmium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Calcium	0.5	2.5	5	6	100	100	100	100
Chromium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Cobalt	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Copper	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Iron	0.5	2.5	5	6	100	100	100	100
Lead	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Lithium	0.005	0.025	0.05	0.06	0	0.02	2	0.5
Magnesium	0.5	2.5	5	6	100	100	100	100
Manganese	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Molybdenum	0.005	0.025	0.05	0.06	2	2	2	0.5
Nickel	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Potassium	0.5	2.5	5	6	100	100	100	100
Selenium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Silver	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Sodium	0.5	2.5	5	6	100	100	100	100
Strontium	0.005	0.025	0.05	0.06	0	0.02	2	0.5
Thallium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Tin	0.005	0.025	0.05	0.06	0	0.02	1	20
Titanium	0.005	0.025	0.05	0.06	2	2	2	0.5
Uranium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Vanadium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Zinc	0.005	0.025	0.05	0.06	0	0.02	20	2

Table 4: ICP-MS ALYTICAL SEQUENCE

RUN ID LABEL	SAMPLE DESCRIPTION	SOLUTION ID LABEL
S0	Calibration Standard 1 (blank)	S0
S3, S4, S5	ICAL Standards	S3, S4, S5
ICV	Initial Calibration Verification	ICV
LLICV	Low Level Initial Calibration Verification	LLICV
ICB	Initial Calibration Blank	ICB
ICSA	Initial Interference Solution A	ICSA
ICSAB	Initial Interference Solution A and B	ICSAB
CCV1	Continuing Calibration Verification #1	CCV
CCB1	Continuing Calibration Blank #1	S0
IMSSSSB[3]	Preparation Blank	
IMSSSSL/C	Lab Control Sample	
Sample 1	Sample 1	
Sample 1M	Sample 1 Matrix Spike	
Sample 1S	Sample 1 Matrix Spike Duplicate	
Sample 1J	Sample 1 Serial Dilution(5x dilution sample 1)	
Sample 1A	Sample 1 Post Digestion spike	
Samples 2 to 4	Sample 2 to Sample 5	
CCV2	Continuing Calibration Verification #2	CCV
CCB2	Continuing Calibration Blank #2	S0
Samples 5 to 14	Maximum of 10 Samples	
CCV3	Continuing Calibration Verification #3	CCV
CCB3	Continuing Calibration Blank #3	S0
Samples 15 to 20	Sample 15 to 20 or a maximum of 10 samples (sample 15 to 24)	
ICSA	Initial Interference Solution A	ICSA
ICSAB	Initial Interference Solution B	ICSAB
CCV4	Continuing Calibration Verification #4	CCV
LLCCV	Low Level Continuing Calibration Verification	LLCCV
CCB4	Continuing Calibration Blank #4	S0

[3] where IMSSSS is the digestion batch reference.

Table 5: DL, LOD, LOQ AND LINEAR RANGE CONCENTRATION LEVELS

ELEMENT	WATER (mg/L)			SOIL (mg/kg)			LINEAR RANGE µg/L
	DL	LOQ	LOD	DL	LOQ	LOD	
Aluminum	10	100	20	5	100	10	125000
Antimony	0.25	1	0.5	0.1	0.5	0.2	3000
Arsenic	0.1	1	0.2	0.05	0.5	0.1	3000
Barium	0.25	1	0.5	0.072	0.5	0.1	3000
Beryllium	0.05	1	0.1	0.05	0.5	0.1	500
Boron	2.5	10	5	2.5	10	5	250
Cadmium	0.1	1	0.2	0.057	0.5	0.1	3000
Calcium	13	100	25	17	100	20	400000
Chromium	0.1	1	0.2	0.05	0.5	0.1	3000
Cobalt	0.1	1	0.2	0.05	0.5	0.1	3000
Copper	0.25	1	0.5	0.1	0.5	0.2	3000
Iron	5	100	10	5	100	10	300000
Lead	0.05	1	0.1	0.05	0.5	0.1	3000
Lithium	0.25	2	0.5	0.139	0.5	0.2	500
Magnesium	5	100	10	10	100	20	150000
Manganese	0.1	1	0.2	0.153	0.5	0.2	3000
Molybdenum	0.25	2	0.5	0.1	0.5	0.2	3000
Nickel	0.1	1	0.2	0.063	0.5	0.1	3000
Potassium	10	100	20	10	100	20	400000
Selenium	0.15	1	0.3	0.05	0.5	0.1	3000
Silver	0.1	1	0.2	0.05	0.5	0.1	250
Sodium	25	100	50	10	100	20	300000
Strontium	0.5	2	1	0.05	0.5	0.1	3000
Thallium	0.1	1	0.2	0.05	0.5	0.1	3000
Tin	0.1	1	0.2	5	20	10	3000
Titanium	0.25	2	0.5	0.125	0.5	0.25	3000
Uranium	0.05	1	0.1	0.05	0.5	0.1	3000
Vanadium	0.25	1	0.5	0.19	0.5	0.3	3000
Zinc	5	20	10	0.683	2	1	3000

Figure 1: **TYPICAL SAMPLE REPORT**

METHOD 6020A
METALS BY ICP-MS

Client	: XYZ, INC.	Date Collected:	11/17/10
Project	: CLEAN PROJECT	Date Received:	11/19/10
SDG NO.	: 10K283	Date Extracted:	11/30/10 17:15
Sample ID:	YWB10-2578	Date Analyzed:	12/03/10 18:05
Lab Samp ID:	K283-10	Dilution Factor:	0.991
Lab File ID:	98L04043	Matrix :	SOIL
Ext Btch ID:	IMK029S	% Moisture :	11.6
Calib. Ref.:	98L04035	Instrument ID :	EMAXTI98

PARAMETERS	RESULTS (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
Aluminum	18000	112	22.4
Antimony	ND	0.561	0.112
Arsenic	2.03	0.561	0.112
Barium	51.9	0.561	0.112
Beryllium	0.344J	0.561	0.112
Cadmium	ND	0.336	0.112
Calcium	618	112	22.4
Chromium	5.01	0.561	0.112
Cobalt	3.29	0.561	0.112
Copper	3.12	0.561	0.224
Iron	13300	112	22.4
Lead	4.34	0.561	0.112
Magnesium	2750	112	22.4
Manganese	227	0.561	0.112
Molybdenum	1.24	0.561	0.112
Nickel	3.33	0.561	0.112
Potassium	2050	112	22.4
Selenium	0.188J	0.561	0.112
Silver	ND	0.561	0.112
Sodium	ND	112	22.4
Thallium	0.236J	0.561	0.112
Vanadium	30.0	0.561	0.112
Zinc	28.9	1.12	0.561

Figure 2: **TYPICAL LCS/LCD SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
SDG NO.: 10K283
METHOD: METHOD 6020A

MATRIX:	SOIL			% MOISTURE:	NA
DILTN FACTR:	1	1	1		
SAMPLE ID:	MBLK1S				
CONTROL NO.:	IMK029SB	IMK029SL	IMK029SC		
LAB FILE ID:	98L04037	98L04038	98L04039		
DATIME EXTRCTD:	11/30/1017:15	11/30/1017:15	11/30/1017:15	DATE COLLECTED:	NA
DATIME ANALYZD:	12/03/1017:41	12/03/1017:45	12/03/1017:49	DATE RECEIVED:	11/30/10
PREP. BATCH:	IMK029S	IMK029S	IMK029S		
CALIB. REF:	98L04035	98L04035	98L04035		

ACCESSION:

PARAMETER	BLNK RSLT mg/kg	SPIKE AMT mg/kg	BS RSLT mg/kg	BS % REC	SPIKE AMT mg/kg	BSD RSLT mg/kg	BSD % REC	RPD %	QC LIMIT %	MAX RPD %
Aluminum	ND	2500	2370	95	2500	2400	96	1	80-120	20
Antimony	ND	25.0	23.7	95	25.0	23.8	95	1	80-120	20
Arsenic	ND	25.0	23.8	95	25.0	23.5	94	1	80-120	20
Barium	ND	25.0	24.2	97	25.0	24.6	98	2	80-120	20
Beryllium	ND	25.0	23.8	95	25.0	23.9	96	1	80-120	20
Cadmium	ND	25.0	23.5	94	25.0	23.8	95	1	80-120	20
Calcium	ND	2500	2490	99	2500	2490	99	0	80-120	20
Chromium	ND	25.0	24.4	98	25.0	24.7	99	1	80-120	20
Cobalt	ND	25.0	23.8	95	25.0	24.1	96	1	80-120	20
Copper	ND	25.0	24.2	97	25.0	24.4	98	1	80-120	20
Iron	ND	2500	2440	98	2500	2450	98	0	80-120	20
Lead	ND	25.0	24.5	98	25.0	24.4	97	0	80-120	20
Magnesium	ND	2500	2370	95	2500	2390	95	1	80-120	20
Manganese	ND	25.0	23.8	95	25.0	24.0	96	1	80-120	20
Molybdenum	ND	25.0	24.2	97	25.0	24.2	97	0	80-120	20
Nickel	ND	25.0	24.3	97	25.0	24.6	98	1	80-120	20
Potassium	ND	2500	2440	98	2500	2450	98	0	80-120	20
Selenium	ND	25.0	23.8	95	25.0	23.9	95	0	80-120	20
Silver	ND	25.0	23.6	94	25.0	23.9	96	1	80-120	20
Sodium	ND	2500	2460	98	2500	2440	98	1	80-120	20
Thallium	ND	25.0	23.8	95	25.0	24.0	96	1	80-120	20
Vanadium	ND	25.0	24.3	97	25.0	24.5	98	1	80-120	20
Zinc	ND	25.0	25.0	100	25.0	24.7	99	1	80-120	20

Figure 3: **TYPICAL MS/MSD SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
SDG NO.: 10K283
METHOD: METHOD 6020A

MATRIX:	SOIL			% MOISTURE:	11.6
DILTN FACTR:	0.991	0.992	0.992		
SAMPLE ID:	YWB10-2578				
CONTROL NO.:	K283-10	K283-10M	K283-10S		
LAB FILE ID:	98L04043	98L04040	98L04041		
DATIME EXTRCTD:	11/30/1017:15	11/30/1017:15	11/30/1017:15	DATE COLLECTED:	11/17/10
DATIME ANALYZD:	12/03/1018:05	12/03/1017:53	12/03/1017:57	DATE RECEIVED:	11/19/10
PREP. BATCH:	IMK029S	IMK029S	IMK029S		
CALIB. REF:	98L04035	98L04035	98L04035		

ACCESSION:

PARAMETER	SMPL RSLT mg/kg	SPIKE AMT mg/kg	MS RSLT mg/kg	MS % REC	SPIKE AMT mg/kg	MSD RSLT mg/kg	MSD % REC	RPD %	QC LIMIT %	MAX RPD %
Aluminum	18000	2810	21900	139*	2810	23200	187*	6	80-120	20
Antimony	ND	28.1	23.5	84	28.1	24.5	87	4	80-120	20
Arsenic	2.03	28.1	26.7	88	28.1	27.9	92	5	80-120	20
Barium	51.9	28.1	84.3	116	28.1	90.1	136*	7	80-120	20
Beryllium	0.344J	28.1	26.5	93	28.1	27.0	95	2	80-120	20
Cadmium	ND	28.1	25.8	92	28.1	26.8	95	3	80-120	20
Calcium	618	2810	3330	97	2810	3360	98	1	80-120	20
Chromium	5.01	28.1	31.4	94	28.1	33.1	100	5	80-120	20
Cobalt	3.29	28.1	28.5	90	28.1	29.5	93	3	80-120	20
Copper	3.12	28.1	28.6	91	28.1	29.7	95	4	80-120	20
Iron	13300	2810	17000	131*	2810	18300	176*	7	80-120	20
Lead	4.34	28.1	30.8	94	28.1	32.6	101	6	80-120	20
Magnesium	2750	2810	5550	100	2810	5770	108	4	80-120	20
Manganese	227	28.1	274	170*	28.1	285	207*	4	80-120	20
Molybdenum	1.24	28.1	27.2	93	28.1	28.5	97	5	80-120	20
Nickel	3.33	28.1	29.3	92	28.1	30.7	98	5	80-120	20
Potassium	2050	2810	5000	105	2810	5170	111	3	80-120	20
Selenium	0.188J	28.1	24.4	86	28.1	25.1	89	3	80-120	20
Silver	ND	28.1	26.1	93	28.1	27.0	96	3	80-120	20
Sodium	ND	2810	2620	93	2810	2680	96	2	80-120	20
Thallium	0.236J	28.1	25.9	92	28.1	27.3	96	5	80-120	20
Vanadium	30.0	28.1	58.0	100	28.1	63.4	119	9	80-120	20
Zinc	28.9	28.1	57.7	103	28.1	60.5	113	5	80-120	20

Figure 4: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN PROJECT

SDG : 10K283

METHOD 6020A
METALS BY ICP-MS

A total of twelve (12) soil samples were received on 11/19/10 for Total Metals by ICP-MS analysis, Method 6020A in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Initial Calibration was established as prescribed by the method and was verified using a secondary source. Interference checks were performed and results were within required limits. Continuing calibration verifications and continuing calibration blanks were carried out at the frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for IMK029SL/C were all within QC limits.

Matrix QC Sample
Matrix QC sample was analyzed at the frequency prescribed by the project.
Percent recoveries were within project QC limits except for results qualified with [*] in K283-10M/S summary form, most likely due to matrix interference.
Check QC summaries form for details.
In addition Analytical spike and serial dilution were analyzed for matrix interference evaluation. Results were within method acceptance criteria.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURES	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
Tune Check (Mass calibration and resolution check)	Daily before ICAL.	±0.10 AMU (Mass of Isotope) <0.9 AMU full width resolution RSD of 4 replicates : ≤5%	Correct problem and repeat tune check.		
Initial Calibration (multi-point)	Daily initial calibration prior to sample analysis.	r ≥ 0.998	Correct the problem and repeat the initial calibration.		
Initial Calibration Verifications (ICV) Second Source	Daily after the initial calibration.	All analytes within ±10% of expected value RSD of Replicate integrations: < 5%	Correct the problem and repeat the initial calibration.		
Low Level Calibration Verification (LLICV / LLCCV)	LLICV: Daily after initial calibration. LLCCV: At the end of the analysis sequence	All analytes with ± 30% of expected value.	Correct the problem and repeat the initial calibration.		
Calibration Verifications (CCV)	Daily before sample analysis, after every 10 samples and at the end of the analysis sequence.	All analytes within ±10% of expected value. RSD of replicate integrations < 5%.	Repeat calibration and reanalyze all samples since last successful calibration.		
Calibration Blanks (ICB/CCB)	After every calibration verification	All target analytes < LOQ.	Correct problem then reanalyze calibration blank and previous samples.		
Interference Check Sample (ICSA/ICSAB)	Analyze at the beginning of each analytical run or once every 12 hours , whichever is more frequent.	Within ±20% of expected value	Terminate analysis, correct the problem, reanalyze ICS, and reanalyze all affected samples		
Internal Standard (IS)	ICV, LLICV, CCV, LLCCV, CCBs, MB, LCS, every sample	IS Intensities > 70% from Initial Calibration Blank IS Intensity	Correct problem then re-analyze		
Method Blank	One per preparation batch	All target analytes < ½ LOQ.	Re-digest and reanalyze method blank and all samples processed with the contaminated blank.		
Laboratory Control Sample (LCS)	One per preparation batch	% Recovery: 80% - 120%	Re-digest and reanalyze LCS and all associated samples		
Matrix Spikes (MS/MSD)	One MS/MSD every 20 project samples per matrix	% Recovery: 75% - 125% RPD ≤20%	Evaluate post spike and dilution test: • If parent sample result is "ND", evaluate post spike. • If parent sample result is high (i.e., 4x of spike concentration) and post spike failed, evaluate dilution test.		
Post Digestion Spike Addition	When MS fails.	Recovery within 80-120% of expected value	Correct the problem then reanalyze post digestion spike addition		
Dilution Test (5X)	When MS fails.	1:5 dilution must agree within ±10% of the original determination	Evaluate. Discuss in case narrative.		
Instrument Detection Limit (IDL)	Every three months		Correct the problem and repeat the IDL determination.		
Comments: Refer to PSR for flagging criteria.			Reviewed By:		
			Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: µg/L
Sample Amt(ml): 50

Instrument ID: I98
Analysis date: 1/7/2011
Analyzed by: C. Capulong

MATRIX : WATER

PARAMETER	98A04019	98A04020	98A04021	98A04022	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IMA006WL	IMA006WC	IMA006WX	IMA006WY							
Aluminum	2513	2514	2516	2513	2500	2514	101	1.41	0.06	80 - 120	PASSED
Antimony	25.1	25.1	25.2	25.0	25	25	100	0.09	0.36	80 - 120	PASSED
Arsenic	24.6	25.0	24.8	24.8	25	25	99	0.17	0.67	80 - 120	PASSED
Barium	25.7	25.6	25.7	25.4	25	26	102	0.15	0.58	80 - 120	PASSED
Beryllium	26.2	26.4	26.0	26.4	25	26	105	0.18	0.67	80 - 120	PASSED
Boron	27.3	27.8	27.2	27.7	25	28	110	0.31	1.13	80 - 120	PASSED
Cadmium	25.4	25.3	25.5	25.2	25	25	101	0.13	0.50	80 - 120	PASSED
Calcium	2578	2555	2563	2585	2500	2570	103	13.70	0.53	80 - 120	PASSED
Chromium	25.4	25.4	25.3	25.0	25	25	101	0.18	0.72	80 - 120	PASSED
Cobalt	25.4	26.0	25.6	25.6	25	26	103	0.22	0.87	80 - 120	PASSED
Copper	25.6	25.8	25.7	25.3	25	26	102	0.22	0.86	80 - 120	PASSED
Iron	2600	2583	2596	2594	2500	2593	104	7.27	0.28	80 - 120	PASSED
Lead	25.7	25.8	25.5	25.6	25	26	103	0.10	0.40	80 - 120	PASSED
Lithium	24.6	24.9	24.7	25.1	25	25	99	0.22	0.88	80 - 120	PASSED
Magnesium	2510	2516	2492	2506	2500	2506	100	10.20	0.41	80 - 120	PASSED
Manganese	25.6	25.7	25.7	25.4	25	26	102	0.15	0.59	80 - 120	PASSED
Molybdenum	25.1	25.1	25.1	24.7	25	25	100	0.19	0.74	80 - 120	PASSED
Nickel	25.3	25.6	25.4	25.0	25	25	101	0.23	0.91	80 - 120	PASSED
Potassium	2602	2593	2602	2558	2500	2589	104	20.93	0.81	80 - 120	PASSED
Selenium	25.4	25.1	25.3	25.0	25	25	101	0.16	0.62	80 - 120	PASSED
Silver	25.4	25.6	25.5	25.0	25	25	101	0.27	1.05	80 - 120	PASSED
Sodium	2507	2502	2507	2544	2500	2515	101	19.48	0.77	80 - 120	PASSED
Strontium	25.3	25.4	25.3	25.2	25	25	101	0.09	0.35	80 - 120	PASSED
Thallium	25.5	25.9	25.7	25.7	25	26	103	0.16	0.63	80 - 120	PASSED
Tin	25.1	25.2	25.5	25.3	25	25	101	0.15	0.59	80 - 120	PASSED
Titanium	25.2	25.0	25.2	24.8	25	25	100	0.17	0.66	80 - 120	PASSED
Uranium	26.1	26.1	25.9	25.9	25	26	104	0.13	0.50	80 - 120	PASSED
Vanadium	25.3	25.4	25.2	24.8	25	25	101	0.26	1.03	80 - 120	PASSED
Zinc	25.3	25.4	25.6	25.2	25	25	101	0.15	0.59	80 - 120	PASSED

Appendix 2 (Cont.): DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: mg/Kg
Sample Amt(gm): 1

Instrument ID: I98
Analysis date: 1/7/2011
Analyzed by: C. Capulong

MATRIX : SOIL

PARAMETER	98A04027	98A04028	98A04029	98A04030	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IMA007SL	IMA007SC	IMA007SX	IMA007SY							
Aluminum	2439	2397	2422	2435	2500	2423	97	18.95	0.78	80 - 120	PASSED
Antimony	21.1	20.9	20.8	20.8	25	21	84	0.13	0.61	80 - 120	PASSED
Arsenic	20.7	20.5	20.9	20.9	25	21	83	0.22	1.04	80 - 120	PASSED
Barium	21.6	21.5	21.4	21.7	25	22	86	0.12	0.54	80 - 120	PASSED
Beryllium	21.7	21.7	21.7	21.6	25	22	87	0.05	0.23	80 - 120	PASSED
Boron	23.0	23.2	23.4	23.5	25	23	93	0.23	1.00	80 - 120	PASSED
Cadmium	21.1	20.8	20.7	21.0	25	21	83	0.19	0.92	80 - 120	PASSED
Calcium	2535	2511	2502	2524	2500	2518	101	14.49	0.58	80 - 120	PASSED
Chromium	21.3	21.3	21.5	21.2	25	21	85	0.11	0.51	80 - 120	PASSED
Cobalt	21.5	21.2	21.6	21.5	25	21	86	0.20	0.95	80 - 120	PASSED
Copper	21.1	21.2	21.2	20.8	25	21	84	0.17	0.82	80 - 120	PASSED
Iron	2509	2501	2470	2525	2500	2501	100	23.10	0.92	80 - 120	PASSED
Lead	21.8	21.6	21.5	21.6	25	22	87	0.13	0.59	80 - 120	PASSED
Lithium	20.9	21.1	21.1	21.1	25	21	84	0.07	0.31	80 - 120	PASSED
Magnesium	2424	2401	2413	2427	2500	2416	97	11.81	0.49	80 - 120	PASSED
Manganese	21.5	21.5	21.6	21.5	25	22	86	0.06	0.29	80 - 120	PASSED
Molybdenum	21.4	21.2	21.3	21.4	25	21	85	0.11	0.53	80 - 120	PASSED
Nickel	20.9	20.8	21.0	20.8	25	21	83	0.08	0.36	80 - 120	PASSED
Potassium	2493	2499	2495	2483	2500	2493	100	6.81	0.27	80 - 120	PASSED
Selenium	21.1	20.8	21.3	21.1	25	21	84	0.19	0.92	80 - 120	PASSED
Silver	21.6	21.4	21.5	21.8	25	22	86	0.17	0.80	80 - 120	PASSED
Sodium	2440	2435	2390	2464	2500	2432	97	30.88	1.27	80 - 120	PASSED
Strontium	21.5	21.3	21.5	21.7	25	21	86	0.17	0.80	80 - 120	PASSED
Thallium	21.6	21.4	21.4	21.5	25	21	86	0.08	0.39	80 - 120	PASSED
Tin	24.6	24.2	24.1	24.3	25	24	97	0.24	1.00	80 - 120	PASSED
Titanium	21.6	21.4	21.5	21.5	25	22	86	0.08	0.38	80 - 120	PASSED
Uranium	22.4	22.0	22.4	22.4	25	22	89	0.21	0.96	80 - 120	PASSED
Vanadium	21.4	21.2	21.3	21.1	25	21	85	0.12	0.57	80 - 120	PASSED
Zinc	22.6	21.8	21.9	22.7	25	22	89	0.47	2.11	80 - 120	PASSED

Appendix 3: COMPARATIVE STUDY OF MODIFIED 3050B

ANALYTICAL METHOD: SW 6020A
PREPARATION BATCH: IMG031S - Modified Method 3050B
IMG032S - Reference Method 3050B
ANALYTICAL BATCH: I98H01
QC STANDARD: 09G281-02

Preparation Date: 7/27/2010
Extracted by: M. Mendoza
Analytical Run Date: 8/3/2010
Analyzed by: C. Capulong

COMPOUND	TRUE VALUES (mg/Kg)	ACCEPTANCE LIMITS (mg/Kg)	RECOVERY LIMITS (%)	REFERENCE METHOD 3050B				MODIFIED METHOD 3050B			
				Concentration (mg/Kg)		Recovery		Concentration (mg/Kg)		Recovery	
				98H01041 G281-02	98H01043 G281-02D	98H01041 G281-02	98H01043 G281-02D	98H01030 G281-02	98H01032 G281-02D	98H01030 G281-02	98H01032 G281-02D
Aluminum	7320	4940 - 16400	67 - 224	10900	10700	149%	146%	10700	10700	146%	146%
Antimony	110	11.0 - 121	10 - 110	20.0	19	18%	17%	61.4	66.6	56%	61%
Arsenic	84.2	42.8 - 92.7	51 - 110	61.2	61.7	73%	73%	63.6	65.3	76%	78%
Barium	247	186 - 318	75 - 129	255	260	103%	105%	275	273	111%	111%
Beryllium	49.0	29.0 - 53.9	59 - 110	39.7	39.6	81%	81%	42	41.7	86%	85%
Boron	130	61.8 - 149	48 - 115	104	104	80%	80%	126	126	97%	97%
Cadmium	76.5	48.7 - 84.4	64 - 110	65.3	66.7	85%	87%	69.9	69.8	91%	91%
Calcium	10200	7860 - 12900	77 - 126	9360	10700	92%	105%	10200	10300	100%	101%
Chromium	116	74.8 - 140	64 - 121	99.5	98.4	86%	85%	107	110	92%	95%
Cobalt	64.6	47.2 - 79.7	73 - 123	62.1	61.3	96%	95%	63.8	64	99%	99%
Copper	143	99.7 - 166	70 - 116	116	115	81%	80%	127	126	89%	88%
Iron	23300	11500 - 36200	49 - 155	23900	23700	103%	102%	24800	24800	106%	106%
Lead	82.0	41.9 - 90.2	51 - 110	63.3	64.9	77%	79%	67.5	67.6	82%	82%
Magnesium	7400	5300 - 9060	72 - 122	6770	6760	91%	91%	6930	7100	94%	96%
Manganese	475	428 - 724	90 - 152	546	562	115%	118%	584	571	123%	120%
Molybdenum	66.1	36.0 - 72.7	54 - 110	54.9	53.5	83%	81%	60.1	59.4	91%	90%
Nickel	144	88.8 - 158	62 - 110	112	113	78%	78%	122	122	85%	85%
Potassium	3740	2360 - 4990	63 - 133	3620	3600	97%	96%	3690	3560	99%	95%
Selenium	189	97.2 - 208	51 - 110	142	148	75%	78%	154	157	81%	83%
Silver	40.6	21.2 - 44.6	52 - 110	30.9	32.7	76%	81%	34.2	34.9	84%	86%
Sodium	200	31.4 - 324	16 - 162	292	197	146%	99%	192	200	96%	100%
Strontium	135	88.1 - 162	65 - 120	123	121	91%	90%	129	128	96%	95%
Thallium	127	73.2 - 144	58 - 113	110	114	87%	90%	117	112	92%	88%
Tin	250	39.5 - 275	16 - 110	71.2	73.2	28%	29%	84.7	85.2	34%	34%
Titanium	609	426 - 792	70 - 130	737	744	121%	122%	772	760	127%	125%
Uranium	1.12	0.784 - 1.46	70 - 130	0.93	1.1	83%	98%	1.03	1.01	92%	90%
Vanadium	61.8	55.6 - 123	90 - 199	90.2	89.7	146%	145%	92.8	93.1	150%	151%
Zinc	208	145 - 270	70 - 130	208	207	100%	100%	225	214	108%	103%

** Note: Modified 3050B procedure is specified in EMAX-3050 Rev. 4*

6020FA: ANALYSIS RUN LOG

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
ICP-MS

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Start Date:

End Date:

Comments:

Book #: A98-025

Instrument No.: 98

Analytical Batch:

Analytical Sequence:

Method File:

SOP #	Rev. #
☐ EMAX-6020	
☐ EMAX-200.8	
☐ EMAX-	

STANDARDS ID	
S0	
S1	
S2	
S3	
S4	
S5	
S6	
S7	
ICV	
CCV	
ICSA	
ICSAB	
6020 TUNE SOLN.	
200.8 TUNE SOLN.	
CRI/MRL	

Analyzed By:

Date:

6020FS: SAMPLE PREPARATION LOG

EMAX LABORATORIES, INC.

DIGESTION LOG *for* ICP-MS

Page 1

Note: For samples, relevant QCs/Standards digested, refer to attached digestion sequence.

Comments:

Book #: EIM-029

Batch:

Matrix:

SOP #	Rev. #
☐ EMAX-200.8	
☐ EMAX-6020	
☐ EMAX-	

Start	Temp °C	End	Temp °C

Standards	ID	Amount Added (ml)
LCS-1		
LCS-2		
MS		
Reagent	**Lot# / ID**	**Amount Added (ml)**
HNO_3		
HCl		
H_2O_2		
HNO3(1:1)		

Digestate Location	
Extract Location	

☐ Soil Samples: -diluted 1 ml of digestate to 10 ml reagent water (DF=10X)

☐ Reagent Water ID:

☐ HNO_3 dispenser checked @ 5.0 ml with Class A volumetric flask

☐ HCl dispenser checked @ 10.0 ml with Class A volumetric flask

☐ Thermometer ID:

Prepared By:

Standard Added By: Witnessed By:

Extract Rcvd By: Checked By:

Date endorsed to waste Disposal:

Accepted By:

6020FM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

ICP-MS MAINTENANCE LOG

Instrument No: 98 Month: Year: 201_ Book # M98-007

Date							
Argon, Hydrogen, Helium							
Instrument Discharge							
Pump Tubings							
Rinse Bottle							
Printer Paper							
Autosampler							
Cooling Water							
Peri Pump Rate (0.08-0.12 RPS)							
Nebulizer Gas (0.8-1.30 L/min)							
Makeup Gas (0.1-0.3 L/min)							
ICP-MS TUNE							
Li - 7 (≥ 6400 Counts)							
Y - 89 (≥ 16000 Counts)							
Tl - 205 (≥ 9600 Counts)							
Oxides (MO^+) ≤ 2%							
Double Charge (M^{++}) ≤ 2%							
Analyst Initials							
ICP-MS TUNE							
Problem(s) Encountered							
Corrective Action							
Return To Specs (Analyst Initials)							

Code	Problems Encountered	Code	Corrective Action

STANDARD OPERATING PROCEDURE

MERCURY IN SOLID OR SEMISOLID WASTE

SOP No.:	EMAX-7471	Revision No.	5	Effective Date:	31-Mar-10
Prepared By:	Mary Jane Mendoza			Date:	03.30.10
Approved By:	Kenette Pimentel QA Manager			Date:	03.30.10
Approved By:	Caspar Pang Laboratory Director			Date:	3/30/10

Control Number: 7471-05-

1.0 SCOPE AND APPLICATION

1.1. This procedure applies to the measurement of Mercury in domestic and industrial wastes, soils, sediments, extracts and sludge samples by Cold Vapor Absorption Technique. This SOP is an adaptation of Method 7471B.

2.0 SUMMARY OF METHOD

2.1. A representative amount of sample is digested in nitric and hydrochloric acids, followed by oxidation with potassium permanganate.

2.2. Organic mercurial are broken down and converted into mercuric ions in order to respond to the cold vapor atomic absorption technique. Addition of permanganate ensures that organo-mercury compounds are oxidized.

2.3. Absorption of radiation by mercury vapor at 253.7 nm is then measured in the digested samples.

2.4. **Interferences**

2.4.1. Sulfides (as sodium sulfide), copper and chloride at high concentrations are known to interfere with the recovery of mercury. Samples containing such interference may require additional permanganate (about 12.5 mL).

2.4.2. Care must be taken to ensure that free chlorine is absent before the mercury is swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent. In addition, the dead air space in the digestion vessel must be purged before adding stannous sulfate.

2.4.3. Certain volatile organic materials that absorb at this wavelength may also cause interference. A preliminary run without reagents should determine if this type of interference is present.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL)**

3.1.1. Refer to EMAX-QA04 for detection limit generation, evaluation and verification.

3.2. **Limit of Quantitation (LOQ)**

3.2.1. LOQ is equal to the concentration of the lowest calibration point, unless otherwise specified by the project.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable range requiring no dilution is equal to the concentration of the highest calibration point (See Section 9.6). All samples analyzed above this range shall be considered "over-range" and shall require dilution to properly quantitate.

4.2. The lowest quantifiable range of diluted samples is equal to the concentration of the lowest calibration point. All diluted samples analyzed below this range shall be considered "under-range" and shall require lower dilution factor to properly quantitate.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. Check that samples received are contained in HDPE pre-cleaned containers preserved with HNO_3 and cooled at $\leq 6^{o}C$ without freezing.

5.2. Digest all samples within 28 days from date of collection.

6.0 ASSOCIATED SOPs

6.1.	EMAX-QA04	Detection Limit Study
6.2.	EMAX-QA08	Corrective Action
6.3.	EMAX-QC01	Quality Control of Chemicals
6.4.	EMAX-QC02	Analytical Standard Preparation
6.5.	EMAX-QC07	Glassware Cleaning

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves, at all times when performing this procedure. Perform preparation and analysis of mercury in a fume hood equipped with an exhaust fan or blower.

7.3. Place all wastes generated during analytical process in satellite waste containers. Endorse these wastes to waste disposal section for proper disposal.

7.4. If for any reason, sample and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritation persists inform your supervisor immediately so that proper action can be taken.

7.5. Do not look directly at the Mercury Lamp while lit. The radiation may cause damage to your eyes.

7.6. Perform all reagent additions under a fume hood.

7.7. Mercury analyzers are to be used by trained personnel only.

8.0 INSTRUMENTS, CHEMICALS, AND REAGENTS

8.1. **Instruments and Supplies**

8.1.1. Mercury Analyzers

8.1.1.1. Leeman PS-200 Automated Mercury Analyzer with Autosampler, Computer, Printer and PS 200 Software.

8.1.1.2. Leeman Hydra AA Automated Analyzer with Autosampler, Computer, Printer and PS200 Software.

8.1.2. 100 ml Digestion vessel

8.1.3. Digestate containers

8.1.4. Digestion block or equivalent.

8.1.5. Magnetic stirrer

8.1.6. Micropipettes and tips

8.1.7. Thermometer

8.2. **Chemicals and Reagents**

8.2.1. Hydrochloric acid, concentrated. Reagent grade.

8.2.2. Nitric acid, concentrated. Reagent grade.

8.2.3. Stannous chloride: Dissolve 200 g. of $SnCl_2$ in reagent water, add 200-ml concentrated HCl and dilute to 2-liter.

8.2.4. Hydroxylamine hydrochloride, 12% solution: Dissolve 120 g of hydroxylamine hydrochloride in 1 liter reagent water.

8.2.5. Potassium permanganate, 5% solution. Dissolve 50 g of potassium permanganate in 1 liter reagent water.

8.2.6. Reagent water – mercury-free water

9.0 STANDARDS

9.1. Refer to EMAX-QC02 for proper standard preparation procedure.

9.2. Other concentration levels may be prepared to meet the data quality objective of a project.

9.3. **Stock Standard**

9.3.1. Purchase stock standards as certified solutions from two different vendors. Use one as primary standard and the other as secondary standard.

9.3.2. Transfer standards on a properly labeled inert vial with minimal headspace and store at -10°C to -20°C.

9.3.3. Prepare calibration standards from the primary standard.

9.3.4. Prepare initial calibration verification standards and spiking standards from the secondary standard.

Stock Std	Name	Source	CAT #	CONC	NOTES
Primary / CCV	Mercury	Leeman	602-00064	100 mg/L	Or equivalent
ICV/LCS/MS	Mercury	ERA	027	1000 mg/L	Or equivalent

9.4. **Intermediate Standard Solution**

9.4.1. From 100 mg/L stock solution take a 2 ml aliquot and dilute to 200 ml using reagent water. The solution shall have a final concentration of 1.0 mg/L.

9.4.2. Prepare secondary dilution from 1000 mg/L stock solution, take a 1 ml aliquot and dilute to 100 ml using reagent water. This solution shall have a final concentration of 10 mg/L.

9.5. **Working Standard**

9.5.1. From the secondary dilution of intermediate standard, prepare the working standard solution to have a final concentration of 100 µg/L.

9.6. **Initial Calibration Standards**

9.6.1. From the working solution, prepare the following *Leeman* standards.

Level	Aliquot(ml)	Final DigestionVolume(ml)	Concentration (µg/L)
S1	0	100	0
S2	0.2	100	0.2
S3	1.0	100	1.0
S4	2.0	100	2.0
S5	5.0	100	5.0
S6	10.0	100	10.0
CCV	5.0	100	5.0

9.7. **ICV/ LCS/MS**

9.7.1. From the working standard, prepare ICV/CCV/LCS/MS solutions using *ERA* Standards.

Name	Aliquot(ml)	Final Digestion Volume(ml)	Concentration (µg/L)
ICV	2.0	100	2.0
LCS/MS	5.0	100	5.0

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Weigh a representative 0.6 g portion of wet sample into digestion vessels.

10.1.2. Add spike standards to the LCS/MS. Add appropriate standards for Initial Calibration, ICV and CCVs in clean digestion vessels. (Refer to Section 9.6.1 and 9.7.1 for spike amounts).

10.1.3. Add 5 mL of reagent water and 5 mL of aqua regia with mixing after each addition.

10.1.4. Heat for 2 minutes at 95°C ± 3°C in the digestion block, cool and add 50 mL of reagent water.

10.1.5. Add 15 mL of 5% $KMnO_4$ solution to each bottle.

10.1.6. Swirl each vessel to mix and let it stand for 15 mins. Check each vessel if purple color persists. If not, add permanganate solution at 2.5 mL increments swirling the digestion vessel at every addition until purple color persists.

Add the maximum amount of permanganate solution added to a solution, to the method blank, LCS, calibration standards and calibration verification standards.

10.1.7. Place samples on the digestion block for 30 minutes at 95°C ± 3°C.

10.1.8. Allow the samples to cool.

10.1.9. Add 6 mL hydroxylamine hydrochloride solution and dilute to 100 mL using reagent water.

10.2. **Instrument Parameters**

10.2.1. PROTOCOL

10.2.1.1. Set values as follows.

Instrument ID:	PS200	HYDRA AA
Number of Integration	1	
Uptake time	20 sec.	18 sec.
Weight	N	N
Dilution	N	N
On/Off, times, gains		
On	Y	Y
Time	10	10
Gas	0.35 LPM	0.15 LPM
Pump Rate	5 mL/min	7 mL/min
AUTOSAMPLER – Setup		
Station 1 (rack1)	From cup 1 to cup 44	From cup 1 to cup 44
Station 2 (rack 2)	From cup 1 to cup 44	From cup 1 to cup 44
Rinse time	60 sec.	60 sec.

CALIBRATION S1, S2, S3, S4, S5, S6	Concentration, µg/L 0 0,.20, 1.0, 2.0, 5.0, 10.0	Concentration, µg/L 0 0,.20, 1.0, 2.0, 5.0, 10.0

10.2.2. DATA OUTPUT – Specify Report

Data Output	Real Time	Post Run
Samples	Y	Y

Standards	Y	Y
Updates	Y	Y
Peaks	N	N
IEC Stds.	N	N
Check Stds.	Y	Y
Dups and % Diff.	Y	Y
Wavelength	N	N
Rel. Absorbances	N	N
% RSD	Y	Y
Scans to PRN		N
Detail		Y
Summary		N
Post Run Copies		1
Post Run Report Order [1-sorted; 2- sequential]	2	

10.3. **Calibration**

10.3.1. **Initial Calibration (ICAL)**

10.3.1.1. Prepare initial calibration solution as described in Section 9.6.1.

10.3.1.2. Perform the same procedure used for analytical samples as described in Section 10.1.

10.3.1.3. Analyze as described in Section 10.4.

10.3.1.4. Refer to Section 10.6 for calculations.

10.3.1.5. Initiate initial calibration as described in the instrument operations manual and acquire the calibration data for review after calibration is completed.

10.3.1.6. Refer to Appendix 1 for Quality Control acceptance criteria.

10.3.1.7. Verify the initial calibration by a secondary source standard.

10.3.2. **Initial Calibration Verification (ICV)**

10.3.2.1. Prepare ICV as described in Section 9.7.

10.3.2.2. Perform the same procedure used for analytical samples as described in Section 10.1.

10.3.2.3. Analyze the ICV sample to verify the concentration of the ICAL.

10.3.2.4. Refer to Appendix 1 for Quality Control acceptance criteria.

10.3.3. **Continuing Calibration Verification (CCV)**

10.3.3.1. Prepare CCV as described in Section 9.6.

10.3.3.2. Perform the same procedure used for analytical samples as described in Section 10.1.

10.3.3.3. Analyze the CCV sample to verify the concentration of the ICAL.

10.3.3.4. Refer to Appendix 1 for Quality Control acceptance criteria.

10.4. **Analysis**

10.4.1. Calibration and Analytical Sequence

10.4.1.1. Refer to the instrument operations manual for proper calibration and analytical sequence setup (autosampler setup).

10.4.1.2. Analytical batch ID naming convention: MIIMSSS

where:

M – is for Mercury and is always the first character

II – is the instrument number

M – is the month code (A for January, B for February, and so on)

SSS – is a sequential number (resets to 001 for the first folder created each month)

10.4.1.3. Typical Calibration Sequence

- S1 – 0.00000
- S2 – 0.20000
- S3 – 1.00000
- S4 – 2.00000
- S5 – 5.00000
- S6 – 10.0000

10.4.1.4. Typical Analytical Sequence

- ICV
- ICB
- CCV1
- CCB1
- Method Blank
- LCS
- QC Sample
- Post Analytical Spike
- Serial Dilution
- Matrix Spike
- Maximum of 4 samples
- CCV2
- CCB2
- Maximum of 10 samples

- CCV3
- CCB3

10.4.2. Prepare a Dilution Test sample at 5 times dilution. Pipette 2 mL of sample, add 10-mL of S_0 into a sample tube. Seal the tube with parafilm and invert the tube several times to ensure adequate mixing.

10.4.3. Prepare a Post Digestion Spike test sample. Using the un-spiked sample digestate (preferably the QC sample), add MS standard to maintain the same spike level as the MS sample digestate.

10.4.4. Check QC criteria as soon as the data is available.

10.4.4.1. Check the LCS recoveries against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 for QC limits.

10.4.4.2. Check the matrix spike recovery against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 for QC limits.

10.4.4.3. Check that sample result concentrations are within the calibration range.

10.4.5. **Dealing with Carryover**

10.4.5.1. Check the sample analyzed preceded by another sample found to have target analyte concentrations exceeding the calibration range.

10.4.5.2. If no target analyte is detected as found in preceding high concentration sample, proceed with data reduction.

10.4.5.3. If there is any target analyte detected as found in preceding high concentration sample, re-analyze the sample to rule-out carryover. If carryover is confirmed, proceed with data reduction and report the data from re-analysis.

10.4.6. **Method of Standard Addition (MSA)**

10.4.6.1. Perform MSA for all EP extracts, samples for de-listing petition, whenever a new matrix is encountered and/or as indicated above.

10.4.6.2. Prepare three sample solutions (Ms1, Ms2, Ms3) to objectively produce equal increments of concentration in the final solution without diluting the sample more than 50% of its original volume and expected concentrations falls within the linear range.

Example: Sample concentration is tentatively determined at 2 µg/L.

Ms1 – take 10-ml of digestate and add 0.2-ml of 100-µg/L spike standard (≈ 6-µg/L)

Ms2 – take 10-ml of digestate and add 0.4-ml of 100-µg/L spike standard (≈ 7-µg/L)

Ms 3 – take 10-ml of digestate and add 0.6-ml of 100-µg/L spike standard (≈ 8-µg/L)

10.4.6.3. Analyze Ms1, Ms2 and Ms3 and calculate the results using Eq-10.6.7.

10.4.6.4. Download the electronic data to the network.

10.4.6.5. Complete the analytical log and make a copy. Highlight the data to be reported and draft the case narrative.

10.4.6.6. Submit the analytical folder to data processing.

10.5. **Data Reduction**

10.5.1. Check that the analytical data generated which indicates positive results are quantitatively correct.

10.5.2. Check that analytical results are generated by the prescribed calibration schedule of method.

10.5.3. Check for possible carry-over. Reanalyze samples having trace level concentration preceded by a sample having a concentration over the calibration range.

10.5.4. Check the MS/MSD, serial dilution and the post digestion spike results. If a matrix interference is indicated, check the PSR if MSA is waived. Otherwise, refer to Section 10.4.6.

10.6. **Calculations**

10.6.1. **Calibration Factor**

$$CF = \frac{R_a}{C_a} \qquad \textit{Eq. 10.6.1}$$

where:

CF	=	*Calibration factor*
R_a	=	*Response for analyte measured in absorbance*
C_a	=	*Known concentration of analyte measured in µg/L*

10.6.2. **Average Calibration Factor**

$$ACF = \frac{\sum CF}{n} \qquad \textit{Eq. 10.6.2}$$

where:

ACF	=	*Average calibration factor*
ΣCF	=	*Sum of calibration factors*
N	=	*number of calibration factors*

10.6.3. **Correlation Coefficient**

$$r(x,y) = \frac{\frac{1}{N}\sum_{i-1}^{N}(x_1 - \bar{x})(y_1 - \bar{y})}{(SD_x)(SD_y)} \qquad \textit{Eq. 10.6.3}$$

where:

$r(x,y)$	=	*Correlation coefficient*
N	=	*number of measurements*
x_i	=	*found value of the ith measurement*
$\bar{x}$	=	*mean of found values*
y_i	=	*true value of the ith measurement*
$\bar{y}$	=	*mean of true values*
SD_x	=	*standard deviation of the found values*
SD_y	=	*standard deviation of the true values*

10.6.4. **Sample Result**

$$C = (R_s)(CF)(DF)\frac{V_e}{S_a}$$ *Eq. 10.6.4*

where:

C	=	*Sample concentration in µg/L or µg/Kg*
CF	=	*Calibration factor*
DF	=	*Dilution factor*
R_s	=	*Sample absorbance*
V_e	=	*Extract volume in L*
S_a	=	*Sample amount in mL or g*

10.6.5. **Accuracy**

$$\%R = \frac{C_r - C}{C_s} x100\%$$ *Eq. 10.6.5*

where:

$\%R$	=	*Percent recovery*
C_r	=	*Recovered concentration*
C	=	*Sample concentration*
C_s	=	*Known spike concentration*

10.6.6. **Precision**

$$\%RPD = \frac{|C1 - C2|}{\left(\frac{C1 + C2}{2}\right)} x100\%$$ *Eq. 10.6.6*

where:

$\%RPD$	=	*Relative Percent Difference*
C_1	=	*Measured concentration of first sample aliquot*
C_2	=	*Measured concentration of second sample aliquot*

10.6.7. **Calculation for MSA**

$$C_x = \frac{(S_2)(V_s)(C_s)}{(S_2 - S_1)V_x}$$ *Eq. 10.6.7*

where:

C_x	=	*Concentration of the sample*
C_s	=	*Concentration of the spike*
S_1	=	*Analytical signal of MS1*
S_2	=	*Analytical signal of MS2*
V_x	=	*Volume of sample aliquot*
V_s	=	*Volume of spike or reagent water*

10.7. **Report Generation**

10.7.1. Generate the report using the following in-house reporting program:

Executable Files	Required Support Files	Output
WDBX[1].exe	Login File (requires network) Seq_name.sq; Gcints.txt	Method.txt [this file integrates the login sample information and the analytical sample information]
MSRBX.exe	Method.txt; Method.met; Method.crf; Project.pln; Qcell.txt	Sample Results (Form1)
IQCVXC.exe	Method.txt; Method.crf; Method.qc; Project.pln;Qcell.txt	QC Summary for LCS, MS, Post Digestion Spike
CQX.exe	Method.txt; Method.crf; Method.qc; Project.pln;Qcell.txt	Summary for Dilution Test, Sample Duplicate
LABCHRNX.exe	Method.txt	Lab Chronicle
CN2.exe		Case Narrative

10.8. **Data Review**

10.8.1. Check the data entry against the analytical log.

10.8.2. Check the Method Blank against the LOQ.

10.8.3. Check LCS, MS/MSD and dilution test against QC limits.

10.8.4. Evaluate the analytical spike test if dilution test failed.

10.8.5. Check for possible carry-over and if so, check if confirmation is performed.

10.8.6. Check that the case narrative accurately describes what transpired in the analytical process.

10.8.7. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Daily routine maintenance shall be observed religiously. Observe manufacturer's notes regarding Dos and DONTs:

- System preparation is a ***MUST*** before instrument startup.
- Make certain that drying tube has been packed loosely. If drying tube is blocked, liquid may backflow into the optical cell. This will require disassembly and cleaning.

[1] X – latest program version

- Do not shutdown the instrument when operational. Abort the run first if interruption is needed.

10.9.2. Daily routine maintenance, troubleshooting and major repairs shall be recorded in the maintenance log.

10.9.3. Maintain the instrument clean at all times.

10.9.4. For troubleshooting, consult the Operations Manual, Section 4.

11.0 QUALITY CONTROL

11.1. Sample Preparation QC

11.1.1. A preparative batch consists of 20 or fewer samples of the same matrix, that are prepared for analysis simultaneously or sequentially, using the same lot of reagents.

11.1.2. Every preparative batch shall have at least one method blank, one LCS and a set of MS/MSD unless otherwise specified by the project. These QC samples shall be digested together with the field samples.

11.1.3. All reagents shall be subjected to QC check prior to use. Refer to EMAX-QC01.

11.2. Sample Analysis QC

11.2.1. Every analytical run shall be preceded by an initial calibration and an initial calibration verification. The ICV standard should be obtained from a different source from that of the initial calibration. Analyze an instrument calibration blank (ICB) after the ICV. No further analysis shall be valid unless acceptance criteria are met.

11.2.2. Verify calibration with continuing calibration verification (CCV) standard and continuing calibration blank (CCB) after every ten samples and at the end of the analytical run.

11.2.2.1. Dilution Test shall be performed whenever a new or unusual sample matrix is encountered.

11.2.2.2. Evaluate Post Digestion Spike result if the dilution test failed to meet the acceptance criteria.

11.2.3. Use Method of Standard Addition (MSA) technique for analysis of all EP extracts and whenever a new sample matrix is being analyzed.

11.2.4. Refer to Appendix 1 for acceptance criteria.

11.3. Method QC

11.3.1. Detection Limit must be established before the analytical procedure can be used and a quarterly verification must be performed.

11.3.2. Method proficiency must be established before the analytical procedure can be used.

11.3.3. All analysts conducting this analysis must have established demonstration of capability

11.3.4. Perform Instrument Detection Limit quarterly unless otherwise specified by the project.

12.0 CORRECTIVE ACTION

12.1. Calibration

12.1.1. If initial calibration is non-compliant, consider the following suggestions to correct the problem:

- Replace the sample tubing, prepare fresh rinsate and re-prepare fresh $SnCl_2$. Rinse the system for at least 15 minutes prior to calibration.
- If problem persists, run the latest passing calibration standard to check for possible instrumentation problem. If it passes, this is an indication that no instrumentation problem exists. Re-digest the calibration standards. If it fails, clean the lamp prior to re-calibration.
- If problem persists, inform the supervisor for further action

12.1.2. If the ICV is non-compliant, consider the following suggestions to correct the problem:

- Run the latest passing ICV standard to check for possible standards preparation error. If it passes, this is an indication of standards preparation error. Re-digest the ICV and re-analyze. If it fails, refer to 12.1.1 prior to re-calibration.

12.1.3. If the CCV is non-compliant, consider the following suggestions to correct the problem:

- Run the latest passing CCV standard to check for possible standards preparation error. If it passes, this is an indication of standards preparation error. Re-digest the CCV and re-analyze. If it fails, refer to 12.1.1 prior to re-calibration.

12.2. **Sample Prep QCs**

12.2.1. It method blank is non-compliant, consider the following suggestions to correct the problem:

- Check the sample results. If sample results are non-detected, you may report the result upon concurring with the PM. Otherwise, perform the corrective action as specified in the PSR.

12.2.2. If LCS is non-compliant, consider the following suggestions to correct the problem:

- Check for errors in calculation and concentration of the analyte solution.
- Check instrument performance to determine if it is within acceptable guidelines.
- Recalculate the data and/or reanalyze the extract if any of the above checks reveals a problem.
- If re-analysis results are the same as the initial result, consult the Supervisor for further action. If results indicate digestion problem, fill-up an NCR and order re-digestion to include the associated sample(s).

12.2.3. If MS is non-compliant, consider the following suggestions to correct the problem:

- If recovery failed to meet the acceptance criteria, and sample result is > 5X the RL, and the spike amount is >4X of the parent sample concentration, evaluate the serial dilution sample result. Refer to Appendix 1 for acceptance criteria. If it fails to meet the acceptance criteria, perform MSA.
- If recovery failed to meet the acceptance criteria, and sample result is $\leq$ 5X the RL, and the spike amount is >4X the parent sample concentration, evaluate the post digestion spike sample result. Refer to Appendix 1 for acceptance criteria. If it fails to meet the acceptance criteria, perform MSA.

13.0 POLLUTION PREVENTION

13.1. Mercury is a very volatile element, dangerous levels are readily attained in air. Mercury vapor should not exceed 0.1 mg/m^{-3} in air. Air saturated with the vapor at 20°C contains mercury in a concentration far greater than that limit. The danger increases at higher temperatures. It is, therefore, important that mercury be handled with care. Containers of mercury should be securely covered and spillage should be

avoided. Mercury should only be handled under the hood in a well-ventilated area. Prepare all standards in the fume hoods.

13.2. Because of the toxic nature of mercury vapor, precaution must be taken to avoid its inhalation. A by-pass must be included on the system to vent the mercury vapor into an exhaust hood.

13.3. Small amounts of mercury spillage can be cleaned up by addition of sulfur powder. The resulting mixture should be properly labeled and turned over to the waste disposal unit for proper disposal.

14.0 WASTE MANAGEMENT

14.1. Collect all generated waste and properly turn over to the waste disposal unit.

14.2. All expired standards and highly concentrated samples must be separated and properly labeled before endorsement to the waste disposal unit.

15.0 SUPPLEMENTARY NOTES

15.1. Since there is no technical difference between SW846 7471A and 7471B, this SOP may also be applicable for projects requiring method SW846 7471A.

15.2. **Definition of Terms**

15.2.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.2.2. Batch – Is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.2.2.1. Preparation batch is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.2.2.2. Analytical batch is composed of prepared samples (extracts, digestates or concentrates) which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.2.3. Calibration – Is defined as an instrument response per unit measure. It is an experimental value by measuring the response of an instrument per unit target analyte under the method specific condition. A determinant measured from a standard to obtain the correct value of an instrument output.

15.2.4. Corrective Action – Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

15.2.5. Instrument Blank – Is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.2.6. Instrument Method – Is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.2.7. Lab Control Sample (LCS) – Is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.2.8. Matrix – Is a physical state of a sample. Most of environmental samples are classified as water, soil or air.

15.2.9. Matrix Spike (MS) – Is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.2.10. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.2.11. Method Blank – Is a target-analyte-free sample subjected to the entire sample preparation and/or analytical process to monitor contamination.

15.2.12. Mercury – Also known as quicksilver, is a chemical (element) that occurs naturally in the environment in several forms. One form of mercury is used in thermometers. This form is called "metallic mercury". Mercury is also used in barometers and other common consumer products. Mercury can also be combined with other chemicals, such as chlorine, carbon or oxygen to form either "inorganic" or "organic" mercury compounds.

15.2.13. Nonconformance – An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

15.2.14. Raw Data – Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheet, record, memoranda, notes or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

15.2.15. Sample – Is a specimen received in the laboratory bearing a sample label traceable to the accompanying chain of custody. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified in the project.

15.2.16. Sample Duplicate – Is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.2.17. Sub-sample – Is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.3. **Application of EMAX QC Procedures**

15.3.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing analysis for mercury. In instances where there is a project or program QAPP, the requirements given in the project shall take precedence over this SOP.

15.4. **Department of Defense (DoD) Projects**

15.4.1. When samples from DoD sponsored projects are analyzed for mercury, the calibration, QC, corrective action, and data flagging requirements shall follow the specifics outlined in the DoD Quality Systems Manual for Environmental Laboratories, latest version. In the absence of a project QAPP or directive from the client project manager, DoD Quality Systems Manual latest version shall be applied.

15.5. **Department of Energy (DoE) Projects**

15.5.1. When samples from DoE sponsored projects are analyzed for mercury, the calibration, QC, corrective action, and data flagging requirements shall follow the quality assurance project plan

(QAPP). In the absence of QAPP, the DoE Quality Systems for Analytical Services, latest version shall be applied.

16.0 REFERENCES

16.1. Method 7471B, Rev. 2, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, USEPA SW-846, Feb. 2007.

16.2. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Figures**

Figure 1	Autosampler Layout
Figure 2	Typical Calibration Curve
Figure 3	Typical Sample Result Summary
Figure 4	Typical LCS Report Summary
Figure 5	Typical Matrix Spike Report Summary
Figure 6	Typical Dilution Test Report Summary
Figure 7	Typical Post Digestion Spike Report Summary
Figure 8	Typical Case Narrative

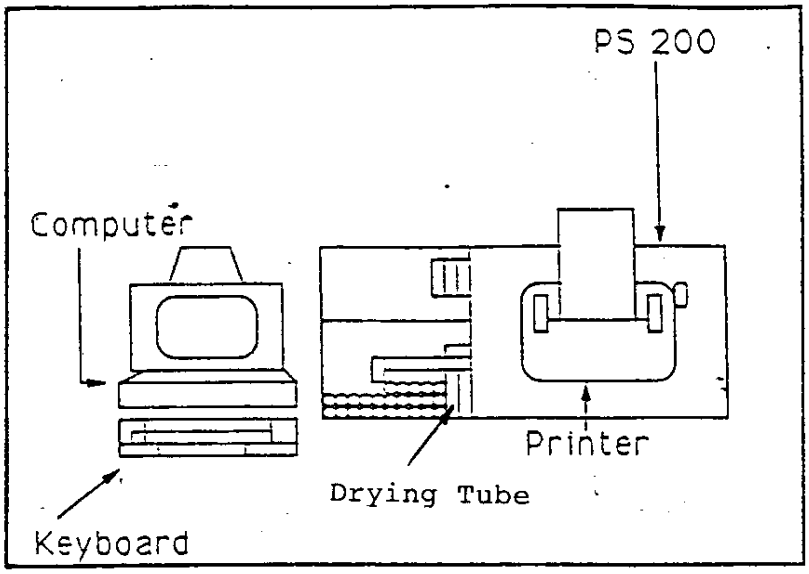
17.2. **Appendices**

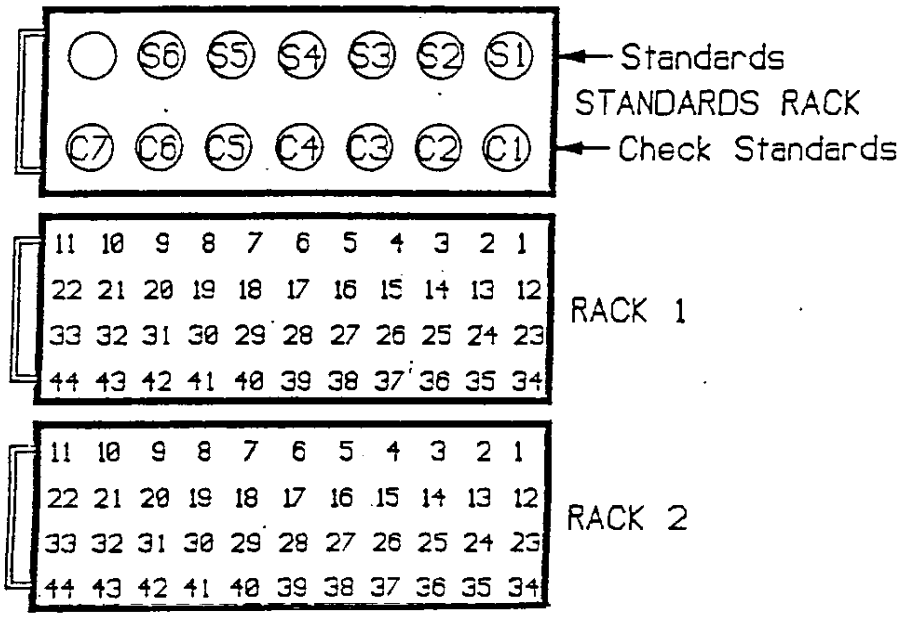
Appendix 1	Summary of Quality Control Procedures
Appendix 2	Demonstration of Capability

17.3. **Forms**

7471FS	Sample Preparation Log
7471FA	Analytical Run Log
7471FM	Instrument Maintenance Log

Figure 1. **AUTOSAMPLER LAYOUT**





Autosampler layout

Figure 2. **TYPICAL CALIBRATION CURVE**

```
RunProt: HGCOM
RunFold: M47C011  Seq: 6    Batch:
                  Prnt: R/T On                    Pump: On
                  Rev: 4.2    15:23:19 12 Mar 2010 Xmit: Off Gas:    0.35 LPM
State: Idle                                       User: NT/JC       A/S: On
CALIBRATION:  Line  proto: HGCOM
     Hg                        Accepted
    Conc.   Calc.    Dev. ->linear
S1  .000   -.032   -.032   Quadratic
S2  .200    .148   -.052   Wtdlinear
S3  1.00    .970   -.030           C
S4  2.00    2.03    .026   Accept   o
S5  5.00    5.19    .191            n
S6  10.0    9.90   -.102            c
A   .0000000      r    .999652
B   8.45241e-6    C   -6.68307e-2
      Mean                                  Relative Absorbance
S1      4115        0 SD      4115
S2     25365        0 %RSD   25365
S3    122632        0 %RSD  122632
S4    247569        0 %RSD  247569
S5    622010        0 %RSD  622010
S6   1178982        0 %RSD 1178982

New cal coefficients stored
```

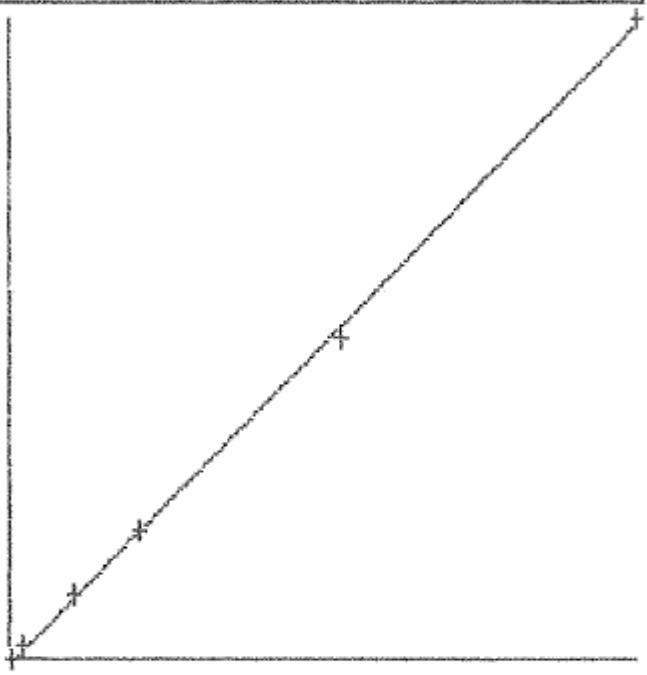


Figure 3. **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 7471B
MERCURY BY COLD VAPOR

Client : XYZ, INC.
Project : CLEAN LAND PROJECT
Batch No. : 10C029
Matrix : SOIL
Instrument ID : TI047

SAMPLE ID	EMAX SAMPLE ID	RESULTS (mg/kg)	DLF	MOIST	LOQ (mg/kg)	LOD (mg/kg)	Analysis DATETIME	Extraction DATETIME	LFID	CAL REF	PREP BATCH	Collection DATETIME	Received DATETIME
MBLK1S	HGC016SB	ND	1	NA	0.100	0.0330	03/12/1015:33	03/12/1011:00	M47C011010	M47C011008	HGC016S	NA	03/12/10
LCS1S	HGC016SL	0.845	1	NA	0.100	0.0330	03/12/1015:35	03/12/1011:00	M47C011011	M47C011008	HGC016S	NA	03/12/10
LCD1S	HGC016SC	0.848	1	NA	0.100	0.0330	03/12/1015:37	03/12/1011:00	M47C011012	M47C011008	HGC016S	NA	03/12/10
B340-002SAS	C029-06A	14.3	1	14.3	0.117	0.0385	03/12/1015:40	03/12/1011:00	M47C011013	M47C011008	HGC016S	03/02/10	03/02/10
B340-002S	C029-06	ND	1	14.3	0.117	0.0385	03/12/1015:42	03/12/1011:00	M47C011014	M47C011008	HGC016S	03/02/10	03/02/10
B340-002SDL	C029-06J	ND	5	14.3	0.583	0.193	03/12/1015:44	03/12/1011:00	M47C011015	M47C011008	HGC016S	03/02/10	03/02/10
B340-002SMS	C029-06M	1.00	1	14.3	0.117	0.0385	03/12/1015:46	03/12/1011:00	M47C011016	M47C011008	HGC016S	03/02/10	03/02/10
B340-002SMSD	C029-06S	0.996	1	14.3	0.117	0.0385	03/12/1015:49	03/12/1011:00	M47C011017	M47C011008	HGC016S	03/02/10	03/02/10
B340-003S	C029-07	ND	1	16.6	0.120	0.0396	03/12/1015:51	03/12/1011:00	M47C011018	M47C011008	HGC016S	03/02/10	03/02/10
B340-004S	C029-08	ND	1	16.1	0.119	0.0393	03/12/1015:53	03/12/1011:00	M47C011019	M47C011008	HGC016S	03/02/10	03/02/10

Figure 4. **TYPICAL LCS REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND PROJECT
SDG NO.: 10C029
METHOD: METHOD 7471B

MATRIX:	SOIL			% MOISTURE:	NA
DILTN FACTR:	1	1	1		
SAMPLE ID:	MBLK1S				
CONTROL NO.:	HGC016SB	HGC016SL	HGC016SC		
LAB FILE ID:	M47C011010	M47C011011	M47C011012		
DATIME EXTRCTD:	03/12/1011:00	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	NA
DATIME ANALYZD:	03/12/1015:33	03/12/1015:35	03/12/1015:37	DATE RECEIVED:	03/12/10
PREP. BATCH:	HGC016S	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008	M47C011008		

ACCESSION:

PARAMETER	BLNK RSLT mg/kg	SPIKE AMT mg/kg	BS RSLT mg/kg	BS % REC	SPIKE AMT mg/kg	BSD RSLT mg/kg	BSD % REC	RPD %	QC LIMIT %	MAX RPD %
Mercury	ND	0.833	0.845	101	0.833	0.848	102	0	80-120	20

Figure 5. **TYPICAL MATRIX SPIKE REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND PROJECT
SDG NO.: 10C029
METHOD: METHOD 7471B

MATRIX:	SOIL			% MOISTURE:	14.3
DILTN FACTR:	1	1	1		
SAMPLE ID:	B340-002S				
CONTROL NO.:	C029-06	C029-06M	C029-06S		
LAB FILE ID:	M47C011014	M47C011016	M47C011017		
DATIME EXTRCTD:	03/12/1011:00	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	03/02/10
DATIME ANALYZD:	03/12/1015:42	03/12/1015:46	03/12/1015:49	DATE RECEIVED:	03/02/10
PREP. BATCH:	HGC016S	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008	M47C011008		

ACCESSION:

PARAMETER	SMPL RSLT mg/kg	SPIKE AMT mg/kg	MS RSLT mg/kg	MS % REC	SPIKE AMT mg/kg	MSD RSLT mg/kg	MSD % REC	RPD %	QC LIMIT %	MAX RPD %
Mercury	ND	0.972	1.00	103	0.972	0.996	102	1	80-120	20

Figure 6. **TYPICAL DILUTION TEST REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
SERIAL DILUTION ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND PROJECT
BATCH NO.: 10C029
METHOD: METHOD 7471B

MATRIX:	SOIL		% MOISTURE:	14.3
DILUTION FACTOR:	1	5		
SAMPLE ID:	B340-002S	B340-002SDL		
EMAX SAMP ID:	C029-06	C029-06J		
LAB FILE ID:	M47C011014	M47C011015		
DATE EXTRACTED:	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	03/02/10
DATE ANALYZED:	03/12/1015:42	03/12/1015:44	DATE RECEIVED:	03/02/10
PREP. BATCH:	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008		

ACCESSION:

PARAMETER	SMPL RSLT (mg/kg)	SERIAL DIL RSLT (mg/kg)	DIF RSLT %	QC LIMIT (%)
Mercury	ND	ND	0	10

Figure 7. **TYPICAL POST DIGESTION SPIKE REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
ANALYTICAL SPIKE ANALYSIS

CLIENT:	XYZ, INC.
PROJECT:	CLEAN LAND PROJECT
SDG NO.:	10C029
METHOD:	METHOD 7471B

MATRIX:	SOIL		% MOISTURE:	14.3
DILTN FACTR:	1	1		
SAMPLE ID:	B340-002S			
CONTROL NO.:	C029-06	C029-06A		
LAB FILE ID:	M47C011014	M47C011013		
DATIME EXTRCTD:	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	03/02/10
DATIME ANALYZD:	03/12/1015:42	03/12/1015:40	DATE RECEIVED:	03/02/10
PREP. BATCH:	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008		

ACCESSION:

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	AS RSLT (mg/kg)	AS % REC	QC LIMIT (%)
Mercury	ND	0.972	1.02	105	85-115

Figure 8. **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN LAND PROJECT

SDG : 10C029

METHOD 7471B
MERCURY BY COLD VAPOR

A total of three (3) soil samples were received on 03/02/10 for Mercury analysis, Method 7471B in accordance with Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, USEPA SW-846.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source. Continuing calibration verifications were carried out at the frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for HGC016SL/C were all within QC limits.

Matrix QC Sample
Matrix QC sample was analyzed at the frequency prescribed by the project.
Percent recoveries for C029-06M/S were within project QC limits.
Analytical spike and serial dilution were analyzed for matrix interference evaluation. Results were within method acceptance criteria.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix **1.** **SUMMARY OF QUALITY CONTROL PROCEDURES**

PARAMETER	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	FLAGING CRITERIA	1ST Rvw	2nd Rvw
Initial multipoint calibration	Daily initial calibration prior to sample analysis	Correlation coefficient R≥0.995 for linear regression	Correct the problem then repeat initial calibration			
Initial calibration verification (second source)	Daily after initial calibration	Analyte within ±10% of expected value	Correct the problem then repeat initial calibration			
Calibration blank	After every calibration verification	No analyte detected ≥ RL	Correct the problem then re-analyze calibration blank and previous samples			
Calibration verification	Daily, before sample analysis, every 10 samples and at the end of analysis sequence	The analyte within ±20% of expected value	Repeat calibration and re-analyze all samples since last successful calibration			
Method blank	One per preparation batch	No analytes detected ≥ RL	Re-prep and re-analyze method blank and all samples processed with the contaminated blank	Apply B on all associated samples		
LCS	One LCS per preparation batch	%Rec.: 80-120%	Re-prep and re-analyze the LCS and all associated samples			
Dilution Test	Each preparatory batch	Within ±10% of the undiluted sample result	Perform recovery test			
Recovery test (Analytical Spike)	When dilution test fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition			
MS/MSD	One MS/MSD per every preparation batch.	%Rec.: 80-120%, RPD=20%	If all other QC samples are in control, discuss in the case narrative, otherwise check the source of the problem and re-analyze the parent sample and the MS/MSD.			
Comments: RL = lowest calibration point				Reviewed by		
				Date		

wibby environmental

ACCREDITED
Certificate # 2427.01

6390 Joyce Drive
100
Golden, CO 80403

Phone 303-940-0033
Fax 866-283-0269
www.wibby.com

Final Report - Soil / Hazardous Waste PT

Study: HW0709

Opening Date: July 20, 2009 - Closing Date: September 4, 2009

Laboratory: EMAX Laboratories
1825 205th Street
Torrance, CA 90501

Contact: Kenette Pimentel, Quality Assurance Manager
310-618-8889 ext. 205

EPA Lab ID: CA00291

Metals (PT-MET-SOIL) **Lot #: 7037-04**

NELAC Code	Analyte	Method Code	Method Description	Units	Assigned Value	Result	Acceptance Limits	Evaluation
1095	Mercury	10166402	SW 7471 B	mg/kg	7.65	6.38	3.27 - 9.50	Acceptable

7470FS. **SAMPLE PREPARATION LOG**

SOP ☐ **EMAX-7470 Rev. No.4** ☐ **EMAX-7471 Rev. No.5** ☐ **EMAX-CLP-245.5** ☐ **EMAX-CLP-245.1** ☐ **EMAX EPA 245.1** ☐

Matrix: **Start Date:** **Time:** **Ending Date:** **Time:** **Book # E47-078**

BATCH: _____

Sample Prep ID	Lab Sample ID	Matrix Description			Sample Amount (g | ml)	Dry Weight	pH	Extract Volume (ml)	Matrix Description	
		Color	Texture / Clarity	Artifacts					Color	Clarity
01										
02										
03										
04										
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										

Standards	ID	Conc. (µg/L)	Amount Added (ml)
ICAL			
CCV			
ICV			
LCS/MS			
Reagent	Lot# / ID		
HNO_3			
HCl			
H_2SO_4			
$KMnO_4$			
$K_2S_2O_8$			
$NH_2OH.HCl$			
$SnCl_2$			
Temp of Digestion Bath: °C			
Legend			
Color			
Bu = blue	Cs = Coarse	Cr = Clear	Rk = rocks
Bk = black	Md = Medium	Cy = Cloudy	Sl = Shale
Bn = Brown	Fn = Fine	Td = Turbid	Vg=Vegetation
Gn = Green			
Og = Orange			
Rd = Red			
Yw = Yellow			

Comments: _____

Prepared By:

Standard Added By: Witnessed By:

Checked By:

Disposed By: Date Disposed:

7470FA. **ANALYTICAL RUN LOG**

ANALYSIS LOG
for
MERCURY

Page

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Start Date: **Start Time:**

End Date: **End Time:**

Comments:

Book #: A47-71

Instrument No.: 47

Analytical Sequence/Batch:

Method File:

SOP #	Rev. #
☐ EMAX-7470	4
☐ EMAX-7471	5
☐ EMAX-245.1	2
☐ EMAX-	

STANDARDS ID
S1
S2
S3
S4
S5
S6
CCV
ICV
LCS
Analytical Spike

Analyzed By:

Date:

LEEMAN -PS200II MERCURY ANALYZER MAINTENANCE LOG

Instrumetnt No: 47 Month: Year: 201_ Book # M47-007

Argon Input Pressure (Input: 75-90 psi)						
Fume Hood						
Gas Outflow/Inflow (0 - 1.0 LPM)						
Pump Rate: 2-15 mL/min						
Reductant Bottle						
Rinse Solution						
Instrument Warm-up						
Perestaltic Pump						
Tubings Pump/Capillary						
Test DAQ: Sample 400,000 - 1,720,000						
Hg Lamp Volt: 4.0 - 10						
Power Supply Voltage: 5V+/-0.25, +12V+/-0.5, -12V+/-0.5						
Computer Date/Time						
Printer Paper						
Analyst Initial						

Trouble Shooting							
Problem(s) Encountered							
Return To Specs (Analyst Initial)							

Code		Code	Corrective Action

Reviewed by: _____

STANDARD OPERATING PROCEDURES

DIESEL RANGE ORGANICS

SOP No.:	EMAX-8015D	Revision No.	4	Effective Date:	05-Apr-10
Prepared By:	Lucita Arzadon			Date:	03-31-10
Approved By:	Kenette Pimentel QA Manager			Date:	03.31.10
Approved By:	Caspar Pang Laboratory Director			Date:	3-31-10

Control Number: 8015D-04-

1.0 SCOPE AND APPLICATION

1.1. This method is used to analyze extractable fuel hydrocarbons in water, soil and other sediment samples. In the vast field of petroleum hydrocarbons, this method is limited to provide semiquantitative results on those extractable hydrocarbons with a comparable aliphatic hydrocarbon range from C_{10} to C_{34}. This is an adaptation of Method 8015C.

2.0 SUMMARY OF METHOD

2.1. Petroleum hydrocarbons are extracted in methylene chloride, analyzed by flame ionization detector (FID) in gas chromatograph and quantified as diesel fuel at C_{10} to C_{28} range. The hydrocarbons that fall in this range are defined as Diesel Range Organics (DRO).

2.2. Other fuel standards that fall in the range of C_{10} to C_{34} can also be quantitated by this method.

2.3. **Interference**

2.3.1. Glassware can be a potential source of contamination. They must be scrupulously cleaned prior to its use.

2.3.2. Carry-over from a highly concentrated sample can be a potential source of contamination. Instrument performance must be observed keenly for possible carry-over. If this is apparent, inject solvent blank until no trace of carry-over is observed.

2.3.3. Deposits may adhere in the injection port/glass liner over a period of time and can cause interference. The injection port and glass liner must be routinely cleaned.

3.0 DETECTION LIMITS

3.1. **Detection Limit (MDL)**

3.1.1. Refer to EMAX QA04 for detection limit generation, evaluation and verification.

3.2. **Limit of Quantitation (LOQ)**

3.2.1. The LOQ is equal to the concentration of the lowest calibration point, unless otherwise specified by the project.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable range requiring no dilution is equal to the concentration of the highest calibration point (See Section 9.5.1). Dilute and reanalyze all samples having results above this range to properly quantitate.

4.2. The lowest quantifiable range of diluted samples is equal to the lowest calibration point (See Section 9.5.1.) Lower the dilution factor and reanalyzed all diluted samples analyzed below this range to properly quantitate

5.0 SAMPLE COLLECTION, PRESERVATION, AND HOLDING TIME

5.1. Holding Time

5.1.1. Water samples must be extracted within 7 days from sampling date.

5.1.2. Soil samples must be extracted within 14 days from sampling date.

5.1.3. All extracts must be analyzed within 40 days from extraction completion date.

5.2. Preservation

5.2.1. All samples and extracts must be stored at ≤ 6°C without freezing.

6.0 ASSOCIATED SOPs

EMAX-QC02	Analytical Standard Preparation
EMAX-SM04	Analytical and QC Sample Labeling
EMAX-QA04	Detection Limit Study
EMAX-QA08	Corrective Action
EMAX-DM01	Data Flow & Review
EMAX-SM03	Waste Disposal
EMAX-LUFTE	Total Petroleum Hydrocarbons by Extraction
EMAX-3510	Extraction, Separatory Funnel
EMAX-3520	Extraction, Continuous Liquid/Liquid
EMAX-3540	Extraction, Soxhlet
EMAX-3550	Extraction , Pulse Sonication
EMAX-3580	Waste Dilution

7.0 SAFETY

7.1. Read all MSDS for chemicals listed in this SOP.

7.2. All reagents, standards, and samples shall be treated as potential hazards. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves, shall be worn at all times when performing this procedure. All sample and standard handling shall be performed in the fume hood.

7.3. All wastes generated during analytical process shall be placed in the wastes containers. These wastes shall be endorsed to the waste disposal section for proper disposal.

7.4. If, for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritation persists, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS, AND SUPPLIES

8.1. Instruments and Supplies

8.1.1. Gas Chromatography: GC HP5890 II with FID and 7673HP Autosampler, or equivalent

8.1.2. Detector: FID

8.1.3. Column: DB5, (0.25 mm x 30 m) 0.25 µm thickness, or equivalent

8.1.4. Data Acquisition: EZ Chrom, or equivalent

8.1.5. Syringes: 10, 25, 100 µL microsyringe

8.1.6. Volumetric Flask: 10, 100 and 1000 mL

8.1.7. Vials: 2,10 and 40 ml, amber

8.1.8. Bottle: 250-ml (amber)

8.2. Chemicals and Reagents

8.2.1. Methylene Chloride

8.2.2. Acetone

8.2.3. High purity He, H_2, Air

9.0 STANDARDS

9.1. Stock Standard

9.1.1. Purchase stock standards as certified solutions from certified vendors as listed below or equivalent:

Standard Name	Catalog Number	Source	Concentration	Solvent	Intended Use
Diesel	Cat # 31259	Restek	50,000 mg/L	$MeCl_2$	ICAL, DCC
Diesel	FU-009N	Accu Std	Neat	$MeCl_2$	ICV, LCS/LCD MS/MSD
Bromobenzene	23987-9	Aldrich	Neat	$MeCl_2$	Surrogate
Hexacosane	24168-7	Aldrich	Neat	$MeCl_2$	Surrogate

9.2. Intermediate Standard

9.2.1. Dilute Diesel Stock Standard first with Methylene Chloride as follows:

Standard Name	Concentration	Amount	Final Conc.	Solvent	Final Volume
Diesel	Neat	1.0 g	100,000 mg/L	$MeCl_2$	10 mL

9.2.2. Then dilute with water-soluble solvent Acetone as follows:

Standard Name	Concentration	Amount	Final Conc.	Solvent	Final Volume
Intermediate Standard	100,000 mg/L	10 mL	5000 mg/L	Acetone	200 ml

9.3. Surrogate Standards

9.3.1. Dilute Surrogate Stock Standards with Methylene Chloride as follows:

Standard Name	Concentration	Amount	Final Conc.	Solvent	Final Volume
Bromobenzene	Neat	1.0 g	10000 mg/L	$MeCl_2$	100 mL
Hexacosane	Neat	0.25 g	2500 mg/L	$MeCl_2$	

9.3.2. Then dilute Surrogate Standards Stock in Acetone as follows:

Standard Name	Concentration	Amount	Final Conc.	Solvent	Final Volume
Surrogate Standard	Bromobenzene – 10000 mg/L	100 mL	Bromobenzene – 1000 mg/L	Acetone	1000 mL
	Hexacosane – 2500 mg/L		Hexacosane – 250 mg/L		

9.4. **Standard Preparation**

9.4.1. The procedure for analytical standard preparation is detailed in EMAX-QC02.

9.4.2. Other concentration levels may be prepared other than the concentration levels specified in this SOP as long as the quality control requirements are met.

9.5. **Initial Calibration Standard**

9.5.1. Prepare a minimum of 5-point calibration standards (ideally 6-point) from the intermediate standard and store in Teflon sealed vial with minimal headspace; suggested concentration and injection volume are as follows:

ICAL Pt.	Stock Standard (50,000mg/L) Aliquot (µL)	Final Volume (mL)	Final Concentration (mg/L)
1	0.2	1	10
2	2.0	1	100
3	10	1	500
4	20	1	1000
5	40	1	2000
6	60	1	3000

9.6. **Continuing Calibration Check Standard**

9.6.1. Prepare certified calibration check standard at 500 mg/L and analyze at designated frequency.

9.7. **Second Source Standard**

9.7.1. Prepare another stock solution of Diesel at 500 mg/L of different source from initial calibration standard to verify the validity of the calibration.

9.8. **Surrogate Initial Calibration Standards**

9.8.1. Prepare a minimum of 5-point calibration standard (ideally 6-point) from the intermediate surrogate standard and store in Teflon sealed vial with minimal headspace; suggested concentration and injection volume are as follows:

Surrogate ICAL Pt.	Surrogate Standard (1,000/250mg/L) Aliquot (µL)	Final Volume (mL)	Final Conc. – Bromobenzene / Hexacosane (mg/L)
1	20	1	20 / 5
2	60	1	60 / 15

3	100	1	100 / 25
4	140	1	140 / 35
5	180	1	180 / 45
6	220	1	220 / 55

9.9. **Alkane Standard**

9.9.1. Prepare a standard containing a homologous series of n-alkanes from C_8 to C_{34} at 100 mg/L for retention time window analysis.

9.10. **Other Fuel Standards**

9.10.1. Refer to SOP EMAX-LUFTE – Total Petroleum Hydrocarbons by Extraction.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. For aqueous samples refer to EMAX-3520 and/or EMAX-3510.

10.1.2. For soil samples refer to EMAX-3540, EMAX-3550**,** or EMAX-3580 and/or EMAX-LUFTE.

10.2. **Instrument Parameters**

10.2.1. Fine tune the instrument guided by the parameter conditions as listed below:

Instrument	Temp (°C)	Rate (°C/min)	Time (min)	Temperature (°C)		Injection Volume (µL)	Head Pressure (psi)
				Injector	Detector		
105	55	0	0.5	280	320	2	21-22
	320	60	5.8				

10.3. **Initial Calibration**

10.3.1. Analyze the initial calibration standards prepared. Sum the area of all peaks eluting between C_{10} to C_{28} for each of the calibration point. Generate this area by rejoining a horizontal baseline between the retention time of C_{10} to C_{28}. Check that the highest point does not have saturated peak(s).

10.3.2. After the initial calibration, analyze a 500-mg/L check standard from a second source to verify the concentration of the original calibration.

10.3.3. Evaluate the results and refer to Appendix 1 for acceptance criteria and corrective action. If the %RSD is out of acceptance criteria, review the results and identify presence of an outlier.

- If one of the standards returns a bias-low or bias-high, that point could be an outlier. Prepare a standard at that ICAL point and re-analyze.
- If the highest ICAL point appears to be saturated, drop the highest point.
- If the lowest point returns a bias low response or the pattern is not distinct and sharp, drop the point.

Note: The lowest calibration point determines the limit of quantitation (LOQ). Therefore, check that the LOQ is in conformance to the current projects where the ICAL will be used.

10.4. **Continuing Calibration (DCC)**

10.4.1. Analyze a continuing calibration at the beginning of a 12-hour shift or as specified by the project.

10.4.2. Refer to Appendix 1for acceptance criteria and corrective action.

10.5. **Analysis**

10.5.1. Extract Preparation

10.5.1.1. Allow the extracts to equilibrate with the room temperature.

10.5.1.2. Transfer about 1 mL of extracts into autosampler vials.

10.5.2. Analytical Sequence

10.5.2.1. Analyze Daily Calibration Check Standard (DCC) and check ICAL validity.

10.5.2.2. Analyze samples to include method blank(s), lab control sample(s) and matrix spike sample(s) up to a maximum of 12 hours, or as per project specific requirement (PSR).

10.5.2.3. Close the analytical sequence with a continuing calibration.

10.5.3. Sample Result Evaluation

10.5.3.1. Check QC Criteria as soon as available.

- Check surrogate recoveries against project specific requirement (PSR). In the absence of PSR, default to in-house QC limits.

10.5.3.2. Qualitative Identification

- Compare the sample chromatogram to the pattern established by the calibration standard.
- When peaks other than diesel pattern are detected within the DRO, take note of it and discuss in the case narrative.

10.5.3.3. Quantitation

- Assign the appropriate hydrocarbon range for quantitation (e.g. $C_{10} – C_{28}$; C_{18} - C_{34}; etc.)
- Integrate all peaks bracketed by the hydrocarbon range baseline to baseline. Set the integration range at least 95% within of the total spectrum of the expected DRO range.
- Calculate the result as specified in Figure 2 based on the appropriate fuel standard (e.g. Diesel: $C_{10} – C_{28}$; Motor Oil: $C_{18} – C_{34}$). In the absence of alkane range specification for the project, request for directive from the PM.
- Check that all positively identified target analytes are quantitated within the calibration range.
- Dilute and re-analyze all positively identified target analytes exceeding calibration range.
- When peaks other than diesel pattern are detected within the DRO range, quantitate using the DRO calibration factor and discuss it in the case narrative (e.g. peaks within the DRO range does not resemble diesel pattern or motor oil pattern). When saturated peaks are present, dilute the extract appropriately until peaks are eluted properly.

10.5.4. Retention Time Range

10.5.4.1. Analyze a mixture containing aliphatic hydrocarbons with chain length from C_{10} to C_{28} at 100 mg/L daily within 72 hours to establish the retention time window of C_{10} and C_{28} alkanes. Establish the lower retention time limit of DRO based on –3 x SD of the gathered retention time of C_{10} and the upper retention time limit base on +3 x SD of the gathered retention time of C_{28}.

10.5.4.2. Use the same technique to establish the retention time for other TPH ranges, e.g. motor oil range is normally from C_{18} to C_{34}.

10.5.5. Manual Integration

10.5.5.1. If re-integration is needed, refer to EMAX-DM01, Section 4.4.

10.6. **Calculations**

10.6.1. Initial Calibration

10.6.1.1. Calculate for Calibration Factor

$$CF = \frac{R_t}{C_v} \qquad \textit{Eq.10.6.1.1}$$

where:

CF – *Calibration Factor*

R_t – *Total response of the integrated peaks*

C_v – *Known value of the standard concentration , mg/L*

10.6.1.2. Calculate for the Average Calibration Factor

$$ACF = \frac{\sum CF}{n} \qquad \textit{Eq.10.6.1.2}$$

where:

ACF – *Average Calibration Factor*

$\sum CF$ – *Summation of Calibration Factors*

n – *Number of measurements*

10.6.1.3. Calculate for Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}} \qquad \textit{Eq.10.6.1.3}$$

where:

SD – *Standard Deviation*

x_i – *Result at the* i^{th} *measurement*

$\bar{x}$ – *mean*

n – *number of measurements*

10.6.1.4. Calculate for Percent Relative Standard Deviation

$$\%RSD = \frac{SD}{ACF} * 100 \qquad \textit{Eq.10.6.1.4}$$

where:

%RSD – Percent Relative Standard Deviation

SD – Standard Deviation

ACF – Average Calibration Factor

10.6.2. Calculate for Percent Difference of DCC from ACF

$$\%D = \frac{C_f - C_k}{C_k} * 100 \qquad \textit{Eq.10.6.2}$$

where:

%D – Percent Difference DCC from known concentration

C_k *– Known concentration of the analyte, in mg/L*

C_f *– Found concentration, in mg/L*

10.6.3. Calculate for Sample Concentration

$$C = \frac{(R_t)(V_e)(DF)}{(ACF)(A_s)(\%S)} \qquad \textit{Eq.10.6.3}$$

where:

C – Concentration of the sample, mg/L or mg/Kg

R_t *– Total response of the integrated peaks*

V_e *– Volume of Extract, ml*

A_s *– Sample amount, ml or g*

DF – Dilution Factor

ACF – Average Calibration Factor

%S – Percent solids (%S for water = 1)

10.6.4. Calculate for Precision

$$\%RPD = \frac{|R_1 - R_2|}{R_{ave}} * 100 \qquad \textit{Eq.10.6.4}$$

where:

%RPD – Relative Percent Difference

R_1 *– result of first measurement*

R_2 – *result of second measurement*

R_{ave} – *average result of first and second measurements*

10.7. **Report Generation and Data Reduction and Review**

10.7.1. Generate the method.txt file using WDBX[1].exe.

10.7.2. Generate Lab Chronicle using LABCHRNX.exe

10.7.3. Generate the sample results using F1VX.exe

10.7.4. Generate the QC summary using QCVX.exe

10.7.5. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration and re-analyses.

- Sample Results
- LCS Summary
- MS/MSD Summary
- ICAL Summary
- ICV Summary
- DCC Summary
- Analysis Log
- Extraction Log

10.7.6. Generate the case narrative using CN1.exe. Check the case narrative to ensure accuracy and edit as necessary to include all issues and/or anomalies encountered during the analytical process.

10.7.7. Perform a 100% data review in accordance to EMAX-DM01 and the project specific requirements.

10.7.8. Submit the analysis package for secondary review.

10.8. **Preventive Maintenance**

10.8.1. Instruments should receive routine preventive maintenance as suggested but not limited to the table below.

Maintenance Activity	Description	Frequency
Autosampler	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis.
Verification	Check instrument parameters to ensure normal operating conditions. Change liner as necessary. Clean injection port as necessary. Check instrument performance (e.g., Daily calibration check, instrument blank)	Daily prior to analysis.
System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector. Check septa and replace as necessary.	Every 6 months or as necessary

[1] X - version number

Maintenance Activity	Description	Frequency
Check Flow Path Components	Check and replace the following as necessary: tubing assembly, union, column	Once a year as necessary
Complete Inspection	Perform general inspection of the complete system. Inspect autosampler cabling and configuration setting.	Once a year
Documentation	Record all instrument maintenance performed in the instrument maintenance log.	Daily prior to analysis

11.0 QUALITY CONTROL

11.1. **Preparative Batch**

11.1.1. A preparative batch shall consist of a method blank, LCS, MS/MSD and a maximum of 20 field samples of similar matrix.

11.1.2. In the absence of MS/MSD, LCS/LCD is prepared.

11.2. **Analytical Batch QC**

11.2.1. Daily Calibration Check (DCC) shall be analyzed:

- at the beginning of each analytical sequence
- every 12 hours thereafter, or as specified by the PSR
- at the end of the analytical sequence.

11.2.2. Refer to Appendix 1 for acceptance criteria.

11.3. **Method QC**

11.3.1. All analysts performing this procedure must have a current certificate of demonstration of proficiency as described in EMAX-QA05.

11.3.2. Establish detection limit (DL), limit of detection (LOD) and limit of quantitation (LOQ).

11.3.3. A valid LOD, LOQ and ICAL must exist prior to analysis.

11.3.4. Instrument performance must be checked prior to analysis.

11.3.5. Check Appendix 1 for acceptance criteria.

11.3.6. Prepare, analyze and control QC samples as required by the project. In the absence of PSR, refer to Appendix 1 for Quality Control Procedures.

11.3.7. Surrogate standard shall be added to all samples, including quality control samples (e.g., method blank, LCS and MS). Check PSR for QC Control Limits. In the absence of PSR default to EMAX QC limits.

12.0 CORRECTIVE ACTION

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures (Appendix 1). Document out-of-control event and corrective action taken in the analytical logbook. If problem persists, consult the supervisor.

12.2. **Continuing Calibration**

12.2.1. If non-compliant, consider the following suggestions to correct the problem:

- Change the liner

- Clean the injection port
- Prepare a new standard
- Cut or replace the column
- Clean the detector
- Rule-out leaks
- Perform new calibration.

12.3. **Preparative Batch**

12.3.1. If method blank is non-compliant, consider the following suggestions to correct the problem:

- Check the sample results. If sample results are non-detected, you may report the result upon concurring with the PM, otherwise, perform the corrective action as specified in the PSR.

12.3.2. If LCS is non-compliant, consider the following suggestions to correct the problem:

- Check the result of MS/MSD. If standard degradation is apparent, prepare a fresh standard and perform the corrective action as described in Appendix 1.
- If no MS/MSD is prepared with the sample and the result is outside the higher QC limit, the solvent of the standard may have evaporated. Prepare a fresh standard and perform the corrective action as described in Appendix 1.

12.4. If samples are out of technical holding time, the analyst fills out a Non-Conformance Report (NCR) and forwards it to the project manager who will consult with the client for further instruction.

12.5. For other out-of-control situations that require another department's participation in the corrective action (i.e., re-extraction, etc.), an NCR shall be filled with the supervisor's approval before proceeding.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped in the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Application of EMAX QC Procedures**

15.1.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing diesel range organics analysis by GC. In the instance where there is project or program specific quality control, the requirements given in the project shall take precedence over this SOP.

15.2. **Department of Defense (DoD) Projects**

15.2.1. When samples from DoD sponsored projects are analyzed for diesel range organic analysis by GC, the analyte list, detection limits, calibration, QC, corrective action, and data requirements

shall be applied as specified by the Quality Assurance Project Plan. In the absence of QAPP, the DoD QSM latest version shall be applied.

15.3. **Department of Energy (DOE) Projects**

15.3.1. When samples from DoE sponsored projects are analyzed for diesel range organic analysis by GC, the analyte list, detection limits, calibration, QC, corrective action, and data requirements shall be applied as specified by the Quality Assurance Project Plan (QAPP). In the absence of a QAPP, the DoE QSAS latest version shall be applied.

15.4. **Definition of Terms**

15.4.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents. Preparation batch is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate. Analytical batch is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.4.2. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.4.3. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.4.4. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.4.5. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.4.6. Matrix – is a component or form of a sample.

15.4.7. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.4.8. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.4.9. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.4.10. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying chain of custody (COC). Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.4.11. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.4.12. Surrogate – compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard; used to evaluate analytical efficiency by measuring recovery. Compounds not expected to be detected in environmental media.

16.0 REFERENCES

16.1. Method 8015C, Rev. 3, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, USEPA SW-846.

16.2. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Figures**

Figure 1	Peak Evaluation Technique
Figure 2A	Typical DRO Chromatogram
Figure 2B	Typical Motor Oil Chromatogram
Figure 2C	Typical n-Alkane Chromatogram
Figure 3	Typical Initial Calibration Summary
Figure 4	Typical Continuing Calibration Summary
Figure 5	Typical Sample Result Summary
Figure 6	Typical LCS Report Summary
Figure 7	Typical Matrix Spike Report Summary
Figure 8	Typical Case Narrative

17.2. **Appendices**

Appendix 1	Summary of Quality Control Procedures
Appendix 2	Demonstration of Capability

17.3. **Forms**

8015D FS	Sample Preparation Log
8015D FA	Analytical Run Log
8015D FM	Instrument Maintenance Log

Figure 1. **PEAK EVALUATION TECHNIQUE**

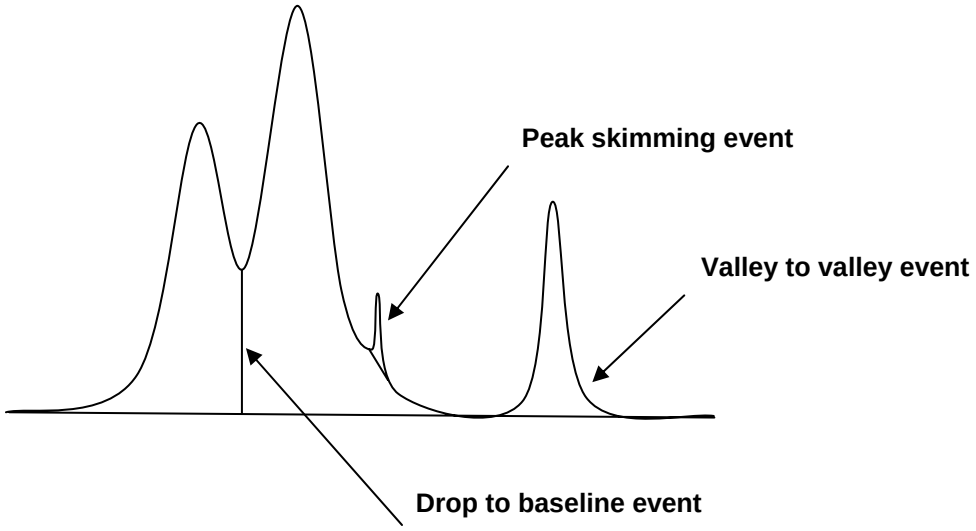


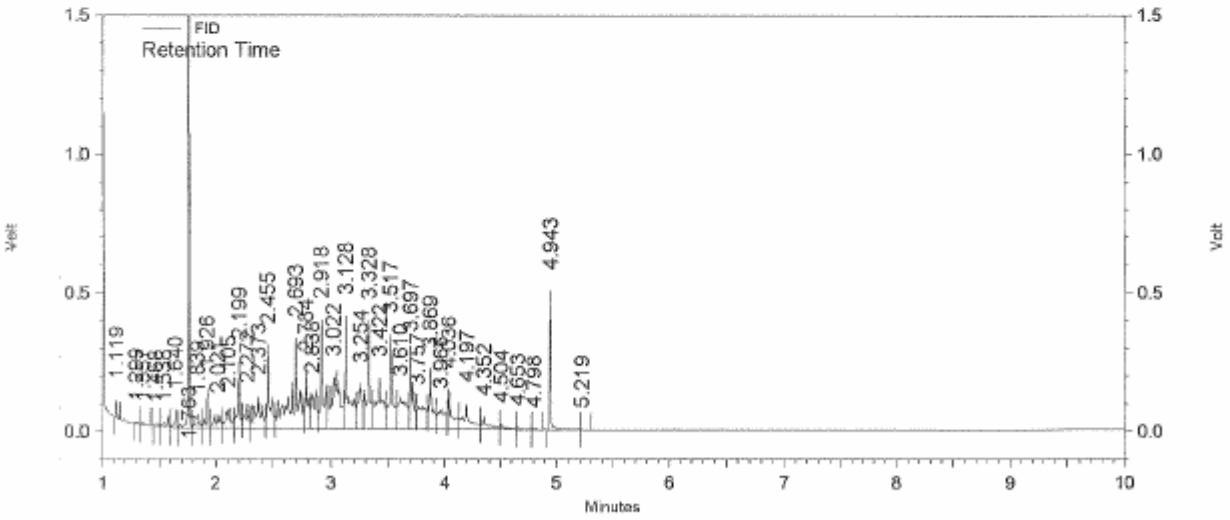
Figure 2B. **TYPICAL MOTOR OIL CHROMATOGRAM**

METHOD 8015 by GC/FID
EMAX Laboratories, Inc.

Inst. Name:	: GCT-105 (Offline)
File	: D:\Projects\EZC331\Data\LB22\LB22028.dat
Method	: D:\Projects\EZC331\Method\DS105B22.met
Sequence:	: D:\Projects\EZC331\Sequence\LB22.seq
Sample ID	: IDS105B22001 500/100/25PPM
Acquired	: 02/23/10 04:07:00
Printed	: 03/25/10 10:28:33
User	: CChen

FID Results

Name	Retention Time	Area	Average RF	ESTD concentration
BROMOBENZENE	1.763	1431362	14899.82809	96.066
HEXACOSANE	4.943	392700	16072.45782	24.433
DIESEL(TOTAL)		12072505	23316.03089	517.777
DIESEL(C10-C24)		11759196	22789.79606	515.985
DIESEL(C10-C28)		11765559	22805.53028	515.908
DIESEL(C10-C25)		11763081	22802.59606	515.866
Totals		49184403		2186.035



Software Version: Version 3.3.1

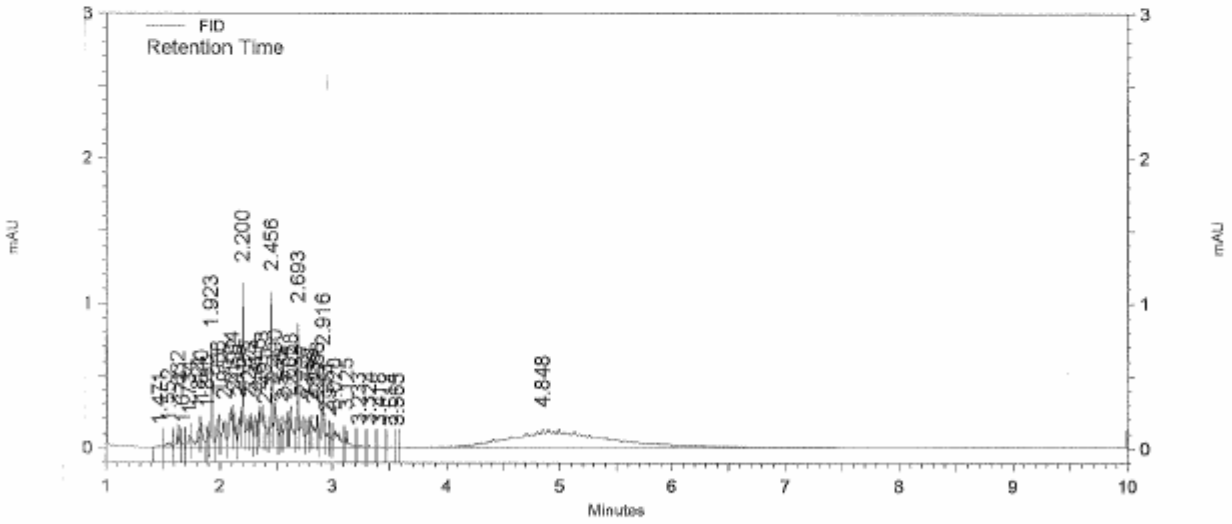
Figure 2B. **TYPICAL MOTOR OIL CHROMATOGRAM**

METHOD 8015 by GC/FID
EMAX Laboratories, Inc.

Inst. Name:	: GCT-105 (Offline)
File	: D:\Projects\EZC331\Data\LB22\LB22064.dat
Method	: D:\Projects\EZC331\Method\JM105B22.met
Sequence:	: D:\Projects\EZC331\Sequence\LB22.seq
Sample ID	: IJM10B22001 500PPM
Acquired	: 02/23/10 16:58:15
Printed	: 03/25/10 10:28:17
User	: CChen

FID Results

Name	Retention Time	Area	Average RF	ESTD concentration
JP5		11780413	22117.92821	532.618
MOTOR OIL		7405379	14277.86681	518.661
Totals		19185792		1051.280

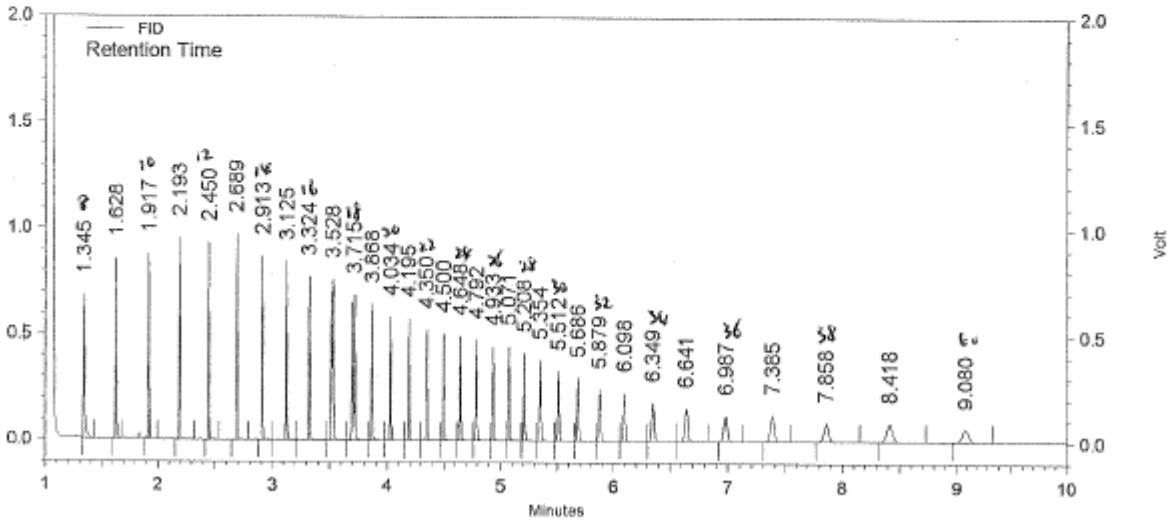


Software Version: Version 3.3.1

Figure 2C. **TYPICAL n-ALKANE CHROMATOGRAM**

METHOD 8015 by GC/FID
EMAX Laboratories, Inc.

Inst. Name:	: GCT-105 (Offline)
File	: D:\Projects\EZC331\Data\LC17\LC17018.dat
Method	: D:\Projects\EZC331\Method\DS105C17.met
Sequence:	: D:\Projects\EZC331\Sequence\LC17.seq
Sample ID	: HC-CHAIN (C8-C40+C9-C39)
Acquired	: 03/17/10 19:54:52
Printed	: 03/18/10 09:39:48
User	: CChen



Software Version: Version 3.3.1

Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD M8015

Lab Name : EMAX Inc
Instrument ID : GCT105
GC Column : HP5
Column size ID : 30MX0.32MM 0.25UM
LFID & Datetime: LB22016A 02/23/10 00:48 LB22022A 02/23/10 02:27
LFID & Datetime: LB22017A 02/23/10 01:05 LB22023A 02/23/10 02:44
LFID & Datetime: LB22018A 02/23/10 01:21 LB22024A 02/23/10 03:00
LFID & Datetime: LB22019A 02/23/10 01:38 LB22025A 02/23/10 03:17
LFID & Datetime: LB22020A 02/23/10 01:54 LB22026A 02/23/10 03:34
LFID & Datetime: LB22021A 02/23/10 02:11 LB22027A 02/23/10 03:50
CONC UNIT: ppm

COMPOUND	CONC X	CALIBRATION FACTORS (AREA)/UNIT 2.00X	10.00X	20.00X	100.00X	300.00X	600.00X	MEAN	%RSD
DIESEL(TOTAL)	5.00	24995	23969	23432	23673	21919	21908	23316.0	5.2
DIESEL(C10-C24)	5.00	24793	23623	23088	22933	21117	21185	22789.8	6.3
DIESEL(C10-C28)	5.00	24819	23632	23095	22947	21136	21204	22805.5	6.3
DIESEL(C10-C25)	5.00	24819	23632	23095	22941	21130	21199	22802.6	6.3
SURROGATE	X	1.00X	2.00X	3.00X	5.00X	7.00X	11.00X	MEAN	%RSD
N-TRIACONTANE	20.00	11985	12094	12200	12466	11822	12203	12128.3	1.8
O-TERPHENYL	5.00	24750	24321	24447	24224	22590	23161	23915.4	3.5

FORM VI DIESEL -2 1/96 Rev 2/2006

Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD M8015

Lab Name : EMAX Inc
Instrument ID : GCT105
GC Column : HP5
Column size ID : 30MX0.32MM 0.25UM
LFID & Datetime: LB22057A 02/23/10 15:02
LFID & Datetime: LB22058A 02/23/10 15:18
LFID & Datetime: LB22059A 02/23/10 15:35
LFID & Datetime: LB22060A 02/23/10 15:51
LFID & Datetime: LB22061A 02/23/10 16:08
LFID & Datetime: LB22062A 02/23/10 16:25
LFID & Datetime: LB22063A 02/23/10 16:41
CONC UNIT: ppm

COMPOUND	CONC X	CALIBRATION FACTORS (AREA)/UNIT 1.00X	2.00X	5.00X	50.00X	100.00X	200.00X	300.00X	MEAN	%RSD
JP5	10.00	19631	19700	21517	22617	23064	24249	24047	22117.9	8.6
MOTOR OIL	10.00	13265	13394	14008	13732	14548	15448	15550	14277.9	6.5

JM105B22.MET

FORM VI JP5+5W30 -2 1/96 Rev 2/2006

Figure 4. **TYPICAL CONTINUING CALIBRATION SUMMARY**

CONTINUE CALIBRATION
METHOD M8015

Lab Name : EMAX Inc
Instrument ID : GCT105
GC Column : HP5
Column size ID : 30MX0.32MM 0.25UM
Mid Conc Init LFID & Datetime: LB22019A 02/23/2010 01:38
Conc Cont LFID & Datetime: LB23002A 02/23/2010 17:48
CONC UNIT : ppm

COMPOUND	RT MINUTES	RT WINDOW FROM	RT WINDOW TO	TRUE CONC	AVERAGE CF	RESULT AREA	RESULT CONC	%D	QL	%D LIMITS
DIESEL(TOTAL)	NA	NA	NA	500.0	23316.0	11828742	507.32	1		15
DIESEL(C10-C24)	NA	NA	NA	500.0	22789.8	11513589	505.21	1		15
DIESEL(C10-C28)	NA	NA	NA	500.0	22805.5	11516143	504.97	1		15
DIESEL(C10-C25)	NA	NA	NA	500.0	22802.6	11516143	505.04	1		15
SURROGATE	**MINUTES**	**FROM**	**TO**	**TRUECON**	**CF**	**AREA**	**CONC**	**%D**	**QL**	**LIMITS**
BROMOBENZENE	1.763	1.760	1.766	100.0	14899.8	1527898	102.54	3		15
HEXACOSANE	4.943	4.793	5.093	25.0	16072.5	438835	27.30	9		15

CONTINUE CALIBRATION
METHOD M8015

Lab Name : EMAX Inc
Instrument ID : GCT105
GC Column : HP5
Column size ID : 30MX0.32MM 0.25UM
Mid Conc Init LFID & Datetime: LB22060A 02/23/2010 15:51
Conc Cont LFID & Datetime: LB23003A 02/23/2010 18:04
CONC UNIT : ppm

COMPOUND	RT MINUTES	RT WINDOW FROM	RT WINDOW TO	TRUE CONC	AVERAGE CF	RESULT AREA	RESULT CONC	%D	QL	%D LIMITS
JP5	NA	NA	NA	500.0	22117.9	11337754	512.60	3		15
MOTOR OIL	NA	NA	NA	500.0	14277.9	7145548	500.46	0		15

Figure 5. **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 3520C/8015C
PETROLEUM HYDROCARBONS BY EXTRACTION WITH SILICA GEL CLEAN UP

Client	: XYZ, INC.	Date Collected:	03/23/10
Project	: CLEAN WATER	Date Received:	03/24/10
Batch No.	: 10C285	Date Extracted:	03/24/10 14:45
Sample ID:	9102-TW03-GW04	Date Analyzed:	03/25/10 13:27
Lab Samp ID:	C285-02	Dilution Factor:	0.94
Lab File ID:	LC25007A	Matrix :	WATER
Ext Btch ID:	DSC036W	% Moisture :	NA
Calib. Ref.:	LC25002A	Instrument ID :	GCT105

PARAMETERS	RESULTS (mg/L)	RL (mg/L)	MDL (mg/L)
DIESEL W/ SG	ND	0.47	0.094
MOTOR OIL W/ SG	ND	0.47	0.094

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	77	40-130
HEXACOSANE	51	40-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

Figure 6. **TYPICAL LCS SUMMARY REPORT**

EMAX QUALITY CONTROL DATA
LCS ANALYSIS

CLIENT:	XYZ, INC.			
PROJECT:	CLEAN WATER			
BATCH NO.:	10C285			
METHOD:	METHOD 3520C/8015C			
MATRIX:	WATER		% MOISTURE:	NA
DILUTION FACTOR:	1	1		
SAMPLE ID:	MBLK1W			
LAB SAMP ID:	DSC036WB	DSC036WL		
LAB FILE ID:	LC25005A	LC25004A		
DATE EXTRACTED:	03/24/1014:45	03/24/1014:45	DATE COLLECTED:	NA
DATE ANALYZED:	03/25/1012:54	03/25/1012:37	DATE RECEIVED:	03/24/10
PREP. BATCH:	DSC036W	DSC036W		
CALIB. REF:	LC25002A	LC25002A		

ACCESSION:

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	QC LIMIT (%)
Diesel w/ SG	ND	5.00	4.00	80	60-130

SURROGATE PARAMETER	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	QC LIMIT (%)
Bromobenzene	1.00	0.793	79	50-130
Hexacosane	0.250	0.234	94	60-140

Figure 7. **TYPICAL MATRIX SPIKE SUMMARY REPORT**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER
BATCH NO.: 10C285
METHOD: METHOD 3520C/8015C

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	0.94	0.94	0.94		
SAMPLE ID:	9102-TW03-GW04				
LAB SAMP ID:	C285-02	C285-02M	C285-02S		
LAB FILE ID:	LC25007A	LC25008A	LC25009A		
DATE EXTRACTED:	03/24/1014:45	03/24/1014:45	03/24/1014:45	DATE COLLECTED:	03/23/10
DATE ANALYZED:	03/25/1013:27	03/25/1013:44	03/25/1014:00	DATE RECEIVED:	03/24/10
PREP. BATCH:	DSC036W	DSC036W	DSC036W		
CALIB. REF:	LC25002A	LC25002A	LC25002A		

ACCESSION:

PARAMETER	SMPL RSLT (mg/L)	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Diesel w/ SG	ND	4.70	1.94	41	4.70	2.24	48	15	20-150	30

SURROGATE PARAMETER	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	QC LIMIT (%)
Bromobenzene	0.940	0.712	76	0.940	0.631	67	40-130
Hexacosane	0.235	0.140	59	0.235	0.183	78	40-150

Figure 8. **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN WATER

SDG : 10C285

METHOD 3520C/8015C
PETROLEUM HYDROCARBONS BY EXTRACTION WITH SILICA GEL CLEAN UP

A total of seven (7) water samples were received on 03/24/10 for TPH Diesel & Motor Oil analysis, Method 3520C/8015C in accordance with Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, USEPA SW-846.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source (ICV). Continuing calibration (CCV) verifications were carried on a frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A lab control sample was analyzed with the samples in this SDG.
Percent recoveries for DSC036WL were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for C285-02M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1. **SUMMARY OF QUALITY CONTROL PROCEDURES**

QC Procedure	Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	1st Rvw	2nd Rvw
Minimum five-point initial calibration	Initially; as needed	Linear - mean RSD ≤20%	Correct the problem then repeat initial calibration			
Second-source calibration verification	After initial calibration	Within ±25% of expected value	Correct the problem then repeat initial calibration			
Initial calibration verification	Daily, before sample analysis	Within ±20% of expected value	Correct the problem then repeat initial calibration			
Calibration verification	Every 12 hours of analysis time and at the end of analysis sequence	Within ±20% of expected value	Correct the problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification			
Method blank	One per preparation batch	No analyte detected ≥ RL	Reprep and reanalyze method blank and all samples processed with the contaminated blank	Apply B to specific analyte(s) on all associated samples		
LCS	One LCS per preparation batch	Within EMAX QC Limits	Reprep and reanalyze the LCS and all associated samples			
Surrogate spike	Every sample, spiked sample, standard, and method blank	Within EMAX QC Limits	Correct the problem then reextract and analyze sample			
MS/MSD	One MS/MSD per every 20 project samples per matrix	Refer to EMAX QC Limits	None			
Chromatogram	All sample results	Within calibration range NO SATURATED PEAK(s)	Dilute and re-analyze all samples over the calibration range Diluted and re-analyzed all samples demonstrating saturated peak(s) even if the total integrated peaks do not exceed the calibration range.			
Results reported between MDL and RL	None	None	None			
Comments: RL= lowest calibration point				Reviewed By		
				Date		

PERFORMANCE TEST SAMPLE RESULTS

Prepared by Siu, Catherine and Analyzed by Chen, Chia Wen

PT # UST0110 1/18/2010 - 3/4/2010 10A272

LID	Method	Analyte	Result	Assigned Value	Acceptance Limits	UNIT	Comment
10A272-17	SW 3550 B/SW	Diesel	769	929	245 - 1170	mg/kg	Acceptable

PERFORMANCE TEST SAMPLE RESULTS

Prepared by Muertigue, Juanita and Analyzed by Chen, Chia Wen

PT # UST0110 1/18/2010 - 3/4/2010 10A272

LID	Method	Analyte	Result	Assigned Value	Acceptance Limits	UNIT	Comment
10A272-03	SW 3520 C/SW 8015 C	Diesel	3210	3510	866 - 4520	µg/L	Acceptable

EXTRACTION LOG FOR TPH

SOP ☐ EMAX-3550 Rev. No.2 ☐ EMAX-3520 Rev. No.2 ☐ EMAX-LUFT E Rev. No.3 ☐ EMAX-3540 Rev. No.0 ☐ EMAX-3510Rev.No. 1

Matrix: Start Date: Time: End Date: Time: Book # EDS-048

PREPARATION BATCH * _____

Sample Prep ID	Lab Sample ID	Sonicator Number	Sample Amount (g | ml)	Extract Volume (ml)	Silica Gel Clean-up	Notes
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						

Standards	ID	Amount Added (ml)
Surrogate		
LCS/MS		

Reagent	Lot# / ID
CH_2Cl_2	
Na_2SO4	
HCl	
Silica Sand	
Silica Gel	

TUNING	
Sonicator #	Reading

Concentrator Water Bath Temp. (C)		
1		
2		
3		
4		
5		
6		

Comments: Test thermometer = T_1

Prepared By: Standard Added By:

Witnessed By: Checked By:

Extract Received by: Extract Location:

Disposal Date: Disposed By:

This page is checked during data review.

EMAX LABORATORIES, INC.

ANALYSIS LOG FOR TPH

Page 1

Note:
For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Comments:

Book #: A105-012

Instrument No.: 105

Analytical Sequence:

Method File:

Analytical Batch:

SOP #	Rev. #
☐ EMAX-8015D	4
☐ EMAX-LUFT	3
☐ EMAX-AK102	2

STANDARDS ID	Conc (mg/L)
ICAL	
☐ Diesel ☐ Alcohol	
☐ Motor Oil ☐ JP5	
CH_2Cl_2	
DSL DCC	
LCS	
JP5/5W30 DCC	

ELECTRONIC DATA ARCHIVAL	
Location	Date
☐ EZCELITE-11	
☐	

Analyzed By:

Date:

INSTRUMENT MAINTENANCE LOG

Instrument No: 105 Month Year: 201_ Book # M105-003

Date							
Column Head Pressure							
Column Temperature							
FID lit up							
FID signal within specs							
Autosampler							
Check make up gas flow							
Run instrument blank							
Computer Date/Time							
Computer Paper							
Analyst Initial							

Trouble Shooting							
Problem(s) Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

PRINT DRF

STANDARD OPERATING PROCEDURES

GASOLINE RANGE ORGANICS

SOP No.:	EMAX-8015G	Revision No.	3	Effective Date:	14-Jan-11
Prepared By:	Lucita Arzadon			Date:	01-13-11
Approved By:	Kenette Pimentel QA Manager			Date:	01.13.11
Approved By:	Caspar Pang Laboratory Director			Date:	01-13-11

Control Number: 8015G-03-

1.0 SCOPE AND APPLICATION

1.1. This method is applicable for analyzing purgeable petroleum hydrocarbons bracketed by the range of alkanes from C_6 to C_{10} as gasoline range organics (GRO) in samples of various matrices (i.e. soils, water, sludge). Other range of alkanes may be applied (e.g., C_5 to C_{10}, C_6 to C_{12}, etc.) or other purgeable fuel patterns may be analyzed provided that qualitative identification and quantitative determination is properly established. This SOP is an adaptation of SW846 Method 8015C.

2.0 SUMMARY OF METHOD

2.1. A known amount of sample is purged by inert gas into a trap and retains the purgeable organic compounds. The trap is back flushed into the GC system equipped with flame ionization detector (FID). The instrument is calibrated with a gasoline standard. Hydrocarbon markers (C_5 to C_{12}) are analyzed to determine elution time. Quantitation of typical GRO is based on C_6 to C_{10} alkane range.

2.2. **Interferences**

2.2.1. Glassware can be a potential source of contamination. They must be scrupulously cleaned prior to use.

2.2.2. Carry-over from a highly concentrated sample can be a potential source of contamination. Instrument performance must be observed keenly for possible carry-over. If this is apparent, inject solvent blank until no trace of carry-over is observed.

2.2.3. Deposits may adhere in the injection port/glass liner over a period of time and can cause interference. The injection port and glass liner must be routinely cleaned.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Established DL, LOD and LOQ are:

Analyte	Water (µg/L)			Soil 1 gm to 5 ml (µg/Kg)			Soil 1 gm to 5 ml (µg/Kg)		
	DL	LOD	LOQ	DL	LOD	LOQ	DL	LOD	LOQ
Gasoline	5	10	20	20	40	100	350	500	1000
Bromofluorobenzene	2.5	5	20	10	20	100	50	100	1000
1,1,1-Trifluorotoluene	2.5	5	20	10	20	100	50	100	1000

4.0 DYNAMIC RANGE

4.1. The highest quantifiable range requiring no dilution is equal to the concentration of the highest calibration point (See Section 9.6.1). Dilute and re-analyze all samples having results above this range for proper quantitation.

4.2. The lowest quantifiable range of diluted samples is equal to the lowest calibration point (See Section 9.6.1). Lower the dilution factor and re-analyze all diluted samples analyzed below this range for proper quantitation.

5.0 SAMPLE HOLDING TIME & PRESERVATION

5.1. Water samples received are expected to be contained in 40 ml vial with teflon-lined septa preserved at pH < 2 with HCl with zero head space.

Note: The size of any bubble caused by degassing upon cooling the sample should not exceed 6 mm.[1]

5.2. Soil samples are expected to be contained in encore tubes and frozen or in jars or brass tubes.

5.3. Aqueous samples are stored at ≤ 6°C if not analyzed immediately.

5.4. Analyze all samples within 14 days from the date of collection. Analyze unpreserved water samples within 7 days from the date of collection.

5.5. Analyze frozen encore tube samples within 14 days or as specified by the project.

6.0 ASSOCIATED SOPs

6.1. EMAX-5030 Purge and Trap

6.2. EMAX-5035 Closed System Purge and Trap

6.3. EMAX-DM01 Data Flow and Review

6.4. EMAX-QA04 Method Detection Limit

6.5. EMAX-QA08 Corrective Action

6.6. EMAX-QC01 Quality Control of Chemicals

6.7. EMAX-QC02 Analytical Standard Preparation

6.8. EMAX-QC07 Glassware Cleaning

6.9. EMAX-SM03 Waste Disposal

6.10. EMAX-SM04 Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

[1] Referenced from SW846 Method 5030B, Section 6.1.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure.

7.3. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS & REAGENTS

8.1. Instruments and Supplies

Purge and Trap System (Concentrator)	LSC 2000 Tekmar/OI4560 or equivalent
Autosampler	Archon or equivalent
Gas Chromatography	HP 5890 Series II, GC with FID
Column	DB5 – 30m x .53 mm, 1.5 µm thickness, or equivalent
Gas	ultra-high purity helium, ultra-high purity hydrogen, hydrogen generator unit, compressed air
Syringes	5 ml Luerlok hypodermic gas-tight with shut-off valve
Microsyringes	Hamilton or equivalent
Data System	EZ-Chrom
Purge Trap	Supelco, Trap “G” or equivalent

9.0 STANDARDS

9.1. Stock Standard

9.1.1. All stock standards are purchased as certified solutions. Intermediate and working standards are prepared according to EMAX-QC02.

9.1.2. All standards should be transferred in inert vials labeled with ID from standard preparation logbook, date of expiration, concentration, and stored with minimal headspace at –10°C to -20°C.

9.2. Calibration Standards

Name	Source	Catalog #	Conc. (µg/ml)	Notes
Unleaded Gas Comp. Std.	Restek	30081	2500	or equivalent

9.3. Surrogate Standards

Name	Source	Catalog #	Conc. (µg/ml)	Notes
Bromofluorobenzene/TFT	Ultra Scientific	STM-410	2000	or equivalent

9.4. LCS/Matrix Spike/Second Source Standard

Name	Source	Catalog #	Conc. (µg/ml)	Notes
Cert. BTEX in Unleaded Gas	AccuStd	30237	5000	or equivalent

9.5. **Intermediate Standard**

Using the stock standard solution, prepare in methanol and store with minimal headspace in an inert vial. Prepare secondary dilution standards from the stock standards at concentration levels as follows:

Gasoline	Surrogate	LCS/Matrix Spike
2500 mg/L	50 mg/L	5000 mg/L

9.6. **Working Standard**

9.6.1. Initial Calibration Standard

Prepare initial calibration standards in 5 ml organic free water with concentrations as suggested below:

Standard	2500 mg/L	50 mg/L (BFB)	Final Conc. (gas, µg/L)
1	0.04 µl	1 µl	20/10
2	0.1µl	2 µl	50/20
3	0.2 µl	3 µl	100/30
4	1 µl	4 µl	500/40
5	2 µl	5 µl	1000/50
6	4 µl	7.5 µl	2000/75
7	6 µl	10 µl	3000/100

9.6.2. Continuing Calibration Standard

Using intermediate standards, prepare daily calibration standards in a syringe with 5 ml of organic free water as suggested below:

Standard	2500 mg/L (Gas)	50 mg/L (BFB)	Final Conc. µg/L
DCC	2.0 µl	5.0 µl	1000/50

9.6.3. Surrogate Solution

Blank	Surrogate Standard	Conc. µg/L
5 ml	4.0 µl	40

9.6.4. Spiking Solution

Sample (Blank)	Spiking Standard (5000 mg/L)	Surrogate (50 mg/L)	Conc. (µg/L)
5 ml	0.5 µl	4 µl	500/40

9.7. **Initial Calibration Verification/Second Source Standard: Accu Standard**

Sample (Blank)	Spiking Standard (5000 mg/L)	Surrogate (50 mg/L)	Conc. (µg/L)
5 ml	0.5 µl	4 µl	500/40

9.7.1. Prepare an intermediate standard at 5000 mg/L from an independent source to verify the concentration after the initial calibration. Use this standard to spike ICV sample.

9.8. **Retention Time Window Standard**

9.8.1. Prepare a standard containing a mixture of 2-methylpentane and 1,2,4-trimethylbenzene (or C_6 to C_{10}) at 10 mg/L for retention time analysis. Use this standard to spike RTW sample.

9.9. Other concentration levels may be used as appropriate.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Prepare aqueous samples in accordance with EMAX-5030. Add surrogates to all samples to yield 40µg/L prior to purging unless otherwise specified by the project.

10.1.2. Prepare soil samples in accordance with EMAX-5035. Add surrogates to all samples to yield 40µg/Kg prior to purging unless otherwise specified by the project.

10.1.3. Prepare LCS/LCD by spiking a reagent blank to yield 500 µg/L spike standard unless otherwise specified by the project. Add surrogate at the same level as the samples.

10.1.4. Prepare MS/MSD sample using the assigned matrix QC sample similarly as the LCS sample.

10.2. **Instrument Parameters**

10.2.1. Initially, set the instrument parameters as suggested in the table below.

10.2.2. Gas Chromatographic Condition

Carrier gas flow (column) helium	9-10 ml/min			
Make up gas (He)	20-21 ml/min			
Helium Tank	80 psi			
Detector Temperature	Detector A: OFF; Detector B: 235°C			
Temperature programming:	Initial temperature: 35°C Initial time: 6 minutes			
	Level	Rate (°C/min)	Initial Temp(°C)	Final Time (min)
	1	8.00	70.0	0
	2(A)	5.00	120	5.0
	2(B)	25.0	230	5.0

10.2.3. Purge and Trap Condition

Purge	10 min. at room temperature

Desorb	2 min. at 180°C
Bake	15 min. at 185°C

10.2.4. Optimize the instrument for its intended use.

10.2.5. Record the instrument operating condition on the instrument maintenance log and post the latest instrument parameter setup in front of the instrument for ease when performing the instrument routine check.

10.2.6. When instrument parameter setup requires change due to instrument optimization document the change as described in 10.2.5.

10.3. **Calibration**

10.3.1. Initial Calibration (ICAL)

10.3.1.1. Prepare initial calibration solution as described in Section 9.6.1. Analyze them as described in Section 10.4.

10.3.1.2. Refer to Section 10.5 for calculation.

10.3.1.3. Acceptance criteria are specified in Appendix 1.

10.3.2. Initial Calibration Verification (ICV)

10.3.2.1. Spike 5 ml water reagent with 0.5 µl of 5000 mg/L ICV standard and 4µl of 50 mg/L of surrogate standard. The ICV result is expected to yield 500 µg/L of GRO and 40 µg/L of surrogate.

10.3.2.2. After establishing ICAL, analyze the ICV standard to verify the concentration of the ICAL. Refer Appendix 1 for acceptance criteria. If non-compliant refer to Section 12 for corrective action.

10.3.3. Retention Time Window Check (RTW)

10.3.3.1. Spike 5 ml water reagent with 0.5 µl of 2000 mg/L RTW standard.

10.3.3.2. Analyze the RTW check sample after every ICAL to ensure retention time window validity. Refer to Section 10.4.3 for establishing RTW.

10.3.4. Continuing Calibration (DCC)

10.3.4.1. Spike 5 ml water reagent with 2.0 µl of 2500 mg/L DCC standard and 5 µL of 50 mg/L of surrogate standard. The sample result is expected to yield 500 µg/L of GRO and 50 µg/L of surrogate.

10.3.4.2. Analyze the DCC (Refer to Section 9.6.2 for standard preparation) standard to verify the validity of the ICAL. Refer to Appendix 1 for acceptance criteria. If non-compliant refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. Analytical Sequence

10.4.1.1. Analyze instrument blank to ensure that the instrument is free from contamination.

10.4.1.2. Analyze DCC to check ICAL validity.

10.4.1.3. Analyze Method Blank to check for prep batch contamination

10.4.1.4. Analyze Lab Control Sample to check accuracy

10.4.1.5. Analyze Lab Control Sample Duplicate (if required by the project)

10.4.1.6. Analyze samples to a maximum number of 12-hour runs or as specified by the project.

10.4.1.7. Analyze a pair of matrix spikes (MS/MSD) per project requirement.

10.4.1.8. Record the analytical sequence in the GC Run Log.

10.4.1.9. Print instrument sequence before and after the analysis run and attached it to the analytical run. Document any changes that occurred during the process.

10.4.2. Identification and Quantitation

10.4.2.1. Identification is based on pattern recognition. Hence, compare sample chromatograms to reference hydrocarbons standard chromatograms for their response hydrocarbon range and peak distribution to determine the most probable petroleum product. Gasoline falls within the C_6-C_{10} range.

10.4.2.2. All peaks eluting within the established RT window identifies the GRO.

10.4.2.3. When the elution profile of a sample does not match that of gasoline standard, but falls within the retention time window, quantitate results as gasoline range organics (GRO) and denote the observed deviation in case narrative.

10.4.2.4. Quantitation is achieved by the summation of all peaks in the chromatogram minus the solvent peak, and the sample result is calculated using Equation 10.5.3.

10.4.2.5. Integrate the total peak area response and quantitate the total area by using the ACF of gasoline (see section 10.5.1).

10.4.2.6. When manual integration is necessary follow the procedures described in EMAX-DM01, Manual Integration section.

10.4.3 Retention Time Windows (RTW)

10.4.3.1 Establishing RTW

10.4.3.1.1 Run RTW standard over a period of 72 hours.

10.4.3.1.2 Calculate the Standard Deviation (SD) of absolute retention time obtained for each analyte.

10.4.3.1.3 The width of RTW is defined by ±3XSD obtained from 10.4.3.1.2.

10.4.3.2 Evaluating RTW

10.4.3.2.1 If the SD is equal to 0.00, default to the previous study until historical data is obtained to define the RTW for the current instrument.

10.4.3.2.2 For new instruments, use the established retention time from another instrument having the same instrument parameters (e.g. detector, temperature program and column.) If there are no instruments with the

same instrument parameter, use 0.03 minutes as the default RTW until historical data is obtained to define the RTW for the current instrument parameters condition.

10.4.3.3 Application of RTW

10.4.3.3.1 Establish the center of absolute retention time for each analyte to include the surrogate(s) from the daily calibration check at the beginning of the analytical shift then apply the established RTW.

10.4.3.3.2 Whenever the observed retention time is outside the established RTW, the analyst is advised to determine the cause and perform necessary corrective action before continuing analyses.

10.4.3.4 Updating RTW

10.4.3.4.1 Re-establish the RTW as described in Section 10.4.3.1 when any of the following conditions occur.

- Yearly RTW update
- Significant shifting is observed (e.g. succeeding calibration checks or LCS are out of the RTW)
- Major instrument maintenance (e.g. replacements of detector or column, temperature program change, etc.)

10.4.3.4.2 If the calculated new RTW is significantly narrower than the previously established RTW, default to the previously established RTW.

10.4.4 Sample Result Evaluation

10.4.4.1 Check surrogate recoveries against project specific requirement (PSR). In the absence of PSR, default to in-house QC procedures described in Appendix 1.

10.4.4.2 Dilute and re-analyze samples having concentrations greater than the highest calibration range.

10.4.4.3 Dilute and re-analyze samples having saturated peak(s) within C_6 – C_{10}. See Figure 1 for typical saturated peak.

10.4.4.4 Re-analyze samples suspected of carry-over from a proceeding sample that has high concentration.

10.4.4.5 Report discrete peak(s) observed as required by the project. Column bleed subtraction is not generally required in GRO analysis.

10.5 **Calculations**

10.5.1 Initial Calibration

10.5.1.1 Calculate the Calibration Factor (CF).

$$CF = \frac{R_a}{C_k} \qquad \textit{Eq. 10.5.1.1}$$

where:

CF - *is the calibration factor*

R_a - *is the analyte response measured in peak area*

C_k - *is the known concentration of the analyte in µg/L (H_2O); µg/Kg (Soil)*

10.5.1.2 Calculate the Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}} \qquad \textit{Eq. 10.5.1.2}$$

where:

SD - *is the standard deviation*

x_i - *is the result at the ith measurement*

$\bar{x}$ - *is the mean*

N - *is the number of measurements*

10.5.1.3 Calculate the Percent Relative Standard Deviation (%RSD).

$$\%RSD = \left[\frac{SD}{ACF}\right] 100 \qquad \textit{Eq. 10.5.1.3}$$

where:

%RSD - *is the percent relative standard deviation*

SD - *is the standard deviation*

ACF - *is the average calibration factor*

10.5.1.4 Calculate the Average Calibration Factor (ACF)

$$ACF = \frac{\sum CF}{N} \qquad \textit{Eq. 10.5.1.4}$$

where:

ACF - *is the average calibration factor*

∑CF - *is the summation of the calibration factors*

N - *is the number of calibration points*

10.5.2 Calculate the Percent Difference for DCC from ACF

$$\%D = @\,abs\left[\frac{Ck - Cf}{Ck}\right] * 100 \qquad \textit{Eq. 10.5.2}$$

where:

%D - *is the percent difference DCC from the ACF*

Ck - *known concentration of analyte, in µg/L*

Cf - *is the concentration found, in µg/L*

10.5.3 Calculate Sample Results

$$C = \left[\frac{R_a}{ACF}\right]\left[\frac{V_e}{S_a}\right] DF$$ *For water samples* *Eq. 10.5.3.1*

$$C = \left[\frac{R_a}{ACF}\right]\left[\frac{V_e}{(S_a)(\%S)}\right] DF$$ *For soil samples* *Eq. 10.5.3.2*

where:

C - *is the concentration of analyte in µg/L (H2O), µg/Kg (soil)*

R_a - *is the analyte response measured in peak area*

ACF - *is the average calibration factor from initial standard calibration*

V_e - *is the purgeable volume in ml*

S_a - *is the sample amount in ml (H_2O); g (Soil)*

DF - *is the dilution factor*

%S - *is the percent solid of the sample*

10.5.4 Calculate the percent recovery of spike in LCS.

$$\% R = \left[\frac{C_f}{C_o}\right] 100$$ *Eq. 10.5.4*

where:

%R - *is the percent recovery*

C_f -*is the concentration found, in µg/L*

C_o - *is the known concentration of spiked solution, in µg/L*

10.5.5 Calculate the MS recovery

$$\% R = \left[\frac{(C_f - C_s)}{C_o}\right] 100$$ *Eq. 10.5.5*

where:

%R - *is the percent recovery*

C_f - *is the concentration found, in µg/L*

C_s - *is the concentration of the sample, in µg/L (H_2O); in µg/Kg (Soil)*

C_o - *is the known concentration of spiked solution*

10.5.6 Calculate the precision.

$$\% RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \textit{Eq. 10.5.6}$$

where:

RPD - is the relative percent recovery

C1 – Measured concentration of the first sample aliquot

C2 – Measured concentration of the second sample aliquot

10.6 **Data Reduction**

10.6.1 Make a copy of the analytical run log and highlight the data to be reported.

10.6.2 Collate the reportable raw data separating the QC results from the sample results.

10.6.3 Keep all other data generated with the analytical folder marked with "For record only".

10.7 **Report Generation**

10.7.1 Generate the method.txt file using WBDX[2].exe.

10.7.2 Generate the sample results using F1NVX[2].exe

10.7.3 Generate the QC summary using QCVX[2].exe

10.7.4 Generate Lab Chronicle using LABCHRNX[2].exe

10.7.5 Generate the Case Narrative using CN1.exe

10.8 **Data Review**

10.8.1 Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analyses.

- Case Narrative
- Lab Chronicle
- Sample Results
- LCS/LCSD Summary
- MS/MSD Summary
- ICAL Summary
- ICV Summary
- DCC Summary
- Analytical Log

X[2] - version number

- Sample Preparation Log

10.8.2 Perform a 100% data review in accordance to EMAX-DM01 and the PSR.

10.8.3 Check that qualitative identification is done properly.

10.8.4 Check that samples results are integrated properly and results over calibration range are diluted and re-analyzed within the calibration range.

10.8.5 Where manual integration was performed, checked that it was done properly and documentation was retained in accordance to EMAX-DM01, Manual Integration Section.

10.8.6 Check that presence of saturated peak(s) are diluted, and quantitated properly.

10.8.7 Check that suspected carry-overs are re-analyzed and results are reported accordingly.

10.8.8 Check that discrete peaks [other than column bleeds] are reported according to project requirement.

10.8.9 Review the case narrative and edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.10 Submit the analysis package for secondary review.

10.9 **Preventive Maintenance**

10.9.1 Perform daily instrument check prior to sample analysis. Refer to Form 8015GFM – Instrument Maintenance Log.

Maintenance Activity	Description	Frequency
Autosampler	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis.
Verification	Check gas pressure Check instrument parameters to ensure normal operating conditions. Change liner as necessary. Check instrument performance (e.g., Daily calibration check, instrument blank)	Daily prior to analysis.
Documentation	Record all instrument maintenance performed in the instrument maintenance log.	Daily prior to analysis
System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector. Check septa and replace as necessary.	Every 6 months or as necessary
Check Flow Path Components	Check and if necessary, change injection port liners, septa and O-rings. Change the carrier gas trap(s) and purifier	Once a year or as necessary
Complete Inspection	Perform general inspection of the complete system. Inspect autosampler cabling and configuration setting.	Once a year

10.9.2 Maintain an inventory of instrument parts and supplies for routinely maintenance.

11.0 QUALITY CONTROL

11.1. **Sample Preparation**

11.1.1. A preparation batch shall consist of a MB, LCS, MS/MSD and ≤ 20 field samples.

11.1.2. Decontaminate volumetric flasks used for standard preparation with methanol.

11.1.3. All solvents and reagents shall undergo quality control check in the stationary laboratory prior to its use.

11.2. **Analytical Batch**

11.2.1. Initial Calibration must be established and verified by daily continuing calibration as described in Appendix 1.

11.2.2. Analytical batch shall consist of a valid ICAL, QC samples and field samples bracketed with DCC every 12-hour analytical sequence, unless other frequency is prescribed by the project.

11.2.3. A record must be established that the analytical instrument is free from contamination prior to any analysis. This can be achieved by analyzing a solvent blank and identifying its result as instrument blank.

11.2.4. Organic free water shall be used for method blank and LCS for water matrix.

11.2.5. Organic free sand shall be used for method blank and LCS for soil matrix.

11.3. **Method QC**

11.3.1. LOD and LOQ must be established before the analytical procedure can be used and verified according to EMAX-QA04.

11.3.2. Retention Time Window must be established and updated accordingly.

11.3.3. Demonstration of capability must be established before the analytical procedure can be used.

11.3.4. All analysts conducting this analysis must have established demonstration of capability.

12.0 CORRECTIVE ACTION

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures in Appendix 1. Document the out of control event and corrective action in the analytical logbook. If the problem persists, consult the supervisor

12.2. **Calibration**

12.2.1. If initial calibration is non-compliant, consider the following suggestions to correct the problem:

12.2.1.1. If RSD > 20%, check each calibration point. If an outlier exists, re-analyze that calibration point.

12.2.1.2. If ICV not within the expected recovery range, review the chromatogram.

- Bias low results are indicative of poor purging or standard degradation.
- Bias high is indicative of inaccurate standard injection of instrument contamination.

- Consider preparing a fresh ICV standard and re-analyze the ICV.

12.2.1.3. If problem persist, inform the Supervisor prior to re-calibration

12.2.2. If the continuing calibration is non-compliant, consider the suggestions described in correcting ICV.

12.2.3. If instrument blank/reagent blank is non-compliant, consider the following suggestions to correct the problem:

12.2.3.1. Check the reagent water source e.g. same source is used by a similar analysis on a different instrument to rule out reagent contamination.

12.2.3.2. Bake the sample concentrator and or GC column for at least 15 min.

12.2.3.3. Re-calculate the data and/or re-analyze the extract if any of the above checks reveals a problem.

12.2.3.4. If problem persists, inform the Supervisor prior to re-analysis.

12.3. **Surrogates**

12.3.1. If surrogates are non-compliant, and are not due to matrix effects, consider the following suggestions to correct the problem:

12.3.1.1. Check that the surrogate peak is properly integrated.

12.3.1.2. Check for calculation errors and that the concentrations of the surrogate solutions are correct.

- High recoveries may be due to co-eluting matrix interference, examine the sample chromatogram.
- Low recoveries may be due to a poor purge, check the purge tube with a blank before re-analyzing the sample.

12.3.1.3. Check instrument performance to determine if it is within acceptable guidelines.

12.4. **Sample Preparation QCs**

12.4.1. If method blank is non-compliant, consider the following suggestions to correct the problem:

- Check the sample results. If sample results are non-detected, you may report the result upon concurring with the PM, otherwise perform the corrective action as specified in the PSR.

12.4.2. If LCS is non-compliant, consider the following suggestions to correct the problem:

- Check for errors in calculation and concentration of the analyte solution.
- Check instrument performance to determine if it is within acceptable guidelines.
- Re-calculate the data and/or re-analyze the extract if any of the above checks reveals a problem.

12.5. **Technical Holding Time**

12.5.1. If samples are out of technical holding time, fill-out a Non-Conformance Report (NCR) and forward it to the project manager who will consult with the client for further instruction**.** Refer to EMAX-QA08 for NCR details**.**

12.6. **Sample Preservation**

12.6.1. If water samples are not labeled preserved or samples were received out of the expected range of refrigeration, inform the PM for the PM to consult with the client for further instruction.

12.6.2. If water samples are marked preserved and pH is > 2, discuss it in the case narrative.

12.7. **Non-conformance Report**

12.7.1. Generate an NCR when the following circumstances occur

- Sample was not analyzed within the holding time
- Sample was insufficient to perform analysis

12.7.2. Refer to EMAX-QA08 for details.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to Waste Disposal Unit.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents. Preparation batch is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate. Analytical batch is compose of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Duplicate Sample – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.4. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.5. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.6. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyze to monitor the accuracy of the analytical system.

15.1.7. Matrix – is a component or form of a sample.

15.1.8. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyze to monitor matrix effect on a method's recovery efficiency.

15.1.9. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.10. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.11. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.12. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing volatile analysis by GC unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied

15.4. **Department of Energy Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. U.S. EPA Method 8015C, SW846, as updated

16.2. EMAX Quality Systems Manual (EMAX-QS00), as updated.

17.0 APPENDICES

17.1. Figures

17.1.1. Figure 1 Typical Peak Evaluation

17.1.2. Figure 2 Typical Chromatogram

17.1.3. Figure 3 Typical ICAL Summary

17.1.4. Figure 4 Typical Continuing Calibration Summary

17.1.5. Figure 5 Typical Raw Data

17.1.6. Figure 6 Typical Sample Report

17.1.7. Figure 7 Typical LCS Summary

17.1.8. Figure 8 Typical MS/MSD Summary

17.1.9. Figure 9 Typical Case Narrative

17.2. Appendices

17.2.1. Appendix 1 Summary of Quality Control Procedures

17.2.2. Appendix 2 Demonstration of Capability

17.3 Forms

17.3.1 8015GFA Analytical Run Log

17.3.2 8015GFM Instrument Maintenance Log

Figure 1: TYPICAL PEAK EVALUATION

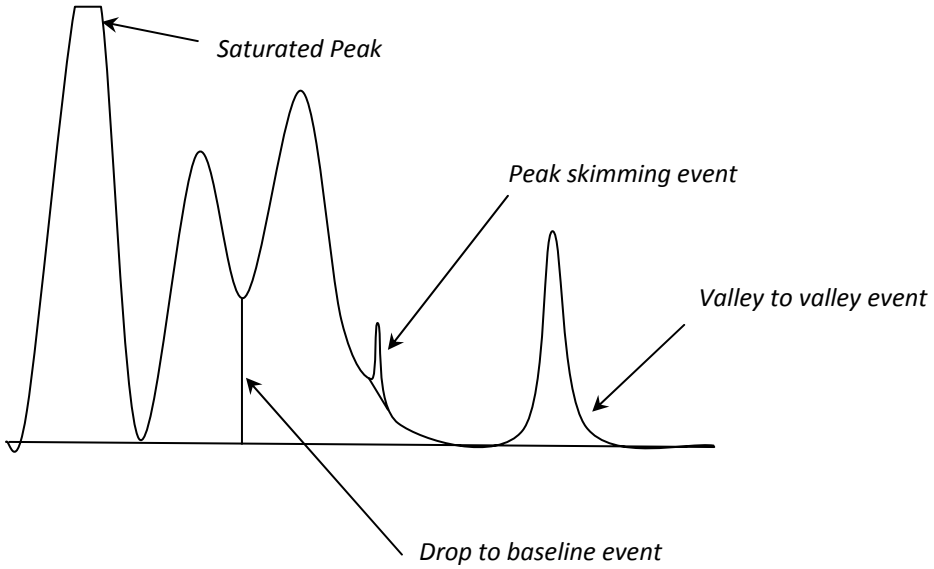


Figure 2: TYPICAL CHROMATOGRAM

METHOD 8015 by FID
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\ek15\ek15.013
Method : c:\ezchrom\methods\vg39k01.met
Sample ID : CVG37K01045 1000/50
Acquired : Nov 15, 2010 18:36:04
Printed : Dec 13, 2010 10:59:26
User : RAYMOND

Channel A Results

#	Peak Name	Ret.Time(Min)	Area	Ave. CF	ESTD Conc.(PPB)
13	1,1,1-TFT	3.150	1109789.0	23512.2	47.20
35	Bromofluorobenzene	10.667	783034.0	15956.4	49.07
G1	GASOLINE(TOTAL)		14306482.0	15508.5	922.49
G2	GRO(C6-C10)		12458496.0	12779.8	974.86
G3	GRO(2MP-124TMB)		12458496.0	12764.9	976.00
G4	GRO(C5-C12)		14306482.0	15501.9	922.89
G5	GRO(C6-C12)		14189894.0	15415.5	920.50

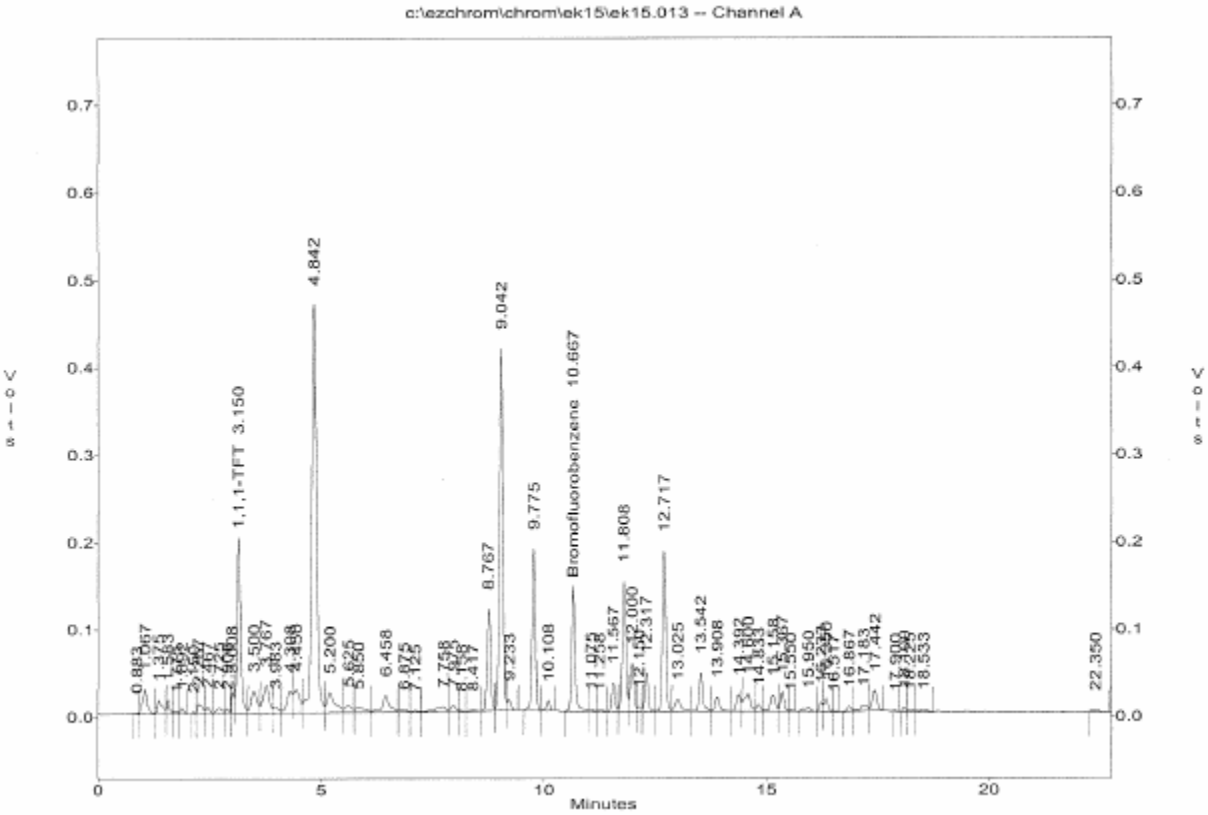


Figure 3: **TYPICAL ICAL SUMMARY**

INITIAL CALIBRATION
5030B/M8015

Lab Name : EMAX Inc
Instrument ID : GCT39
GC Column : DB-5
Column size ID : 30MX.53MM
LFID & Datetime: EK01002A 11/01/10 11:06
LFID & Datetime: EK01003A 11/01/10 11:48
LFID & Datetime: EK01004A 11/01/10 12:29
LFID & Datetime: EK01005A 11/01/10 13:11
LFID & Datetime: EK01009A 11/01/10 15:55
LFID & Datetime: EK01007A 11/01/10 14:33
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS 1.00X	2.50X	5.00X	25.00X	(AREA)/UNIT 50.00X	100.00X	MEAN	%RSD	
Gasoline(TOTAL)	20.00	14203	16029	15706	15253	15738	16122	15508.5	4.6	✓
GRO(C6-C10)	20.00	10800	12361	12524	13429	13700	13865	12779.8	9.0	✓
GRO(2MP-124TMB)	20.00	10800	12361	12524	13429	13700	13776	12764.9	8.9	✓
GRO(C5-C12)	20.00	14203	16029	15682	15253	15726	16118	15501.9	4.5	✓
GRO(C6-C12)	20.00	14203	15978	15633	15100	15587	15990	15415.5	4.4	✓
SURROGATE	**X**	**1.00X**	**2.00X**	**3.00X**	**4.00X**	**5.00X**	**7.50X**	**MEAN**	**%RSD**	
Bromofluorobenzene	10.00	14034	14082	14613	15800	18344	18864	15956.4	13.5	✓
1,1,1-Trifluorotoluene	10.00	22522	21994	21284	23018	25519	26737	23512.2	9.1	✓

VG39K01.MET

INITIAL CALIBRATION
5030B/M8015

Lab Name : EMAX Inc
Instrument ID : GCT39
GC Column : DB-5
Column size ID : 30MX.53MM
LFID & Datetime: EK01002A 11/01/10 11:06
LFID & Datetime: EK01003A 11/01/10 11:48
LFID & Datetime: EK01004A 11/01/10 12:29
LFID & Datetime: EK01005A 11/01/10 13:11
LFID & Datetime: EK01009A 11/01/10 15:55
LFID & Datetime: EK01007A 11/01/10 14:33

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.5X	5.0X	25.0X	50.0X	100.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
Gasoline(TOTAL)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GRO(C6-C10)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GRO(2MP-124TMB)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GRO(C5-C12)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GRO(C6-C12)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURROGATE	**1.0X**	**2.0X**	**3.0X**	**4.0X**	**5.0X**	**7.5X**	**RT**	**FROM**	**TO**	**WIDTH**
Bromofluorobenzene	10.667	10.675	10.667	10.675	10.658	10.650	10.665	10.612	10.718	0.053
1,1,1-Trifluorotoluene	3.158	3.158	3.158	3.158	3.150	3.142	3.154	3.053	3.255	0.101

VG39K01.MET

Figure 4: TYPICAL CONTINUING CALIBRATION SUMMARY

CONTINUE CALIBRATION
5030B/M8015

Lab Name : EMAX Inc
Instrument ID : GCT39
GC Column : DB-5
Column size ID : 30MX.53MM
Mid Conc Init LFID & Datetime: EK01009A 11/01/2010 15:55
Conc Cont LFID & Datetime: EK15013A 11/15/2010 18:36
CONC UNIT : ppb

COMPOUND	RT MINUTES	RT WINDOW FROM	RT WINDOW TO	TRUE CONC	AVERAGE CF	RESULT AREA	RESULT CONC	%D	QL	%D LIMITS
Gasoline(TOTAL)	NA	NA	NA	1000.0	15508.5	14306482	922.49	-8		15
GRO(C6-C10)	NA	NA	NA	1000.0	12779.8	12458496	974.86	-3		15
GRO(2MP-124TMB)	NA	NA	NA	1000.0	12764.9	12458496	976.00	-2		15
GRO(C5-C12)	NA	NA	NA	1000.0	15501.9	14306482	922.89	-8		15
GRO(C6-C12)	NA	NA	NA	1000.0	15415.5	14189894	920.50	-8		15
SURROGATE	**MINUTES**	**FROM**	**TO**	**TRUECON**	**CF**	**AREA**	**CONC**	**%D**	**QL**	**LIMITS**
Bromofluorobenzene	10.667	10.614	10.720	50.0	15956.4	783034	49.07	-2		15
1,1,1-Trifluorotoluene	3.150	3.049	3.251	50.0	23512.2	1109789	47.20	-6		15

Figure 5: **TYPICAL RAW DATA**

METHOD 8015 by FID
EMAX Analytical Laboratories, Inc.

```
File          : c:\ezchrom\chrom\ek15\ek15.014
Method        : c:\ezchrom\methods\vg39k01.met
Sample ID     : 10K080-03 5.0ML W
Acquired      : Nov 15, 2010 19:17:24
Printed       : Dec 13, 2010 11:00:34
User          : RAYMOND
```

Channel A Results

#	Peak Name	Ret.Time(Min)	Area	Ave. CF	ESTD Conc.(PPB)
1	1,1,1-TFT	3.150	803320.0	23512.2	34.17
3	Bromofluorobenzene	10.658	552551.0	15956.4	34.63
G1	GASOLINE(TOTAL)		185238.0	15508.5	11.94
G2	GRO(C6-C10)		43346.0	12779.8	3.39
G3	GRO(2MP-124TMB)		43346.0	12764.9	3.40
G4	GRO(C5-C12)		185238.0	15501.9	11.95
G5	GRO(C6-C12)		185238.0	15415.5	12.02

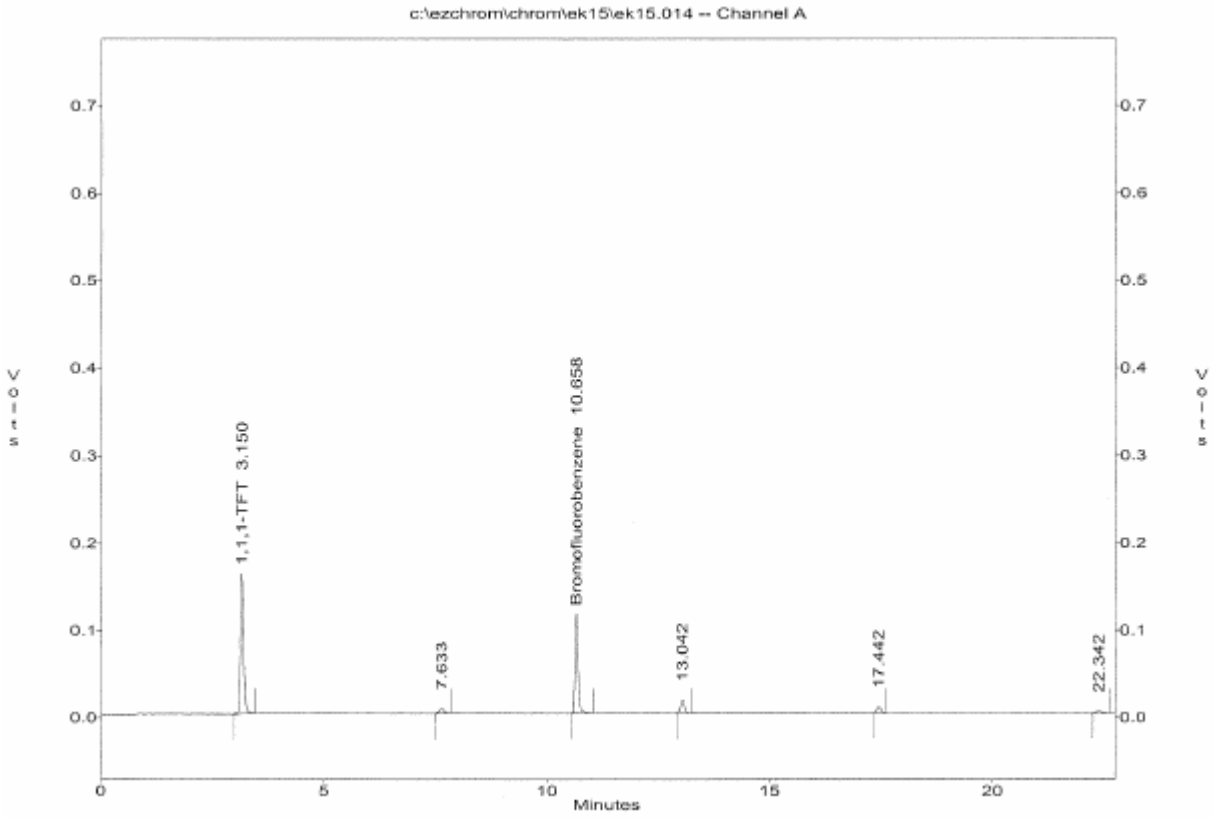


Figure 6: TYPICAL SAMPLE RESULT SUMMARY

METHOD 5030B/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client : XYZ, INC.	Date Collected: 11/08/10
Project : CLEAN PROJECT	Date Received: 11/08/10
Batch No. : 10K080	Date Extracted: 11/15/10 19:17
Sample ID: 54-050	Date Analyzed: 11/15/10 19:17
Lab Samp ID: K080-03	Dilution Factor: 1
Lab File ID: EK15014A	Matrix : WATER
Ext Btch ID: VA39K17	% Moisture : NA
Calib. Ref.: EK15013A	Instrument ID : GCT039

PARAMETERS	RESULTS (mg/L)	LOQ (mg/L)	LOD (mg/L)
GASOLINE	ND	0.10	0.020

SURROGATE PARAMETERS	RESULTS	SPK_AMT	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	0.0346	0.0400	87	60-140

Parameter	H-C Range
Gasoline	C6-C10

Figure 7: **TYPICAL LCS/LCSD SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
BATCH NO.: 10K080
METHOD: METHOD 5030B/M8015

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	MBLK1W				
LAB SAMP ID:	VA39K17B	VA39K17L	VA39K17C		
LAB FILE ID:	EK15003A	EK15004A	EK15005A		
DATE EXTRACTED:	11/15/1011:42	11/15/1012:23	11/15/1013:05	DATE COLLECTED:	NA
DATE ANALYZED:	11/15/1011:42	11/15/1012:23	11/15/1013:05	DATE RECEIVED:	11/15/10
PREP. BATCH:	VA39K17	VA39K17	VA39K17		
CALIB. REF:	EK15002A	EK15002A	EK15002A		

ACCESSION:

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Gasoline	ND	0.500	0.461	92	0.500	0.474	95	3	60-130	30

SURROGATE PARAMETER	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	QC LIMIT (%)
Bromofluorobenzene	0.0400	0.0380	95	0.0400	0.0376	94	70-130

Figure 8: **TYPICAL MS/MSD SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
BATCH NO.: 10K080
METHOD: METHOD 5030B/M8015

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	54-050				
LAB SAMP ID:	K080-03	K080-03M	K080-03S		
LAB FILE ID:	EK15014A	EK15015A	EK15016A		
DATE EXTRACTED:	11/15/1019:17	11/15/1019:58	11/15/1020:40	DATE COLLECTED:	11/08/10
DATE ANALYZED:	11/15/1019:17	11/15/1019:58	11/15/1020:40	DATE RECEIVED:	11/08/10
PREP. BATCH:	VA39K17	VA39K17	VA39K17		
CALIB. REF:	EK15013A	EK15013A	EK15013A		

ACCESSION:

PARAMETER	SMPL RSLT (mg/L)	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Gasoline	ND	0.500	0.426	85	0.500	0.416	83	2	50-130	30

SURROGATE PARAMETER	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	QC LIMIT (%)
Bromofluorobenzene	0.0400	0.0382	95	0.0400	0.0373	93	60-140

Figure 9: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN PROJECT

SDG : 10K080

METHOD 5030B/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

A total of four (4) water samples were received on 11/08/10 for TPH Gasoline analysis, Method 5030B/M8015 in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source (ICV). Continuing calibration (CCV) verifications were carried on a frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for VA39K17L/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for K080-03M/S were within project QC limits.

Surrogate
Surrogate was added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC Procedure	Frequency	Acceptance Criteria	Corrective Action	1st Rvw	2nd Rvw
Five-point initial calibration for all analytes	Initially; as needed	ACF RSD: ≤ 20%	Correct the problem then repeat initial calibration		
Initial calibration verification (ICV)	After initial calibration	Within ± 20% of expected value	Correct the problem then repeat initial calibration		
Calibration verification (DCC)	Every 12 hours of analysis time and at the end of analysis sequence	Within ± 20% of expected value	Correct the problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification		
Method blank	One per preparation batch	No analytes detected ≥ ½ LOQ	If sample results are ND or contamination is < 10X of sample result, consult with the PM if results are reportable. Otherwise, determine the source of contamination and correct the problem. Reanalyze method blank and all samples processed with the contaminated blank. If re-analysis is not possible, apply B to specific analyte(s) on all associated.		
LCS	One LCS per preparation batch	within project QC Limits	Re-prep and reanalyze the LCS and all associated samples		
Surrogate spike	Every sample, spiked sample, standard, and method blank	Within project QC Limits	If no apparent matrix interference is observed, reanalyze the sample. Otherwise inform the PM for further instruction.		
MS/MSD	One MS/MSD per every 20 project samples per matrix	Refer to project QC Limits	Ensure that spike concentration, spike addition was accurate and calculation is correct. If chromatogram exhibits matrix interference narrate observation in the case narrative.		
Chromatogram	All sample results	Within calibration range No saturated peak(s)	Dilute and re-analyze all samples over the calibration range Diluted and re-analyzed all samples demonstrating saturated peak(s) even if the total integrated peaks do not exceed the calibration range.		
Notes: Discrete peaks are included for GRO Discrete peaks are subtracted for Gasoline Refer to PSR for flagging criteria. Report results between LOD and LOQ.				Reviewed By Date	

Appendix 2: **DEMONSTRATION OF CAPABILITY**

INITIAL DEMONSTRATION OF CAPABILITY
GASOLINE RANGE ORGANICS
METHOD: SW 8015C

SOP: EMAX-8015G
Conc Unit: µg/L
Sample Amount(ml): 5

Instrument ID: 39
Analysis date: 11/2/2010
Analyzed by: R. Huang

PARAMETER	EK01030A	EK01031A	EK01032A	EK01033A	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	VA39K01L	VA39K01C	VA39K02L	VA39K02C							
Gasoline (Total)	405.3	418.9	403.0	416.8	500	411	82	8.01	2	70 - 130	PASSED
GRO (C6-C10)	406.7	416.6	403.3	413.1	500	410	82	6.07	1	70 - 130	PASSED
GRO (2MP - 124TMB)	403.7	412.5	400.3	413.6	500	408	82	6.56	2	70 - 130	PASSED
GRO (C5-C12)	405.5	419.1	403.0	417.0	500	411	82	8.07	2	70 - 130	PASSED
GRO (C6-C12)	402.5	416.4	400.1	414.4	500	408	82	8.28	2	70 - 130	PASSED
1,1,1-TFT	39.8	38.5	38.4	39.2	40	39.0	97	0.67	2	70 - 130	PASSED
Bromofluorobenzene	37.9	36.0	36.3	35.9	40	36.5	91	0.92	3	70 - 130	PASSED

8015FA: **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
NONHALOGENATED VOLATILES

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Comments:

Book #: A39- 036

Instrument No.: 39

Analytical Sequence:

Method File: ☐ FID Channel A ☐ PID Channel B

Analytical Batch:

SOP #	Rev. #
☐ EMAX-5030B	
☐ EMAX-BTEXM	
☐ EMAX-8015G	
☐ EMAX-AK101	
☐ EMAX-	

STANDARDS ID	CONC. (mg/L)
ICAL	
ICV	
DCC GAS	
DCC BTEX	
BFB/TFT	
LCS/LCSD	
MS/MSD	

Purge Volume	5 ml

SOLVENT	ID
Methanol	

ELECTRONIC DATA ARCHIVAL	
Location	Date
☐ EZC-3-BTEX	
☐	

Analyzed By:

Date:

8015GFS: **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

EXTRACTION LOG
for
NONHALOGENATED VOLATILES

Page 1

Note: For samples, relevant QCs/Standards extracted, refer to attached extraction sequence.

Comments:

Book #.: E39-025

Preparation Batch:

Matrix

SOP	Rev. #
☐ EMAX-5035	
☐ EMAX-AK101	
☐ EMAX-	

Standards	ID	Amount Added (ml)
Surrogate		
LCS/MS		
Methanol		
Methanol w/ Surrogate		

Reagent	Lot # / ID
Silica Sand	

Prepared By:

Standard Added By: Checked By:

Extract Location:

Disposal By: Disposal Date:

8015GFM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

INSTRUMENT MAINTENANCE LOG

Instrument No: 39 Month: Year: 201_ Book # M39-008

DATE							
Computer Date/Time							
Printer Paper							
GC Keyboard Check							
Check Temperature Program							
Column Head Pressure (5-10 psi)							
Carrier Source Pressure (He @ 50psi)							
H_2 Generator: 40-50 psi							
Air Pressure (45 psi)							
Analyst's Initial							
Trouble Shooting							
Problem(s) Encountered							
Return-to-Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrrective Action / Maintenance

STANDARD OPERATING PROCEDURES

ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY

SOP No.:	EMAX-8081	Revision No.	7	Effective Date:	10-Aug-10
Prepared By:	Tu Nisamaneepong			Date:	08-10-10
Approved By:	Kenette Pimentel QA Manager			Date:	08.10.10
Approved By:	Caspar Pang Laboratory Director			Date:	08-10-10.

Control Number: 8081-07-

1.0 SCOPE AND APPLICATION

1.1. This procedure is used to determine the concentration of various Organochlorine Pesticides in soil, sediment, sludge, and wastewater samples by gas chromatography method. This SOP is an adaptation of Method 8081B. Since Method 8081B is an update and enhancement of 8081A, this SOP is also applicable to Method 8081A.

2.0 SUMMARY OF METHOD

2.1. This method provides gas chromatographic conditions for the identification and quantitation of Organochlorine Pesticides with dual Electron Capture Detectors (ECD). The samples are extracted in methylene chloride and exchanged to hexane before GC analysis.

2.2. **Interferences**

2.2.1. Interferences by phthalate esters introduced during sample preparation can pose a major problem in pesticide determinations. Avoiding contact with any plastic materials and checking all solvents for phthalate contamination can minimize interferences. Glassware must be scrupulously cleaned.

2.2.2. The presence of elemental sulfur will result in broad peaks that interfere with the detection of early-eluting organochlorine pesticides. Sulfur contamination is most likely present in sediment samples. The TBA procedure, GPC or other cleanup technique can be used for sulfur removal.

2.2.3. Other interferences such as aliphatic compounds, aromatics and nitrogen-containing compounds may be eliminated by using Florisil cleanup.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Table 8 lists the DL, LOD and LOQ values of the target analytes of this method.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point. All samples analyzed above this concentration are considered "over-range" and shall require dilution for proper quantitation.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required for proper quantitation.

4.3. The linear dynamic range for this method as determined in this SOP is listed on the table below.

Analytes	Water (µg/L)	Soil (µg/Kg)
alpha-BHC, Endosulfan I, gamma-BHC, Heptachlor, Aldrin, alpha-Chlordane, beta-BHC, delta-BHC, gamma-Chlordane, Heptachlor Epoxide	0.05 – 0.6	2 – 20
DDD, DDE, DDT, Dieldrin, Endrin, Endosulfan II, Endosulfan Sulfate, Endrin Aldehyde, Endrin Ketone	0.1 – 1.2	4 – 40
Methoxychlor	0.5 – 6	20 - 200

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Holding Time**

5.1.1. Extract water and soil samples within 7 and 14 days respectively, from the date of collection.

5.1.2. Analyze extracts within 40 days after extraction completion date.

5.2. **Preservation**

5.2.1. Store samples and extract at ≤6°C.

6.0 ASSOCIATED SOPs

6.1. EMAX-DM01 Data Flow and Review

6.2. EMAX-QA04 Method Detection Limit Study

6.3. EMAX-QA08 Corrective Action

6.4. EMAX-QC01 Quality Control for Chemicals

6.5. EMAX-QC02 Analytical Standard Preparation

6.6. EMAX-QC07 Glassware Cleaning

6.7. EMAX-SM03 Waste Disposal

6.8. EMAX-SM04 Analytical and QC Labeling

6.9. EMAX-3510 Extraction, Separatory Funnel

6.10. EMAX-3520 Extraction, Continuous Liquid/Liquid

6.11. EMAX-3545 Extraction, Pressurized Fluid

6.12. EMAX-3550 Extraction, Pulse Sonication

6.13. EMAX-3540 Extraction, Soxhlet

6.14. EMAX-3620 Cleanup, Florisil

6.15. EMAX-3640 Cleanup, GPC

6.16. EMAX-3660 Cleanup, Sulfur

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards.

7.3. ECD contains minute quantity of Radioactive Ni (63). Conduct a wipe test (experienced personnel or manufacturer respectively only) semi-annually or sooner if potential problem is suspected.

7.4. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves at all times when performing this procedure.

7.5. If, for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS, AND REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatography	HP 5890 Series II
Detector	Dual Electron Capture Detectors
Column	RTX CLPEST I (30 m x 0.32 mm x 0.5 µm) RTX CLPEST II (30 m x 0.32 mm x 0.25 µm) (Alternate columns may be used after verification of performance)
Data System	EZ Chrom
Auto Sampler	HP Model 7673A or equivalent
Gas	ultra-high purity nitrogen ultra-high purity hydrogen
Microsyringes	10, 25, 100and 500 ul with a 0.006 mm ID needle (Hamilton 702N or equivalent) for dilution purposes
Automatic Pipettes	Pipetman, 1000 and 200 µl
Transfer Pipette	Pasteur

8.2. **Chemicals and Reagents**

Solvent [GC-grade]	Methylene Chloride, Hexane

9.0 STANDARDS

9.1. **Standard Preparation**

9.1.1. Follow procedures for all standard preparations and labeling as described in EMAX-QC02 and EMAX-SM04, respectively.

9.1.2. Other concentration levels may be prepared to meet the data quality objective of a project.

9.2. **Stock Standard**

9.2.1. Purchase Primary Calibration stock standards as certified solutions in one mixture. After opening, transfer the stock standard to an inert vial and store with a minimum of headspace.

9.2.2. Purchase a Secondary set of stock standards from a different source to verify the concentration of the first set of standard. Treat the secondary standard similarly as the primary standard.

9.2.3. Purchase LCS/MS, surrogate and performance evaluation standards as certified solutions from various suppliers.

9.2.4. All standards shall be stored at ≤ 6°C.

9.3. **Intermediate Standard**

9.3.1. Prepare intermediate standards as suggested in Tables 3 (primary source) and 4 (secondary source).

9.3.2. Store all prepared standards in an inert vial with minimum headspace at ≤ 6°C.

9.4. **Initial Calibration Standard (ICAL)**

9.4.1. Prepare five or more calibration standards as suggested in Table 2 from primary intermediate standard (refer to Table 3).

9.5. **Initial Calibration Verification (ICV)**

9.5.1. Prepare ICV at concentration levels suggested in Table 5 using intermediate standard from second source stock standard (refer to Table 4).

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Prepare DCC from the same source as the ICAL standard as suggested in Table 5.

9.7. **Surrogate Standard**

9.7.1. Prepare surrogate standard as suggested in Table 6.

9.8. **LCS/MS Spike Standard**

9.8.1. Prepare LCS solution as suggested in Table 4.

9.8.2. Prepare MS spike standard as suggested in Table 7.

9.9. **Performance Evaluation Mixture (PEM)**

9.9.1. Prepare PEM as suggested in Table 8.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Prepare aqueous samples as described in EMAX-3520 or EMAX-3510.

10.1.2. Prepare solid samples as described in EMAX-3550, EMAX-3540 or EMAX-3545.

10.1.3. Perform extract clean up (if necessary) as described in EMAX-3620, EMAX-3640 or EMAX-3660, whichever is appropriate.

10.2. **Instrument Parameters**

10.2.1. Method 8081A requires an analytical system complete with a temperature programmable gas chromatograph equipped with an autosampler suitable for on column injection of 1 to 5 µl.

10.2.2. Gas Pressure

N_2 Tank : 40 psi

H_2 Tank : 80 psi

10.2.3. Temperature Program

Initial Temp	130°C, hold for 0 minute
Rate 1	25°C/min.
Temperature 1	230°C, hold for 2 minutes
Rate 2	3°C/min
Temperature 2	260°C, hold for 1 minute
Rate 3	25°C/ min
Final Temperature	300°C, hold for 1 minute
Injector	230°C
Detector	300°C
Injection Volume	2µL

10.3. **Calibration**

10.3.1. **Performance Evaluation Check**

10.3.1.1. Analyze instrument blank and a PEM containing DDT and Endrin to monitor the system performance at 12-hour interval prior to performing any calibration.

10.3.1.2. Calculate the breakdown by using Equations 10.6.6 ($\%B_T$) for DDT and 10.6.7 ($\%B_E$) for Endrin.

10.3.1.3. Check Appendix 1 for acceptance criteria before proceeding with sample analysis.

10.3.1.4. If system failed to meet the acceptance criteria, refer to Section 12 for corrective action.

10.3.2. **Initial Calibration (ICAL)**

10.3.2.1. Perform ICAL if instrument is new, ICV or DCC failed to meet acceptance criteria or after a major instrument repair.

10.3.2.2. A minimum of five calibration standards, or as suggested in Table 1, over the concentration range of interest are sequentially injected into the GC. Refer to Table 1 for ICAL concentrations. Peak areas are obtained from each analyte.

10.3.2.3. Calculate the calibration factor (CF) using the peak areas and their respective concentration according to Eq-10.6.1.

10.3.2.4. Calculate the Average Calibration Factor (ACF) and the RSD according to Eq. 10.6.4 and 10.6.3 respectively.

10.3.2.5. Refer to Appendix 1 for acceptance criteria. If acceptance criteria are not met refer to Section 12 for corrective action.

10.3.3. **Initial Calibration Verification (ICV)**

10.3.3.1. Analyze ICV prepared from another source as described in Section 9.5 to verify the concentrations of the ICAL.

10.3.3.2. Calculate the CF and the percent difference (%D) according to Eq-10.6.1 and 10.6.5 respectively. Refer to Appendix 1 for acceptance criteria. If acceptance criteria are not met refer to Section 12 for corrective action.

10.3.4. **Multicomponent Target Analyses**

10.3.4.1. For multicomponent target analytes (Toxaphene), a five-point calibration standard shall be included in initial calibration for pattern recognition and quantitation.

10.3.4.2. Integrate the total response of the chromatogram to obtain the total area. Calculate the calibration factor (CF) by using Equation 10.6.1.

10.3.5. **Daily Calibration Check (DCC)**

10.3.5.1. Analyze DCC at the start of the 12-hour shift prior to sample analysis and close the analytical run with an ending DCC.

10.3.5.2. Calculate the %D by using Equation 10.6.5. Check Appendix 1 for acceptance criteria. If acceptance criteria are not met refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. **Analytical Sequence**

10.4.1.1. Following the instrument data acquisition software, prepare the analytical sequence file as suggested below:

- IB - instrument blank
- PEM – performance evaluation mixture
- ICAL – initial calibration standards
- ICV or DCC1 – initial calibration verification or continuing calibration standard
- MB – method blank
- LCS – lab control sample
- Samples – up to 12 hours
- DCC2 – continuing calibration standard or ending DCC

10.4.2. **Sample Analysis**

10.4.2.1. Transfer approximately 0.5 ml of extract to a 2-ml amber auto sampler vial (or

equivalent) using a Pasteur pipette. Seal the vial with a Teflon lined septum and aluminum rim cap. Similarly, prepare the analytical standards and QC samples.

10.4.2.2. Introduce sample extract into the GC using direct injection technique (1 to 5 µl) after all system quality control criteria have been met.

10.4.3. **Sample Result Evaluation**

10.4.3.1. Check QC parameters as soon as the data is available.

- ✓ Check LCS recoveries against Appendix 1.
- ✓ Check MB that it is project compliant.
- ✓ Check retention time.
- ✓ Check surrogate recoveries against Appendix 1.
- ✓ Check concentration of target analytes. If the response exceeds the calibration range, dilute and re-analyze the sample until the response falls within the calibration range.
- ✓ If any of the above checkpoints indicate a problem, re-analysis is required. If re-analysis results are the same as the initial result, consult the Supervisor for further action. If results indicate extraction problem, fill-up an NCR and order re-extraction for the affected sample(s).

10.4.3.2. Positive identification is made when a peak falls within the retention time window of a target analyte on both columns established by the standard reference compound.

10.4.3.3. If one column meets the retention time criteria and a retention time shift is suspected on the other column, use the following guideline in reporting the data:

- ✓ Check that the expanded window does not exceed the RTW of the column in control or the established RTW or the CLP RTW (refer to table 7) whichever is greater.
- ✓ If the above condition is met, report the data and include a description of the observation in the case narrative.

10.4.4. **Retention Time Windows**

10.4.4.1. Establishing RTW

10.4.4.1.1. Collect at least three Daily Calibration Standards analyzed over a period of 72 hours.

10.4.4.1.2. Calculate the Standard Deviation (SD) of absolute retention time obtained for each analyte.

10.4.4.1.3. The width of RTW is defined by ±3X SD obtained from 10.4.4.1.2.

10.4.4.2. Evaluating RTW

10.4.4.2.1. If the SD is equal to 0.00, default to the previous study until historical data is obtained or use the CLP[1] retention time window (refer to Table 9) which ever is narrower.

10.4.4.2.2. For new instruments, in the interim use the CLP retention time window (refer to Table 9) until RTW is obtained for the new instrument parameters condition.

10.4.4.3. Application of RTW

10.4.4.3.1. Establish the center of absolute retention time for each analyte to include the surrogate(s) from the daily calibration check at the beginning of the analytical shift then apply the established RTW.

10.4.4.3.2. Whenever the observed retention time is outside the established RTW, the analyst is advised to determine the cause and perform necessary corrective action before continuing the analyses.

10.4.4.4. Updating RTW

10.4.4.4.1. Re-establish the RTW as described in Section 10.4.4.1 when any of the following conditions occur:

- Yearly RTW update
- Significant shifting is observed (e.g. succeeding calibration checks or LCS are out of RTW)
- Major instrument maintenance (e.g. replacement of detector or column; temperature program change, etc.)

10.4.5. **Manual Integration**

10.4.5.1. Refer to EMAX-DM01 for details of manual integration.

10.4.6. **Dealing with Carryover**

- ✓ Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.
- ✓ If there was no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction.
- ✓ If there was a target analyte detected as found in the sample that exceeded the calibration range, re-analyze the sample to rule-out carry over. If carry over is confirmed, proceed with data reduction and report the data from re-analysis.

10.5. **Data Reduction**

10.5.1. Check the chromatogram of positively identified peaks.

- ✓ Peaks fall within the established retention time window on both columns.
- ✓ Peaks are sharp and not saturated.
- ✓ Peaks are properly integrated (refer to Figure 1 for Peak Evaluation Techniques).

[1] CLP-OLM4.2 Table 1 D-79/PEST

✓ Target analyte peak is present in both columns to confirm positive identification.

10.5.2. Positive identification is confirmed when the identified analyte is present in both columns. The agreement between the quantitative results should be evaluated after the identification is made. Calculate the relative percent difference (RPD) between the two results according to Equation 10.6.10.2.

10.5.2.1. If the RPD is less than 40% and the peaks do not indicate any anomalies, report the higher result.

10.5.2.2. If the RPD is less than 40% and one of the peaks indicate an anomaly, report the result from the better peak.

10.5.2.3. If the RPD is greater than 40%, use professional judgment to select the most appropriate result. If no evidence of any chromatographic interference, report the higher result.

10.6. **Calculations**

10.6.1. Calculate for Calibration Factor (CF).

$$CF = \frac{R_a}{C_k} \qquad \textit{Eq. 10.6.1}$$

where:

CF - *is the calibration factor*

R_a - *is the analyte response measured in peak area*

C_k - *is the known concentration of the analyte in µg/L*

10.6.2. Calculate for Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}} \qquad \textit{Eq. 10.6.2}$$

where:

SD - *is the standard deviation*

x_i - *is the result at the* i^{th} *measurement*

$\bar{x}$ - *is the mean*

N - *is the number of measurements*

10.6.3. Calculate for Percent Relative Standard Deviation (%RSD).

$$\%RSD = \left[\frac{SD}{ACF}\right] 100 \qquad \textit{Eq.10.6.3}$$

where:

%RSD - *is the percent relative standard deviation*

SD - *is the standard deviation*

ACF - *is the average calibration factor*

10.6.4. Calculate for Average Calibration Factor (ACF)

$$ACF = \frac{\sum CF}{N} \qquad \textit{Eq. 10.6.4}$$

where:

ACF - *is the average calibration factor*

∑CF - *is the summation of the calibration factors*

N - *is the number of calibration points*

10.6.5. Calculate for Percent Difference for DCC from ACF

$$\%D = \left[\frac{ACF - CF}{ACF}\right] 100 \qquad \textit{Eq. 10.6.5}$$

where:

ACF - *is the average calibration factor*

CF - *is the calibration factor of the DCC*

10.6.6. Calculate for % Breakdown for DDT ($\%B_T$).

$$\%B_T = \frac{A_D + A_E}{A_T + A_D + A_E} \qquad \text{Eq-10.6.6}$$

where:

$\%B_T$ - *% DDT Breakdown*

A_D - *Total area of DDD*

A_E - *Total area of DDE*

A_T - *Total area of DDT*

10.6.7. Calculate for % Breakdown for Endrin ($\%B_E$).

$$\%B_E = \frac{A_A + A_K}{A_E + A_A + A_K} \qquad \text{Eq-10.6.7}$$

where:

$\%B_E$ - *% Endrin Breakdown*

A_A - *Total area of Endrin Aldehyde*

A_K - *Total area of Endrin Ketone*

A_E - *Total area of Endrin*

10.6.8. Sample Results

10.6.8.1. Water Samples

$$C = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a}\right)DF \qquad \text{Eq-10.6.8.1}$$

where:

C	-	*Concentration of sample measured in µg/L*
R_a	-	*Total response of analyte in peak area*
ACF	-	*Average response factor measure in ICAL*
V_e	-	*Volume of extract in ml*
S_a	-	*Sample amount in ml*
DF	-	*Dilution factor of sample extract*

10.6.8.2. Soil Samples

$$C = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a(\%Solid)}\right)DF \qquad \text{Eq.10.6.8.2}$$

where

C	-	*Concentration of analyte to be measured (µg/kg)*
R_a	-	*Total response of analyte in peak area*
ACF	-	*Average response factor*
V_e	-	*Volume of extract in ml*
S_a	-	*Sample Amount in g*
% Solid	-	$\frac{100 - \%\ moisture}{100}$
DF	-	*Dilution factor of the sample extract*

10.6.9. Multi-peak Compound in Sample (Toxaphene)

10.6.9.1. Total area is integrated and concentration is determined by equation 10.6.8.1 or 10.6.8.2.

10.6.10. Accuracy and Precision

10.6.10.1. Percent Recovery

$$\%R = \frac{C_f - C}{C_s} * 100 \qquad \text{Eq. 10.6.10.1}$$

where:

%R	-	*percent recovery*
C_f	-	*concentration found in spiked sample*
C	-	*concentration of unspiked sample (For LCS, C=0)*

C_s - *theoretical concentration of surrogate spike*

10.6.10.2. Relative Percent Difference (RPD)

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq. 10.6.10.2}$$

where:

%RPD - *Relative Percent Difference*

C_1 - *Measured concentration of the first sample aliquot*

C_2 - *Measured concentration of the second sample aliquot*

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C.exe.

10.7.2. Generate Lab Chronicle using LABCHRN1.exe.

10.7.3. Generate sample results using F1V3C.exe.

10.7.4. Generate the QC Summary file using QCV3C.exe.

10.7.5. Generate the case narrative using CN1.exe.

10.7.6. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analyses.

- Sample Results
- LCS Summary
- MS/MSD Summary
- DCC Summary
- ICAL Summary
- ICV Summary
- Copy of Analysis Log
- Copy of Preparation Log

10.8. **Data Review**

10.8.1. Perform a 100% data review in accordance to EMAX-DM01and the Project Specific Requirements (PSR).

- ✓ Check that all samples required for analysis are performed.
- ✓ Check that samples are extracted and analyzed within Holding Time.
- ✓ Check that all calibration requirements are fulfilled.
- ✓ Check the chromatogram of all positively identified peak(s).
- ✓ Check surrogate recoveries against required limits.

✓ Check that concentration of target analytes are within calibration range.

If any of the above checkpoints indicate a problem, re-analysis is required.

10.8.2. Review the case narrative and edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Refer to Form 8081FM for daily routine maintenance check points.

10.9.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back in control.

10.9.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

Maintenance Activity	Description	Frequency
Autosampler Check	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis
Verification	Check instrument parameters to ensure normal operating conditions. Check liner as necessary. Check instrument performance (e.g., daily calibration check, instrument blank, DDT/Endrin breakdown).	Daily prior to analysis
Documentation	Record maintenance in instrument service logs.	Daily prior to analysis
Leak Test	Perform inlet pressure decay test.	Every 6 months or as necessary
System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector where applicable.	Every 6 months or as necessary
Check Flow Path Components	Check and replace the following as necessary: tubing assembly, union, sample probe, and loop.	Once a year or as necessary
Complete Inspection	Perform general inspection of the complete system. Inspect autosampler cabling and configuration setting.	Once a year

11.0 QUALITY CONTROL

11.1. **Preparative Batch**

11.1.1. A preparative batch shall consist of a method blank, LCS, MS/MSD (when required by the project) and a maximum of 20 field samples of similar matrix.

11.1.2. In the absence of MS/MSD, prepare LCS/LCD to check for precision.

11.1.3. Surrogate standard shall be added to all samples, including method blank LCS/LCD and MS/MSD. Check PSR for QC Control Limits.

11.1.4. Perform QC check prior to utilizing the surrogate and LCS/MS spike standards by analyzing the prepared standard at the spiking level. Results should be within ± 20% of the expected value.

11.2. **Analytical Batch QC**

11.2.1. Instrument Performance Evaluation Check must be analyzed daily. Acceptance criteria and corrective action are discussed in Section 10.3.1.4 and Appendix 1.

11.2.2. A continuing calibration shall be performed before any other analysis is done. The continuing calibration procedure and the acceptance criteria are discussed in Section 10.3.5 and Appendix 1.

11.3. **Method QC**

11.3.1. Analyst demonstration of proficiency is a must prior to performing this analysis.

11.3.2. A valid LOD and LOQ must exist prior to sample analysis.

11.3.3. A valid ICAL must exist prior to sample analysis.

11.3.4. Instrument performance must be checked prior to sample analysis. Check Appendix 1 for acceptance criteria.

11.3.5. Prepare and analyze QC samples, to include, method blank, LCS (LCD), and MS/MSD. QC Control Limits shall follow the Project Specific Requirement (PSR) in each analytical folder.

12.0 CORRECTIVE ACTION

12.1. Corrective actions associated with this analytical procedure are described in the Summary of In-House Quality Control Procedures in Appendix 1. Document out-of-control event/s and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. If PEM failed to meet the DDT and Endrin breakdown acceptance criteria, consider the following suggestions to correct the problem:

12.2.1. Deactivate or replace the injection liner.

12.2.2. Check that the injector nut is leak-free.

12.2.3. If problem persists, inform the Supervisor.

12.3. If Initial calibration is non-compliant, consider the following suggestions to correct the problem:

12.3.1. If %RSD is out of acceptance criteria, review result and identify presence of an outlier.

12.3.2. If one of the standard returns a bias-low or bias-high on all of the analytes, then that point is considered an outlier, prepare a standard at that ICAL point and reanalyze.

12.3.3. If the highest ICAL point appears to be saturated, drop the highest point.

12.3.4. If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

Note: The lowest calibration point identifies the reporting limit (RL). Therefore, check that the RL is in conformance to the current projects where the ICAL will be used.

12.3.5. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

12.3.5.1. Check the connections and make sure they are air-tight and perform maintenance as needed.

12.3.5.2. Check the gas flow.

12.3.5.3. Prepare a fresh standard and repeat calibration.

12.3.6. If the problem persists, inform the supervisor.

12.4. If the ICV is non-compliant, consider the following suggestions to correct the problem:

12.4.1. Re-analyze ICV (to rule out poor injection).

12.4.2. If ICV is still out of acceptance criteria, prepare a fresh standard and re-analyze to rule out any preparation error

12.4.3. If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration.

12.4.4. If the problem persists, inform the supervisor.

12.5. If the instrument blank is non-compliant, consider the following suggestions to correct problem:

12.5.1. Rule out instrument contamination by performing the instrument daily maintenance, such as changing septum, cleaning liner, cleaning or using new auto sampler syringe.

12.5.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.5.3. Rule out preparation contamination by preparing a new instrument blank.

12.5.4. If the problem persists, inform the supervisor.

12.6. If Continuing Calibration is non-compliant, consider the following suggestions to correct the problem:

12.6.1. Change the liner.

12.6.2. Clean injection port.

12.6.3. Prepare new standard.

12.6.4. Cut or replace column.

12.6.5. Clean the detector.

12.6.6. Rule out leaks by checking all connections.

12.6.7. If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL.

12.7. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

12.7.1. Rule out instrument contamination by checking instrument blank.

12.7.2. Rule out reagent contamination by testing each reagent used for extraction as described in

EMAX-QC01.

12.7.3. Rule out glassware contamination used for extraction as described in EMAX-QC07.

12.7.4. Re-extract MB and the associated samples with reagents free of contamination or with newly opened reagents.

12.7.5. If the problem persists, inform the supervisor.

12.8. If LCS is non-compliant, perform the following suggestions to correct the problem:

12.8.1. If result is bias-high or bias-low, check the LCS Standard by analyzing at the spike level.

12.8.2. If LCS check is within 80-120% of expected value, check calibration of the micropipette or syringe used for spiking. Re-extract and re-analyze the LCS and the associated samples.

12.8.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS Standard, re-extract and re-analyze LCS and the associated samples.

12.9. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.9.1. If corrective action needs the function of other department; e.g., if the sample needs to be re-extracted, refer to EMAX-QA08 for details of completing an NCR.

12.9.2. If corrective action needs the assistance of the project manager; e.g. If the sample is non-compliant to the technical holding time requirement, insufficient amount of sample, or other non-conforming issues.

12.10. For other problems encountered, inform the supervisor immediately for further instructions.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.1.2. Batch – A group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.2.1. **Preparation batch** is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.2.2. **Analytical batch** is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.3. Calibration – A determinant measured from a standard to obtain the correct value of an instrument output.

15.1.4. Corrective Action - Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

15.1.5. Instrument Blank – A target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.6. Lab Control Sample (LCS) – A target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.7. Matrix – A component or form of a sample.

15.1.8. Matrix Spike (MS) – A sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.9. Matrix Spike Duplicate (MSD) – A replicate of MS analyzed to monitor precision or recovery.

15.1.10. Method Blank – A target-analyte-free sample subjected to the entire sample preparation and/or analytical process to monitor contamination.

15.1.11. Non-conformance - An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

15.1.12. Raw Data - Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

15.1.13. Sample – A specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.14. Sub-sample – An aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.15. Surrogate - A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing organochlorine pesticides analysis by GC, unless otherwise specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluating Solid Waste, Physical / Chemical Methods", EPA Publication SW-846 Methods 8000B and 8081B.

16.2. EMAX Quality Systems Manual, latest update.

17.0 APPENDICES

17.1. **Figures**

17.1.1.	Figure 1	Peak Evaluation Technique
17.1.2.	Figure 2	Typical Chromatogram
17.1.3.	Figure 3	Typical Initial Calibration Summary
17.1.4.	Figure 4	Typical Retention Time Window Summary
17.1.5.	Figure 5	Typical PEM PEST Breakdown Calculation Summary
17.1.6.	Figure 6	Typical Sample Result Summary
17.1.7.	Figure 7	Typical LCS Report Summary
17.1.8.	Figure 8	Typical MS/MSD Report Summary
17.1.9.	Figure 9	Typical Case Narrative

17.2. **Tables**

17.2.1.	Table 1	ICAL Concentration of Individual Analytes
17.2.2.	Table 2	ICAL Standard Preparation
17.2.3.	Table 3	Intermediate Primary Standard Preparation
17.2.4.	Table 4	Intermediate Secondary Standard Preparation
17.2.5.	Table 5	Check Standard Preparation
17.2.6.	Table 6	Surrogate Standard Preparation
17.2.7.	Table 7	Spike Standard Preparation

17.2.8. Table 8 Performance Evaluation Mixture Preparation

17.2.9. Table 9 CLP Retention Time Window for Pesticides

17.2.10. Table 10 Established Limit of Detection (LOD) & Limit of Quantitation (LOQ)

17.3. **Appendices**

17.3.1. Appendix 1 Summary of In-House Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.4. **Forms**

17.4.1. 8081FA Analytical Run Log

17.4.2. 8081FS Sample Preparation Log

17.4.3. 8081FM Instrument Maintenance Log

Figure 1. **PEAK EVALUATION TECHNIQUE**

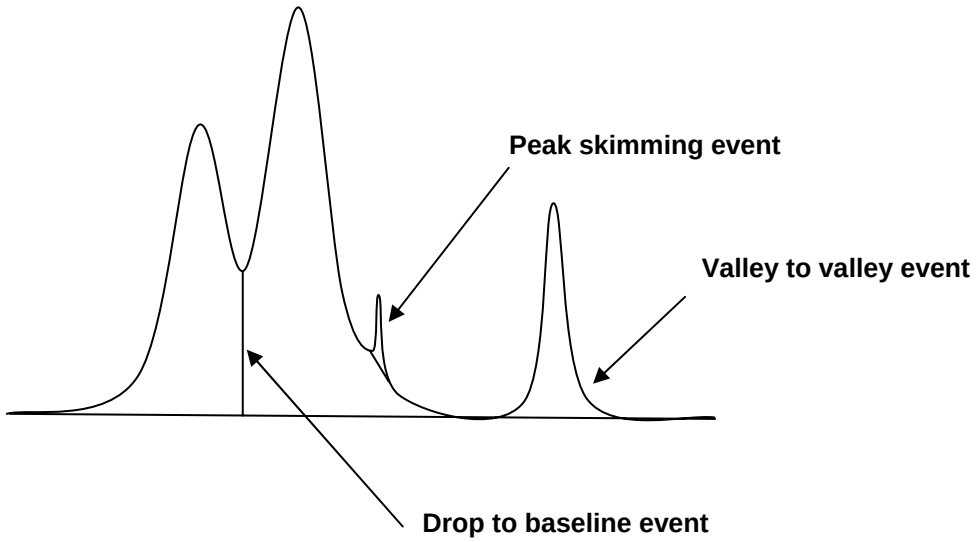
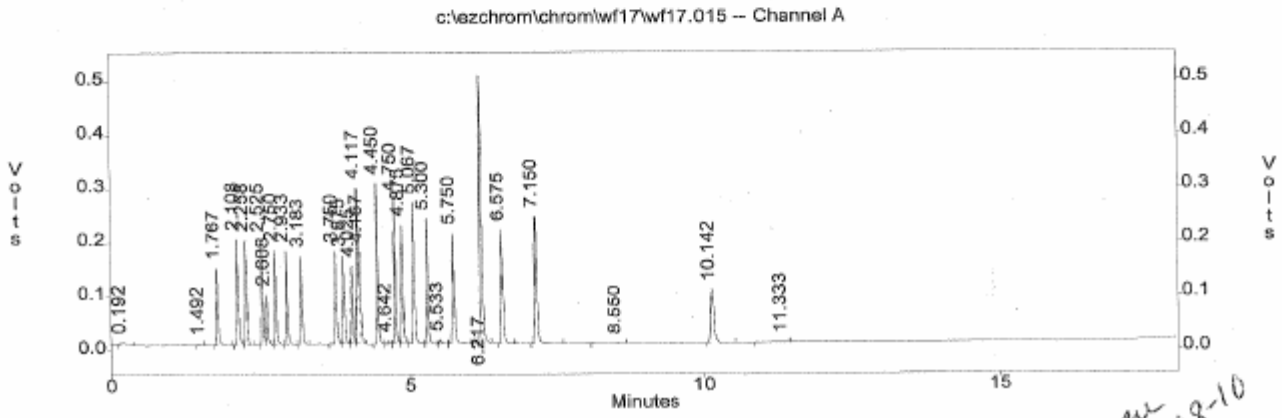


Figure 2. **TYPICAL CHROMATOGRAM**

EPA 8081 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\wf17\wf17.015
Method : c:\ezchrom\methods\cp16f17.met
Sample ID : CP16F1705
Acquired : Jun 17, 2010 20:37:18
Printed : Jun 18, 2010 13:15:17
User : Enrico
Channel A Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc. (ppb)
3	TCX	1.767	316042	10149.5	30.0
4	Hexachlorobenzene	2.108	406480	14033.4	30.0
5	alpha-BHC	2.258	356081	10162.1	30.0
6	gamma-BHC	2.525	333835	9936.0	30.0
7	beta-BHC	2.608	181112	5986.1	30.0
8	delta-BHC	2.750	306513	8901.2	30.0
9	Heptachlor	2.933	293328	9639.1	30.0
10	Aldrin	3.183	282876	8810.2	30.0
11	Heptachlor Epoxide	3.750	304436	10213.6	30.0
12	gamma-Chlordane	3.875	311461	10394.9	30.0
13	alpha-Chlordane	4.025	276649	9158.2	30.0
14	DDE	4.117	550449	8142.2	60.0
15	Endosulfan I	4.167	326942	10965.6	30.0
16	Dieldrin	4.450	577715	9219.0	60.0
18	Endrin	4.750	520296	8357.5	60.0
19	DDD	4.875	427374	6372.5	60.0
20	Endosulfan II	5.067	573361	9477.7	60.0
21	DDT	5.300	514874	7946.9	60.0
23	Endrin Aldehyde	5.750	506475	8526.0	60.0
24	Methoxychlor	6.217	1280315	4520.4	300.0
25	Endosulfan Sulfate	6.575	553093	9053.5	60.0
26	Endrin Ketone	7.150	667060	10554.7	60.0
28	DCB	10.142	370883	13167.0	30.0



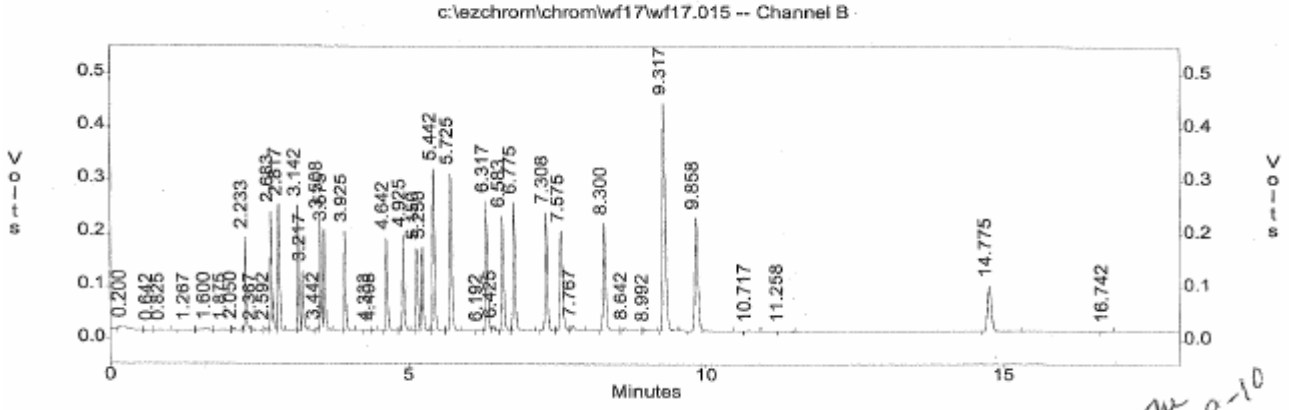
6-28-10

Figure 2. **TYPICAL CHROMATOGRAM**

EPA 8081 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\wf17\wf17.015
Method : c:\ezchrom\methods\cp16f17.met
Sample ID : CP16F1705
Acquired : Jun 17, 2010 20:37:18
Printed : Jun 18, 2010 13:15:18
User : Enrico
Channel B Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
8	TCX	2.233	342477	11675.1	30.0
11	Hexachlorobenzene	2.683	428866	15458.7	30.0
12	alpha-BHC	2.817	411378	12715.4	30.0
13	gamma-BHC	3.142	385043	12271.7	30.0
14	beta-BHC	3.217	198895	6945.2	30.0
16	delta-BHC	3.508	356330	10941.3	30.0
17	Heptachlor	3.575	337642	11361.9	30.0
18	Aldrin	3.925	344050	11109.0	30.0
21	Heptachlor Epoxide	4.642	368353	12612.0	30.0
22	gamma-Chlordane	4.925	382524	13141.1	30.0
23	alpha-Chlordane	5.150	348076	11864.3	30.0
24	Endosulfan I	5.250	353922	11948.6	30.0
25	DDE	5.442	672880	10653.3	60.0
26	Dieldrin	5.725	681418	11113.9	60.0
28	Endrin	6.317	589669	9716.0	60.0
30	DDD	6.583	523165	8133.0	60.0
31	Endosulfan II	6.775	652188	11103.2	60.0
32	DDT	7.308	605130	9754.6	60.0
33	Endrin Aldehyde	7.575	561061	9678.5	60.0
35	Endosulfan Sulfate	8.300	616636	10489.1	60.0
38	Methoxychlor	9.317	1420894	5043.7	300.0
39	Endrin Ketone	9.858	737942	12171.3	60.0
42	DCB	14.775	387410	13540.6	30.0



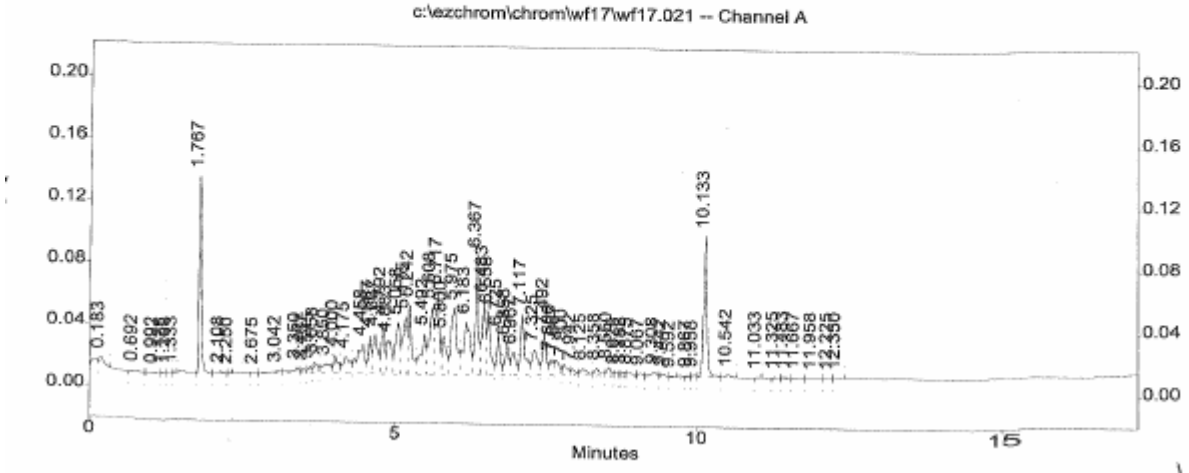
6-28-10

Figure 2. **TYPICAL CHROMATOGRAM**

EPA Toxaphene by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\WF17\WF17.021
Method : c:\ezchrom\methods\to16f17.met
Sample ID : TO16F1703
Acquired : Jun 17, 2010 22:55:09
Printed : Jun 18, 2010 13:54:34
User : Enrico
Channel A Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
7	TCX	1.767	286173	11111.0	25.0
58	DCB	10.133	348818	13899.7	25.0
G1	TOXAPHENE		4416101	9045.5	500.0



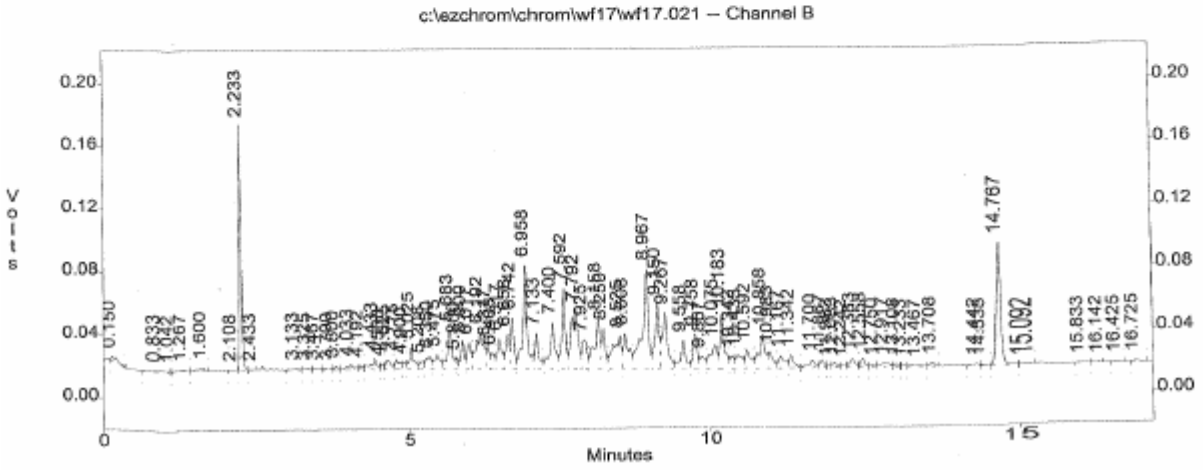
m 6-28-10

Figure 2. **TYPICAL CHROMATOGRAM**

EPA Toxaphene GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\WF17\WF17.021
Method : c:\ezchrom\methods\to16f17.met
Sample ID : TO16F1703
Acquired : Jun 17, 2010 22:55:09
Printed : Jun 18, 2010 13:54:35
User : Enrico
Channel B Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
7	TCX	2.233	311967	12305.5	25.0
75	DCB	14.767	345238	13786.1	25.0
G1	TOXAPHENE		5369542	11217.1	500.0



RW 6-28-10

Figure 2. **TYPICAL CHROMATOGRAM**

EPA Chlordane by GC/ECD
EMAX Analytical Laboratories, Inc.

```
File          : c:\ezchrom\chrom\wc26\wc26.028
Method        : c:\ezchrom\methods\cr16c26.met
Sample ID     : CR16C2603 500 PPB
Acquired      : Mar 27, 2010 02:00:57
Printed       : Mar 29, 2010 15:35:35
User          : Enrico
```

Channel A Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
10	TCX	1.925	253723	10109.8	25.0
66	DCB	10.983	323479	12934.2	25.0
G1	CHLORDANE		4394530	8908.9	500.0

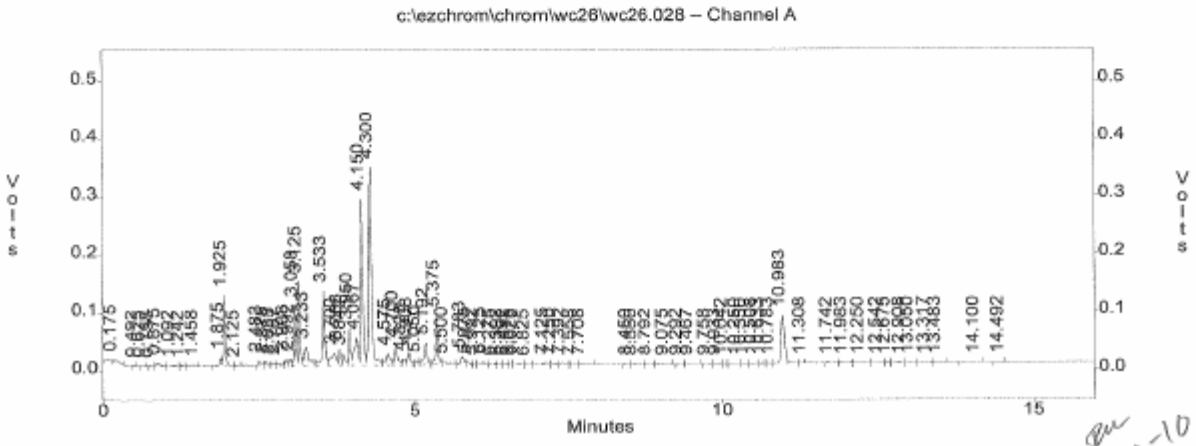


Figure 2. **TYPICAL CHROMATOGRAM**

EPA Chlordane by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\wc26\wc26.028
Method : c:\ezchrom\methods\cr16c26.met
Sample ID : CR16C2603 500 PPB
Acquired : Mar 27, 2010 02:00:57
Printed : Mar 29, 2010 15:35:35
User : Enrico

Channel B Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
11	TCX	2.308	269060	10641.9	25.0
74	DCB	15.217	292100	11687.1	25.0
G1	CHLORDANE		4353253	8729.7	500.0

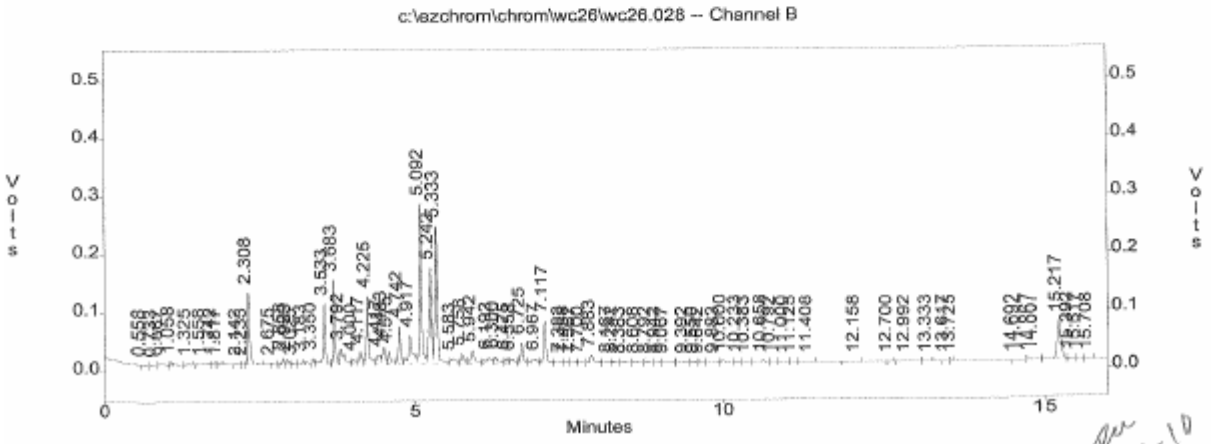


Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPEST
Column size ID : .32MMX30M
LFID & Datetime: WF17011A 06/17/10 19:05
LFID & Datetime: WF17012A 06/17/10 19:28
LFID & Datetime: WF17013A 06/17/10 19:51
LFID & Datetime: WF17014A 06/17/10 20:14
LFID & Datetime: WF17015A 06/17/10 20:37
LFID & Datetime: WF17016A 06/17/10 21:00
LFID & Datetime: WF17017A 06/17/10 21:23
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS (AREA)/UNIT 1.00X	2.00X	4.00X	6.00X	12.00X	16.00X	24.00X	MEAN	%RSD
alpha-BHC	2.50	7012	7922	9661	10827	11869	12073	11771	10162.1	20.0
Hexachlorobenzene	2.50	15106	14969	14761	14561	13549	13114	12173	14033.4	7.9
gamma-BHC	2.50	7514	8339	9695	10671	11128	11295	10909	9936.0	14.9
beta-BHC	2.50	5953	6032	6130	6121	6037	5994	5636	5986.1	2.8
delta-BHC	2.50	6424	7096	8467	9373	10217	10491	10240	8901.2	18.3
Heptachlor	2.50	9528	9474	9711	9924	9778	9754	9304	9639.1	2.2
Aldrin	2.50	7844	7890	8585	9094	9429	9587	9243	8810.2	8.1
Heptachlor Epoxide	2.50	10603	10366	10376	10470	10148	10047	9486	10213.6	3.6
gamma-Chlordane	2.50	10671	10454	10501	10625	10382	10328	9803	10394.9	2.8
alpha-Chlordane	2.50	9232	9128	9285	9423	9222	9163	8655	9158.2	2.6
DDE	5.00	6501	6967	8070	8613	9174	9304	8366	8142.2	13.0
Endosulfan I	2.50	10579	10788	10866	11344	10898	10843	11441	10965.6	2.8
Dieldrin	5.00	8471	8721	9336	9674	9629	9593	9109	9219.0	5.1
Endrin	5.00	7897	7888	8395	8629	8672	8704	8319	8357.5	4.2
DDD	5.00	4987	5221	6117	6695	7123	7338	7126	6372.5	15.0
Endosulfan II	5.00	9442	9455	9698	9833	9556	9441	8919	9477.7	3.0
DDT	5.00	6729	7114	7856	8313	8581	8666	8369	7946.9	9.5
Endrin Aldehyde	5.00	8850	8674	8700	8765	8441	8365	7887	8526.0	3.9
Methoxychlor	25.00	4945	4855	4775	4686	4268	4183	3933	4520.4	8.6
Endosulfan Sulfate	5.00	8929	8874	9130	9290	9218	9190	8743	9053.5	2.3
Endrin Ketone	5.00	9522	9945	10686	11069	11118	11061	10481	10554.7	5.9
SURROGATE	X	1.00X	2.00X	4.00X	6.00X	12.00X	16.00X	24.00X	MEAN	%RSD
TCX	2.50	9451	9676	10235	10530	10535	10554	10066	10149.5	4.4
DCB	2.50	15146	14425	13789	13420	12363	12005	11021	13167.0	11.0

Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPESTII
Column size ID : .32MMX30M
LFID & Datetime: WF17011B 06/17/10 19:05
LFID & Datetime: WF17012B 06/17/10 19:28
LFID & Datetime: WF17013B 06/17/10 19:51
LFID & Datetime: WF17014B 06/17/10 20:14
LFID & Datetime: WF17015B 06/17/10 20:37
LFID & Datetime: WF17016B 06/17/10 21:00
LFID & Datetime: WF17017B 06/17/10 21:23
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS (AREA)/UNIT 1.00X	2.00X	4.00X	6.00X	12.00X	16.00X	24.00X	MEAN	%RSD
alpha-BHC	2.50	10662	11421	12809	13349	13713	13812	13243	12715.4	9.5
Hexachlorobenzene	2.50	18115	17160	16309	15707	14296	13862	12762	15458.7	12.4
gamma-BHC	2.50	11068	11639	12453	12880	12835	12833	12193	12271.7	5.7
beta-BHC	2.50	7721	7370	7191	7079	6630	6498	6129	6945.2	7.9
delta-BHC	2.50	9113	9790	10846	11463	11878	12019	11480	10941.3	10.1
Heptachlor	2.50	11756	11612	11474	11705	11255	11154	10578	11361.9	3.6
Aldrin	2.50	10648	10625	11047	11394	11468	11518	11062	11109.0	3.3
Heptachlor Epoxide	2.50	13691	13110	12836	12784	12278	12125	11459	12612.0	5.8
gamma-Chlordane	2.50	14147	13846	13377	13211	12751	12637	12019	13141.1	5.6
alpha-Chlordane	2.50	12786	12263	12100	12049	11603	11469	10781	11864.3	5.4
DDE	5.00	9539	9928	10718	11167	11215	11232	10775	10653.3	6.3
Endosulfan I	2.50	12627	12267	12113	12189	11797	11651	10995	11948.6	4.4
Dieldrin	5.00	10804	10825	11226	11491	11357	11313	10782	11113.9	2.7
Endrin	5.00	9714	9612	9856	9930	9828	9757	9316	9716.0	2.1
DDD	5.00	7058	7333	8017	8464	8719	8817	8523	8133.0	8.5
Endosulfan II	5.00	11826	11475	11372	11330	10870	10719	10131	11103.2	5.1
DDT	5.00	9205	9308	9728	10028	10086	10138	9791	9754.6	3.8
Endrin Aldehyde	5.00	10625	10107	9882	9847	9351	9232	8706	9678.5	6.5
Methoxychlor	25.00	5720	5513	5257	5105	4736	4632	4342	5043.7	9.9
Endosulfan Sulfate	5.00	11191	10786	10670	10619	10277	10196	9685	10489.1	4.6
Endrin Ketone	5.00	12025	12077	12424	12581	12299	12220	11574	12171.3	2.7
SURROGATE	X	1.00X	2.00X	4.00X	6.00X	12.00X	16.00X	24.00X	MEAN	%RSD
TCX	2.50	12336	12106	12087	11991	11416	11224	10566	11675.1	5.4
DCB	2.50	15878	14980	14155	13638	12914	12063	11158	13540.6	12.1

Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8081

Lab Name : EMAX Inc
Instrument ID : GCTO16 HP-5890
GC Column : RTX-CLPEST
Column size ID : .32MMX30M
LFID & Datetime: WF17019A 06/17/10 22:09
LFID & Datetime: WF17020A 06/17/10 22:32
LFID & Datetime: WF17021A 06/17/10 22:55
LFID & Datetime: WF17022A 06/17/10 23:18
LFID & Datetime: WF17023A 06/17/10 23:41
LFID & Datetime: WF17024A 06/18/10 00:04
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
Toxaphene	100.00	9195.27	8610.96	8832.20	8970.05	9258.53	9406.23	9045.540	3.3

Lab Name : EMAX Inc
Instrument ID : GCTO16 HP-5890
GC Column : RTX-CLPESTII
Column size ID : .32MMX30M
LFID & Datetime: WF17019B 06/17/10 22:09
LFID & Datetime: WF17020B 06/17/10 22:32
LFID & Datetime: WF17021B 06/17/10 22:55
LFID & Datetime: WF17022B 06/17/10 23:18
LFID & Datetime: WF17023B 06/17/10 23:41
LFID & Datetime: WF17024B 06/18/10 00:04
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
Toxaphene	100.00	13632	11541	10739	10462	10519	10410	11217.1	11.2

Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8081

Lab Name : EMAX Inc
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPEST
Column size ID : .32MMX30M
LFID & Datetime: WC26026A 03/27/10 01:16
LFID & Datetime: WC26027A 03/27/10 01:38
LFID & Datetime: WC26028A 03/27/10 02:00
LFID & Datetime: WC26029A 03/27/10 02:23
LFID & Datetime: WC26030A 03/27/10 02:45
LFID & Datetime: WC26031A 03/27/10 03:08
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
CHLORDANE	100.00	9864.09	9192.39	8789.06	8657.43	8632.94	8317.59	8908.917	6.1

Lab Name : EMAX Inc
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPESTII
Column size ID : .32MMX30M
LFID & Datetime: WC26026B 03/27/10 01:16
LFID & Datetime: WC26027B 03/27/10 01:38
LFID & Datetime: WC26028B 03/27/10 02:00
LFID & Datetime: WC26029B 03/27/10 02:23
LFID & Datetime: WC26030B 03/27/10 02:45
LFID & Datetime: WC26031B 03/27/10 03:08
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
CHLORDANE	100.00	8974.77	8985.03	8706.51	8739.83	8630.71	8341.48	8729.722	2.7

Figure 4. **TYPICAL ICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPEST
Column size ID : .32MMX30M
LFID & Datetime: WF17011A 06/17/10 19:05
LFID & Datetime: WF17012A 06/17/10 19:28
LFID & Datetime: WF17013A 06/17/10 19:51
LFID & Datetime: WF17014A 06/17/10 20:14
LFID & Datetime: WF17015A 06/17/10 20:37
LFID & Datetime: WF17016A 06/17/10 21:00
LFID & Datetime: WF17017A 06/17/10 21:23

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.0X	4.0X	6.0X	12.0X	16.0X	24.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
alpha-BHC	2.258	2.258	2.258	2.258	2.258	2.250	2.250	2.256	2.230	2.282	0.026
Hexachlorobenzene	2.108	2.108	2.108	2.108	2.108	2.108	2.100	2.107	2.081	2.133	0.026
gamma-BHC	2.525	2.533	2.533	2.533	2.525	2.525	2.525	2.528	2.490	2.566	0.038
beta-BHC	2.608	2.608	2.608	2.608	2.608	2.608	2.600	2.607	2.583	2.631	0.024
delta-BHC	2.750	2.758	2.758	2.758	2.750	2.750	2.750	2.753	2.715	2.791	0.038
Heptachlor	2.933	2.942	2.933	2.933	2.933	2.933	2.933	2.934	2.896	2.972	0.038
Aldrin	3.192	3.192	3.192	3.192	3.183	3.183	3.183	3.188	3.150	3.226	0.038
Heptachlor Epoxide	3.750	3.758	3.750	3.750	3.750	3.750	3.750	3.751	3.713	3.789	0.038
gamma-Chlordane	3.883	3.883	3.883	3.883	3.875	3.875	3.875	3.880	3.827	3.933	0.053
alpha-Chlordane	4.025	4.025	4.025	4.025	4.025	4.017	4.017	4.023	3.971	4.075	0.052
DDE	4.125	4.125	4.125	4.125	4.117	4.117	4.117	4.122	4.070	4.174	0.052
Endosulfan I	4.167	4.167	4.167	4.167	4.167	4.167	4.158	4.166	4.091	4.241	0.075
Dieldrin	4.458	4.458	4.450	4.458	4.450	4.450	4.450	4.453	4.377	4.529	0.076
Endrin	4.750	4.750	4.750	4.750	4.750	4.750	4.742	4.749	4.662	4.836	0.087
DDD	4.875	4.883	4.875	4.883	4.875	4.875	4.875	4.877	4.802	4.952	0.075
Endosulfan II	5.075	5.075	5.067	5.075	5.067	5.067	5.067	5.070	4.979	5.161	0.091
DDT	5.308	5.308	5.308	5.308	5.300	5.300	5.300	5.305	5.216	5.394	0.089
Endrin Aldehyde	5.758	5.758	5.750	5.758	5.750	5.750	5.750	5.753	5.653	5.853	0.100
Methoxychlor	6.225	6.225	6.217	6.225	6.217	6.217	6.217	6.220	6.121	6.319	0.099
Endosulfan Sulfate	6.583	6.583	6.583	6.583	6.575	6.575	6.575	6.580	6.455	6.705	0.125
Endrin Ketone	7.158	7.158	7.158	7.158	7.150	7.150	7.150	7.155	7.017	7.293	0.138
SURROGATE	**1.0X**	**2.0X**	**4.0X**	**6.0X**	**12.0X**	**16.0X**	**24.0X**	**RT**	**FROM**	**TO**	**WIDTH**
TCX	1.775	1.775	1.775	1.775	1.767	1.767	1.767	1.772	1.734	1.810	0.038
DCB	10.150	10.150	10.150	10.150	10.142	10.142	10.142	10.147	10.084	10.210	0.063

FORM VI PC -1 1/96 Rev 2/2006

6-28-16

Figure 4. **TYPICAL ICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : GCTO16 HP-5890
GC Column : RTX-CLPESTII
Column size ID : .32MMX30M
LFID & Datetime: WF17011B 06/17/10 19:05
LFID & Datetime: WF17012B 06/17/10 19:28
LFID & Datetime: WF17013B 06/17/10 19:51
LFID & Datetime: WF17014B 06/17/10 20:14
LFID & Datetime: WF17015B 06/17/10 20:37
LFID & Datetime: WF17016B 06/17/10 21:00
LFID & Datetime: WF17017B 06/17/10 21:23

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.0X	4.0X	6.0X	12.0X	16.0X	24.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
alpha-BHC	2.808	2.817	2.817	2.817	2.817	2.808	2.808	2.813	2.775	2.851	0.038
Hexachlorobenzene	2.683	2.692	2.683	2.692	2.683	2.683	2.683	2.686	2.648	2.724	0.038
gamma-BHC	3.142	3.142	3.142	3.142	3.142	3.142	3.133	3.141	3.103	3.179	0.038
beta-BHC	3.217	3.217	3.217	3.217	3.217	3.217	3.217	3.217	3.179	3.255	0.038
delta-BHC	3.508	3.508	3.508	3.508	3.508	3.508	3.500	3.507	3.469	3.545	0.038
Heptachlor	3.575	3.575	3.575	3.575	3.575	3.575	3.575	3.575	3.524	3.626	0.051
Aldrin	3.925	3.933	3.933	3.933	3.925	3.925	3.925	3.928	3.876	3.980	0.052
Heptachlor Epoxide	4.642	4.650	4.642	4.650	4.642	4.642	4.642	4.644	4.581	4.707	0.063
gamma-Chlordane	4.925	4.925	4.925	4.925	4.925	4.925	4.917	4.924	4.847	5.001	0.077
alpha-Chlordane	5.150	5.158	5.150	5.158	5.150	5.150	5.150	5.152	5.065	5.239	0.087
DDE	5.442	5.442	5.442	5.442	5.442	5.442	5.433	5.441	5.351	5.531	0.090
Endosulfan I	5.250	5.250	5.250	5.250	5.250	5.250	5.242	5.249	5.160	5.338	0.089
Dieldrin	5.725	5.733	5.725	5.733	5.725	5.725	5.725	5.727	5.614	5.840	0.113
Endrin	6.317	6.317	6.317	6.317	6.317	6.317	6.308	6.316	6.191	6.441	0.125
DDD	6.583	6.583	6.583	6.583	6.583	6.583	6.575	6.582	6.456	6.708	0.126
Endosulfan II	6.775	6.775	6.775	6.775	6.775	6.775	6.767	6.774	6.661	6.887	0.113
DDT	7.308	7.317	7.308	7.317	7.308	7.308	7.308	7.311	7.173	7.449	0.138
Endrin Aldehyde	7.575	7.575	7.575	7.575	7.575	7.575	7.567	7.574	7.436	7.712	0.138
Methoxychlor	9.325	9.325	9.317	9.317	9.317	9.317	9.317	9.319	9.232	9.406	0.087
Endosulfan Sulfate	8.300	8.300	8.300	8.300	8.300	8.300	8.292	8.299	8.161	8.437	0.138
Endrin Ketone	9.858	9.858	9.858	9.858	9.858	9.858	9.850	9.857	9.772	9.942	0.085

SURROGATE	1.0X	2.0X	4.0X	6.0X	12.0X	16.0X	24.0X	RT	FROM	TO	WIDTH
TCX	2.233	2.233	2.233	2.233	2.233	2.233	2.225	2.232	2.190	2.274	0.042
DCB	14.783	14.783	14.775	14.775	14.775	14.775	14.775	14.777	14.714	14.840	0.063

FORM VI PC -1 1/96 Rev 2/2006

6-28-10

Figure 5. **TYPICAL PEM PEST BREAKDOWN CALCULATION SUMMARY**

PEM PEST BREAKDOWN CALCULATION
METHOD 8081

Lab Name : EMAX
Instrument ID : GCTO16 HP-5890
GC Column : RTX-CLPEST RTX-CLPESTII
Column size ID : .32MMX30M .32MMX30M
PEM LFID & Datetime : WF17026A WF17026B 06/18/10 00:50

Base on AREA

	AREA				% Breakdown				
LFID	DDD	DDE	DDT	TOTAL	DDD	DDE	TOTAL	QL	QCLIMIT
WF17026A	0.0	11917.0	826713.0	838630.0	0.00	1.42	1.42		15
WF17026B	21368.0	17092.0	933363.0	971823.0	2.20	1.76	3.96		15
LFID	ENDRIN	ENDRIN ALDEHYDE	ENDRIN KETONE	TOTAL	ENDRIN ALDEHYDE	ENDRIN KETONE	TOTAL	QL	QCLIMIT
WF17026A	893765.0	48233.0	35430.0	977428.0	4.93	3.62	8.56		15
WF17026B	945951.0	60214.0	48710.0	1054875.0	5.71	4.62	10.33		15

Figure 6. **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 3550B/8081B
PESTICIDES

Client	: XYZ, INC.	Date Collected:	06/08/10
Project	: CLEAN LAND	Date Received:	06/10/10
Batch No.	: 10F137	Date Extracted:	06/16/10 15:30
Sample ID:	2B-10-46-10-10.5	Date Analyzed:	06/18/10 11:10
Lab Samp ID:	F137-19	Dilution Factor:	1
Lab File ID:	WF17053A	Matrix :	SOIL
Ext Btch ID:	CPF030S	% Moisture :	20.9
Calib. Ref.:	WF17051A	Instrument ID :	GCT016

PARAMETERS	RESULTS (mg/kg)	LOQ (mg/kg)	(mg/kg)
ALPHA-BHC	(ND)|ND	0.0025	0.00051|0.00051
GAMMA-BHC (LINDANE)	(ND)|ND	0.0025	0.00051|0.00051
BETA-BHC	0.00089J|(ND)	0.0025	0.00051|0.00051
HEPTACHLOR	(ND)|ND	0.0025	0.00051|0.00051
DELTA-BHC	(ND)|ND	0.0025	0.00051|0.00051
ALDRIN	(ND)|ND	0.0025	0.00051|0.00051
HEPTACHLOR EPOXIDE	(ND)|ND	0.0025	0.00051|0.00051
GAMMA-CHLORDANE	(ND)|ND	0.0025	0.00051|0.00051
ALPHA-CHLORDANE	(ND)|ND	0.0025	0.00051|0.00051
ENDOSULFAN I	(ND)|ND	0.0025	0.00051|0.00051
4,4'-DDE	(ND)|ND	0.0025	0.00051|0.00051
DIELDRIN	(ND)|ND	0.0025	0.00051|0.00051
ENDRIN	(ND)|ND	0.0025	0.00051|0.00051
4,4'-DDD	(ND)|ND	0.0025	0.00051|0.00051
ENDOSULFAN II	(ND)|ND	0.0025	0.00051|0.00051
4,4'-DDT	(ND)|ND	0.0025	0.00051|0.00051
ENDRIN ALDEHYDE	(ND)|ND	0.0025	0.00051|0.00051
ENDOSULFAN SULFATE	(ND)|ND	0.0025	0.00051|0.00051
ENDRIN KETONE	(ND)|ND	0.0025	0.00051|0.00051
METHOXYCHLOR	(ND)|ND	0.025	0.0025|0.0025
TOXAPHENE	(ND)|ND	0.063	0.013|0.013

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(100)|90	70-125
DECACHLOROBIPHENYL	(91)|91	55-130

LOW : Limit of Quantitation
Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )

Figure 7. **TYPICAL LCS REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
LCS ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND
BATCH NO.: 10F137
METHOD: METHOD 3550B/8081B

MATRIX:	SOIL		% MOISTURE:	NA
DILUTION FACTOR:	1	1		
SAMPLE ID:	MBLK1S			
LAB SAMP ID:	CPF030SB	CPF030SL		
LAB FILE ID:	WF17029A	WF17030A		
DATE EXTRACTED:	06/16/1015:30	06/16/1015:30	DATE COLLECTED:	NA
DATE ANALYZED:	06/18/1001:59	06/18/1002:22	DATE RECEIVED:	06/16/10
PREP. BATCH:	CPF030S	CPF030S		
CALIB. REF:	WF17027A	WF17027A		

ACCESSION:

PARAMETER	BLNK RSLT (mg/kg)	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	QC LIMIT (%)
alpha-BHC	(ND)|ND	0.0133	(0.0135)|0.0123	(102)|92	60-125
gamma-BHC (Lindane)	(ND)|ND	0.0133	(0.0131)|0.0121	(98)|91	60-125
beta-BHC	(ND)|ND	0.0133	(0.0125)|0.0115	(94)|86	60-125
Heptachlor	(ND)|ND	0.0133	(0.0131)|0.0122	(98)|92	50-140
delta-BHC	(ND)|ND	0.0133	(0.0158)|0.0144	(119)|108	55-130
Aldrin	(ND)|ND	0.0133	(0.0127)|0.0121	(95)|91	45-140
Heptachlor Epoxide	(ND)|ND	0.0133	(0.0130)|0.0123	(98)|92	65-130
gamma-Chlordane	(ND)|ND	0.0133	(0.0134)|0.0124	(101)|93	65-125
alpha-Chlordane	(ND)|ND	0.0133	(0.0148)|0.0134	(111)|101	65-120
Endosulfan I	(ND)|ND	0.0133	(0.0136)|0.0127	(102)|95	15-135
4,4'-DDE	(ND)|ND	0.0133	(0.0143)|0.0141	(108)|106	70-125
Dieldrin	(ND)|ND	0.0133	(0.0154)|0.0148	(116)|111	65-125
Endrin	(ND)|ND	0.0133	(0.0160)|0.0151	(120)|114	60-135
4,4'-DDD	(ND)|ND	0.0133	(0.0160)|0.0159	(120)|120	30-135
Endosulfan II	(ND)|ND	0.0133	(0.0144)|0.0137	(108)|103	35-140
4,4'-DDT	(ND)|ND	0.0133	(0.0176)|0.0147	(132)|111	45-140
Endrin aldehyde	(ND)|ND	0.0133	(0.0145)|0.0133	(109)|100	35-145
Endosulfan Sulfate	(ND)|ND	0.0133	(0.0163)|0.0156	(123)|117	60-135
Endrin Ketone	(ND)|ND	0.0133	(0.0169)|0.0159	(127)|120	65-135
Methoxychlor	(ND)|ND	0.133	(0.138)|0.137	(104)|103	55-145

SURROGATE PARAMETER	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	QC LIMIT (%)
Tetrachloro-m-xylene	0.0133	(0.0104)|0.00909	(78)|68*	70-125
Decachlorobiphenyl	0.0133	(0.0128)|0.0120	(96)|90	55-130

Figure 8. **TYPICAL MS/MSD REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND
BATCH NO.: 10F137
METHOD: METHOD 3550B/8081B

MATRIX: SOIL % MOISTURE: 20.9

DILUTION FACTOR:	1	1	1		
SAMPLE ID:	2B-10-46-10-10.5				
LAB SAMP ID:	F137-19	F137-19M	F137-19S		
LAB FILE ID:	WF17053A	WF17054A	WF17055A		
DATE EXTRACTED:	06/16/1015:30	06/16/1015:30	06/16/1015:30	DATE COLLECTED:	06/08/10
DATE ANALYZED:	06/18/1011:10	06/18/1011:33	06/18/1011:56	DATE RECEIVED:	06/10/10
PREP. BATCH:	CPF030S	CPF030S	CPF030S		
CALIB. REF:	WF17051A	WF17051A	WF17051A		

ACCESSION:

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
alpha-BHC	(ND)|ND	0.0168	0.0229|(0.0203)	136*|(121)	0.0168	0.0228|(0.0202)	136*|(120)	0|(0)	60-125	30
gamma-BHC (Lindane)	(ND)|ND	0.0168	0.0212|(0.0188)	126*|(112)	0.0168	0.0212|(0.0189)	126*|(112)	0|(1)	60-125	30
beta-BHC	0.00089J|(ND)	0.0168	(0.0198)|0.0147	(112)|87	0.0168	(0.0197)|0.0158	(112)|94	(1)|7	60-125	30
Heptachlor	(ND)|ND	0.0168	0.0192|(0.0201)	114|(120)	0.0168	0.0198|(0.0201)	118|(120)	3|(0)	50-140	30
delta-BHC	(ND)|ND	0.0168	0.0238|(0.0211)	142*|(125)	0.0168	0.0237|(0.0209)	141*|(124)	0|(1)	55-130	30
Aldrin	(ND)|ND	0.0168	(0.0206)|0.0190	(123)|113	0.0168	(0.0206)|0.0191	(123)|114	(0)|1	45-140	30
Heptachlor Epoxide	(ND)|ND	0.0168	0.0175|(0.0177)	104|(105)	0.0168	(0.0176)|0.0175	(105)|104	(1)|1	65-130	30
gamma-Chlordane	(ND)|ND	0.0168	(0.0186)|0.0179	(111)|106	0.0168	(0.0185)|0.0180	(110)|107	(1)|1	65-125	30
alpha-Chlordane	(ND)|ND	0.0168	0.0205|(0.0192)	122*|(114)	0.0168	0.0205|(0.0192)	122*|(114)	0|(0)	65-120	30
Endosulfan I	(ND)|ND	0.0168	0.0174|(0.0175)	103|(104)	0.0168	(0.0176)|0.0175	(105)|104	(1)|0	15-135	30
4,4'-DDE	(ND)|ND	0.0168	0.0211|(0.0197)	125*|(117)	0.0168	(0.0207)|0.0197	(123)|117	(2)|0	70-125	30
Dieldrin	(ND)|ND	0.0168	(0.0207)|0.0201	(123)|120	0.0168	(0.0205)|0.0199	(122)|118	(1)|1	65-125	30
Endrin	(ND)|ND	0.0168	(0.0203)|0.0194	(121)|115	0.0168	(0.0200)|0.0192	(119)|114	(1)|1	60-135	30
4,4'-DDD	(ND)|ND	0.0168	(0.0219)|0.0215	(130)|128	0.0168	(0.0218)|0.0213	(130)|127	(0)|1	30-135	30
Endosulfan II	(ND)|ND	0.0168	(0.0185)|0.0180	(110)|107	0.0168	(0.0184)|0.0179	(109)|106	(1)|1	35-140	30
4,4'-DDT	(ND)|ND	0.0168	0.0237|(0.0196)	141*|(117)	0.0168	(0.0234)|0.0195	(139)|116	(1)|1	45-140	30
Endrin aldehyde	(ND)|ND	0.0168	(0.0198)|0.0194	(118)|115	0.0168	(0.0198)|0.0194	(118)|115	(0)|0	35-145	30
Endosulfan Sulfate	(ND)|ND	0.0168	(0.0210)|0.0203	(125)|121	0.0168	(0.0209)|0.0203	(124)|121	(0)|0	60-135	30
Endrin Ketone	(ND)|ND	0.0168	(0.0213)|0.0211	(127)|125	0.0168	(0.0212)|0.0210	(126)|125	(0)|0	65-135	30
Methoxychlor	(ND)|ND	0.168	(0.176)|0.176	(105)|105	0.168	0.175|(0.176)	104|(105)	1|(0)	55-145	30

SURROGATE PARAMETER	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	QC LIMIT (%)
Tetrachloro-m-xylene	0.0168	(0.0184)|0.0152	(109)|91	0.0168	(0.0177)|0.0148	(105)|88	70-125
Decachlorobiphenyl	0.0168	(0.0163)|0.0152	(97)|91	0.0168	(0.0160)|0.0153	(95)|91	55-130

Figure 9. **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN LAND

SDG : 10F137

METHOD 3550B/8081B
PESTICIDES

A total of twenty (20) soil samples were received on 06/10/10 for Pesticides Organochlorine analysis, Method 3550B/8081B in accordance with “Test Methods for Evaluating Solid Waste, Physical / Chemical Methods”, EPA Publication SW846.

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument performance was checked prior to calibration. DDT and Endrin breakdown were within specification. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source (ICV). Continuing calibration (CCV) was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms for ICAL, ICV and CCV for details.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A lab control sample was analyzed with the samples in this SDG.
Percent recoveries for CPF030SL were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries were within project QC limits except for results qualified with [*] in F137-19M/S summary form. Check QC summary form for details.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter. Positive sample results were confirmed by a second column. Relative percentage difference (RPD) between the two results was evaluated. If RPD is less than 40% and peaks are well defined the higher result is reported. Where RPD is greater than 40% the chromatogram is checked for anomalies and results are selected based on processed knowledge. If there is no evidence of any chromatographic ambiguity, the higher result is reported.

Table 1. **ICAL CONCENTRATION OF INDIVIDUAL ANALYTES**

PARAMETERS	ICAL STANDARD CONCENTRATION (µg/L)							
PESTICIDES	1	2	3	4	5	6	7	8
Tetrachloro-m-xylene (surrogate)	2.5	5	10	20	30	40	60	80
alpha-BHC	2.5	5	10	20	30	40	60	80
gamma-BHC	2.5	5	10	20	30	40	60	80
beta-BHC	2.5	5	10	20	30	40	60	80
delta-BHC	2.5	5	10	20	30	40	60	80
Heptachlor	2.5	5	10	20	30	40	60	80
Aldrin	2.5	5	10	20	30	40	60	80
Heptachlor Epoxide	2.5	5	10	20	30	40	60	80
gamma-Chlordane	2.5	5	10	20	30	40	60	80
alpha-Chlordane	2.5	5	10	20	30	40	60	80
DDE	5	10	20	40	60	80	120	160
Endosulfan I	2.5	5	10	20	30	40	60	80
Dieldrin	5	10	20	40	60	80	120	160
Endrin	5	10	20	40	60	80	120	160
DDD	5	10	20	40	60	80	120	160
Endosulfan II	5	10	20	40	60	80	120	160
DDT	5	10	20	40	60	80	120	160
Endrin Aldehyde	5	10	20	40	60	80	120	160
Methoxychlor	25	50	100	200	300	400	600	800
Endosulfan Sulfate	5	10	20	40	60	80	120	160
Endrin Ketone	5	10	20	40	60	80	120	160
Decachlorobiphenyl (Surrogate)	2.5	5	10	20	30	40	60	80
TOXAPHENE	100	250	500	750	1000	1500	-	-
TECHNICAL CHLORDANE	100	250	500	750	1000	1500	-	-

Table 2. **ICAL STANDARD PREPARATION**

Standard #	Compound Name	Stock/Intermediate Solution Conc. (µg/L)	Preparation			Final Conc. (µg/L)
			Aliquot (µL)	Solvent	Final Volume (µL)	
PESTICIDES						
1	Pest ICAL Mix	80 / 160 / 800	25	Hexane	800	2.5 / 5 / 25
2	Pest ICAL Mix	80 / 160 / 800	50	Hexane	800	5 / 10 / 50
3	Pest ICAL Mix	80 / 160 / 800	100	Hexane	800	10 / 20 / 100
4	Pest ICAL Mix	80 / 160 / 800	200	Hexane	800	20 / 40 / 200
5	Pest ICAL Mix	80 / 160 / 800	300	Hexane	800	30 / 60 / 300
6	Pest ICAL Mix	80 / 160 / 800	400	Hexane	800	40 / 80 / 400
7	Pest ICAL Mix	80 / 160 / 800	600	Hexane	800	60 / 120 / 600
8	Pest ICAL Mix	80 / 160 / 800	800	Hexane	800	80 / 160 / 800
TOXAPHENE						
1	Tox. ICAL	2000	40	Hexane	800	100
2	Tox. ICAL	2000	100	Hexane	800	250
3	Tox. ICAL	2000	200	Hexane	800	500
4	Tox. ICAL	2000	300	Hexane	800	750
5	Tox. ICAL	2000	400	Hexane	800	1000
6	Tox. ICAL	2000	600	Hexane	800	1500
TECHNICAL CHLORDANE						
1	T. Chlor. ICAL	2000	40	Hexane	800	100
2	T. Chlor. ICAL	2000	100	Hexane	800	250
3	T. Chlor. ICAL	2000	200	Hexane	800	500
4	T. Chlor. ICAL	2000	300	Hexane	800	750
5	T. Chlor. ICAL	2000	400	Hexane	800	1000
6	T. Chlor. ICAL	2000	600	Hexane	800	1500

Table 3. **INTERMEDIATE PRIMARY STANDARD PREPARATION**

PESTICIDES*: RESTEK Pesticide Mix*	Stock Std. Conc. (µg/mL)	Final Conc. (µg/L)	Preparation
alpha-BHC	8	80	Using a gas-tight syringe, measure 1000 µL of (Restek) Pesticides Mix and 40 µL of (AccuStandard) Pest Surrogate and dilute with hexane to 100 mL.
gamma-BHC	8	80	
beta-BHC	8	80	
delta-BHC	8	80	
Heptachlor	8	80	
Aldrin	8	80	
Heptachlor Epoxide	8	80	
gamma-Chlordane	8	80	
alpha-Chlordane	8	80	
DDE	16	160	
Endosulfan I	8	80	
Dieldrin	16	160	
Endrin	16	160	
DDD	16	160	
Endosulfan II	16	160	
DDT	16	160	
Endrin Aldehyde	16	160	
Methoxychlor	80	800	
Endosulfan Sulfate	16	160	
Endrin Ketone	16	160	
AccuStandard Surrogate			
Tetrachloro-m-xylene	200	80	
Decachlorobiphenyl	200	80	
TOXAPHENE: *AccuStandard*			
Toxaphene	1000	2000	Using a gas-tight syringe, measure 200 µL of (AccuStandard) Toxaphene standard and 50 µL of (AccuStandard) Pest Surrogate and dilute with hexane to 100 mL.
AccuStandard Surrogate			
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	
TECHNICAL CHLORDANE: *AccuStandard*			
Technical Chlordane	1000	2000	Using a gas-tight syringe, measure 200 µL of (AccuStandard) Tech. Chlordane standard and 50 µL of (AccuStandard) Pest Surrogate and dilute with hexane to 100 mL.
AccuStandard Surrogate			
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	

Table 4. **INTERMEDIATE SECONDARY STANDARD PREPARATION**

	Stock Std. Conc. (µg/mL)	Final Conc. (µg/L)	Preparation
PESTICIDES*: SUPELCO Pesticide Mix*			
alpha-BHC	200	200	Using a gas-tight syringe, measure 1000 µL of (Supelco) Pesticides Mix and 180 µL of (SpexCertiPrep) Methoxychlor solution and dilute with hexane to 100 mL.
gamma-BHC	200	200	
beta-BHC	200	200	
delta-BHC	200	200	
Heptachlor	200	200	
Aldrin	200	200	
Heptachlor Epoxide	200	200	
gamma-Chlordane	200	200	
alpha-Chlordane	200	200	
DDE	200	200	
Endosulfan I	200	200	
Dieldrin	200	200	
Endrin	200	200	
DDD	200	200	
Endosulfan II	200	200	
DDT	200	200	
Endrin Aldehyde	200	200	
Methoxychlor	200	2,000	
Methoxychlor (SpexCertiPrep)	1,000		
Endosulfan Sulfate	200	200	
Endrin Ketone	200	200	
Tetrachloro-m-xylene	200	200	
Decachlorobiphenyl	200	200	
TOXAPHENE: *Ultra Scientific*			
Toxaphene	2500	2000	Using a gas-tight syringe, measure 20 µL of (Ultra Scientific) Toxaphene standard and 12.5 µL of (Supelco) Pest Surrogate Mix and dilute with hexane to 25 mL.
Supelco Surrogate			
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	
TECHNICAL CHLORDANE: *Ultra Scientific*			
Technical Chlordane	2500	2000	Using a gas-tight syringe, measure 20 µL of (Ultra Scientific) Technical Chlordane standard and 12.5 µL of (Supelco) Pest Surrogate Mix and dilute with hexane to 25 mL.
Supelco Surrogate			
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	

Note: Table 2 and Table 2A may be interchanged. However, the source of LCS shall follow the source of the secondary standard or from a third vendor.

Table 5. CHECK STANDARD PREPARATION(DCC/ICV)

Standard	Compound Name	Intermediate Soln. Conc. (µg/L)	Source	Preparation			Final Conc. (µg/L)
				Aliquot (µL)	Dil.Soln./ Modifier	Final Vol. (µL)	
PESTICIDES							
DCC	Pest ICAL Mix	80/160/800	Restek	200	Hexane	800	20/40/200
	Surrogate Mix	80	AccuStandard				20
ICV	Pest ICV Mix	200/2000	Supelco / SpexCertiPrep	100	Hexane	1000	20/200
	Surrogate Mix	200	Supelco				20
TOXAPHENE							
DCC	Toxaphene ICAL	2000	AccuStandard	200	Hexane	800	500
	Surrogate Mix	100	AccuStandard				25
ICV	Toxaphene ICV	200	Ultra Scientific	200	Hexane	800	500
	Surrogate Mix	100	Supelco				25
TECHNICAL CHLORDANE							
DCC	Toxaphene ICAL	2000	AccuStandard	200	Hexane	800	500
	Surrogate Mix	100	AccuStandard				25
ICV	Toxaphene ICV	200	Ultra Scientific	200	Hexane	800	500
	Surrogate Mix	100	Supelco				25

Table 6. SURROGATE STANDARD PREPARATION

Compound Name	Stock Soln. Conc. (µg/mL)	Source	Preparation			Final Conc. (µg/L)
			Aliquot (mL)	Dil.Soln./ Modifier	Final Vol. (mL)	
Surrogate Mix (Tetrachloro-m-xylene & Decachlorobiphenyl)	200	Supelco	2.0	Hexane	1,000	400

Table 7. SPIKE STANDARD PREPARATION

Compound Name	Stock/Intermediate Soln. Conc. (µg/mL)	Source	Preparation			Final Conc. (µg/L)
			Aliquot (µL)	Dil.Soln./ Modifier	Dil. Vol. (mL)	
Pesticide Matrix Spike Mix	2,000	Supelco	20	Hexane	100	400/4000
Methoxychlor	1,000	SpexCertiPrep	360			

Table 8. **PERFORMANCE EVALUATION MIXTURE PREPARATION**

Compound Name	Stock/Intermediate Soln. Conc. (µg/mL)	Source	Preparation			Final Conc (µg/L)
			Aliquot (µL)	Dil.Soln./ Modifier	Dil. Vol. (mL)	
PEM (DDT + Endrin Mix)	500	Supelco	20	Hexane	100	100/100

Table 9. **CLP RETENTION TIME WINDOWS**
(CLP OLM4.2 D-79/PEST)

Compound	Retention Time Window (minutes)	Compound	Retention Time Window (minutes)
alpha-BHC	± 0.05	Endrin Ketone	± 0.07
beta-BHC	± 0.05	4,4'-DDD	± 0.07
gamma-BHC(Lindane)	± 0.05	4,4'-DDE	± 0.07
delta-BHC	± 0.05	4,4'-DDT	± 0.07
Heptachlor	± 0.05	Endosulfan II	± 0.07
Aldrin	± 0.05	Endosulfan Sulfate	± 0.07
alpha-Chlordane	± 0.07	Methoxychlor	± 0.07
gamma-Chlordane	± 0.07	Aroclors	± 0.07
Heptachlor Epoxide	± 0.07	Toxaphene	± 0.07
Dieldrin	± 0.07		
Endrin	± 0.07	Tetrachloro-m-xylene	± 0.05
Endrin Aldehyde	± 0.07	Decachlorobiphenyl	± 0.10

Table 8. ESTABLISHED LIMIT OF DETECTION (LOD) & LIMIT OF QUANTITATION (LOQ)

MATRIX: AQUEOUS	DL	LOD	LOQ	Unit
Aldrin	0.005	0.01	0.1	µg/L
Alpha-BHC	0.005	0.01	0.1	µg/L
Beta-BHC	0.007	0.01	0.1	µg/L
Delta-BHC	0.007	0.01	0.1	µg/L
Gamma-BHC (Lindane)	0.005	0.01	0.1	µg/L
DDD (4,4)	0.005	0.01	0.1	µg/L
DDE (4,4)	0.005	0.01	0.1	µg/L
DDT (4,4)	0.005	0.01	0.1	µg/L
Dieldrin	0.005	0.01	0.1	µg/L
Endosulfan I	0.008	0.01	0.1	µg/L
Endosulfan II	0.005	0.01	0.1	µg/L
Endosulfan Sulfate	0.005	0.01	0.1	µg/L
Endrin	0.008	0.01	0.1	µg/L
Endrin Aldehyde	0.005	0.01	0.1	µg/L
Heptachlor	0.007	0.01	0.1	µg/L
Heptachlor epoxide	0.005	0.01	0.1	µg/L
Methoxychlor	0.05	0.1	1	µg/L
Alpha-Chlordane	0.005	0.01	0.1	µg/L
Gamma-Chlordane	0.005	0.01	0.1	µg/L
Endrin Ketone	0.005	0.01	0.1	µg/L
Toxaphene	0.25	0.5	2	µg/L
Technical Chlordane	0.005	0.25	1	µg/L
SURROGATES				
Tetrachloro-m-xylene	0.005	0.01	0.02	µg/L
Decachlorobiphenyl	0.005	0.01	0.02	µg/L

Reference: Detection Limit Study dated April 20,2010.

PARAMETER (MATRIX: SOIL)	DL	LOD	LOQ	Unit
Aldrin	0.02	0.4	2	µg/Kg
Alpha-BHC	0.02	0.4	2	µg/Kg
Beta-BHC	0.02	0.4	2	µg/Kg
Delta-BHC	0.27	0.4	2	µg/Kg
Gamma-BHC (Lindane)	0.2	0.4	2	µg/Kg
DDD (4,4)	0.02	0.4	2	µg/Kg
DDE (4,4)	0.02	0.4	2	µg/Kg
DDT (4,4)	0.02	0.4	2	µg/Kg
Dieldrin	0.02	0.4	2	µg/Kg
Endosulfan I	0.2	0.4	2	µg/Kg
Endosulfan II	0.2	0.4	2	µg/Kg
Endosulfan Sulfate	0.2	0.4	2	µg/Kg
Endrin	0.2	0.4	2	µg/Kg
Endrin Aldehyde	0.35	0.4	2	µg/Kg
Heptachlor	0.2	0.4	2	µg/Kg
Heptachlor epoxide	0.2	0.4	2	µg/Kg
Methoxychlor	2	4	10	µg/Kg
Alpha-Chlordane	0.2	0.4	2	µg/Kg
Gamma-Chlordane	0.2	0.4	2	µg/Kg
Endrin Ketone	0.2	0.4	2	µg/Kg
Toxaphene	5	10	50	µg/Kg
Technical Chlordane	10	20	50	µg/Kg
SURROGATES				
Tetrachloro-m-xylene	0.167	0.33	0.7	µg/Kg
Decachlorobiphenyl	0.167	0.33	0.7	µg/Kg

Reference: Detection Limit Study dated April 5,2010.

SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	FLAGGING CRITERIA	1ST Rvw	2ND Rvw
5 point Initial Calibration for analytes	Initially, as needed	RSD for all analytes ≤20%. Linear – least squares regression r^2>0.995.	Correct then problem then repeat initial calibration.			
Second-source calibration verification for all analytes	Once per 5-point initial calibration	All analytes within ±20of expected value from the ICAL.	Repeat injection of ICV. If the problem persists then perform troubleshooting and repeat the ICAL.			
Initial calibration verification	Daily, before sample analysis	All analytes within ±20%	Correct the problem then repeat initial calibration			
Calibration verification	Every 12 hours of analysis time and at the end of the analysis sequence	All analytes within ±20%	Correct the problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification			
Breakdown check (Endrin and DDT)	Every 12-hours	Degradation ≤15% of each analyte.	Repeat breakdown check			
Method Blank	One per preparation batch	No analytes detected > ½ LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Re-prep and re-analyze method blank and all samples processed with the contaminated blank	Apply B to specific analyte(s) on all associated samples		
LCS	One LCS per preparation batch	Within project QC limits	Re-prep and re-analyze the LCS and all associated samples			
Surrogate spike	Every sample, spiked sample, standard and method blank	Within project QC limits	Correct the problem then re-extract and analyze sample			
MS/MSD	One MS/MSD per every 20 project samples per matrix	Within project QC limits	If chromatogram is indicative of matrix interference, discuss in case narrative. Otherwise, check for probably source of error and perform corrective action as necessary			
Confirmation	100% for al positive results	Same as primary column	If quantitation criteria are not met, use confirmation for qualitative identification only.			
Comments: Apply J to all values between LOD and LOQ.				Reviewed By:		
				Date		

DEMONSTRATION OF CAPABILITY

PT # WP0110 Water Pollution Proficiency Testing **PT Study Closing Date: Feb. 18, 2010**

Method: SW 3520 C / SW 8081 B Analyst: Enrico Santos

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aldrin	4	µg/L	3.97	1.13	-	5.49	Acceptable
2	alpha-BHC	12	µg/L	10.6	4.77	-	14.3	Acceptable
3	beta-BHC	9.27	µg/L	9.25	3.85	-	12.5	Acceptable
4	delta-BHC	3.55	µg/L	3.32	1.11	-	4.66	Acceptable
5	gamma-BHC (Lindane)	6.08	µg/L	5.8	2.35	-	8.03	Acceptable
6	alpha-Chlordane	3.54	µg/L	3.25	1.45	-	4.49	Acceptable
7	gamma-Chlordane	5.67	µg/L	5.61	2.31	-	7.64	Acceptable
8	DDD (4,4)	4.74	µg/L	4.76	1.79	-	6.85	Acceptable
9	DDE (4,4)	2.88	µg/L	2.7	1.16	-	3.62	Acceptable
10	DDT (4,4)	8.71	µg/L	8.27	3.09	-	11.7	Acceptable
11	Dieldrin	9.32	µg/L	8.53	4.18	-	11.6	Acceptable
12	Endosulfan I	4.85	µg/L	4.81	1.12	-	6.68	Acceptable
13	Endosulfan II	7.03	µg/L	6.55	2.19	-	8.91	Acceptable
14	Endosulfan Sulfate	16.48	µg/L	14.8	5.53	-	21.3	Acceptable
15	Endrin	7.89	µg/L	9.12	3.24	-	13.6	Acceptable
16	Endrin aldehyde	15.11	µg/L	13.5	4.12	-	20.1	Acceptable
17	Heptachlor	2.17	µg/L	2.33	0.759	-	3.25	Acceptable
18	Heptachlor Epoxide (beta)	8.13	µg/L	8.15	4.08	-	11.4	Acceptable
19	Methoxychlor	6.95	µg/L	5.62	1.43	-	9.03	Acceptable
20	Endrin Ketone	10.84	µg/L	8.91	4.9	-	12.9	Acceptable
21	Chlordane (total)	14.3	µg/L	13.7	5.12	-	19.7	Acceptable
22	Toxaphene (total)	28.78	µg/L	25.7	2.57	-	46.6	Acceptable

DEMONSTRATION OF CAPABILITY

PT # **HW0110 Soil/Hazardous Waste Proficiency Testing** **PT Study Closing Date: Mar. 4, 2010**

Method: SW 3550 C / SW 8081 B Analyst: Enrico Santos

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aldrin	419	µg/Kg	412	130	-	562	Acceptable
2	alpha-BHC	428	µg/Kg	236	126	-	555	Acceptable
3	beta-BHC	156	µg/Kg	172	30.4	-	263	Acceptable
4	delta-BHC	307	µg/Kg	344	77.7	-	431	Acceptable
5	gamma-BHC (Lindane)	276	µg/Kg	299	84.6	-	412	Acceptable
6	alpha-Chlordane	200	µg/Kg	194	65.3	-	262	Acceptable
7	gamma-Chlordane	303	µg/Kg	331	139	-	428	Acceptable
8	DDD (4,4)	288	µg/Kg	324	118	-	464	Acceptable
9	DDE (4,4)	47.9	µg/Kg	57.6	11.1	-	96.4	Acceptable
10	DDT (4,4)	130	µg/Kg	181	44.4	-	276	Acceptable
11	Dieldrin	475	µg/Kg	483	190	-	653	Acceptable
12	Endosulfan I	329	µg/Kg	374	123	-	487	Acceptable
13	Endosulfan II	252	µg/Kg	265	76.1	-	361	Acceptable
14	Endosulfan Sulfate	105	µg/Kg	124	21.9	-	180	Acceptable
15	Endrin	155	µg/Kg	186	60.8	-	228	Acceptable
16	Endrin aldehyde	172	µg/Kg	371	37.1	-	409	Acceptable
17	Endrin Ketone	407	µg/Kg	459	121	-	634	Acceptable
18	Heptachlor	70.0	µg/Kg	86.4	22.9	-	118	Acceptable
19	Heptachlor Epoxide (beta)	56.2	µg/Kg	71.7	21.9	-	98.3	Acceptable
20	Methoxychlor	374	µg/Kg	392	43.4	-	601	Acceptable
21	Chlordane (total)	572	µg/Kg	652	140	-	926	Acceptable
22	Toxaphene (total)	783	µg/Kg	785	78.5	-	1130	Acceptable

8081FA. **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
PESTICIDES/PCBs

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Comments:

Book #:	A16-022
Instrument No.:	16
Analytical Sequence:	
Method File:	
Analytical Batch:	

SOP #	Rev. #
☐ EMAX-8081	
☐ EMAX-8082	
☐ EMAX-608	
☐ EMAX-CLP-PEST	
☐ EMAX-	

ICAL REFERENCE		
ICAL ID	BATCH	DATE

STANDARDS ID	Conc (µg/L)
Hexane	

Column	A. RTX CLPEST I B. RTX CLPEST II

ELECTRONIC DATA ARCHIVAL	
Location	Date
☐ EZC_4_Pesticides	
☐ EZC_10_Pesticides	

Analyzed By: Date:

Date Disposed: Disposed By:

This page is checked during data review.

EMAX LABORATORIES, INC.

FileID: CP10H01W.xls

EXTRACTION LOG FOR PESTICIDES AND PCBs

PrepBatchID	Lab Sample ID	Aliquot	Unit	DateTime	Sonicator	pH	Ve(ml)	DateTime	Cleanup	Comments

Prepared By: _____

Checked By: _____ Date _____

8081FM. **INSTRUMENT MAINTENANCE LOG**

Instrument No: 08 **Month:** **Year: 200_** **Book #: M08-005**

Date							
Column Head Pressure (8-15 psi)							
Column Temperature							
Signal # 1 10-150							
Signal #2 10-150							
Autosampler							
Update Cal. Table							
Computer Date/Time							
Computer Paper							
Septa Change							
Liner Clean-up							
Analyst Initial							

TroubleShooting							
Problems Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

PRINT DRF

STANDARD OPERATING PROCEDURES

POLYCHLORINATED BIPHENYLS (PCB) BY GAS CHROMATOGRAPHY

SOP No.:	EMAX-8082	Revision No.	3	Effective Date:	10-Aug-10
Prepared By:	Tu Nisamaneepong			Date:	08-10-10
Approved By:	Kenette Pimentel QA Manager			Date:	08.10.10
Approved By:	Caspar Pang Laboratory Director			Date:	08-10-10.

Control Number: 8082-03-

1.0 SCOPE AND APPLICATION

1.1. This procedure is used to determine the concentration of Polychlorinated Biphenyls as Aroclors in soil, sediment, sludge, and wastewater samples by gas chromatography method. This SOP is an adaptation of Method 8082A. Since Method 8082A is an update and enhancement of 8082, this SOP is also applicable to Method 8082.

2.0 SUMMARY OF METHOD

2.1. This method provides gas chromatographic conditions for the detection of polychlorinated biphenyls compounds with dual Electron Capture Detector (ECD). The samples are extracted in methylene chloride, exchanged to hexane and clean up by appropriate method before GC analysis.

2.2. **Interferences**

2.2.1. Interferences by phthalate esters co-extracted from the sample or introduced during sample preparation can pose a major problem in PCB determinations. Interferences can be minimized by avoiding contact with any plastic materials and checking all solvents for phthalate contamination. Glassware must be scrupulously cleaned. Sulfuric acid/permanganate cleanup technique can be used for Phthalate esters removal from the extract.

2.2.2. The presence of elemental sulfur will result in broad peaks that may cause chromatographic interfere with the determination of PCBs. Sulfur contamination is most likely present in sediment samples. The TBA procedure, GPC or other cleanup technique can be used for sulfur removal from the extract.

2.2.3. Other interferences such as aliphatic compounds, aromatics and nitrogen-containing compounds may be eliminated by using Florisil cleanup.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point (see Sec. 9.4). All samples analyzed above this concentration are considered "over-range" and shall require

dilution to properly quantitate.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required to properly quantitate.

4.3. Typical dynamic ranges are:

4.3.1. Water – 1.0 to 10.0 µg/L

4.3.2. Soil – 33 to 330 µg/kg

5.0 SAMPLE HOLDING TIME AND PRESERVATION,

5.1. **Holding Time**

5.1.1. Water samples must be extracted within 7 days from the time of sample collection.

5.1.2. Soil and sediment samples must be extracted within 14 days from the time of sample collection.

5.1.3. Analysis should be within 40 days after extraction completion date.

5.2. **Preservation**

5.2.1. Samples and extract should be kept at ≤ 6°C.

6.0 ASSOCIATED SOPs

6.1.	EMAX-DM01	Data Flow and Review
6.2.	EMAX-QC02	Analytical Standard Preparation
6.3.	EMAX-SM04	Analytical and QC Labeling
6.4.	EMAX-QA08	Corrective Action
6.5.	EMAX-3510	Separatory Funnel Liquid/Liquid Extraction
6.6.	EMAX-3520	Extraction of Organic Compounds by Continuous Liquid/Liquid Extraction
6.7.	EMAX-3550	Extraction of Organic Compounds from Solid Samples by Pulse Sonication
6.8.	EMAX-3540	Soxhlet Extraction
6.9.	EMAX-3620	Florisil Cleanup
6.10.	EMAX-3640	GPC Cleanup
6.11.	EMAX-3660	Sulfur Cleanup
6.12.	EMAX-3665	Sulfuric Acid/Permanganate Cleanup

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. All reagents, standards, and samples shall be treated as potential hazards. ECD contains minute quantity of Radioactive Ni (63), a wipe test performed by experienced personnel or manufacturer should be conducted semiannually or sooner if potential problem is suspected. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves, shall be worn at all times when performing this procedure.

7.3. All wastes generated during analytical process shall be placed in the waste containers. These wastes shall be endorsed to the waste disposal section for proper disposal.

7.4. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS, AND REAGENTS

8.1. Instruments and Supplies

Gas Chromatography	:	HP 5890 Series II
Detector	:	Dual Electron Capture Detectors
Column	:	RTX CLPESTI (30 m x 0.32 mm x 0.5 μm)
		RTX CLPESTII (30 m x 0.32 mm x 0.25 μm)
		(or equivalents)
Data System	:	EZ Chrom
Auto Sampler	:	HP Model 7673B or equivalent
Gas	:	Ultra-high purity hydrogen
		Ultra-high purity nitrogen
Microsyringes	:	10, 25, 100 and 500 μL with a 0.006 mm ID needle
Volumetric Flasks	:	0,50, and 100 ml with ground glass stopper
Automatic Pipette	:	Pipetman, 1000 and 200μL
Transfer Pipette	:	Pasteur

8.2. Chemicals and Reagents

Solvent	:	Pesticide-free grade hexane, methylene chloride

9.0 STANDARDS

9.1. Preparation

9.1.1. Prepare and label analytical standards according to EMAX-QC02 and EMAX-SM04.

9.2. Stock Standard

9.2.1. Calibration stock standards are purchased as certified solutions at 1000 mg/L. All stock standards should be transferred to an inert vial and stored with minimum headspace after opening.

9.2.2. Additional set of stock standards should be purchased from a different source to verify the concentration of the first set of standards. The verification should take place whenever a new lot of stock solution is used. It is prepared using the same procedure as that of the working standard.

9.2.3. Surrogate and matrix standards are purchased as certified solutions from various suppliers.

9.2.4. Store all standards at ≤ 6°C, unless otherwise specified.

9.3. **Intermediate Standard**

9.3.1. Prepare intermediate standards at 2000 µg/L as suggested in Table 1.

9.4. **Initial Calibration Standard (ICAL)**

9.4.1. Prepare five calibration standards according to Table 2.

9.5. **Initial Calibration Verification (ICV)**

9.5.1. Prepare ICV using an intermediate standard prepared from a second source stock standard similarly as described in Table 3.

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Prepare DCC using the an intermediate standard prepared from the same source as the ICAL standard as described in Table 3.

9.7. **Surrogate Standard**

9.7.1. Prepare surrogate standard as described in Table 4.

9.8. **LCS/MS Spike Standard**

9.8.1. Prepare LCS/MS spike standard as described in Table 4.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Aqueous samples shall be prepared as described in EMAX-3520.

10.1.2. Solid samples shall be prepared as described in EMAX-3550 and clean up with concentrated sulfuric acid as described in EMAX-3665.

10.2. **Instrument Parameters**

10.2.1. Method 8082 requires an analytical system complete with a temperature programmable gas chromatograph equipped with an autosampler suitable for on column injection of 2 to 5 µl.

10.2.2. **Gas Pressure**

Nitrogen Pressure	:	40 psi
Hydrogen Pressure	:	50 psi

10.2.3. **Temperature Program**

Column	RESTEK STXCLPesticides 1 & 2	PHENOMENEX ZB-Multiresidue 1 & 2
Initial Temp	130°C, hold for 0 minute	180°C, hold for 0 minute
Rate 1	25°C/min	25°C/min
Temp 1	230°C, hold for 2 minutes	240°C, hold for 0 minute
Rate 2	3°C/min	5°C/min
Temp 2	260°C, hold for 1 minute	260°C, hold for 0 minute
Rate 3	25°C/min	12°C/min
Final Temp	300°C, hold for 1 minute	300°C, hold for 10 minutes
Injector	230°C	250°C
Detector	300°C	300°C
Injection Volume	2µL	1µL

10.3. **Calibration**

10.3.1. Initial Calibration (ICAL)

10.3.1.1. A standard containing a mixture of Aroclor 1016 and Aroclor 1260 will include many of the peaks represented in other five Aroclor mixtures. As a result, a multi-point initial calibration employing a mixture of Aroclor 1016 and 1260 at five concentrations should be sufficient to demonstrate the linearity of the detector response without the necessity of performing initial calibration for each of the seven Aroclors.

10.3.1.2. The five levels of calibration standards (or as suggested in Table 2) of Aroclors 1016 and 1260 are analyzed by direct injection.

10.3.1.3. Three to five characteristic peaks from each Aroclor are chosen for quantitation. Peaks should be at least 25% of the height of the largest Aroclor peak. Tabulate each peak area response against concentration of injected standard. Calculate each calibration factor according to Equation 10.6.1.1. Five sets of calibration factors will be generated for each Aroclor. Calculate the average mean calibration factor (Equation 10.6.1.2), standard deviation (Equation 10.6.1.3) and the relative standard deviation (Equation 10.6.1.4) for each Aroclor peak. The average RSD of five calibration factors for each Aroclor should be equal to or less than 20 before linearity to be assumed and the average calibration factor to be used in quantitation.

10.3.1.4. Prepare a mid-level calibration standard of Aroclors (1260 + 1016) from a second source. Analyze it after the initial calibration to verify the standard. The %D should be equal to or less than 15%.

10.3.1.5. The standards of the other five Aroclors are used to determine a single-point calibration factor for each Aroclor and pattern recognition. It can be analyzed before or after the five 1016/1260 standards.

10.3.1.6. In situations where a particular Aroclor is of interest for a specific project, a five point calibration curve of that Aroclor may be employed instead of 1016/1260 mixture.

10.3.2. Daily Calibration Check (DCC)

10.3.2.1. For daily analysis, a mid-level Aroclors (1016 + 1260) standard should be analyzed. A same calibration standard must also be injected at interval of not less than 20 samples interval and at the end of the analysis sequence.

10.3.2.2. The calibration verification process does not require analysis of the other Aroclor standards used for pattern recognition.

10.3.2.3. The calibration factor calculated from each DCC must not exceed a difference of more than 15% when compared to the mean CF from the initial calibration curve (Equation 10.6.1.2).

10.3.2.4. Continuing calibration for sites that specific PCB is expected to be found, 500 µg/L of that particular PCB shall be analyzed.

10.4. **Analysis**

10.4.1. **Sample Analysis**

10.4.1.1. Introduce extract into the gas chromatograph using direct injection technique (1 to 5 µl) after all quality control criteria have been met. Positive identification is made when a target peak falls within the retention time window on both columns established by the standard reference compound.

10.4.1.2. Identification of a multicomponent analyte in the sample is based on pattern recognition in conjunction with the elution of three or five sample peaks on both GC columns.

10.4.2. **Analytical Sequence**

10.4.2.1. Before analysis, approximately 0.5 ml of extract is transferred to a 2 ml amber auto sampler vial (or equivalent) with a Pasteur pipette, sample vial is capped with a teflon septum and sealed with an aluminum rim. Standards and QC samples are sealed the same way.

10.4.2.2. Following the data acquisition software's instruction, prepare the analytical sequence as suggested below:

- Instrument Blank
- Five Calibration Standards of Aroclors 1016/1260
- Calibration Standard of Aroclor 1254*
- Calibration Standard of Aroclor 1248*
- Calibration Standard of Aroclor 1242*
- Calibration Standard of Aroclor 1232*

* Calibrate if the pattern is found in a sample

- Calibration Standard of Aroclor 1221*
- Initial Calibration Verification of Aroclor 1016/1260 by a Second Source
- Method Blank
- Lab Control Sample
- Samples (up to 20 samples)
- Continuing Calibration Standard of Aroclors 1016/1260 or other calibrated Aroclors

10.4.3. **Sample Result Evaluation**

10.4.3.1. Check QC parameters as soon as the data is available.

- ✓ Check LCS recovery that it is within QC limits.
- ✓ Check MB that is compliant to PSR.
- ✓ Check surrogate recoveries against Appendix 1.
- ✓ Check concentration of target analytes. If the response exceeds the calibration range, dilute and re-analyze the sample until the response falls within the calibration range.
- ✓ If any of the above checkpoints indicate a problem, re-analysis is required. If re-analysis results are the same as the initial result, consult the Supervisor for further action. If results indicate extraction problem, fill-up an NCR and order re-extraction for the affected sample(s).

10.4.3.2. For positive identification, check that the PCB pattern characteristic peaks are detected in both columns within the established retention time window.

10.4.3.3. If one column meets the retention time criteria and a retention time shift is suspected on the other column, use the following guideline in reporting the data:

- ✓ Check that the expanded window does not exceed the RTW of the column in control or the established RTW or the CLP RTW[1] whichever is greater.
- ✓ If the above condition is met, report the data and include a description of the observation in the case narrative.

10.4.4. **Retention Time Windows**

10.4.4.1. Establishing RTW

10.4.4.1.1. Collect at least three Daily Calibration Standards analyzed over a period of 72 hours.

10.4.4.1.2. Calculate the Standard Deviation (SD) of absolute retention time obtained for each of the major peaks used for calibration.

10.4.4.1.3. Determine the width of RTW by ±3X SD.

[1] CLP-OLM4.2 Table 1 D-79/PEST

10.4.4.2. Evaluating RTW

10.4.4.2.1. If the SD is equal to 0.00, default to the previous study until historical data is obtained or use the CLP retention time window for Aroclors (±0.07 minutes) which ever is narrower.

10.4.4.2.2. For new instruments, in the interim use the CLP retention time window for Aroclors (±0.07 min) until RTW is obtained for the new instrument parameters condition.

10.4.4.3. Application of RTW

10.4.4.3.1. Establish the center of absolute retention time for each of the characteristic peak to include the surrogate(s) from the daily calibration check at the beginning of the analytical shift then apply the established RTW.

10.4.4.3.2. Whenever the observe retention time is outside the established RTW, the analyst is advised to determine the cause and perform necessary corrective action before continuing analyses.

10.4.4.4. Updating RTW

10.4.4.4.1. Re-establish the RTW as described in Section 10.4.4.1 when any of the following conditions occur:

- Yearly RTW update
- Significant shifting is observed (e.g. succeeding calibration checks or LCS are out of RTW)
- Major instrument maintenance (e.g. replacements of detector or column; temperature program change, etc.)

10.4.5. **Manual Integration**

10.4.5.1. Refer to EMAX-DM01 for details of manual integration.

10.4.6. **Dealing with Carryover**

✓ Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.

✓ If there was no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction.

✓ If there was a target analyte detected as found in the sample that exceeded the calibration range, re-analyze the sample to rule-out carry over. If carry over is confirmed, proceed with data reduction and report the data from re-analysis.

10.5. **Data Reduction**

10.5.1. Identification of a multicomponent analyte in the sample is based on pattern recognition in conjunction with the elution of three to five peaks on both GC columns.

10.5.2. The agreement between the quantitative results should be evaluated after the identification is made. Calculate the relative percent difference (RPD) between the two results according to Equation 10.6.5.2.

10.5.2.1. If the RPD is less than 40% and the pattern peaks do not indicate any anomalies, report the higher result.

10.5.2.2. If the RPD is less than 40% and the pattern peaks indicate an anomaly, report the result from the better pattern peaks.

10.5.2.3. If the RPD is greater than 40%, use professional judgment. If no anomaly is found, report the higher result.

10.6. **Calculations**

10.6.1. Initial Calibration

10.6.1.1. Calculate for Calibration Factor (CF).

$$CF = \frac{R_a}{C_a}$$ Eq.-10.6.1.1

where:

R_a - *response for analyte measured in peak area*

C_a - *Concentration of analyte (µgL) x 1/N*

N - *number of identification peak in each Aroclor*

10.6.1.2. Calculate for Average Calibration Factor (ACF)

$$ACF = \frac{\sum CF_a}{n}$$ Eq.-10.6.1.2

where:

ACF - *average calibration factor*

ΣCF_a - *sum of calibration factors*

n - *number of calibration points*

10.6.1.3. Calculate for Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}}$$ Eq.-10.6.1.3

where:

SD - *standard deviation*

x_i - *result at i^{th} measurement*

$\bar{x}$ - *mean*

N - *number of measurements*

10.6.1.4. Calculate for % relative standard deviation (%RSD).

$$\%RSD = \frac{SD}{ACF} * 100\% \qquad \text{Eq.-10.6.1.4}$$

where:

RSD - *relative standard deviation*

SD - *standard deviation*

ACF - *average calibration factor*

10.6.2. Calibration Check/Continuing Calibration

10.6.2.1. Calculate Percent Difference.

$$\%D = \frac{ACF - CF}{ACF} * 100\% \qquad \text{Eq.-10.6.2.1}$$

where:

ACF - *average calibration factor*

CF - *calibration factor at calibration check standard*

10.6.3. Sample Results

10.6.3.1. Identify 3 to 5 major peaks as quantitative peaks for each Aroclor. Establish the ACF of each peak as outlined in Section 10.6.1.1. Calculate C of each peak in Aroclor according to Equations 10.6.3.2 or 10.6.3.3. The concentration of Aroclor equals to the sum of the concentrations of these major peaks according to Equation 10.6.3.4.

10.6.3.2. Water Samples

$$C_n = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a}\right)DF \qquad \text{Eq-10.6.3.2}$$

where:

C_n - *Concentration of characteristic peak n measured (µg/L)*

R_a - *Total response of analyte in peak area*

ACF - *Average response factor*

V_e - *Volume of extract in ml*

S_a - *Sample amount in ml*

DF - *Dilution factor of sample extract*

10.6.3.3. Soil Samples

$$C_n = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a(\%Solid)}\right)DF \qquad \text{Eq.10.6.3.3}$$

where

C_n	-	*Concentration of characteristic peak n measured (µg/kg)*
R_a	-	*Total response of analyte in peak area*
ACF	-	*Average response factor*
V_e	-	*Volume of extract in ml*
S_a	-	*Sample Amount in g*
% Solid	-	$\frac{100 - \%\ moisture}{100}$
DF	-	*Dilution factor of the sample extract*

10.6.3.4. Final Aroclor Concentration

$$C = C_1 + C_2 + \ldots C_n \qquad \text{Eq.-10.6.3.4}$$

where:

C	-	*Concentration of Aroclor in sample (µg/L or µg/kg)*
C_1	-	*Concentration of characteristic peak 1*
C_2	-	*Concentration of characteristic peak 2*
n	-	*Characteristic peak number in each Aroclor*

10.6.4. Accuracy and Precision

10.6.4.1. Percent Recovery

$$\%R = \frac{C_f - C}{C_s} * 100 \qquad \text{Eq.-10.6.4.1}$$

where:

%R	-	*percent recovery*
C_f	-	*concentration of spiked sample*
C_s	-	*concentration of spike*
C	-	*concentration of unspiked sample (For LCS recovery, C=0)*

10.6.4.2. Relative Percent Difference

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.6.4.2}$$

where:

%RPD - *Relative Percent Difference*

C_1 - *Measured concentration of the first sample aliquot*

C_2 - *Measured concentration of the second sample aliquot*

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C .exe

10.7.2. Generate Lab Chronicle using LABCHRN1.exe

10.7.3. Generate sample results using F1V3C .exe

10.7.4. Generate the QC Summary file using QCV3C .exe

10.7.5. Generate the case narrative using CN1.exe.

10.7.6. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analyses.

- Sample Results
- LCS Summary
- MS/MSD Summary
- DCC Summary
- ICAL Summary
- ICV Summary
- Copy of Analysis Log
- Copy of Preparation Log

10.8. **Data Review**

10.8.1. Perform a 100% data review in accordance to EMAX-DM01 and the project specific requirements (PSR).

- ✓ Check that samples are extracted and analyzed within Holding Time.
- ✓ Check that all calibration requirements are fulfilled.
- ✓ Check that all samples required for analysis are performed.
- ✓ Check the chromatogram of all positively identified Aroclor patterns that they are qualitatively identified and qualitatively accurate.
- ✓ Check surrogate recoveries against required limits.

- ✓ Check that concentration of target analytes are within calibration range.
- ✓ If any of the above checkpoints indicate a problem, re-analysis is required.

10.8.2. Review the case narrative and edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Refer to Form 8081FM for daily routine maintenance check points.

10.9.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back in control.

10.9.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

Maintenance Activity	Description	Frequency
Autosampler Check	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis
Verification	Check instrument parameters to ensure normal operating conditions. Check liner as necessary. Check instrument performance (e.g., daily calibration check, instrument blank, DDT/Endrin breakdown).	Daily prior to analysis
Documentation	Record maintenance in instrument service logs.	Daily prior to analysis
Leak Test	Perform inlet pressure decay test.	Every 6 months or as necessary
System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector where applicable.	Every 6 months or as necessary
Check Flow Path Components	Check and replace the following as necessary: tubing assembly, union, sample probe, and loop.	Once a year or as necessary
Complete Inspection	Perform general inspection of the complete system. Inspect autosampler cabling and configuration setting.	Once a year

11.0 QUALITY CONTROL

11.1. **Preparative Batch**

11.1.1. A preparative batch shall consist of a method blank, LCS, MS/MSD and a maximum of 20 field samples of similar matrix.

11.1.2. In the absence of MS/MSD, LCS/LCD is prepared.

11.1.3. Surrogate standard shall be added to all samples, including method blank LCS/LCD and MS/MSD. Check PSR for QC Control Limits.

11.1.4. Perform QC check prior to utilizing the surrogate and LCS/MS spike standards by analyzing the prepared standard at the spiking level. Results should be within ± 20% of the expected value.

11.2. **Analytical Batch QC**

11.2.1. Instrument Blank must be analyzed daily to establish zero baseline or background value.

11.2.2. A continuing calibration shall be performed before any other analysis is done. The continuing calibration procedure and the acceptance criteria are discussed in Section 10.3.2 and Appendix 1.

11.3. **Method QC**

11.3.1. Analyst demonstration of proficiency is a must prior to performing this analysis.

11.3.2. A valid LOD and LOQ must exist prior to sample analysis.

11.3.3. A valid ICAL must exist prior to sample analysis.

11.3.4. Instrument performance must be checked prior to sample analysis. Check Appendix 1 for acceptance criteria.

11.3.5. Prepare and analyze QC samples, to include, method blank, LCS (LCD), and MS/MSD. QC Control Limits shall follow the Project Specific Requirement (PSR) in each analytical folder.

12.0 CORRECTIVE ACTION

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures in Appendix 1. Document out-of-control event and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. If Initial calibration is non-compliant, consider the following suggestions to correct the problem:

12.2.1. If %RSD is out of acceptance criteria, review result and identify presence of an outlier.

12.2.2. If one of the standard returns a bias-low or bias-high on all of the analytes, then that point is considered an outlier, prepare a standard at that ICAL point and reanalyze.

12.2.3. If the highest ICAL point appears to be saturated, drop the highest point.

12.2.4. If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

Note: The lowest calibration point identifies the limit of quantitation (LOQ). Therefore, check that the LOQL is in conformance to the current projects where the ICAL will be used.

12.2.5. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

12.2.5.1. Check the connections and make sure they are air-tight and perform maintenance as needed.

12.2.5.2. Check the gas flow

12.2.5.3. Prepare a fresh standard and repeat calibration

12.2.6. If the problem persists, inform the supervisor.

12.3. If the ICV is non-compliant, consider the following suggestions to correct the problem:

12.3.1. Re-analyze ICV (to rule out poor injection)

12.3.2. If ICV is still out of acceptance criteria, prepare a fresh standard and re-analyze to rule out any preparation error

12.3.3. If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration

12.3.4. If the problem persists, inform the supervisor

12.4. If the instrument blank is non-compliant, consider the following suggestions to correct problem:

12.4.1. Rule out instrument contamination by performing the instrument daily maintenance, such as changing septum, cleaning liner, cleaning or using new auto sampler syringe.

12.4.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.4.3. Rule out preparation contamination by preparing a new instrument blank

12.4.4. If the problem persists, inform the supervisor.

12.5. If Continuing Calibration is non-compliant, consider the following suggestions to correct the problem:

12.5.1. Change the liner

12.5.2. Clean injection port

12.5.3. Prepare new standard

12.5.4. Cut or replace column

12.5.5. Clean the detector

12.5.6. Rule out leaks by checking all connections

12.5.7. If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL

12.6. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

12.6.1. Rule out instrument contamination by checking instrument blank

12.6.2. Rule out reagent contamination by testing each reagent used for extraction as described in EMAX-QC01

12.6.3. Rule out glassware contamination used for extraction as described in EMAX-QC07

12.6.4. Re-extract MB and the associated samples with reagents free of contamination or with newly opened reagents

12.6.5. If the problem persists, inform the supervisor

12.7. If LCS is non-compliant, perform the following suggestions to correct the problem:

12.7.1. If result is bias-high or bias-low, check the LCS Standard by analyzing at the spike level

12.7.2. If LCS check is within 80-120% of expected value, check calibration of the micropipette or syringe used for spiking. Re-extract and re-analyze the LCS and the associated samples.

12.7.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS Standard, re-extract and re-analyze LCS and the associated samples.

12.8. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.8.1. If corrective action needs the function of other department; e.g., if the sample needs to be re-extracted, refer to EMAX-QA08 for details of completing an NCR.

12.8.2. If corrective action needs the assistance of the project manager; e.g. If the sample is non-compliant to the technical holding time requirement, insufficient amount of sample, or other non-conforming issues.

12.9. For other problems encountered, inform the supervisor immediately for further instructions.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to WDU shall be disposed in accordance to EMAX-SM03

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents. Preparation batch is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate. Analytical batch is compose of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Characteristic Peaks – are major identifying and quantifying peaks for each type of Aroclor.

15.1.4. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.5. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.6. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.7. Matrix – is a component or form of a sample.

15.1.8. Matrix Spike (MS) – is a sample spiked with a verified known amount of target anayte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.9. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.10. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.11. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.12. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing PCB analysis by GC/MS unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. Methods 8000B and 8082A, Test Methods for Evaluating Solid Wastes, USEPA SW846.

16.2. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Figures**

17.1.1.	Figure 1	Peak Evaluation Technique
17.1.2.	Figure 2	Typical PCB Patterns
17.1.3.	Figure 3	Typical 1016/1260 Chromatogram
17.1.4.	Figure 4	Typical Initial Calibration Summary
17.1.5.	Figure 5	Typical Retention Time Window Summary
17.1.6.	Figure 6	Typical Sample Result Summary
17.1.7.	Figure 7	Typical LCS Report Summary
17.1.8.	Figure 8	Typical Matrix Spike Summary
17.1.9.	Figure 9	Typical Case Narrative

17.2. **Tables**

17.2.1.	Table 1	Intermediate Standard Preparation
17.2.2.	Table 2	Initial Calibration Standard Preparation
17.2.3.	Table 3	Calibration Check Standard Preparation
17.2.4.	Table 4	Spike Standard and Surrogate Standards Preparation
17.2.5.	Table 5	Compound List
17.2.6.	Table 6	Established Limit of Detection (LOD) and Limit of Quantitation (LOQ)

17.3. **Appendices**

17.3.1.	Appendix 1	Summary of In-House Quality Control Procedures
17.3.2.	Appendix 2	Demonstration of Capability

17.4. **Forms**

17.4.1.	8082FA	Analysis Run Log
17.4.2.	8082FP	Sample Preparation Log
17.4.3.	8082FM	Instrument Maintenance Log

Figure 1. **PEAK EVALUATION TECHNIQUE**

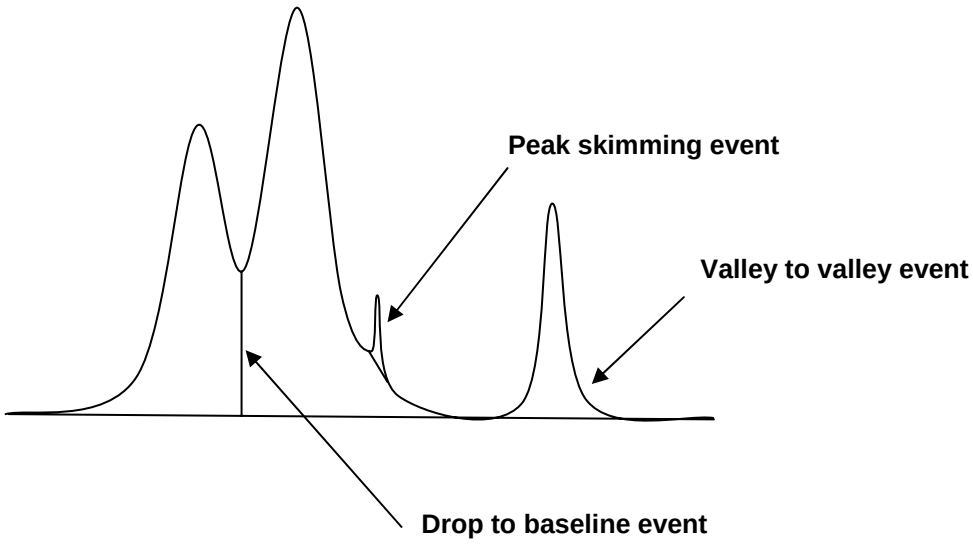


Figure 2. **TYPICAL PCB PATTERNS**

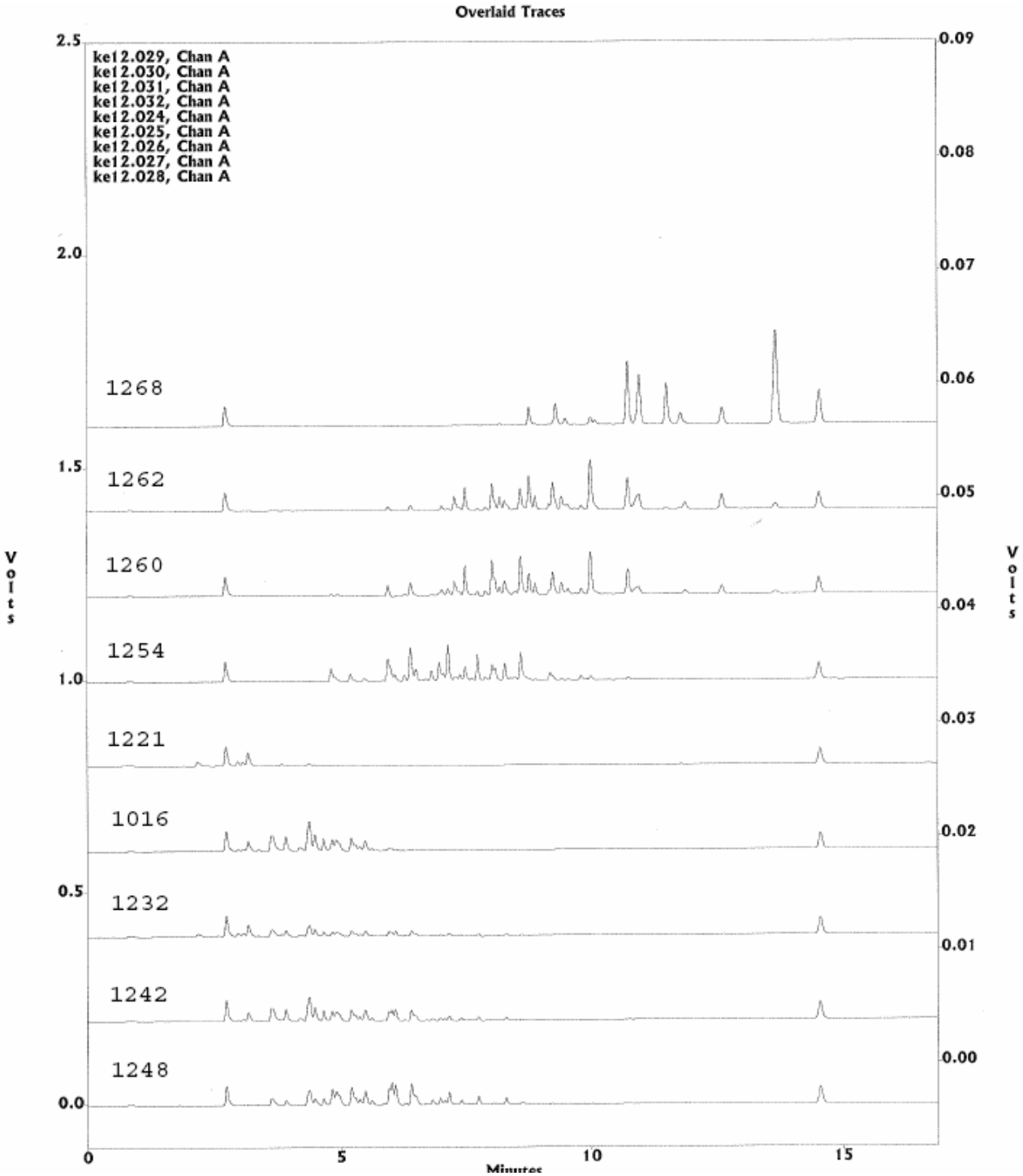


Figure 2. **TYPICAL PCB PATTERNS**

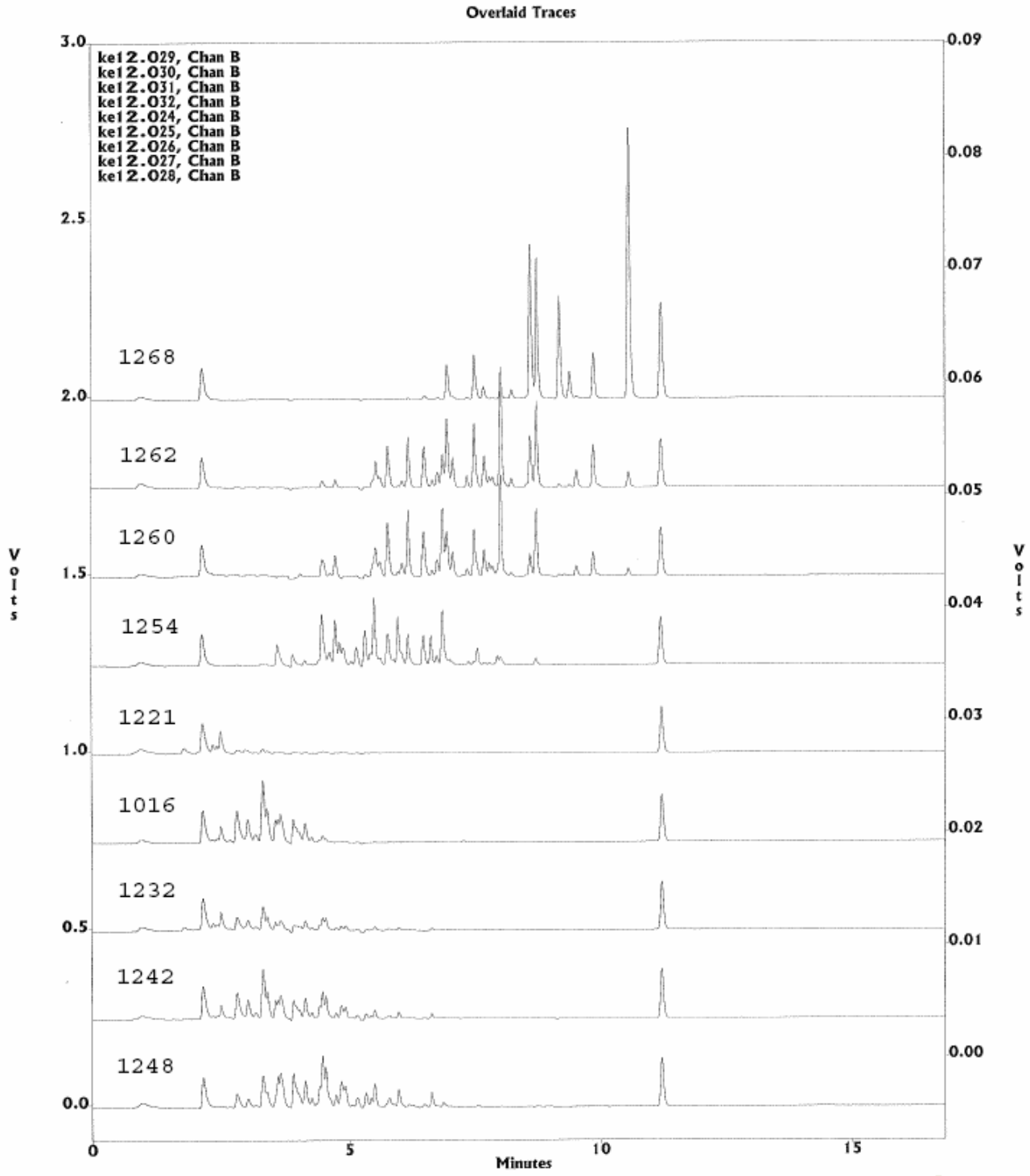


Figure 3. **TYPICAL 1016 / 1260 CHROMATOGRAM**

EPA 8082 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\ke12\ke12.005
Method : c:\ezchrom\methods\6071e12.met
Sample ID : 6071E1203 500 PPB
Acquired : May 12, 2010 13:46:34
Printed : Jul 06, 2010 11:47:48
User : SUPAKIT

Channel A Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
2	TCX	2.742	184646	7843.7	25.0
5	1016-1	3.183	98764	966.5	100.0
8	1016-2	3.917	130541	1300.0	100.0
10	1016-3	4.375	331618	3303.7	100.0
11	1016-4	4.483	156449	1528.8	100.0
18	1016-5	5.475	94509	943.5	100.0
29	1260-1	7.500	226712	2257.3	100.0
37	1260-2	8.617	308711	3204.4	100.0
41	1260-3	9.267	182078	1940.0	100.0
46	1260-4	10.008	334873	3400.9	100.0
47	1260-5	10.750	205847	2092.8	100.0
54	DCB	14.542	190472	8157.5	25.0

Channel A Group Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
G1	PCB1016		811881	0.0	500.0
G2	PCB1260		1258221	0.0	500.0

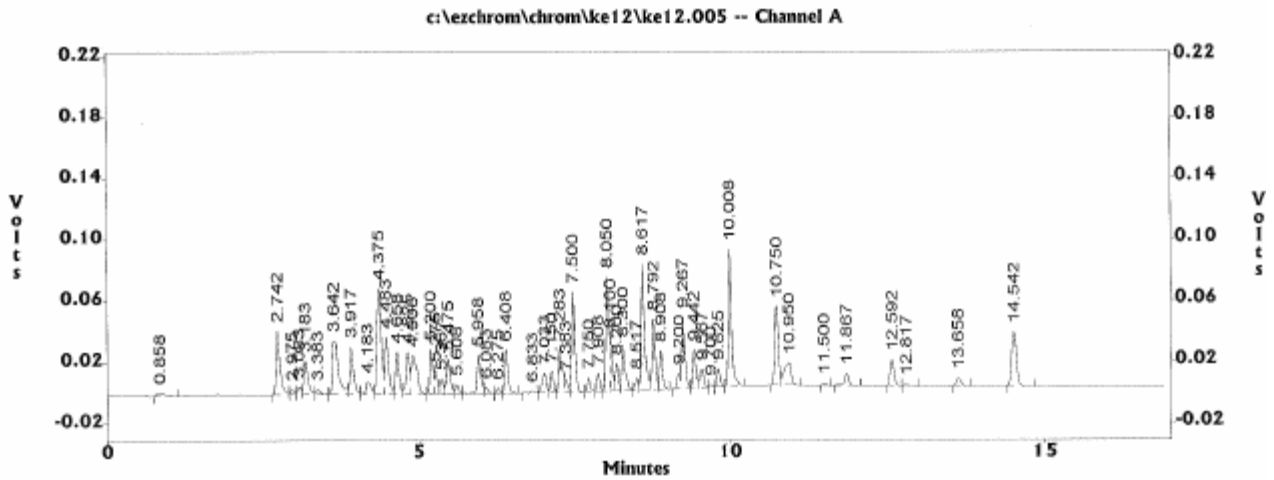


Figure 3. **TYPICAL 1016 / 1260 CHROMATOGRAM**

EPA 8082 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\ke12\ke12.005
Method : c:\ezchrom\methods\6071e12.met
Sample ID : 6071E1203 500 PPB
Acquired : May 12, 2010 13:46:34
Printed : Jul 06, 2010 11:47:48
User : SUPAKIT

Channel B Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
2	TCX	2.058	405999	17227.8	25.0
5	1016-1	2.417	216146	2158.1	100.0
7	1016-2	2.750	492961	4918.2	100.0
8	1016-3	2.967	292033	2947.8	100.0
10	1016-4	3.258	707016	6870.8	100.0
16	1016-5	4.108	228031	2312.7	100.0
27	1260-1	5.775	547555	5532.4	100.0
31	1260-2	6.483	560272	5650.6	100.0
34	1260-3	6.858	723859	7144.4	100.0
38	1260-4	7.492	473088	4839.6	100.0
42	1260-5	8.008	952668	9596.1	100.0
53	DCB	11.217	518117	22340.3	25.0

Channel B Group Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
G1	PCB1016		1936187	0.0	500.0
G2	PCB1260		3257442	0.0	500.0

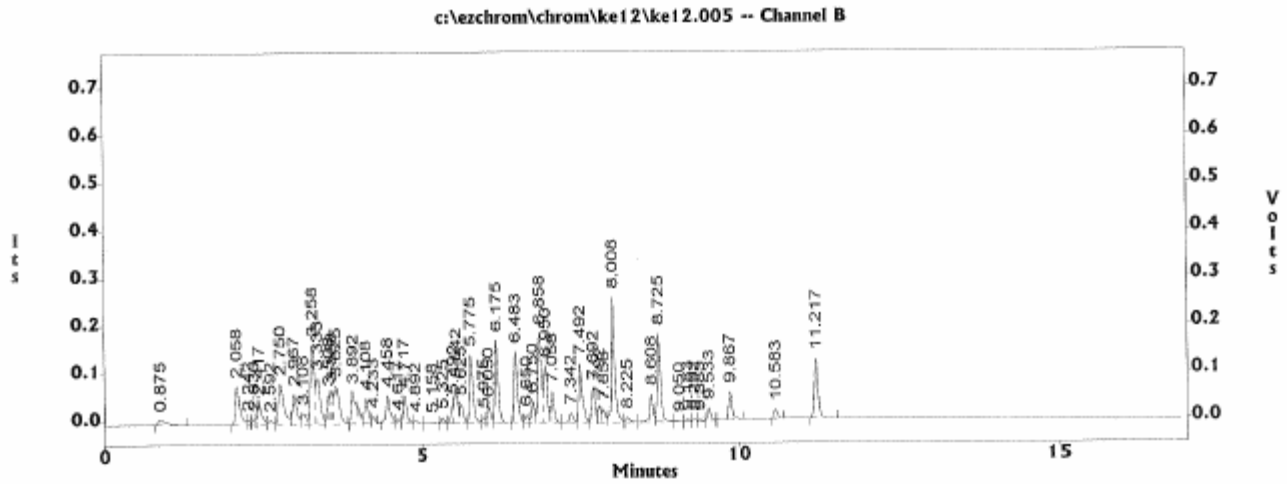


Figure 4. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12003A 05/12/10 13:04
LFID & Datetime: KE12004A 05/12/10 13:25
LFID & Datetime: KE12005A 05/12/10 13:46
LFID & Datetime: KE12006A 05/12/10 14:07
LFID & Datetime: KE12007A 05/12/10 14:28
LFID & Datetime: KE12008A 05/12/10 14:49
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1016-1	20.00	987.05	1038.88	987.64	960.15	934.82	890.44	966.497	5.3
PCB1016-2	20.00	1413.40	1343.84	1305.41	1293.97	1250.43	1193.01	1300.011	5.8
PCB1016-3	20.00	3364.75	3317.44	3316.18	3346.63	3309.61	3167.37	3303.663	2.1
PCB1016-4	20.00	1679.15	1544.80	1564.49	1488.03	1467.24	1429.37	1528.846	5.8
PCB1016-5	20.00	971.00	958.40	945.09	941.39	934.59	910.50	943.497	2.2
PCB1260-1	20.00	2569.85	2405.92	2267.12	2189.85	2126.44	1984.86	2257.338	9.2
PCB1260-2	20.00	3844.05	3256.32	3087.11	3075.08	3054.09	2910.04	3204.448	10.4
PCB1260-3	20.00	2156.30	2283.26	1820.78	1831.65	1809.52	1738.57	1940.013	11.5
PCB1260-4	20.00	3726.55	3512.28	3348.73	3351.35	3306.04	3160.39	3400.892	5.7
PCB1260-5	20.00	2183.05	2130.60	2058.47	2092.66	2072.56	2019.48	2092.805	2.7
SURROGATE	**X**	**1.00X**	**2.50X**	**5.00X**	**7.50X**	**10.00X**	**15.00X**	**MEAN**	**%RSD**
TCX	5.00	9588.80	7204.40	7385.84	7544.72	7664.22	7674.35	7843.721	11.1
DCB	5.00	10811.20	8312.32	7618.88	7590.00	7476.86	7136.00	8157.543	16.6

6071E12.MET

Figure 4. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12003B 05/12/10 13:04
LFID & Datetime: KE12004B 05/12/10 13:25
LFID & Datetime: KE12005B 05/12/10 13:46
LFID & Datetime: KE12006B 05/12/10 14:07
LFID & Datetime: KE12007B 05/12/10 14:28
LFID & Datetime: KE12008B 05/12/10 14:49
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1016-1	20.00	2531.45	2306.74	2161.46	2075.43	2003.85	1869.80	2158.122	10.9
PCB1016-2	20.00	5998.70	5331.48	4929.61	4653.03	4475.03	4121.31	4918.193	13.6
PCB1016-3	20.00	3400.80	3158.40	2920.33	2854.77	2734.06	2618.29	2947.775	9.8
PCB1016-4	20.00	7446.30	7058.40	7070.16	6812.91	6638.33	6198.53	6870.771	6.2
PCB1016-5	20.00	2554.75	2406.06	2280.31	2245.73	2230.83	2158.41	2312.682	6.2
PCB1260-1	20.00	6709.55	5976.02	5475.55	5249.51	5061.71	4722.36	5532.450	12.9
PCB1260-2	20.00	6475.75	5952.82	5602.72	5484.26	5350.77	5037.32	5650.606	8.9
PCB1260-3	20.00	7890.30	7385.60	7238.59	7049.84	6869.64	6432.58	7144.424	6.9
PCB1260-4	20.00	5623.90	5052.46	4730.88	4677.04	4583.27	4370.15	4839.618	9.2
PCB1260-5	20.00	10787.75	10010.90	9526.68	9400.84	9168.59	8681.76	9596.087	7.6
SURROGATE	**X**	**1.00X**	**2.50X**	**5.00X**	**7.50X**	**10.00X**	**15.00X**	**MEAN**	**%RSD**
TCX	5.00	22174	16063	16240	16423	16416	16051	17227.8	14.1
DCB	5.00	30064	22874	20725	20671	20389	19319	22340.3	17.7

6071E12.MET

Figure 4. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12017A 05/12/10 17:59
LFID & Datetime: KE12018A 05/12/10 18:20
LFID & Datetime: KE12019A 05/12/10 18:41
LFID & Datetime: KE12020A 05/12/10 19:02
LFID & Datetime: KE12021A 05/12/10 19:23
LFID & Datetime: KE12022A 05/12/10 19:44
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1254-1	20.00	1745.15	1508.44	1541.66	1508.27	1524.72	1449.51	1546.292	6.6
PCB1254-2	20.00	2968.10	2825.48	2598.64	2504.80	2465.00	2329.33	2615.225	9.1
PCB1254-3	20.00	2712.95	2670.38	2516.27	2486.73	2970.83	2883.74	2706.817	7.1
PCB1254-4	20.00	2061.75	1996.88	1827.72	1717.84	1811.94	1748.45	1860.762	7.4
PCB1254-5	20.00	1290.55	1236.58	1137.25	1131.21	1165.51	1158.65	1186.624	5.3

5471E12.MET

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12017B 05/12/10 17:59
LFID & Datetime: KE12018B 05/12/10 18:20
LFID & Datetime: KE12019B 05/12/10 18:41
LFID & Datetime: KE12020B 05/12/10 19:02
LFID & Datetime: KE12021B 05/12/10 19:23
LFID & Datetime: KE12022B 05/12/10 19:44
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1254-1	20.00	7034.10	6630.54	6135.43	5886.83	5495.82	5114.34	6049.510	11.7
PCB1254-2	20.00	5282.65	4879.32	4430.71	4305.54	3938.39	3517.12	4392.288	14.4
PCB1254-3	20.00	8787.45	7704.46	7407.97	7251.58	6952.21	6575.30	7446.497	10.2
PCB1254-4	20.00	5818.55	5466.08	5323.35	5128.29	5100.35	4325.48	5193.684	9.6
PCB1254-5	20.00	3664.55	3506.54	3238.12	3257.10	3171.97	2955.18	3298.910	7.6

5471E12.MET

Figure 4. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12010A 05/12/10 15:31
LFID & Datetime: KE12011A 05/12/10 15:52
LFID & Datetime: KE12012A 05/12/10 16:13
LFID & Datetime: KE12013A 05/12/10 16:34
LFID & Datetime: KE12014A 05/12/10 16:56
LFID & Datetime: KE12015A 05/12/10 17:17
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1248-1	20.00	1843.10	1763.30	1715.84	1697.99	1687.93	1654.19	1727.057	3.9
PCB1248-2	20.00	1521.90	1411.90	1303.59	1260.51	1205.49	1131.78	1305.861	10.8
PCB1248-3	20.00	1286.25	1237.96	1214.85	1192.17	1197.47	1187.97	1219.445	3.1
PCB1248-4	20.00	1623.60	1561.46	1562.23	1519.13	1553.84	1543.37	1560.604	2.2
PCB1248-5	20.00	1717.60	1631.02	1442.60	1526.57	1481.25	1423.11	1537.026	7.5

4871E12.MET

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12010B 05/12/10 15:31
LFID & Datetime: KE12011B 05/12/10 15:52
LFID & Datetime: KE12012B 05/12/10 16:13
LFID & Datetime: KE12013B 05/12/10 16:34
LFID & Datetime: KE12014B 05/12/10 16:56
LFID & Datetime: KE12015B 05/12/10 17:17
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1248-1	20.00	3818.70	3696.56	3596.55	3554.63	3490.39	3327.74	3580.761	4.7
PCB1248-2	20.00	3214.65	3076.66	2982.88	2939.41	2875.33	2765.65	2975.765	5.3
PCB1248-3	20.00	5261.95	4964.34	4747.95	4590.34	4487.60	4255.45	4717.939	7.6
PCB1248-4	20.00	2924.55	2790.58	2696.63	2655.51	2598.89	2468.50	2689.110	5.8
PCB1248-5	20.00	2529.30	2430.32	2484.94	2368.52	2368.48	2269.00	2408.426	3.9

4871E12.MET

Figure 5. **TYPICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12003A 05/12/10 13:04
LFID & Datetime: KE12004A 05/12/10 13:25
LFID & Datetime: KE12005A 05/12/10 13:46
LFID & Datetime: KE12006A 05/12/10 14:07
LFID & Datetime: KE12007A 05/12/10 14:28
LFID & Datetime: KE12008A 05/12/10 14:49

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
PCB1016-1	3.183	3.183	3.183	3.183	3.183	3.183	3.183	3.145	3.221	0.038
PCB1016-2	3.925	3.925	3.917	3.925	3.917	3.925	3.922	3.893	3.951	0.029
PCB1016-3	4.375	4.375	4.375	4.375	4.375	4.375	4.375	4.361	4.389	0.014
PCB1016-4	4.492	4.492	4.483	4.492	4.483	4.492	4.489	4.475	4.503	0.014
PCB1016-5	5.475	5.483	5.475	5.475	5.475	5.483	5.478	5.440	5.516	0.038
PCB1260-1	7.500	7.508	7.500	7.500	7.500	7.508	7.503	7.465	7.541	0.038
PCB1260-2	8.617	8.617	8.617	8.617	8.617	8.617	8.617	8.601	8.633	0.016
PCB1260-3	9.267	9.267	9.267	9.267	9.267	9.267	9.267	9.239	9.295	0.028
PCB1260-4	10.008	10.008	10.008	10.008	10.008	10.008	10.008	9.970	10.046	0.038
PCB1260-5	10.750	10.750	10.750	10.750	10.750	10.750	10.750	10.712	10.788	0.038
SURROGATE	**1.0X**	**2.5X**	**5.0X**	**7.5X**	**10.0X**	**15.0X**	**RT**	**FROM**	**TO**	**WIDTH**
TCX	2.742	2.750	2.742	2.750	2.742	2.750	2.746	2.718	2.774	0.028
DCB	14.533	14.542	14.542	14.542	14.542	14.542	14.541	14.478	14.604	0.063

6071E12.MET

Figure 5. **TYPICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCTO71 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12003B 05/12/10 13:04
LFID & Datetime: KE12004B 05/12/10 13:25
LFID & Datetime: KE12005B 05/12/10 13:46
LFID & Datetime: KE12006B 05/12/10 14:07
LFID & Datetime: KE12007B 05/12/10 14:28
LFID & Datetime: KE12008B 05/12/10 14:49

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
PCB1016-1	2.417	2.417	2.417	2.417	2.417	2.417	2.417	2.379	2.455	0.038
PCB1016-2	2.750	2.750	2.750	2.750	2.750	2.750	2.750	2.712	2.788	0.038
PCB1016-3	2.967	2.967	2.967	2.967	2.967	2.967	2.967	2.929	3.005	0.038
PCB1016-4	3.258	3.258	3.258	3.258	3.258	3.258	3.258	3.220	3.296	0.038
PCB1016-5	4.108	4.117	4.108	4.108	4.108	4.117	4.111	4.073	4.149	0.038
PCB1260-1	5.783	5.783	5.775	5.783	5.783	5.783	5.782	5.729	5.835	0.053
PCB1260-2	6.492	6.492	6.483	6.492	6.492	6.492	6.490	6.452	6.529	0.038
PCB1260-3	6.858	6.858	6.858	6.858	6.858	6.858	6.858	6.815	6.901	0.043
PCB1260-4	7.492	7.492	7.492	7.492	7.492	7.492	7.492	7.440	7.544	0.052
PCB1260-5	8.008	8.017	8.008	8.008	8.008	8.008	8.009	7.966	8.052	0.043
SURROGATE	**1.0X**	**2.5X**	**5.0X**	**7.5X**	**10.0X**	**15.0X**	**RT**	**FROM**	**TO**	**WIDTH**
TCX	2.058	2.058	2.058	2.058	2.058	2.058	2.058	2.020	2.096	0.038
DCB	11.217	11.225	11.217	11.217	11.217	11.225	11.220	11.168	11.272	0.052

6071E12.MET

Figure 5. **TYPICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCTO71 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12017A 05/12/10 17:59
LFID & Datetime: KE12018A 05/12/10 18:20
LFID & Datetime: KE12019A 05/12/10 18:41
LFID & Datetime: KE12020A 05/12/10 19:02
LFID & Datetime: KE12021A 05/12/10 19:23
LFID & Datetime: KE12022A 05/12/10 19:44

COMPOUND	RT OF STANDARDS (MIN)						MEAN	RT WINDOW		RTWINDOW
	1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	RT	FROM	TO	WIDTH
PCB1254-1	5.967	5.967	5.933	5.933	5.958	5.958	5.953	5.915	5.991	0.038
PCB1254-2	6.417	6.417	6.417	6.417	6.417	6.417	6.417	6.374	6.460	0.043
PCB1254-3	7.167	7.167	7.167	7.167	7.158	7.158	7.164	7.126	7.202	0.038
PCB1254-4	7.767	7.767	7.767	7.767	7.758	7.758	7.764	7.735	7.793	0.029
PCB1254-5	8.317	8.317	8.317	8.317	8.308	8.308	8.314	8.285	8.343	0.029

5471E12.MET

Lab Name : EMAX Inc
Instrument ID : GCTO71 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12017B 05/12/10 17:59
LFID & Datetime: KE12018B 05/12/10 18:20
LFID & Datetime: KE12019B 05/12/10 18:41
LFID & Datetime: KE12020B 05/12/10 19:02
LFID & Datetime: KE12021B 05/12/10 19:23
LFID & Datetime: KE12022B 05/12/10 19:44

COMPOUND	RT OF STANDARDS (MIN)						MEAN	RT WINDOW		RTWINDOW
	1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	RT	FROM	TO	WIDTH
PCB1254-1	4.467	4.467	4.467	4.467	4.458	4.458	4.464	4.421	4.507	0.043
PCB1254-2	4.733	4.733	4.733	4.725	4.725	4.725	4.729	4.686	4.772	0.043
PCB1254-3	5.517	5.517	5.517	5.517	5.508	5.517	5.516	5.473	5.559	0.043
PCB1254-4	5.983	5.983	5.992	5.983	5.983	5.983	5.984	5.946	6.022	0.038
PCB1254-5	6.183	6.183	6.183	6.183	6.183	6.183	6.183	6.155	6.211	0.028

5471E12.MET

Figure 5. **TYPICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12010A 05/12/10 15:31
LFID & Datetime: KE12011A 05/12/10 15:52
LFID & Datetime: KE12012A 05/12/10 16:13
LFID & Datetime: KE12013A 05/12/10 16:34
LFID & Datetime: KE12014A 05/12/10 16:56
LFID & Datetime: KE12015A 05/12/10 17:17

COMPOUND	RT OF STANDARDS (MIN)						MEAN	RT WINDOW		RTWINDOW
	1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	RT	FROM	TO	WIDTH
PCB1248-1	4.383	4.383	4.383	4.383	4.383	4.383	4.383	4.359	4.407	0.024
PCB1248-2	4.833	4.833	4.833	4.833	4.833	4.833	4.833	4.807	4.859	0.026
PCB1248-3	5.483	5.483	5.483	5.483	5.483	5.483	5.483	5.445	5.521	0.038
PCB1248-4	6.092	6.092	6.092	6.092	6.092	6.092	6.092	6.068	6.116	0.024
PCB1248-5	6.408	6.408	6.408	6.408	6.408	6.417	6.410	6.384	6.436	0.026

4871E12.MET
Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12010B 05/12/10 15:31
LFID & Datetime: KE12011B 05/12/10 15:52
LFID & Datetime: KE12012B 05/12/10 16:13
LFID & Datetime: KE12013B 05/12/10 16:34
LFID & Datetime: KE12014B 05/12/10 16:56
LFID & Datetime: KE12015B 05/12/10 17:17

COMPOUND	RT OF STANDARDS (MIN)						MEAN	RT WINDOW		RTWINDOW
	1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	RT	FROM	TO	WIDTH
PCB1248-1	3.258	3.258	3.258	3.258	3.258	3.258	3.258	3.244	3.272	0.014
PCB1248-2	4.117	4.117	4.117	4.117	4.117	4.117	4.117	4.091	4.143	0.026
PCB1248-3	4.458	4.458	4.458	4.458	4.458	4.458	4.458	4.434	4.482	0.024
PCB1248-4	4.842	4.842	4.842	4.842	4.842	4.842	4.842	4.813	4.871	0.029
PCB1248-5	5.517	5.517	5.517	5.517	5.517	5.517	5.517	5.479	5.555	0.038

4871E12.MET

Figure 6. **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 3520C/8082A
PCBs

Client	: XYZ, INC.	Date Collected:	05/19/10
Project	: CLEAN WATER	Date Received:	05/24/10
Batch No.	: 10E287	Date Extracted:	05/26/10 16:00
Sample ID:	YWEC-MW3-2487	Date Analyzed:	05/27/10 18:12
Lab Samp ID:	E287-01	Dilution Factor:	0.94
Lab File ID:	KE26087A	Matrix :	WATER
Ext Btch ID:	CPE068W	% Moisture :	NA
Calib. Ref.:	KE26084A	Instrument ID :	GCT071

PARAMETERS	RESULTS (ug/L)	LOQ (ug/L)	LOD (ug/L)
PCB-1016	(ND)|ND	0.94	0.47|0.47
PCB-1221	(ND)|ND	0.94	0.47|0.47
PCB-1232	(ND)|ND	0.94	0.47|0.47
PCB-1242	(ND)|ND	0.94	0.47|0.47
PCB-1248	(ND)|ND	0.94	0.47|0.47
PCB-1254	(ND)|ND	0.94	0.47|0.47
PCB-1260	(ND)|ND	0.94	0.47|0.47

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(84)|88	70-125
DECACHLOROBIPHENYL	(100)|91	40-135

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

Figure 7. **TYPICAL LCS REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
LCS ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER
BATCH NO.: 10E287
METHOD: METHOD 3520C/8082A

MATRIX: WATER % MOISTURE: NA
DILUTION FACTOR: 1 1
SAMPLE ID: MBLK1W
LAB SAMP ID: CPE068WB 60E068WL
LAB FILE ID: KE26085A KE26086A
DATE EXTRACTED: 05/26/1016:00 05/26/1016:00 DATE COLLECTED: NA
DATE ANALYZED: 05/27/1017:30 05/27/1017:51 DATE RECEIVED: 05/26/10
PREP. BATCH: CPE068W CPE068W
CALIB. REF: KE26084A KE26084A

ACCESSION:

PARAMETER	BLNK RSLT (ug/L)	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	QC LIMIT (%)
PCB-1016	(ND)|ND	5.00	(5.16)|4.81	(103)|96	25-145
PCB-1260	(ND)|ND	5.00	(5.52)|4.77	(110)|95	30-145

SURROGATE PARAMETER	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	QC LIMIT (%)
Tetrachloro-m-xylene	0.400	(0.353)|0.342	(88)|85	70-125
Decachlorobiphenyl	0.400	(0.397)|0.363	(99)|91	40-135

Figure 8. **TYPICAL MATRIX SPIKE SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER
BATCH NO.: 10E287
METHOD: METHOD 3520C/8082A

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	0.94	1.04	0.98		
SAMPLE ID:	YWEC-MW3-2487				
LAB SAMP ID:	E287-01	E287-01M	E287-01S		
LAB FILE ID:	KE26087A	KE26088A	KE26089A		
DATE EXTRACTED:	05/26/1016:00	05/26/1016:00	05/26/1016:00	DATE COLLECTED:	05/19/10
DATE ANALYZED:	05/27/1018:12	05/27/1018:33	05/27/1018:54	DATE RECEIVED:	05/24/10
PREP. BATCH:	CPE068W	CPE068W	CPE068W		
CALIB. REF:	KE26084A	KE26084A	KE26084A		

ACCESSION:

PARAMETER	SMPL RSLT (ug/L)	SPIKE AMT (ug/L)	MS RSLT (ug/L)	MS % REC	SPIKE AMT (ug/L)	MSD RSLT (ug/L)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
PCB-1016	(ND)|ND	5.20	(4.92)|4.59	(95)|88	4.90	(4.88)|4.60	(100)|94	(1)|0	25-145	30
PCB-1260	(ND)|ND	5.20	(5.38)|4.64	(103)|89	4.90	(5.32)|4.58	(109)|93	(1)|1	30-145	30

SURROGATE PARAMETER	SPIKE AMT (ug/L)	MS RSLT (ug/L)	MS % REC	SPIKE AMT (ug/L)	MSD RSLT (ug/L)	MSD % REC	QC LIMIT (%)
Tetrachloro-m-xylene	0.416	(0.338)|0.330	(81)|79	0.392	(0.344)|0.331	(88)|84	70-125
Decachlorobiphenyl	0.416	(0.404)|0.369	(97)|89	0.392	(0.392)|0.357	(100)|91	40-135

* : Outside of QC limits

Figure 9. **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN WATER

SDG : 10E287

METHOD 3520C/8082
PCBS

A total of five (5) water samples were received on 05/24/10 for Polychlorinated Biphenyls (PCBs) analysis, Method 3520C/8082A in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source (ICV). Continuing calibration (CCV) verifications were carried on a frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A lab control sample was analyzed with the samples in this SDG.
Percent recoveries for 60E068WL were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for E287-01M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Table 1. **INTERMEDIATE STANDARD PREPRATION**

Standard Name	Stock Standard Conc. (ppm)	Preparation			Final Conc. (µg/L)
		Aliquot (ml)	Solvent	Final Vol. (ml)	
PCB 1016	1000	0.2	Hexane	100	2000
PCB 1260	1000	0.2	Hexane	100	2000
PCB 1221	1000	0.2	Hexane	100	2000
PCB 1232	1000	0.2	Hexane	100	2000
PCB 1242	1000	0.2	Hexane	100	2000
PCB 1248	1000	0.2	Hexane	100	2000
PCB 1254	1000	0.2	Hexane	100	2000
Surrogate					
TCX	200	0.05	Hexane	100	100
DCB	200	0.05	Hexane	100	100

Table 2. **INITIAL CALIBRATION STANDARD PREPARATION**

Standard #	Standard Name	Intermediate Std. (µg/L)	Preparation			Final Conc. (µg/L)
			Aliquot (µl)	Solvent	Final Vol. (µl)	
1	PCB 1016/1260	2000	40	Hexane	800	100
	Surrogate	100				5
2	PCB 1016/1260	2000	100	Hexane	800	250
	Surrogate	100				12.5
3	PCB 1016/1260	2000	200	Hexane	800	500
	Surrogate	100				25
4	PCB 1016/1260	2000	300	Hexane	800	750
	Surrogate	100				37.5
5	PCB 1016/1260	2000	400	Hexane	800	1000
	Surrogate	100				50
6	PCB 1016/1260	2000	600	Hexane	800	1500
	Surrogate	100				75

Table 3. CALIBRATION CHECK STANDARD PREPRATION

Standard Name	Intermediate Standard Conc. (mg/L)	Preparation			Final Conc. (µg/L)
		Aliquot (µl)	Solvent	Final Vol. (ml)	
PCB 1016	2000	200	Hexane	800	500
PCB 1260	2000	200			
PCB 1221	2000	400	Hexane	800	1000
PCB 1232	2000	200	Hexane	800	500
PCB 1242	2000	200	Hexane	800	500
PCB 1248	2000	200	Hexane	800	500
PCB 1254	2000	200	Hexane	800	500
Surrogate					
TCX	100	200	Hexane	800	25
DCB	100	200	Hexane	800	25

Table 4 SPIKE STANDARD AND SURROGATE STANDARDS PREPARATION

Standard Name	Stock Standard Conc. (mg/L)	Preparation			Final Conc. (µg/L)
		Aliquot (ml)	Solvent	Final Vol. (ml)	
PCB 1016	1000	1.0	Hexane	100	10,000
PCB 1260	1000	1.0	Hexane		
Surrogate					
TCX	200	2	Hexane	1000	400
DCB	200	2	Hexane	1000	400

Table 5. COMPOUND LIST

Analyte		Surrogate
PCB-1016	PCB-1248	Decachlorobiphenyl
PCB-1221	PCB-1254	Tetrachloro-m-xylene
PCB-1232	PCB-1260	
PCB-1242		

Table 6. ESTABLISHED LIMIT OF DETECTION (LOD) AND LIMIT OF QUANTITATION (LOQ)

MATRIX: AQUEOUS	DL	LOD	LOQ	Unit
PCB1016	0.454	0.5	1	µg/L
PCB1221	0.287	0.5	1	µg/L
PCB1232	0.165	0.5	1	µg/L
PCB1242	0.196	0.5	1	µg/L
PCB1248	0.149	0.5	1	µg/L
PCB1254	0.196	0.5	1	µg/L
PCB1260	0.309	0.5	1	µg/L
PCB1262	0.191	0.5	1	µg/L
PCB1268	0.170	0.5	1	µg/L
SURROGATES				
Tetrachloro-m-xylene	0.020	0.025	0.05	µg/L
Decachlorobiphenyl	0.025	0.025	0.05	µg/L

Reference: Detection Limit Study dated January 2010.

MATRIX: SOIL	DL	LOD	LOQ	Unit
PCB1016	13.2	16.7	33.3	µg/Kg
PCB1221	7.04	16.7	33.3	µg/Kg
PCB1232	9.04	16.7	33.3	µg/Kg
PCB1242	9.33	16.7	33.3	µg/Kg
PCB1248	6.51	16.7	33.3	µg/Kg
PCB1254	6.62	16.7	33.3	µg/Kg
PCB1260	9.86	16.7	33.3	µg/Kg
PCB1262	4.18	16.7	33.3	µg/Kg
PCB1268	6.15	16.7	33.3	µg/Kg
SURROGATES				
Tetrachloro-m-xylene	1.2	1.2	1.67	µg/Kg
Decachlorobiphenyl	0.3	1.2	1.67	µg/Kg

Reference: Detection Limit Study dated January 2010.

MATRIX: SOIL (LOW LEVEL)	DL	LOD	LOQ	Unit
PCB1016	1.26	5	10	µg/Kg
PCB1221	2.93	5	10	µg/Kg
PCB1232	2.08	5	10	µg/Kg
PCB1242	2.07	5	10	µg/Kg
PCB1248	1.52	5	10	µg/Kg
PCB1254	1.33	5	10	µg/Kg
PCB1260	1.43	5	10	µg/Kg
PCB1262	1.64	5	10	µg/Kg
PCB1268	1.11	5	10	µg/Kg
SURROGATES				
Tetrachloro-m-xylene	0.07	0.25	0.5	µg/Kg
Decachlorobiphenyl	0.08	0.25	0.5	µg/Kg

Reference: Detection Limit Study dated February/March 2010.

SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	FLAGGING CRITERIA	1ST Rvw	2ND Rvw
5 Point Initial Calibration for PCB 1016 + 1260	Initially, as needed	Mean RSD for each PCB ≤20%. Linear – least squares regression r>0.995.	Correct then problem then repeat initial calibration			
Initial calibration verification for PCB 1016/1260 mix (Second Source)	Once per 5-point initial calibration	All analytes within ±20% of expected value from the ICAL.	Correct then problem then repeat initial calibration			
Continuing calibration verification for PCB 1016/1260 mix	After every 12 hours and at the end of the analytical sequence	All analytes within ± 20% of expected value	Correct the problem then reanalyze all samples since last successful continuing calibration			
Method Blank	One per preparation batch (≤ 20 samples per matrix)	No analytes detected ≥ ½ LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Re-prep and re-analyze method blank and all samples processed with the contaminated blank	Apply B to specific analyte(s) on all associated samples		
LCS (PCB 1016/1260)	One LCS per analytical batch (≤20 samples per matrix)	Within project QC Limits	Correct the problem then re-prep and re-analyze the LCS and all samples in the affected AFCEE analytical batch			
Surrogate Spike	Every sample, spiked sample, standard, and method blank	Within project QC Limits	Re-extract and re-analyze the sample when both surrogates are out of control.			
Matrix Spike/ Matrix Spike Duplicate (PCB 1016/1260 mix)	One MS/MSD per 20 project samples per matrix	Within project QC Limits	If chromatogram is indicative of matrix interference, discuss in case narrative. Otherwise, check for probable source of error and perform corrective action as necessary.			
Comments: Apply J to all values between LOD and LOQ				Reviewed By:		
				Date:		

DEMONSTRATION OF CAPABILITY

PT # WP0110 Water Pollution Proficiency Testing **PT Study Closing Date: Feb. 18, 2010**

Method: SW 3520 C / SW 8082 A Analyst: Supakit Deesopha

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aroclor 1016	0	µg/L	0				Acceptable
2	Aroclor 1221	0	µg/L	0				Acceptable
3	Aroclor 1232	3.05	µg/L	2.77	0.542	-	4.54	Acceptable
4	Aroclor 1242	0	µg/L	0				Acceptable
5	Aroclor 1248	0	µg/L	0				Acceptable
6	Aroclor 1254	0	µg/L	0				Acceptable
7	Aroclor 1260	0	µg/L	0				Acceptable

PT # WP0110 Water Pollution Proficiency Testing **PT Study Closing Date: Feb. 18, 2010**

Method: SW 3580 / SW 8082 A Analyst: Supakit Deesopha

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aroclor 1016	18.6	mg/Kg	30.1	4.83	-	42.0	Acceptable
4	Aroclor 1242	0	mg/Kg	0				Acceptable
6	Aroclor 1254	0	mg/Kg	0				Acceptable
7	Aroclor 1260	0	mg/Kg	0				Acceptable

PT # HW0110 Soil/Hazardous Waste Proficiency Testing **PT Study Closing Date: Mar. 4, 2010**

Method: SW 3550 C / SW 8081 B Analyst: Enrico Santos

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aroclor 1016	5.81	mg/kg	6.03	1.22	-	8.42	Acceptable
2	Aroclor 1221	<0.05	mg/kg	<0.2				Acceptable
3	Aroclor 1232	<0.05	mg/kg	<0.2				Acceptable
4	Aroclor 1242	<0.05	mg/kg	<0.2				Acceptable
5	Aroclor 1248	<0.05	mg/kg	<0.2				Acceptable
6	Aroclor 1254	<0.05	mg/kg	<0.2				Acceptable
7	Aroclor 1260	<0.05	mg/kg	<0.2				Acceptable
8	Total PCBs	5.81	mg/kg	6.03	1.22	-	8.42	Acceptable

ANALYSIS RUN LOG
for
PESTICIDES/PCBs

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Comments:

Book #: A071-25

Instrument No.: 71

Analytical Sequence:

Method File:

Analytical Batch:

SOP #	Rev. #
☐ EMAX-8081	6
☐ EMAX-8082	3
☐ EMAX-608	0
☐ EMAX-CLP-PEST	
☐ EMAX-	

ICAL REFERENCE

ICAL ID	BATCH	DATE

STANDARDS ID	Conc (µg/L)
Hexane	

Column	A. ZB-MULTI RES I B. ZB-MULTI RES I I

ELECTRONIC DATA ARCHIVAL

Location	Date
☐ EZC_4_Pesticides	
☐ EZC_10_Pesticides	

Analyzed By: Date:

Date Disposed: Disposed By:

This page is checked during data review.

8082FP. **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

FileID: CP10H01W.xls

EXTRACTION LOG FOR PESTICIDES AND PCBs

PrepBatchID	Lab Sample ID	Aliquot	Unit	DateTime	Sonicator	pH	Ve(ml)	DateTime	Cleanup	Comments

Prepared By: _____

Checked By: _____ Date _____

INSTRUMENT MAINTENANCE LOG

Instrument No: 72 **Month** **Year: 200_** **Book #** **M72-001**

Date							
Column Head Pressure							
Column Temperature							
FID lit up							
FID signal within specs							
Autosampler							
Check make up gas flow							
Run instrument blank							
Computer Date/Time							
Computer Paper							
Analyst Initial							

Trouble Shooting							
Problem(s) Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

STANDARD OPERATING PROCEDURES

VOLATILE ORGANICS BY GC/MS

SOP No.:	EMAX-8260	Revision No.	6	Effective Date:	25-Oct-10
Prepared By:	W. Tu Nisamaneepong			Date:	10-29-10
Approved By:	Kenette Pimentel QA Manager			Date:	10-25-10
Approved By:	Caspar Pang Laboratory Director			Date:	10-25-10

Control Number: 8260-06-

1.0 SCOPE AND APPLICATION

1.1. This analytical method is used to determine the concentration of volatile organic compounds whose boiling points are below 200°C and are water insoluble or slightly water-soluble found in solid or liquid samples. The list of compounds is summarized in Tables 7 and 8. Additional analytes may be added after verification. This SOP is an adaptation of Method 8260B.

2.0 SUMMARY OF METHOD

2.1. A measured sample is extracted using a purge and trap concentrator system. The extract is introduced to a temperature-programmed GC. The analytes are eluted through the GC column separating each analyte relative to its volatility. These analytes are captured and ionized by the mass spectrometer. The ionized fragments are measured by mass to charge ratio. Analyte qualitative identification is based on the characteristic electron impact mass spectra. Analyte quantitative identification is based on the response of the major ion relative to an internal standard using a multi-point calibration curve.

2.2. **Interferences**

2.2.1. Contamination may occur by diffusion of volatile organics (particularly chlorofluorocarbons and methylene chloride) through sample container septum during shipment and storage. Trip blanks and storage blanks can serve as means of monitoring.

2.2.2. Glassware and other sample processing materials in which the samples come into contact with are possible sources of contamination. All glassware and other materials used must be purchased pre-cleaned or decontaminated prior to use.

2.2.3. Solvents and reagents are possible sources of contamination. All solvents and reagents must be GC grade and must pass the QC checks prior to use.

2.2.4. Contamination by carry-over can occur whenever high concentration samples are analyzed in sequence with a low concentration sample. To reduce potential carry-over, the concentrator must be thoroughly baked-out between samples and the sample syringe and purging device must be thoroughly rinsed with an appropriate solvent between samples.

2.2.5. Another possible source of contamination is the analytical instrument itself. This can be monitored by analyzing an instrument blank prior to any analysis.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Refer to Tables 7 and 8 for established DL, LOD and LOQ levels.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point (see Sec. 9.4). All samples analyzed above this concentration are considered "over-range" and shall require dilution to properly quantitate.

4.2. The concentration in the diluted sample should be at or above the project reporting limit. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required to properly quantitate.

4.3. **Typical Dynamic Range**

4.3.1. Water: 5 µg/L to 200 µg/L (5 ml purge)
1 µg/L to 40 µg/L (25 ml purge)

4.3.2. Soil: 5 µg/kg to 200 µg/kg

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Aqueous Samples**

5.1.1. Samples received in the laboratory should be contained in 40 ml vials with teflon lined septa with zero headspace.

Note: The size of any bubble caused by degassing upon cooling the sample should not exceed 6 mm.[1]

5.1.2. All samples must be stored at $\leq 6^{o}$C).

5.1.3. Samples preserved in HCL shall be analyzed within 14 days from the date of sampling. Samples with no chemical preservative must be analyzed within 7 days from the date of sampling.

5.2. **Soil Samples**

5.2.1. Samples receive in a glass jars or brass tubes shall be stored at $\leq 6^{o}$C. Samples must be analyzed within 14 days from sampling date.

5.2.2. Samples received in encore tubes are frozen, preserved with sodium bisulfate or extracted with methanol prior to analysis.

- Frozen encore tubes must be analyzed within 14 days from sampling date.
- Samples preserved with sodium bisulfate within 48 hours from sampling date must be analyzed within 14 days from sampling date.
- Methanol extracts shall be analyzed within 14 days from sampling date.
- Preserved samples and extracts shall be stored at $\leq 6^{o}$C.

[1] Referenced from SW846 Method 5030B, Section 6.1.

6.0 ASSOCIATED SOPs

6.1. EMAX-5030 - Purge and Trap For Aqueous Samples

6.2. EMAX-5035 - Closed-System Purge and Trap For Solid Samples

6.3. EMAX-DM01- Data Flow and Review

6.4. EMAX-QA04 - Method Detection Limit

6.5. EMAX-QA05 - Training

6.6. EMAX-QA08 - Corrective Action

6.7. EMAX-QC01 - Quality Control for Chemicals

6.8. EMAX-QC02 - Analytical Standard Preparation

6.9. EMAX-QC07 - Glassware Cleaning

6.10. EMAX-SM03 - Waste Disposal

6.11. EMAX-SM04 - Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. All reagents, standards, and samples shall be treated as potential hazards. Observe standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, and gloves, shall be worn at all times when performing this procedure. All sample and standard handling shall be performed in the fume hood.

7.3. All waste generated during analytical process shall be placed in the waste containers. Waste shall be endorsed to the waste disposal section for proper disposal.

7.4. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatography	HP 5890 Series II or equivalent
Detector	HP 5970 MSD or equivalent
Column	RTX 502.2 (0.32 mm x 60 m), 1.8um thickness or equivalent after verification that the four gases (chloromethane, bromomethene, chloroethane, and vinyl chloride) can be resolved > 90% from each other in the total ion chromatogram
Data Acquisition Software	ChemStation or equivalent
Purge & Trap Device	2000/OI 4460A/Dyna Tech/EST or equivalent

Multiple purging module	DynaTech/Archon or equivalent
Gases	Ultra-high purity helium/Air
Syringes	5-ml, 25-ml Luerlok gas-tight
Microsyringes	1, 10, 20, 25, 50, 100, and 1000 µL (Hamilton 702N or equivalent) for dilution purposes
Volumetric Flasks	2,5,10, 50, and 100 ml with ground glass stopper
Heated Jacket	Tekmar or O.I. Automatic sample heating jacket or equivalent

8.2. **Chemicals and Reagents**

Extraction Solvent	Purge & Trap Grade Methanol or equivalent
Reagent Water	Organic-free water
Reagent Soil	Organic-free Ottawa Sand or equivalent
Preservative	Sodium Bisulfate

9.0 STANDARDS

9.1. Standard preparation for VOA is summarized in Tables 1 to 4. Refer to EMAX-QC02 for proper analytical standard preparation. Other concentration levels may be prepared provided it complies with the method and project requirements.

9.2. **Stock Standard**

9.2.1. Purchase Stock Standards as certified solutions.

9.2.2. Purchase one set of calibration standard (Refer to Tables 1) for calibration and a secondary source Stock Standard for calibration verification (Refer to Table 2).

9.2.3. Purchase Surrogate Mix at 2500 mg/L and Internal Standard at 2000 mg/L (Refer to Table 3).

9.2.4. Purchase BFB as Tuning Standard at 5000 mg/L (refer to Table 4).

9.2.5. After opening, transfer in inert vials with minimal headspace and store at -10°C to -20°C.

9.3. **Intermediate Standards**

9.3.1. Using the stock standard solutions, prepare intermediate standards in methanol according to Tables 1 to 4 and store with minimal headspace in an inert vial.

9.4. **Initial Calibration Standards (ICAL)**

9.4.1. ICAL for 5-ml Purge.

9.4.1.1. Using intermediate standards, prepare a minimum of 6 calibration standards as suggested below.

Calibration Pt.	VOA (µg/L)*	Surrogate (µg/L)	Internal Std (µg/L)
1	5	5	50
2	10	10	50
3	20	20	50
4	50	50	50
5	100	100	50
6	200	200	50

* Ketones, Acrolein, Acrylonitrile and tert-Butanol are 5X the indicated concentration and m/p-Xylene is 2x the indicated concentration.

9.4.2. ICAL for 25-ml Purge

9.4.2.1. Using intermediate standards, prepare a minimum of 6 calibration standards as suggested below:

Calibration Pt.	VOA (µg/L)*	Surrogate (µg/L)	Internal Std (µg/L)
1	0.5	0.5	10
2	1	1	10
3	2	2	10
4	10	10	10
5	20	20	10
6	40	40	10

* Ketones, Acrolein, Acrylonitrile and tert-Butanol are 5X the indicated concentration and m/p-Xylene is 2x the indicated concentration.

9.5. **Initial Calibration Verification Standard (ICV)**

9.5.1. Using the Intermediate Standard prepared from the secondary source, spike into 5-ml or 25-ml purge. Refer to Table 5 for concentration levels of each analyte.

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Using the Intermediate Standard prepared from the same source as the ICAL Standard, spike into 5-ml or 25-ml purge. Spike also Surrogate Standard. Refer to Table 5 for concentration levels of each analyte.

9.7. **LCS and Matrix Spike Standard**

9.7.1. For spike standards, use the ICV standard unless otherwise specified by the project. Refer to Table 5.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Refer to EMAX-5030 and EMAX-5035.

10.2. **Instrument Parameters**

10.2.1. From the main gas supply (gas Tanks) regulate gas pressure at 80 psi.

10.1.1. Fine-tune the instrument guided by the parameter conditions suggested below. Adjust the parameter conditions accordingly to obtain optimum condition. Print the instrument parameter and post it on the instrument for daily routine maintenance check.

10.2.2. Typical GC Parameters

Carrier gas flow (column) helium	1 - 5 ml/min
Initial Temp	40°C; hold for 1 min.
Rate	6°C/min.
Final Temp	200°C; hold for 1 min.
Inject Port	160°C
Interface	250°C

10.2.3. Mass Spectrometer Parameter

Scan Start	0.5 min.
Splitless value time	0 min.
Mass Range	35 to 300
Multiplier	1200 to 2700

10.2.4. Typical Purge and Trap Condition

10.2.4.1. Purge samples at 40°C for 11 minutes, desorbed at 250°C for 2 minutes and then bake the trap at 260°C for 11 minutes.

10.3. **Calibration**

10.3.1. Set GC/MS operating condition as described in Section 10.2.

10.3.2. **Perform Tune Check**

10.3.2.1. Introduce a BFB[2] to yield 5 – 50ng on column by either direct injection or purge and trap in 5-ml or 25-ml organic-free water.

10.3.2.2. Evaluate the tune check by the highest scan on the peak or the average of at least 3 scans (before, at, and after the apex) with a background subtraction using a single scan no more than 20 scans prior to the elution of BFB.

10.3.2.3. Check Table 6 for acceptance criteria or follow the manufacturer's recommendation for tuning. A valid tune check expires after 12 hours.

10.3.2.4. If non-compliant refer to Section 12 for corrective action.

10.3.3. **Initial Calibration (ICAL)**

[2] Alternatively, BFB in DCC can be used to evaluate tuning.

10.3.3.1. Perform ICAL when one of the conditions occurs.

- Instrument is new
- Instrument undergoes a major repair
- DCC failed to meet the acceptance criteria

10.3.3.2. Analyze minimum of 6-point initial calibration curve (Refer to Section 9.4) after a valid tune check.

10.3.3.3. Check for completeness of target compound list. If there is/are missing compound(s), perform the following:

- Check the established retention time window
- Check the relative intensity of major ions
- Adjust accordingly if necessary.

10.3.3.4. Establish a summary of Relative Response Factors for each analyte at each concentration. Calculate the Average Relative Response Factor (RRF_m), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to Eq. 10.6.1.2, Eq. 10.6.1.5 and Eq. 10.6.1.6, respectively.

10.3.3.5. Evaluate System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) as specified in Appendix 1.

10.3.3.6. Evaluate the ICAL for appropriate quantitation method.

- Use RRF_m if the RSD of individual analyte $\leq$15%.
- Apply Inverse Weighting Factor (1/y or $1/y^2$; where y is the instrument response) if it is determined to be the best fit for the specific analytes. This approach may be applied to any analyte including analyte that has RSD of $\leq$15% and correlation coefficient of ≥0.99.
- Apply linear least squares regression if past experience or priori knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of $\leq$15% and correlation coefficient of ≥0.99.
- It may be appropriate to force the regression through zero for specific analytes.[3] When exercising this option (as included in the data acquisition software) make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.3.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.4. **Initial Calibration Verification (ICV)**

10.3.4.1. Analyze ICV to verify the concentration of the ICAL standards (refer to Section 9.5).

[3] SW846 Method 8000B, Section 7.5.3

10.3.4.2. Check for completeness of analytes as described in Section 10.4.2.

10.3.4.3. Compare the retention times of the internal standards to the ICAL mid-point. Excursion of ± 30 seconds indicates instrument malfunction. When non-compliant check the column head pressure, gas supply or leaks. Corrective action is required prior to further analysis.

10.3.4.4. Compare the area of the Internal Standards (IS) acquired against the midpoint of the initial calibration point. The extracted ion current profile (EICP) must be within a factor of two (-50% to +100%).

10.3.4.5. Refer to Appendix 1 for ICV acceptance criteria and/or corrective action.

10.3.4.6. When non-compliant refer to Section 12 for corrective action.

10.3.5. **Daily Continuing Calibration (DCC)**

10.3.5.1. Analyze DCC to check the validity of the ICAL (refer to 9.6).

10.3.5.2. Check for completeness of analytes as described in Section 10.4.2.

10.3.5.3. Evaluate System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) as specified in Appendix 1.

10.3.5.4. Compare the retention times of the internal standards to the ICAL mid-point. Excursion of ± 30 seconds indicates instrument malfunction. When non-compliant check the column head pressure, gas supply or leaks. Corrective action is required prior to further analysis.

10.3.5.5. Compare the area of the Internal Standards (IS) acquired against the midpoint of the initial calibration point. The extracted ion current profile (EICP) must be within a factor of two (-50% to +100%).

10.3.5.6. Establish RRF of each analyte, calculate %D (Eq. 10.6.2.1) against the ICAL.

10.3.5.7. Refer to Appendix 1 for DCC acceptance criteria and/or corrective action.

10.3.5.8. When non-compliant refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. **Analytical Sequence**

10.4.1.1. Analyze BFB and evaluate tuning

10.4.1.2. Analyze DCC and check ICAL validity

10.4.1.3. Analyze Lab Control Sample

10.4.1.4. Analyze Lab Control Sample Duplicate (if required)

10.4.1.5. Analyze Method Blank

10.4.1.6. Analyze samples to a maximum number of 12-hours from the time of BFB injection.

10.4.1.7. Analyze a pair of matrix spikes (MS/MSD) for every 20 samples of the same matrix.

10.4.1.8. Record analytical sequence in the analytical run log.

10.4.2. **Sample Result Evaluation**

10.4.2.1. Check the QC criteria as soon as the data is available.

- Check surrogate recoveries against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 QC limits.
- Check concentration of target analytes if calibration range is exceeded.
- If any of the above checkpoints indicate a problem, re-analysis is required. Note observations on the analytical run log. When results arise to questionable result, e.g. inconsistency from the first analysis, consult the Supervisor for further action.

10.4.3. **Qualitative Identification**

- The intensities of the characteristic ions maximize in the same scan or within one scan of each other.
- The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
- The relative intensity of the characteristic ions agrees within 30% of the relative intensity of these ions in the reference spectrum.
- Check the chromatogram for possible misidentified analytes. Investigate visible peaks in the chromatogram that were not identified in the data output. Manually integrate the peak if necessary.

10.4.3.1. For samples containing components not associated with the calibration standards, perform a library search for purposes of tentative identification4 (TIC). Execute *FTICB exe (HP RTE-1000 program) or LSC (Chem Station program) to initiate the library search using NIST/EPA/MSDC mass spectral library. Visually inspect each extracted mass ion chromatograph to determine the identification of the unknown before final reporting following the guidelines below.

- Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within + 20%. Example: for an ion with an abundance of 50% of the standard spectra, the corresponding sample ion abundance must be between 30 and 70%.
- Molecular ions present in reference spectrum should be present in sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting analytes.
- Ions present in the reference spectrum but not present in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting analytes. Data system library reduction programs can sometimes create these discrepancies.

10.4.3.2. Reporting TICs

- If the library search produces a match at or above 85%, report the analyte.

[4] Library search is performed only when indicated in the PSR.

- If the library search produces more than one analyte at or above 85%, report the first analyte (highest).
- If the library search produces no matches at or above 85%, the compound should be reported as unknown.

10.4.4. **Quantitation**

- Apply the appropriate quantitation method (Section 10.3.3.6). Calculate the concentration of any positively identified target analyte using the appropriate equation in Section 10.6.3. Apply the dilution factor for diluted samples to calculate for the final concentration of the sample.

10.4.5. **Manual Integration**

10.4.5.1. Refer to EMAX-DM01, Section 4.4.3.

10.4.6. **Dealing with Carryover**

10.4.6.1. Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.

10.4.6.2. If there is no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction.

10.4.6.3. If there is any target analyte detected as found in the sample that exceeded the calibration range, re-analyze the sample to rule out carry over. If carry over is confirmed, proceed with data reduction and report the data from re-analysis.

10.4.6.4. For decontaminating the sample purger consider the following suggestion:

- Rinse the purging apparatus and the contaminated port with organic-free reagent water containing 10% methanol. Dry purge the system overnight and analyze reagent blank prior to sample analysis. Repeat the process until no evidence of contamination is observed.

10.5. **Data Reduction**

10.5.1. Make a copy of the analytical run log and highlight the data to be reported.

10.5.2. Check that all positively identified analytes are within the calibration range.

10.5.3. Collate the reportable raw data separating the QC results from the sample results.

10.5.4. Keep all other data generated with the analytical folder marked with “For record only”.

10.5.5. Proceed to report generation.

10.6. **Calculations**

10.6.1. Initial Calibration

10.6.1.1. Calculate for the Relative Response Factor (RRF)

$$RRF = \frac{A_X C_{IS}}{A_{IS} C_X} \qquad \textit{Eq. 10.6.1.1}$$

where:

RRF – Relative Response Factor

A_X – Area of characteristic ion for the compound being measured

A_{IS} – Area of characteristic ion for the specific internal standard

C_X – Concentration of the compound being measured

C_{IS} – Concentration of the specific internal standard

10.6.1.2. Calculate for the Average Relative Response Factor (RRF_m).

$$RRF_m = \frac{\sum RRF}{n} \qquad \textit{Eq. 10.6.1.2}$$

where:

RRF_m – Average response factor

$\sum RRF$ – Summation of response factors

n – Number of measurements

10.6.1.3. Calculate for Least Square Linear Regression

$$y = ax + b \qquad \textit{Eq. 10.6.1.3}$$

where:

y – Response ratio (A_X/A_{IS})

x – Amount ratio (C_X/C_{IS})

a – x1 = slope of the line

$$a = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2}$$

where: $\bar{x}$ = average of amount ratios

$\bar{y}$ = average of response ratios

b – x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.6.1.4. Calculate for Inverse Weighting Factor

$$y = ax + b \qquad \textit{Eq. 10.6.1.4}$$

where:

y – Response ratio (A_X/A_{IS})

x – Amount ratio (C_X/C_{IS})

a – x1 = slope of the line

$$a = \frac{\sum (x - x_a)(y - y_a)}{\sum (x - x_a)^2}$$

where: $x_a = \sum \left[x(1/x) / \sum (1/x) \right]$

$y_a = \sum \left[y(1/x) / \sum (1/x) \right]$

or $x_a = \sum \left[x(1/x^2) / \sum (1/x^2) \right]$

$y_a = \sum \left[y(1/x^2) / \sum (1/x^2) \right]$

b – x0 = intercept of the line

$$b = y_a - a * x_a$$

10.6.1.5. Calculate the Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}} \qquad \textit{Eq. 10.6.1.5}$$

where:

SD – Standard deviation

x_i – Result at i^{th} measurement

$\bar{x}$ – Mean of the n measurements

n – Number of measurements

10.6.1.6. Calculate the % relative standard deviation (%RSD).

$$\%RSD = \frac{SD}{RRF_m} * 100\% \qquad \textit{Eq. 10.6.1.6}$$

where:

SD – Standard deviation

RRF_m – Average response factor

10.6.2. Calibration Check/Continuing Calibration

10.6.2.1. Calculate Percent Difference (%D)

$$\%D = \frac{[RRF_c - RRF_m]}{RRF_m} * 100\% \qquad \textit{Eq. 10.6.2.1}$$

where:

RRF_c – Response factor from continuing calibration standard

RRF_m – Average response factor

10.6.2.2. % Drift

$$\%Drift = \frac{[found\ Conc. - true\ Conc]}{true\ Conc.} * 100\% \qquad Eq.\ 10.6.2.2$$

10.6.3. Calculation of Sample Concentration (Water and Soil/Sediment Samples). When a compound is identified, the quantitation of that compound shall be based on the integrated abundance from the EICP of the primary characteristic ion.

10.6.3.1. Water Samples

$$Concentration\ (ug/L) = \frac{(Ax)(Is)}{(Ais)(RRF_m)}\ x\ DF \qquad Eq.\ 10.6.3.1$$

where:

A_x – Area of characteristic ion for the compound to be measured

I_s – Concentration of internal standard added in µg/L

A_{is} – Area of characteristic ion for the internal standard

RRF_m – Average response factor

DF – Dilution factor = $\frac{purge\ volume\ in\ ml\ \ (5\ ml\ or\ 25\ ml)}{sample\ \ amount\ \ in\ ml}$

10.6.3.2. Soil/Sediment Samples (Dry weight basis)

$$Concentration\ (ug/kg) = \frac{(Ax)(Is)}{(Ais)(RRF_m)(DW)}\ x\ DF \qquad Eq.\ 10.6.3.2$$

where:

A_x – Area of characteristic ion for the compound to be measured

I_s – Concentration of internal standard added in µg/L

A_{is} – Area of characteristic ion for the internal standard

RRF_m – Average response factor

DF – Dilution factor = $\frac{5\ g}{(sample\ \ amount\ \ in\ g)}$

DW – % solid = $\frac{100 - \%moisture}{100}$

10.6.3.3. Extracted Soil/Sediment Samples (Dry weight basis)

$$Concentration\ (ug/kg) = \frac{(Ax)(Is)}{(Ais)(RRF_m)(DW)}\ x\ DF \qquad Eq.\ 10.6.3.3$$

where:

A_x – Area of characteristic ion for the compound to be measured

I_s – Concentration of internal standard added in µg/L

A_{is} – Area of characteristic ion for the internal standard

RRF_m – Average response factor

DF – Dilution factor = $\frac{(purged\ \ volume\ \ in\ \mu L)(5\,g)}{(extract\ \ aliquot\ \ in\ \mu L)(sample\ \ amount\ \ in\ g)}$

DW – % solid = $\frac{100 - \%moisture}{100}$

10.6.4. Alternatively, the regression line (area ratio of Ax/Ais versus concentration using first degree) fitted to the initial calibration may be used for determination of the sample concentration when RSD of the analyte is greater than 15% (Section 10.3.3.6).

10.6.5. Concentration of TIC is estimated by the same method as target compounds with the following assumptions:

10.6.5.1. The area Ax and Ais are derived from total ion chromatogram. Ais refers to the closest internal standard (IS) free of interference.

10.6.5.2. RRF of the TIC is 1.

10.6.6. Method Proficiency

10.6.6.1. Percent Recovery

$$\%\ \mathrm{Recovery} = \frac{C_f - C}{C_s} * 100\% \qquad \textit{Eq. 10.6.6.1}$$

where:

C_f – Concentration found

C – Concentration of sample

C_s – Concentration of spike

10.6.6.2. Relative Percent Difference (%RPD)

$$\%\ RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \textit{Eq. 10.6.6.2}$$

where:

RPD – Relative Percent Difference

$C1$ – Measured concentration of the first sample aliquot

$C2$ – Measured concentration of the second sample aliquot

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WBDX[5].exe.

10.7.2. Generate Lab Chronicle using Labchron.exe

10.7.3. Generate the sample results using F1VX[5].exe

10.7.4. Generate the QC summary using QCVX[5].exe

10.7.5. Generate Case Narrative using CN1.exe

10.8. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration and re-analyses.

- Sample Results
- LCS Summary
- MS/MSD Summary
- ICAL Summary
- ICV Summary
- DCC Summary

10.8.2. Perform a 100% data review in accordance to EMAX-DM01and the PSR.

- Check internal standard area. They should be within -50 to +100% of DCC to be acceptable.
- Check surrogate recoveries against project specific criteria (PSR). In the absence of PSR, default to in-house QC limits.
- Check concentration of target analytes if calibration range is exceeded.
- If any of the above checkpoints indicate a problem, re-analysis is required.

10.8.3. Review case narrative that it accurately describes what transpired in the analytical process

10.8.4. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Perform instrument routine preventive maintenance and record on instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction that may affect data quality.

10.9.2. The table below list suggested routine maintenance schedule.

Task	**Every Day**	**Every Week**	**Every Month**	**Every 3 Months**	**Every 6 Months**	**As Needed**
Quick Tune	✓					

[5] X - version number

Task	Every Day	Every Week	Every Month	Every 3 Months	Every 6 Months	As Needed
Tune Check	✓					
Check the tightness of the column nuts.	✓					
Check gas cylinders pressure	✓					
Check the foreline pump oil level		✓				
Check the calibration vial			✓			
Check and if necessary, change injection port liners, septa and O-rings.				✓		
Clean the split/splitless inlet vent line trap.					✓	
Replace the foreline pump oil					✓	
Replace the diffusion pump fluid					✓	
Replace the traps and filters					✓	
Clean the ion source						✓
Change the carrier gas trap(s) and purifier						✓
Replace column						✓
AutoTune the MSD						✓
Replace the worn out parts						✓

11.0 QUALITY CONTROL

11.1. Sample Preparation Batch QC

11.1.1. Analyze Method Blank (MB) to demonstrate that preparation of samples was free from contamination.

11.1.2. Analyze Lab Control Sample (LCS/LCD) to assess preparative batch accuracy and precision.

11.1.3. Analyze Matrix Spike (MS/MSD) to assess matrix interference.

11.1.4. All lab wares used in the sample preparation shall be properly treated as specified in EMAX-QC07.

11.1.5. All solvents and reagents shall undergo quality control check in the stationary laboratory prior to its use.

11.2. Analytical Batch QC

11.2.1. Perform tune check to verify that the mass spectrometer meets standard mass spectra abundance criteria prior to calibration and check for any contamination.

11.2.2. Perform initial calibration (ICAL) to establish a calibration curve for the quantification of the analytes of interest.

11.2.3. Establish retention time window position for each analyte every after ICAL for proper qualitative identification.

11.2.4. Perform initial continuing calibration verification (ICV) every after ICAL to verify accuracy of ICAL.

11.2.5. Perform continuing calibration verification (CCV) every 12 hours to verify that instrument response is reliable, and has not changed significantly from the current ICAL curve.

11.2.6. Evaluate relative retention time for each anlaytes in every sample to be within ±0.06 RRT units.

11.2.7. Verify internal standards(IS) for quantitative accuracy and that its Retention time is within ± 30 seconds from retention time of the midpoint standard in the ICAL and EICP area is within -50% to +100% of ICAL midpoint standard.

11.2.8. Evaluate surrogate recovery to monitor instrument response on every sample.

11.3. **Method QC**

11.3.1. Establish detection limit (DL) to determine the smallest analyte concentration that can be demonstrated to be different from zero.

11.3.2. Establish limit of detection (LOD) to determine the smallest concentration of an analyte that can be qualitatively identified in a sample with 99% confidence level.

11.3.3. Establish limit of quantitation (LOQ) to determine the lowest concentration that produces a quantitative result within specified limits of precision and bias.

11.3.4. Demonstrate capability by understanding and applying procedures set forth by this SOP and culminating it with demonstration of capability as described in EMAX-QA05.

11.4. Refer to Appendix 1 for all related Quality Control parameters, frequency, acceptance criteria and corrective action

12.0 CORRECTIVE ACTION

12.1. **Sample Preparation QC**

12.1.1. If MB is non-compliant, consider the following suggestions to correct the problem:

- If contaminant is trace level, bake the trap at 260 ^{o}C for about 30 minutes.
- If contamination is high, flush the sample line with methanol and replace the trap.
- If problem persist, inform the supervisor for further advice.

12.1.2. LCS is non-compliant, consider the following suggestions to help you correct the problem:

- If majority of the analyte response are low and no evidence of leak is apparent, it is indicative of a bad purge or standard degradation. Prepare a fresh standard and re-analyze LCS and the associated samples.

- If result is bias high, rule out contamination. Refer to 12.2.1
- If problem persist, inform the supervisor for further advice.

12.1.3. If MS is non-compliant consider the following suggestion to correct the problem:

- Verify that the spike amount added is accurate by checking the record and the micropipette calibration
- If LCS is within acceptance criteria then and the right amount of spike is added into the sample then it is indicative of matrix interference. Discuss the probable matrix interference in the case narrative

12.2. **Analytical Batch QC**

12.2.1. **Tune Check.** If tune check is non-compliant consider the following suggestion to correct the problem:

- Check the abundance of mass 95 and 174. If it is significantly less than previous tune checks, it is indicative of insufficient amount of BFB injected. Probable causes are: improper spiking, leaks, standard degradation or low vacuum system. Repeat tune check ensuring that BFB was properly spiked or rule out leaks, prepare a fresh BFB standard and repeat the tune check.
- If problem persist, retune the instrument and repeat tune check.

12.2.2. **Initial Calibration.**

12.2.2.1. If the %RSD is out of acceptance criteria, consider the following suggestions to correct the problem.

- If one of the standards returns a bias low or bias high on all of the analytes then that point is considered an out-liner. Prepare a standard at that ICAL point and re-analyze.
- If the highest ICAL point appears to be saturated, drop the highest point.
- If the lowest point returns a bias low or bias high response or the peaks are not distinct and sharp, drop the lowest point.

Note : The lowest calibration point identifies the reporting limit (RL). Therefore, check that the RL is in conformance to the current projects where the ICAL will be used.

12.2.3. **Daily Continuing Calibration Check (DCC)** If DCC is non-compliant consider the following suggestions to correct the problem

- If majority of the analyte response are low and no evidence of leak is apparent, it is indicative of a bad purge or leak. Re-analyze DCC.
- If problem persist, rule out standard degradation. Prepare a fresh standard and repeat DCC.
- Otherwise execute instrument maintenance and perform ICAL.

12.2.4. **Instrument Blank.** If instrument blank is non-compliant, consider the following suggestions to correct the problem

- If contaminant is trace level, bake the trap at 260 ^{o}C for about 30 minutes.

- If contamination is high, flush the sample line with methanol and replace the trap.
- If problem persist, inform the supervisor for further action.

12.3. Generate a Non-Conformance Report (NCR) when an anomaly other than specified in Appendix 1 is observed. Refer to EMAX-QA08 for NCR details.

12.4. Discuss water samples that are labeled preserved having a pH value > 2 in the case narrative.

13.0 POLLUTION PREVENTION

13.1. Endorse all unused samples to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. Separate and properly identify all unused expired analytical standards prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM-03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – A group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.1.1 ***Preparation batch*** is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.2 ***Analytical batch*** is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – A determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Carry-over – Are contaminants retained in the instrument/apparatus from a highly contaminated sample that is passed into the succeeding sample(s).

15.1.4. CCC – Calibration check compounds that evaluate the integrity of the system. Variability of these compounds may indicate system leak or reactive sites in the column.

15.1.5. Instrument Method – A file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.6. Instrument Blank – A target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.7. Lab Control Sample (LCS) – A target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the

entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.8. Matrix – is a component or form of a sample.

15.1.9. Matrix Spike (MS) –A sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.10. Matrix Spike Duplicate (MSD) – A replicate of MS analyzed to monitor precision or recovery.

15.1.11. Method Blank – A target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.12. MSDS – Material safety data sheet is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.13. Response Factor – The ratio of the peak area of the target compound in the sample or sample extracts to the peak area of the internal standard in the sample or sample extract.

15.1.14. Sample – A specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.15. Sample Duplicate – A replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.16. SPCC – System performance check compounds are compounds that are used to check compound stability and to check for degradation cause by contaminated lines or active sites in the system.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing volatile analysis by GC/MS. The standard analyte list and RL are presented in Tables 7 & 8. In instances where there is a project or program QAPP, the requirements given in the project shall take precedence over this SOP.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied

15.4. **Department of Energy Basic Ordering Agreement (DOE-BOA) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. U.S. EPA Method 8260B; SW846, as updated.

16.2. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Figures**

17.1.1.	Figure 1	Peak Evaluation Techniques
17.1.2.	Figure 2	Typical Chromatogram
16.1.1.	Figure 3	Typical ICAL Summary
16.1.2.	Figure 4	Typical Instrument Performance Check (Tuning)
16.1.3.	Figure 5	Typical Internal Standard Area and Retention Time Summary
16.1.4.	Figure 6	Typical Sample Result Summary
16.1.5.	Figure 7	Typical LCS Report Summary
16.1.6.	Figure 8	Typical MS/MSD Report Summary
16.1.7.	Figure 9	Typical Case Narrative

17.2. **Tables**

17.2.1.	Table 1	Initial Calibration Intermediate Standard Preparation
17.2.2.	Table 2	Initial Calibration Verification Intermediate Standard Preparation
17.2.3.	Table 3	Surrogate/Internal Standards Preparation
17.2.4.	Table 4	Tuning Solution Standard Preparation
17.2.5.	Table 5	Typical Initial Calibration and QC Standards Concentration Levels
17.2.6.	Table 6	BFB Key Ion Abundance Criteria
17.2.7.	Table 7	Established DL, LOD and LOQ
17.2.8.	Table 8	Characteristic Ions for Purgeable Organic Compounds
17.2.9.	Table 9	Internal Standards with Corresponding Target Compounds and Surrogates Assigned for Quantitation

17.3. **Appendices**

17.3.1.	Appendix 1	Summary of Quality Control Procedures
17.3.2.	Appendix 2	Demonstration of Capability

17.4. **Forms**

17.4.1.	8260FA	Analytical Run Log
17.4.2.	8260FM	Instrument Maintenance Log

Figure 1: **PEAK EVALUATION TECHNIQUES**

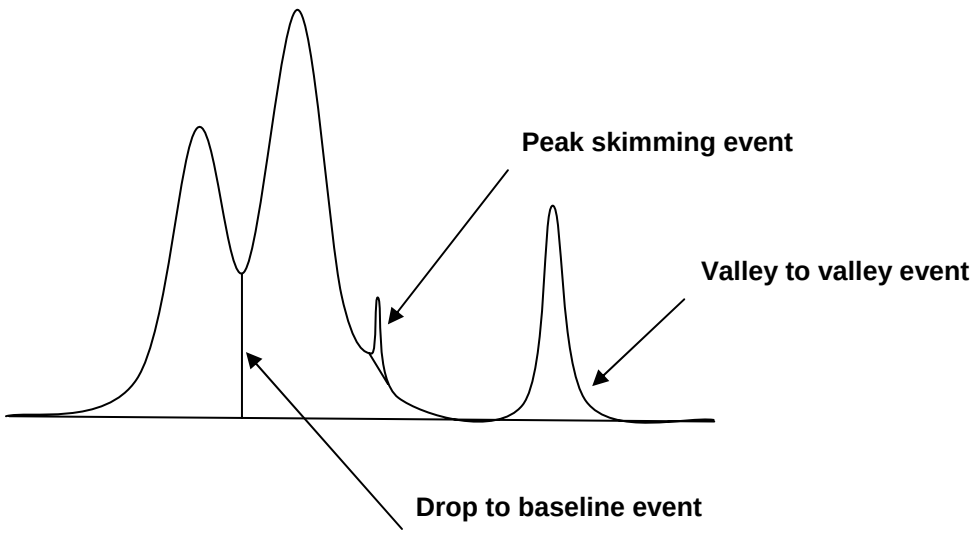
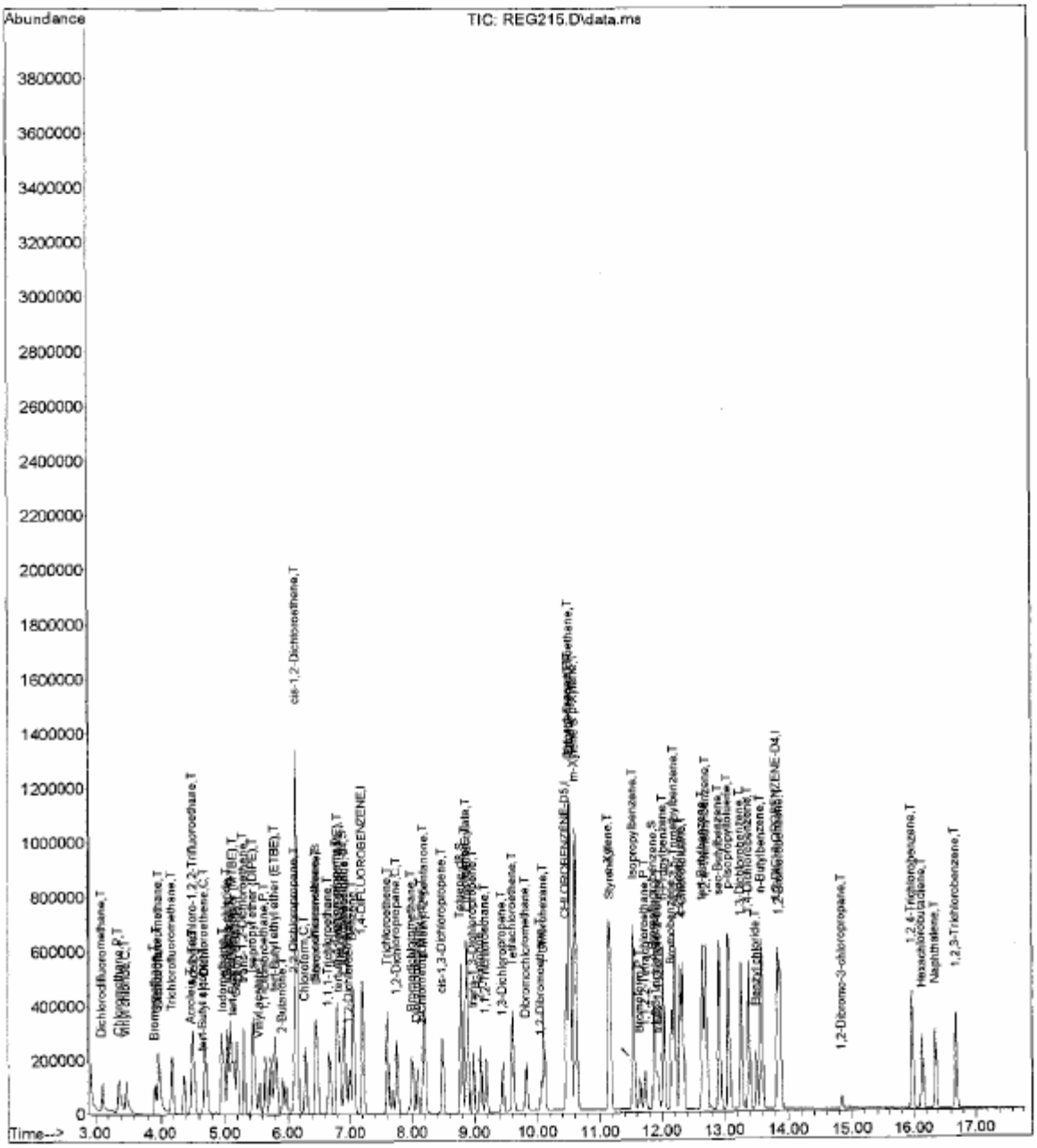


Figure 2: **TYPICAL CHROMATOGRAM**

Quantitation Report (Not Reviewed)

```
Data File : D:\Data\09E08\REG215.D                          Vial: 14
Acq On    :  8 May 2009  16:45                          Operator: CGM
Sample    : IVOE2E081                                   Inst    : E2
Misc      : 10ppb 8260/50ppb KET-A-TBA/60ppb AC         Multiplr: 1.00
Integrator: RTE
Quant Time: May 13 13:20:08 2009
Quant Results File: VOE2E08.RES

Quant Method : C:\msdchem\1\METHODS\VOE2E08.M
Quant Title  : METHOD  8260  10mL
QLast Update : Wed May 13 13:16:50 2009
Response via : Initial Calibration
DataAcq Meth:VOE2E08.M
```



VOE2E08.M Wed May 13 13:20:09 2009 Page: 3

Figure 3: **TYPICAL ICAL SUMMARY**

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E2
Beginning DateTime :05/08/09 12:03
Spike Units :PPB
IC File :REG208

Column Spec :RTX-502.2 ID :0.32MM
Ending DateTime :05/08/09 15:33
HPChem Method :VOE2E08

M	IDX	Parameters	.3 12:03 REG203	.5 12:26 REG204	1 12:49 REG205	2 13:13 REG206	5 13:36 REG207	10 14:00 REG208	30 14:23 REG209	50 14:47 REG210	100 15:10 REG211	200 15:33 REG212	Av_RRF	%_RSD	Av_Rt_M
	1	1,4-DIFLUOROBENZENE	1	1	1	1	1	1	1	1	1	1	1	0	7.2174
	2	Dichlorodifluoromethane	0.243	0.210	0.233	0.223	0.275	0.267	0.267	0.261	0.238	0.238	0.245	8.72	3.1069
	3	Chloromethane	------	0.891	0.649	0.552	0.523	0.509	0.468	0.458	0.400	0.403	0.539	28.34	3.3674
	4	Vinyl chloride	0.439	0.385	0.353	0.361	0.380	0.378	0.357	0.348	0.276	------	0.364	11.78	3.4775
	5	Bromomethane	0.192	0.242	0.195	0.194	0.217	0.219	0.236	0.251	0.233	0.239	0.222	9.78	3.9081
	6	Chloroethane	0.174	0.202	0.203	0.202	0.216	0.219	0.215	0.217	0.192	0.193	0.203	7.00	3.9543
	7	Dichlorofluoromethane	0.466	0.453	0.495	0.517	0.581	0.548	0.517	0.535	0.482	0.489	0.508	7.70	3.9653
	8	Trichlorofluoromethane	0.521	0.502	0.426	0.455	0.484	0.470	0.468	0.477	0.431	0.416	0.465	7.25	4.1832
5	9	Acrolein	0.028	0.026	0.029	0.030	0.032	0.028	0.029	0.030	0.028	0.031	0.029	6.59	4.4837
	10	1,1,2-Trichloro-1,2,2-Trifluoroethane	0.178	0.227	0.217	0.196	0.239	0.238	0.227	0.236	0.220	0.217	0.220	8.89	4.5134
5	11	Acetone	0.079	0.071	0.069	0.062	0.069	0.052	0.055	0.057	0.051	0.058	0.062	14.78	4.5156
	12	1,1-Dichloroethene	0.346	0.374	0.392	0.371	0.420	0.403	0.386	0.401	0.371	0.361	0.383	5.81	4.6917
5	13	tert-Butyl alcohol	------	------	0.016	0.015	0.020	0.014	0.014	0.016	0.014	0.018	0.016	12.76	4.6697
	14	Iodomethane	0.285	0.360	0.368	0.407	0.455	0.465	0.438	0.456	0.410	0.406	0.405	13.66	4.9888
	15	Methylene chloride	0.505	0.478	0.462	0.479	0.499	0.471	0.449	0.459	0.412	0.416	0.463	6.69	5.0549
6	16	Acrylonitrile	0.090	0.096	0.100	0.091	0.102	0.084	0.086	0.089	0.082	0.090	0.091	7.35	5.0989
	17	Carbon disulfide	0.880	0.806	0.718	0.692	0.738	0.708	0.670	0.700	0.647	0.647	0.721	10.12	5.1979
	18	tert-Butyl methyl ether (MTBE)	0.485	0.532	0.533	0.509	0.591	0.501	0.507	0.527	0.483	0.517	0.519	5.97	5.1429
	19	trans-1,2-Dichloroethene	0.451	0.406	0.413	0.412	0.448	0.414	0.402	0.424	0.388	0.380	0.414	5.54	5.3091
	20	Isopropyl ether (DIPE)	1.136	0.993	1.019	1.051	1.159	1.055	1.018	1.058	0.964	0.969	1.042	6.22	5.4620
	21	Vinyl acetate	0.444	0.455	0.453	0.444	0.522	0.448	0.443	0.465	0.425	0.462	0.456	5.68	5.5501
	22	1,1-Dichloroethane	0.487	0.518	0.513	0.518	0.560	0.519	0.502	0.518	0.476	0.464	0.507	5.33	5.6392
	23	tert-Butyl ethyl ether (ETBE)	0.790	0.793	0.768	0.806	0.910	0.786	0.788	0.826	0.764	0.801	0.803	5.18	5.8021
5	24	2-Butanone	0.108	0.095	0.109	0.097	0.113	0.089	0.093	0.097	0.090	0.104	0.099	8.40	5.9132
	25	2,2-Dichloropropane	0.326	0.360	0.361	0.359	0.388	0.384	0.367	0.385	0.352	0.358	0.364	5.10	6.1223
	26	cis-1,2-Dichloroethene	0.514	0.509	0.496	0.483	0.511	0.479	0.455	0.481	0.437	0.421	0.479	6.67	6.1543
	27	Chloroform	0.476	0.447	0.455	0.465	0.497	0.464	0.440	0.462	0.424	0.417	0.455	5.27	6.2863
5	28	tert-Amyl alcohol (TAA)	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
	29	Bromochloromethane	0.332	0.308	0.297	0.308	0.330	0.299	0.287	0.299	0.270	0.270	0.300	7.07	6.4525
	30	Dibromofluoromethane	------	0.315	0.328	0.355	0.373	0.349	0.346	0.362	0.328	0.328	0.343	5.56	6.4770
	31	1,1,1-Trichloroethane	0.393	0.390	0.396	0.405	0.445	0.429	0.411	0.432	0.399	0.396	0.410	4.68	6.6693
	32	tert-Amyl methyl ether (TAME)	0.724	0.640	0.657	0.604	0.661	0.584	0.592	0.625	0.581	0.625	0.629	6.95	6.8245
	33	1,2-Dichloroethane-d4	------	0.303	0.297	0.301	0.345	0.297	0.301	0.309	0.281	0.293	0.303	5.79	6.9148
	34	CHLOROBENZENE-D5	1	1	1	1	1	1	1	1	1	1	1	0	10.4694
	35	1,1-Dichloropropene	0.147	0.163	0.176	0.151	0.161	0.172	0.152	0.167	0.143	0.124	0.156	9.93	6.7981
	36	Carbon tetrachloride	0.432	0.492	0.483	0.472	0.455	0.497	0.437	0.477	0.412	0.354	0.451	9.75	6.9257
	37	1,2-Dichloroethane	0.431	0.440	0.406	0.413	0.402	0.395	0.363	0.387	0.329	0.301	0.387	11.39	6.9973
	38	Benzene	1.445	1.318	1.187	1.132	1.145	1.153	1.030	1.119	0.960	------	1.166	12.37	7.0627
	39	Trichloroethene	0.439	0.419	0.380	0.361	0.360	0.369	0.329	0.365	0.317	0.277	0.362	12.98	7.6081
	40	1,2-Dichloropropane	0.380	0.359	0.340	0.329	0.331	0.333	0.303	0.332	0.289	0.266	0.326	10.15	7.7610
20	41	1,4-Dioxane	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
	42	Bromodichloromethane	0.440	0.446	0.417	0.407	0.425	0.424	0.383	0.417	0.362	0.332	0.405	8.84	8.0031
	43	Dibromomethane	0.194	0.175	0.185	0.175	0.178	0.170	0.156	0.170	0.145	0.137	0.169	10.40	8.0791
	44	2-Chloroethyl vinyl ether	0.118	0.126	0.127	0.120	0.138	0.135	0.133	0.145	0.129	0.134	0.130	6.37	8.1693
5	45	4-Methyl-2-pentanone	0.270	0.271	0.294	0.254	0.275	0.242	0.245	0.264	0.231	0.236	0.258	7.70	8.2023
	46	cis-1,3-Dichloropropene	0.452	0.423	0.425	0.419	0.429	0.435	0.407	0.442	0.394	0.379	0.420	5.28	8.4885
	47	Toluene-d8	------	1.163	1.121	1.138	1.125	1.191	1.133	1.239	1.103	1.024	1.137	5.21	8.7942
	48	Toluene	1.261	1.121	1.134	1.070	1.099	1.122	1.038	1.143	1.021	0.950	1.096	7.65	8.8736
	49	Ethyl methacrylate	0.169	0.172	0.197	0.185	0.217	0.200	0.198	0.217	0.193	0.205	0.195	8.42	8.8813
	50	trans-1,3-Dichloropropene	0.345	0.320	0.315	0.331	0.337	0.340	0.323	0.354	0.317	0.320	0.330	4.02	8.9837

Figure 3 (cont.): **TYPICAL ICAL SUMMARY**

5	51	2-Hexanone	0.131	0.140	0.155	0.131	0.146	0.128	0.130	0.142	0.124	0.132	0.136	7.13	9.0938
	52	1,1,2-Trichloroethane	0.187	0.178	0.220	0.215	0.221	0.205	0.194	0.210	0.189	0.192	0.201	7.54	9.1818
	53	1,3-Dichloropropane	0.338	0.316	0.333	0.307	0.336	0.316	0.295	0.322	0.288	0.292	0.314	5.88	9.4470
	54	Tetrachloroethene	0.284	0.279	0.282	0.258	0.269	0.291	0.262	0.289	0.266	0.250	0.273	5.07	9.6110
	55	Dibromochloromethane	0.299	0.307	0.309	0.306	0.319	0.313	0.299	0.330	0.299	0.303	0.308	3.20	9.8212
	56	1,2-Dibromoethane	0.245	0.245	0.226	0.211	0.234	0.221	0.210	0.228	0.206	0.210	0.223	6.48	10.0611
	57	1-Chlorohexane	0.296	0.312	0.351	0.314	0.345	0.380	0.349	0.392	0.358	0.345	0.344	8.70	10.1084
	58	Chlorobenzene	0.896	0.869	0.798	0.779	0.775	0.822	0.756	0.841	0.767	0.723	0.803	6.71	10.5233
	59	1,1,1,2-Tetrachloroethane	0.362	0.335	0.335	0.328	0.344	0.343	0.320	0.354	0.317	0.292	0.333	6.02	10.5354
	60	Ethylbenzene	1.321	1.245	1.312	1.204	1.213	1.302	1.187	1.331	1.216	1.141	1.247	5.25	10.5354
2	61	m-Xylene & p-Xylene	1.007	0.942	0.937	0.898	0.926	0.967	0.900	1.017	0.934	0.873	0.940	4.91	10.6191
	62	o-Xylene	1.168	1.073	1.077	0.995	1.012	1.074	0.988	1.101	0.997	0.913	1.040	6.97	11.1484
	63	Styrene	0.720	0.670	0.702	0.688	0.714	0.762	0.716	0.821	0.740	0.701	0.723	5.92	11.1737
	64	1,2-DICHLOROBENZENE-D4	1	1	1	1	1	1	1	1	1	1	1	0	13.8370
	65	Isopropylbenzene	2.356	2.408	2.391	2.389	2.578	2.600	2.456	2.776	2.749	2.521	2.522	5.99	11.5468
	66	Bromoform	0.292	0.316	0.342	0.335	0.407	0.350	0.357	0.400	0.404	0.421	0.362	11.98	11.6459
	67	1,1,2,2-Tetrachloroethane	0.432	0.525	0.524	0.494	0.567	0.477	0.470	0.517	0.497	0.513	0.502	7.36	11.7306
	68	4-Bromofluorobenzene	------	0.810	0.728	0.779	0.839	0.826	0.813	0.910	0.907	0.890	0.834	7.30	11.8744
	69	1,2,3-Trichloropropane	------	0.085	0.150	0.139	0.169	0.144	0.142	0.153	0.150	0.154	0.143	16.39	11.9123
	70	trans-1,4-Dichloro-2-butene	------	0.107	0.133	0.121	0.157	0.129	0.136	0.146	0.142	0.154	0.136	11.64	11.9453
	71	n-Propylbenzene	2.881	2.798	2.797	2.827	3.036	3.090	2.899	3.279	3.203	3.014	2.983	5.72	12.0310
	72	Bromobenzene	0.772	0.713	0.671	0.660	0.710	0.715	0.680	0.765	0.761	0.750	0.720	5.67	12.1642
	73	1,3,5-Trimethylbenzene	1.903	1.911	2.069	2.004	2.217	2.226	2.146	2.391	2.209	2.111	2.118	7.21	12.2082
	74	2-Chlorotoluene	1.982	1.892	1.923	1.801	1.919	1.952	1.793	2.011	1.927	1.793	1.899	4.16	12.2963
	75	4-Chlorotoluene	1.544	1.467	1.536	1.495	1.628	1.610	1.535	1.753	1.729	1.715	1.601	6.39	12.3403
	76	tert-Butylbenzene	1.950	2.047	2.140	2.118	2.328	2.354	2.293	2.525	2.285	2.162	2.220	7.59	12.6594
	77	1,2,4-Trimethylbenzene	2.032	1.882	1.956	2.006	2.207	2.203	2.115	2.328	2.164	2.088	2.098	6.36	12.7123
	78	sec-Butylbenzene	2.509	2.613	2.684	2.628	2.930	2.993	2.878	3.160	2.862	2.708	2.797	7.20	12.9236
	79	p-Isopropyltoluene	2.163	2.221	2.237	2.315	2.540	2.584	2.518	2.713	2.528	2.399	2.422	7.52	13.0765
	80	1,3-Dichlorobenzene	1.440	1.410	1.430	1.334	1.466	1.455	1.361	1.502	1.442	1.425	1.427	3.44	13.2647
	81	1,4-Dichlorobenzene	1.607	1.367	1.413	1.323	1.431	1.431	1.355	1.495	1.429	1.419	1.427	5.58	13.3858
	82	Benzyl chloride	0.908	0.889	0.918	0.870	1.003	0.931	0.941	1.013	0.959	1.067	0.950	6.47	13.5068
	83	n-Butylbenzene	1.847	1.937	2.070	1.948	2.194	2.208	2.138	2.286	2.201	2.042	2.087	6.83	13.5839
	84	1,2-Dichlorobenzene	1.491	1.286	1.342	1.282	1.413	1.358	1.294	1.375	1.314	1.305	1.346	4.94	13.8711
	85	1,2-Dibromo-3-chloropropane	0.121	0.077	0.103	0.099	0.127	0.103	0.105	0.110	0.107	0.116	0.107	12.84	14.8407
	86	1,2,4-Trichlorobenzene	0.878	0.790	0.816	0.821	0.902	0.895	0.875	0.950	0.900	0.839	0.867	5.65	15.9830
	87	Hexachlorobutadiene	0.218	0.311	0.340	0.331	0.352	0.379	0.346	0.385	0.366	0.321	0.335	14.16	16.1392
	88	Naphthalene	1.482	1.446	1.661	1.550	1.785	1.544	1.590	1.730	1.636	1.620	1.604	6.56	16.3572
	89	1,2,3-Trichlorobenzene	0.704	0.664	0.766	0.715	0.809	0.742	0.746	0.801	0.756	0.704	0.741	6.11	16.6884

Spike Amount = Nominal Amount * M
Ave_%RSD : 7.8 Max_%RSD : 28.3

Use Least Square Linear Regression with weighting factor of inverse concentration for comps with %_RSD > 15
Resp_Ratio = xo + x1 * Amt_Ratio

IDX	Parameter	x0	x1	CCF
3	Chloromethane	0.02923	0.41361	0.9980
69	1,2,3-Trichloropropane	-0.00215	0.15213	0.9996

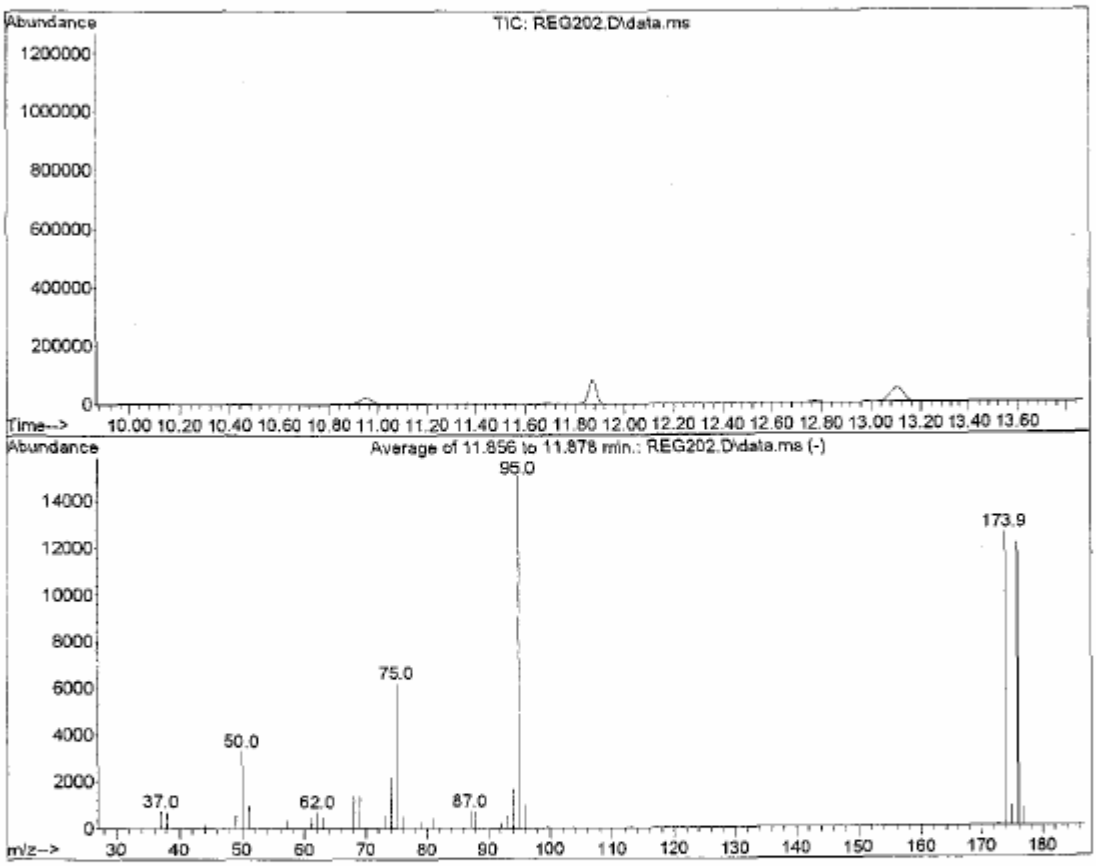
Figure 4: **TYPICAL INSTRUMENT PERFORMANCE CHECK (TUNING)**

BFB

```
Data Path : D:\Data\09E08\
Data File : REG202.D
Acq On    :  8 May 2009  11:08
Operator  : CGM
Sample    : BFBE2E10
Misc      : T/CHK
ALS Vial  : 1   Sample Multiplier: 1

Integration File: rteint.p

Method    : C:\msdchem\1\METHODS\VOE2E08.M
Title     : METHOD  8260  10mL
Last Update  : Wed May 13 13:05:40 2009
```



AutoFind: Scans 815, 816, 817; Background Corrected with Scan 810

Target Mass	Rel. to Mass	Lower Limit%	Upper Limit%	Rel. Abn%	Raw Abn	Result Pass/Fail
50	95	15	40	21.8	3288	PASS
75	95	30	60	40.9	6175	PASS
95	95	100	100	100.0	15091	PASS
96	95	5	9	6.5	976	PASS
173	174	0.00	2	0.9	111	PASS
174	95	50	100	83.1	12540	PASS
175	174	5	9	6.8	849	PASS
176	174	95	101	96.3	12070	PASS
177	176	5	9	6.3	765	PASS

VOE2E08.M Wed May 13 13:06:56 2009 Page: 1

Figure 5: TYPICAL INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

8A
VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: REG208
Instrument ID: TOE2
GC Column: RTX502.2 ID: 0.32mm (mm)

Project: XYZ, INC.
SDG No.: 09E108
Date Analyzed: 05/08/09
Time Analyzed: 14:00
Heated Purge: (Y/N) N

		IS1(DBF)		IS2(CBZ)		IS3(DCB)	
		AREA #	RT #	AREA #	RT #	AREA #	RT #
	12 HOUR STD	437085	7.21	360505	10.47	188592	13.84
	UPPER LIMIT	874170	7.71	721010	10.97	377184	14.34
	LOWER LIMIT	218543	6.71	180253	9.97	94296	13.34
	SAMPLE ID						
1	VSTD010	507459	7.22	411195	10.47	226757	13.84
2	MBLK1W	516413	7.22	401562	10.47	236124	13.84
3	LCS1W	525586	7.22	424430	10.47	233099	13.84
4	LCD1W	520018	7.21	425171	10.47	230850	13.84
5	TRIP01-05052009	507617	7.22	396523	10.47	232631	13.84
6	TRIP02-05062009	472644	7.22	364071	10.47	210029	13.84
7	45MW13-05062009	499453	7.22	394036	10.47	231414	13.84
8	45MW13-05062009MS	504742	7.21	417810	10.47	234683	13.84
9	45MW13-05062009MSD	519198	7.22	424344	10.47	241377	13.84
10	45MW08-05052009	524027	7.22	400210	10.47	231882	13.84
11	45MW10-05052009	512150	7.22	407314	10.47	221461	13.84
12	45MW10D-05052009	543481	7.22	434322	10.47	229178	13.84
13	45MW11-05052009	612985	7.22	459226	10.48	234255	13.84
14	45MW12-05052009	509816	7.22	418635	10.48	240019	13.84

IS1 (DFB) = 1,4-Difluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,2-Dichlorobenzene-d4

AREA UPPER LIMIT = + 100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
AREA UPPER LIMIT = + 50% of surrogate area
AREA LOWER LIMIT = - 50% of surrogate area

Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.
page 1 of 1

FORM VIII VOA-8260 1/2000

Figure 6: **TYPICAL SAMPLE RESULT SUMMARY REPORT**

SW 5030B/8260B
VOLATILE ORGANICS BY GC/MS

Client	: XYZ, INC.	Date Collected:	05/06/09
Project	: CLEAN WATER PROJECT	Date Received:	05/08/09
Batch No.	: 09E108	Date Extracted:	05/08/09 22:51
Sample ID:	45MW13-05062009	Date Analyzed:	05/08/09 22:51
Lab Samp ID:	E108-07	Dilution Factor:	1
Lab File ID:	REG230	Matrix :	WATER
Ext Btch ID:	VOE2E11	% Moisture :	NA
Calib. Ref.:	REG208	Instrument ID :	T-OE2

RESULTS PARAMETERS	RL (ug/L)	MDL (ug/L)	(ug/L)
1,1,1,2-TETRACHLOROETHANE	ND	1.0	0.20
1,1,1-TCA	3.0	1.0	0.20
1,1,2,2-TETRACHLOROETHANE	ND	1.0	0.20
1,1,2-TCA	ND	1.0	0.20
1,1-DCA	0.88F	1.0	0.20
1,1-DCE	1.5	1.0	0.20
1,1-DICHLOROPROPENE	ND	1.0	0.20
1,2,3-TRICHLOROBENZENE	ND	1.0	0.20
1,2,3-TRICHLOROPROPANE	ND	1.0	0.50
1,2,4-TRICHLOROBENZENE	ND	1.0	0.20
1,2,4-TRIMETHYLBENZENE	5.5	1.0	0.20
1,2-DIBROMO-3-CHLOROPROPANE	ND	2.0	0.50
1,2-DCB	ND	1.0	0.20
1,2-DCA	ND	1.0	0.20
1,2-DICHLOROPROPANE	ND	1.0	0.20
1,2-DIBROMOETHANE (EDB)	ND	1.0	0.20
1,3,5-TRIMETHYLBENZENE	1.3	1.0	0.20
1,3-DCB	ND	1.0	0.20
1,3-DICHLOROPROPANE	ND	1.0	0.20
1,4-DCB	ND	1.0	0.20
1-CHLOROHEXANE	ND	1.0	0.20
2,2-DICHLOROPROPANE	ND	1.0	0.20
2-CHLOROTOLUENE	ND	1.0	0.20
4-CHLOROTOLUENE	ND	1.0	0.20
BENZENE	0.56F	1.0	0.20
BROMOBENZENE	ND	1.0	0.20
BROMOCHLOROMETHANE	ND	1.0	0.20
BROMODICHLOROMETHANE	ND	1.0	0.20
BROMOFORM	ND	1.0	0.30
BROMOMETHANE	ND	3.0	0.20
CARBON TETRACHLORIDE	ND	1.0	0.20
CHLOROBENZENE	ND	1.0	0.20
CHLOROETHANE	ND	1.0	0.20
CHLOROFORM	0.83F	1.0	0.20
CHLOROMETHANE	ND	1.0	0.20
CIS-1,2-DCE	62	1.0	0.20
CIS-1,3-DICHLOROPROPENE	ND	1.0	0.20
DIBROMOCHLOROMETHANE	ND	1.0	0.20
DIBROMOMETHANE	ND	1.0	0.20
DICHLORODIFLUOROMETHANE	ND	1.0	0.30
ETHYLBENZENE	5.3	1.0	0.20
HEXACHLOROBUTADIENE	ND	1.0	0.20
ISOPROPYL BENZENE	0.65F	1.0	0.20
M/P-XYLENE	30	2.0	0.50
METHYLENE CHLORIDE	ND	1.0	0.50
N-BUTYLBENZENE	0.34F	1.0	0.20
N-PROPYLBENZENE	0.62F	1.0	0.20
NAPHTHALENE	2.6	1.0	0.50
O-XYLENE	9.8	1.0	0.20
P-ISOPROPYLTOLUENE	0.37F	1.0	0.20
SEC-BUTYLBENZENE	0.26F	1.0	0.20
STYRENE	ND	1.0	0.20
TERT-BUTYLBENZENE	ND	1.0	0.20
TETRACHLOROETHENE	0.22F	1.0	0.20
TOLUENE	26	1.0	0.20
TRANS-1,2-DCE	0.40F	1.0	0.20
TRANS-1,3-DICHLOROPROPENE	ND	1.0	0.20
TCE	740J	1.0	0.20
TRICHLOROFLUOROMETHANE	ND	1.0	0.20
VINYL CHLORIDE	ND	1.0	0.20

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	101	70-140
TOLUENE-D8	107	70-140
4-BROMOFLUOROBENZENE	94	70-130

Figure 7: **TYPICAL LCS SUMMARY REPORT**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: 09E108
METHOD: SW5030B/8260B

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	MBLK1W				
LAB SAMP ID:	VOE2E11Q	VOE2E11L	VOE2E11C		
LAB FILE ID:	REG226	REG222	REG223		
DATE EXTRACTED:	05/08/0921:17	05/08/0919:44	05/08/0920:09	DATE COLLECTED:	NA
DATE ANALYZED:	05/08/0921:17	05/08/0919:44	05/08/0920:09	DATE RECEIVED:	05/08/09
PREP. BATCH:	VOE2E11	VOE2E11	VOE2E11		
CALIB. REF:	REG208	REG208	REG208		

ACCESSION:

PARAMETER	BLNK RSLT (ug/L)	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
1,1,1,2-Tetrachloroethane	ND	10.0	10.8	108	10.0	10.2	102	6	81-129	20
1,1,1-TCA	ND	10.0	10.2	102	10.0	9.64	96	6	67-132	20
1,1,2,2-Tetrachloroethane	ND	10.0	9.47	95	10.0	9.23	92	3	63-128	20
1,1,2-TCA	ND	10.0	10.7	107	10.0	10.3	103	4	75-125	20
1,1-DCA	ND	10.0	10.3	103	10.0	9.94	99	4	69-133	20
1,1-DCE	ND	10.0	10.5	105	10.0	9.92	99	5	68-130	20
1,1-Dichloropropene	ND	10.0	11.4	114	10.0	10.9	109	4	73-132	20
1,2,3-Trichlorobenzene	ND	10.0	10.2	102	10.0	9.96	100	3	67-137	20
1,2,3-Trichloropropane	ND	10.0	8.95	89	10.0	9.15	92	2	73-124	20
1,2,4-Trichlorobenzene	ND	10.0	10.3	103	10.0	10.0	100	3	66-134	20
1,2,4-Trimethylbenzene	ND	10.0	10.2	102	10.0	9.89	99	3	74-132	20
1,2-Dibromo-3-chloropropane	ND	10.0	10.4	104	10.0	10.1	101	3	50-132	20
1,2-DCB	ND	10.0	10.1	101	10.0	9.81	98	2	71-122	20
1,2-DCA	ND	10.0	10.4	104	10.0	9.96	100	5	69-132	20
1,2-Dichloropropane	ND	10.0	10.7	107	10.0	10.2	102	5	75-125	20
1,2-Dibromoethane (EDB)	ND	10.0	10.4	104	10.0	9.72	97	7	80-121	20
1,3,5-Trimethylbenzene	ND	10.0	10.3	103	10.0	9.99	100	3	74-131	20
1,3-DCB	ND	10.0	10.0	100	10.0	9.59	96	4	75-124	20
1,3-Dichloropropane	ND	10.0	10.4	104	10.0	9.87	99	5	73-126	20
1,4-DCB	ND	10.0	9.83	98	10.0	9.57	96	3	74-123	20
1-Chlorohexane	ND	10.0	10.8	108	10.0	10.2	102	6	70-125	20
2,2-Dichloropropane	ND	10.0	9.81	98	10.0	9.62	96	2	69-137	20
2-Chlorotoluene	ND	10.0	9.48	95	10.0	9.30	93	2	73-126	20
4-Chlorotoluene	ND	10.0	9.63	96	10.0	9.37	94	3	74-128	20
Benzene	ND	10.0	10.3	103	10.0	9.71	97	6	81-122	20
Bromobenzene	ND	10.0	9.70	97	10.0	9.53	95	2	76-124	20
Bromochloromethane	ND	10.0	9.55	95	10.0	9.13	91	4	65-129	20
Bromodichloromethane	ND	10.0	10.3	103	10.0	10.1	101	1	76-121	20
Bromoform	ND	10.0	9.90	99	10.0	9.89	99	0	69-128	20
Bromomethane	ND	10.0	9.66	97	10.0	9.42	94	3	30-141	20
Carbon Tetrachloride	ND	10.0	11.0	110	10.0	10.2	102	8	66-138	20
Chlorobenzene	ND	10.0	10.6	106	10.0	10.1	101	5	81-122	20
Chloroethane	ND	10.0	9.91	99	10.0	10.0	100	1	58-133	20
Chloroform	ND	10.0	10.1	101	10.0	9.60	96	5	69-128	20
Chloromethane	ND	10.0	9.14	91	10.0	9.31	93	2	56-131	20
cis-1,2-DCE	ND	10.0	9.81	98	10.0	9.50	95	3	72-126	20
cis-1,3-Dichloropropene	ND	10.0	10.7	107	10.0	10.3	103	4	69-131	20
Dibromochloromethane	ND	10.0	10.6	106	10.0	10.3	103	3	66-133	20
Dibromomethane	ND	10.0	10.7	107	10.0	10.2	102	5	76-125	20
Dichlorodifluoromethane	ND	10.0	9.80	98	10.0	9.73	97	1	30-153	20
Ethylbenzene	ND	10.0	10.3	103	10.0	9.89	99	4	73-127	20
Hexachlorobutadiene	ND	10.0	10.5	105	10.0	9.96	100	5	67-131	20
Isopropyl Benzene	ND	10.0	10.2	102	10.0	9.80	98	4	75-127	20
m/p-Xylene	ND	20.0	20.8	104	20.0	19.9	100	4	76-128	20
Methylene Chloride	ND	10.0	9.70	97	10.0	9.50	95	2	63-137	20
n-Butylbenzene	ND	10.0	9.98	100	10.0	9.80	98	2	69-137	20
n-Propylbenzene	ND	10.0	9.77	98	10.0	9.47	95	3	72-129	20
Naphthalene	ND	10.0	10.1	101	10.0	9.52	95	5	54-138	20
o-Xylene	ND	10.0	10.5	105	10.0	10.0	100	5	80-121	20
p-Isopropyltoluene	ND	10.0	10.5	105	10.0	10.0	100	4	73-130	20
Sec-Butylbenzene	ND	10.0	10.3	103	10.0	9.89	99	4	72-127	20
Styrene	ND	10.0	10.7	107	10.0	10.1	101	5	65-134	20
Tert-Butylbenzene	ND	10.0	10.7	107	10.0	10.1	101	6	70-129	20
Tetrachloroethene	ND	10.0	11.3	113	10.0	10.4	104	8	66-128	20
Toluene	ND	10.0	10.6	106	10.0	10.2	102	4	77-122	20
Trans-1,2-DCE	ND	10.0	10.1	101	10.0	9.67	97	4	63-137	20
Trans-1,3-Dichloropropene	ND	10.0	10.6	106	10.0	10.4	104	2	59-135	20
TCE	ND	10.0	10.8	108	10.0	10.3	103	5	70-127	20
Trichlorofluoromethane	ND	10.0	9.36	94	10.0	9.47	95	1	57-129	20
Vinyl Chloride	ND	10.0	9.04	90	10.0	8.98	90	1	50-134	20

SURROGATE PARAMETER	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	QC LIMIT (%)
1,2-Dichloroethane-d4	10.0	9.30	93	10.0	9.34	93	70-140
Toluene-d8	10.0	10.4	104	10.0	10.2	102	70-130

Figure 8: **TYPICAL MS/MSD REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: 09E108
METHOD: SW5030B/8260B

MATRIX: WATER % MOISTURE: NA

DILUTION FACTOR:	1	1	1		
SAMPLE ID:	45MW13-05062009				
LAB SAMP ID:	E108-07	E108-07M	E108-07S		
LAB FILE ID:	REG230	REG231	REG232		
DATE EXTRACTED:	05/08/0922:51	05/08/0923:16	05/08/0923:39	DATE COLLECTED:	05/06/09
DATE ANALYZED:	05/08/0922:51	05/08/0923:16	05/08/0923:39	DATE RECEIVED:	05/08/09
PREP. BATCH:	VOE2E11	VOE2E11	VOE2E11		
CALIB. REF:	REG208	REG208	REG208		

ACCESSION:

PARAMETER	SMPL RSLT (ug/L)	SPIKE AMT (ug/L)	MS RSLT (ug/L)	MS % REC	SPIKE AMT (ug/L)	MSD RSLT (ug/L)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
1,1,1,2-Tetrachloroethane	ND	10.0	10.4	104	10.0	10.3	103	1	81-129	20
1,1,1-TCA	2.95	10.0	13.0	100	10.0	12.4	95	5	67-132	20
1,1,2,2-Tetrachloroethane	ND	10.0	9.16	92	10.0	9.70	97	6	63-128	20
1,1,2-TCA	ND	10.0	10.7	107	10.0	10.5	105	3	75-125	20
1,1-DCA	0.882F	10.0	10.9	100	10.0	10.6	97	3	69-133	20
1,1-DCE	1.46	10.0	11.1	96	10.0	10.6	91	4	68-130	20
1,1-Dichloropropene	ND	10.0	10.9	109	10.0	10.7	107	2	73-132	20
1,2,3-Trichlorobenzene	ND	10.0	10.3	103	10.0	10.4	104	2	67-137	20
1,2,3-Trichloropropane	ND	10.0	8.65	87	10.0	8.71	87	1	73-124	20
1,2,4-Trichlorobenzene	ND	10.0	10.3	103	10.0	10.2	102	1	66-134	20
1,2,4-Trimethylbenzene	5.47	10.0	15.9	104	10.0	15.4	99	3	74-132	20
1,2-Dibromo-3-chloropropane	ND	10.0	10.1	101	10.0	10.9	109	8	50-132	20
1,2-DCB	ND	10.0	9.62	96	10.0	9.43	94	2	71-122	20
1,2-DCA	ND	10.0	9.93	99	10.0	9.76	98	2	69-132	20
1,2-Dichloropropane	ND	10.0	10.5	105	10.0	10.3	103	1	75-125	20
1,2-Dibromoethane (EDB)	ND	10.0	9.94	99	10.0	10.1	101	2	80-121	20
1,3,5-Trimethylbenzene	1.28	10.0	11.4	101	10.0	11.0	97	4	74-131	20
1,3-DCB	ND	10.0	9.56	96	10.0	9.50	95	1	75-124	20
1,3-Dichloropropane	ND	10.0	9.95	99	10.0	10.1	101	2	73-126	20
1,4-DCB	ND	10.0	9.57	96	10.0	9.50	95	1	74-123	20
1-Chlorohexane	ND	10.0	11.0	110	10.0	10.8	108	2	70-125	20
2,2-Dichloropropane	ND	10.0	9.33	93	10.0	8.82	88	6	69-137	20
2-Chlorotoluene	ND	10.0	9.11	91	10.0	8.91	89	2	73-126	20
4-Chlorotoluene	ND	10.0	9.22	92	10.0	8.98	90	3	74-128	20
Benzene	0.564F	10.0	10.2	96	10.0	9.83	93	4	81-122	20
Bromobenzene	ND	10.0	9.20	92	10.0	9.20	92	0	76-124	20
Bromochloromethane	ND	10.0	9.27	93	10.0	8.82	88	5	65-129	20
Bromodichloromethane	ND	10.0	10.3	103	10.0	10.2	102	1	76-121	20
Bromoform	ND	10.0	9.42	94	10.0	9.61	96	2	69-128	20
Bromomethane	ND	10.0	10.2	102	10.0	9.80	98	4	30-141	20
Carbon Tetrachloride	ND	10.0	10.5	105	10.0	10.2	102	3	66-138	20
Chlorobenzene	ND	10.0	10.2	102	10.0	10.1	101	1	81-122	20
Chloroethane	ND	10.0	10.3	103	10.0	9.90	99	4	58-133	20
Chloroform	0.826F	10.0	10.5	97	10.0	10.1	93	4	69-128	20
Chloromethane	ND	10.0	9.91	99	10.0	9.44	94	5	56-131	20
cis-1,2-DCE	61.5	10.0	56.6	-49*	10.0	54.4	-71*	4	72-126	20
cis-1,3-Dichloropropene	ND	10.0	10.1	101	10.0	10.1	101	0	69-131	20
Dibromochloromethane	ND	10.0	10.3	103	10.0	10.4	104	1	66-133	20
Dibromomethane	ND	10.0	9.70	97	10.0	9.77	98	1	76-125	20
Dichlorodifluoromethane	ND	10.0	10.3	103	10.0	9.12	91	12	30-153	20
Ethylbenzene	5.32	10.0	15.5	102	10.0	15.3	99	1	73-127	20
Hexachlorobutadiene	ND	10.0	10.2	102	10.0	10.1	101	1	67-131	20
Isopropyl Benzene	0.650F	10.0	10.2	96	10.0	9.98	93	3	75-127	20
m/p-Xylene	30.2	20.0	50.3	100	20.0	49.6	97	1	76-128	20
Methylene Chloride	ND	10.0	9.60	96	10.0	9.27	93	4	63-137	20
n-Butylbenzene	0.343F	10.0	10.2	98	10.0	9.93	96	2	69-137	20
n-Propylbenzene	0.617F	10.0	10.1	95	10.0	9.65	90	4	72-129	20
Naphthalene	2.57	10.0	13.3	108	10.0	13.7	111	2	54-138	20
o-Xylene	9.84	10.0	20.1	102	10.0	19.8	99	1	80-121	20
p-Isopropyltoluene	0.369F	10.0	10.8	104	10.0	10.4	101	3	73-130	20
Sec-Butylbenzene	0.258F	10.0	10.3	101	10.0	10.1	99	2	72-127	20
Styrene	ND	10.0	10.9	109	10.0	10.8	108	1	65-134	20
Tert-Butylbenzene	ND	10.0	11.0	110	10.0	10.6	106	4	70-129	20
Tetrachloroethene	0.223F	10.0	10.8	106	10.0	10.8	106	0	66-128	20
Toluene	25.7	10.0	35.5	99	10.0	34.9	93	2	77-122	20
Trans-1,2-DCE	0.398F	10.0	10.3	99	10.0	9.66	93	6	63-137	20
Trans-1,3-Dichloropropene	ND	10.0	10.3	103	10.0	10.2	102	0	59-135	20
TCE	737J	10.0	717J	-203*	10.0	702J	-349*	2	70-127	20
Trichlorofluoromethane	ND	10.0	9.48	95	10.0	9.32	93	2	57-129	20
Vinyl Chloride	ND	10.0	9.31	93	10.0	8.75	88	6	50-134	20

SURROGATE PARAMETER	SPIKE AMT (ug/L)	MS RSLT (ug/L)	MS % REC	SPIKE AMT (ug/L)	MSD RSLT (ug/L)	MSD % REC	QC LIMIT (%)
1,2-Dichloroethane-d4	10.0	9.74	97	10.0	9.45	94	70-140
Toluene-d8	10.0	10.2	102	10.0	10.3	103	70-140
4-Bromofluorobenzene	10.0	9.45	94	10.0	9.38	94	70-130

Figure 9: **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN WATER PROJECT

SDG : 09E108

SW 5030B/8260B
VOLATILE ORGANICS BY GC/MS

A total of ten (10) water samples were received on 05/08/09 for Volatile Organics by GC/MS analysis, Method SW 5030B/8260B in accordance with AFCEE QAPP, Version 4.0

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument tune check was performed prior to calibration. Instrument mass ratios were within specification. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source. Continuing calibration was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms for ICAL, ICV and CCV for details.

Method Blank
Method blanks were analyzed at the frequency required by the project. For this SDG, two (2) method blanks were analyzed with the samples. All results were compliant to project requirement. Refer to QC result summary form for details.

Lab Control Sample
Two (2) sets of LCS/LCD were analyzed with the samples in this SDG.
Percent recoveries for VOE2E11L/C were all within QC limits.
Percent recoveries for VOE2E13L/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries were within project QC limits except for results qualified with [*] in E108-07 M/S summary form, most likely due to matrix interference. Check QC summaries form for details.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within projects QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.
One analyte in samples E108-01,-02,-03,-05T,-07 and three analytes in samples 09E108-04,-05 were manually integrated to correct improper integration. Chromatograms of before and after manual integrations were retained with the initialed and corrected chromatograms.

Table 1: INITIAL CALIBRATION INTERMEDIATE STANDARD PREPARATION

ICAL/DCC Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µL)	Final Vol. (mL)	
I	1-Chlorohexane	AccuStandard	2000	50	2	50
	2-Chloroethylvinylether	CPI	2000	50	2	50
	Oxygenate Gasoline Additive	AccuStandard	2000-10000	50	2	50 - 250
	Custom VOA Mix	CPI	2000, 20000, 40000	50	2	50, 500, 1000
II	VOC Gas Mix	Ultra Scientific	2000	250	2	250
	Vinyl Acetate	CPI	2500	200	2	250
III	Carbon Disulfide	CPI	5000	100	2	250
IV	VOA Calibration Mix 1	Restek	5000	100	2	250
	Acrolein / Acrylonitrile	AccuStandard	5000	100	2	250

Table 2: INITIAL CALIBRATION VERIFICATION INTERMEDIATE STANDARD PREPARATION

ICV / LCS / MS Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µL)	Final Vol. (mL)	
I	1-Chlorohexane	Ultra Scientific	1000	100	2	50
	2-Chloroethylvinylether	AccuStandard	2000	50	2	50
	Chlorophenol	Restek	5000	20	2	50
	California Oxygenate Mix	Restek	2000 - 10000	50	2	50 - 250
	Custom 8260 Mega Mix	Restek	2000, 20000, 40000	50	2	50, 500, 1000
II	Volatile Organic Cpds Mix 6	Supelco	2000	250	2	250
	Vinyl Acetate	Restek	2000	250	2	250
III	TCL Volatile Mix 1	Supelco	2000	250	2	250
	Acrolein / Acrylonitrile	Ultra Scientific	2000	250	2	250

Table 3: SURROGATE / INTERNAL STANDARD PREPARATION

Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µL)	Final Vol. (mL)	
Surrogate	8260 Surrogate Mix	Restek	2500	200	2	250
Internal Standard	Custom 8260 Internal Standard Mix, 3-30	CPI	2500	200	2	250

Table 4: TUNING SOLUTION TANDARD PREPARATION

BFB Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µL)	Final Vol. (mL)	
Tuning Compound	BFB	Restek	5000	20	2	50

Table 5: TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS

ANALYTES	ICAL ANALYTE CONCENTRATIONS (µg/L) 25-ml Purge									ICV/DCC	LCS/MS
	1	2	3	4	5	6	7	8	9		
1,1,1,2-Tetrachloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1,1-Trichloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1,2,2-Tetrachloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1,2-Trichloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1-Dichloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1-Dichloroethene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1-Dichloropropene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2,3-Trichlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2,3-Trichloropropane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2,4-Trichlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2,4-Trimethylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dibromo-3-chloropropane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dibromoethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dichlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dichloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dichloropropane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,3,5-Trimethylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,3-Dichlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,3-Dichloropropane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,4-Dichlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1-Chlorohexane	0.3	0.5	1	2	5	10	20	30	40	10	10
2,2-Dichloropropane	0.3	0.5	1	2	5	10	20	30	40	10	10
2-Butanone (MEK)	1.5	2.5	5	10	25	50	100	150	200	50	50
2-Chloroethyl vinyl ether	0.3	0.5	1	2	5	10	20	30	40	10	10
2-Chlorotoluene	0.3	0.5	1	2	5	10	20	30	40	10	10
2-Hexanone	1.5	2.5	5	10	25	50	100	150	200	50	50
4-Chlorotoluene	0.3	0.5	1	2	5	10	20	30	40	10	10
4-Methyl-2-pentanone (MIBK)	1.5	2.5	5	10	25	50	100	150	200	50	50
Acetone	1.5	2.5	5	10	25	50	100	150	200	50	50
Acrolein	1.5	2.5	5	10	25	50	100	150	200	50	50
Acrylonitrile	1.5	2.5	5	10	25	50	100	150	200	50	50
Benzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromochloromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromodichloromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromoform	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromomethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Carbon disulfide	0.3	0.5	1	2	5	10	20	30	40	10	10
Carbon tetrachloride	0.3	0.5	1	2	5	10	20	30	40	10	10
Chlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Chloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Chloroform	0.3	0.5	1	2	5	10	20	30	40	10	10
Chloromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
cis-1,2-Dichloroethene	0.3	0.5	1	2	5	10	20	30	40	10	10
cis-1,3-Dichloropropene	0.3	0.5	1	2	5	10	20	30	40	10	10
Dibromochloromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Dibromomethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Dichlorodifluoromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Diisopropyl ether (DIPE)	0.3	0.5	1	2	5	10	20	30	40	10	10
Ethyl Methacrylate	0.3	0.5	1	2	5	10	20	30	40	10	10
Ethylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Ethyl-tert-butyl ether (ETBE)	0.3	0.5	1	2	5	10	20	30	40	10	10
Freon 113	0.3	0.5	1	2	5	10	20	30	40	10	10
Hexachlorobutadiene	0.3	0.5	1	2	5	10	20	30	40	10	10
Iodomethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Isopropylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10

Table 5 (cont.) TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS

ANALYTES	ICAL ANALYTE CONCENTRATIONS (µg/L) 25-ml Purge									ICV/DCC	LCS/MS
	1	2	3	4	5	6	7	8	9		
m/p-Xylene	0.6	1	2	4	10	20	40	60	80	20	20
Methylene chloride	0.3	0.5	1	2	5	10	20	30	40	10	10
Methyl-t-butyl ether (MTBE)	0.3	0.5	1	2	5	10	20	30	40	10	10
Naphthalene	0.3	0.5	1	2	5	10	20	30	40	10	10
n-Butylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
n-Propylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
o-Xylene	0.3	0.5	1	2	5	10	20	30	40	10	10
p-Isopropyltoluene	0.3	0.5	1	2	5	10	20	30	40	10	10
sec-Butylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Styrene	0.3	0.5	1	2	5	10	20	30	40	10	10
tert-Amylmethyl ether (TAME)	0.3	0.5	1	2	5	10	20	30	40	10	10
tert-Butanol	1.5	2.5	5	10	25	50	100	150	200	50	50
tert-Butylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Tetrachloroethene	0.3	0.5	1	2	5	10	20	30	40	10	10
Toluene	0.3	0.5	1	2	5	10	20	30	40	10	10
trans-1,2-Dichloroethene	0.3	0.5	1	2	5	10	20	30	40	10	10
trans-1,3-Dichloropropene	0.3	0.5	1	2	5	10	20	30	40	10	10
trans-1,4-Dichloro-2-butene	0.3	0.5	1	2	5	10	20	30	40	10	10
Trichloroethene	0.3	0.5	1	2	5	10	20	30	40	10	10
Trichlorofluoromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Vinyl acetate	0.3	0.5	1	2	5	10	20	30	40	10	10
Vinyl chloride	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dichloroethane-d4	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromofluorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Chlorobenzene-d5	0.3	0.5	1	2	5	10	20	30	40	10	10
Toluene-d8	0.3	0.5	1	2	5	10	20	30	40	10	10

Table 5 (cont.) TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS

Analytes	ICAL ANALYTE CONCENTRATIONS (µg/L) 5-ml Purge								ICV/DCC	LCS/MS
	1	2	3	4	5	6	7	8		
1,1,1,2-Tetrachloroethane	2	5	10	20	50	80	100	200	50	50
1,1,1-Trichloroethane	2	5	10	20	50	80	100	200	50	50
1,1,2,2-Tetrachloroethane	2	5	10	20	50	80	100	200	50	50
1,1,2-Trichloro-1,2,2-trifluoroethane	2	5	10	20	50	80	100	200	50	50
1,1,2-Trichloroethane	2	5	10	20	50	80	100	200	50	50
1,1-Dichloroethane	2	5	10	20	50	80	100	200	50	50
1,1-Dichloroethene	2	5	10	20	50	80	100	200	50	50
1,1-Dichloropropene	2	5	10	20	50	80	100	200	50	50
1,2,3-Trichlorobenzene	2	5	10	20	50	80	100	200	50	50
1,2,3-Trichloropropane	2	5	10	20	50	80	100	200	50	50
1,2,4-Trichlorobenzene	2	5	10	20	50	80	100	200	50	50
1,2,4-Trimethylbenzene	2	5	10	20	50	80	100	200	50	50
1,2-Dibromo-3-chloropropane	2	5	10	20	50	80	100	200	50	50
1,2-Dibromoethane	2	5	10	20	50	80	100	200	50	50
1,2-Dichlorobenzene	2	5	10	20	50	80	100	200	50	50
1,2-Dichloroethane	2	5	10	20	50	80	100	200	50	50
1,2-Dichloropropane	2	5	10	20	50	80	100	200	50	50
1,3,5-Trimethylbenzene	2	5	10	20	50	80	100	200	50	50
1,3-Dichlorobenzene	2	5	10	20	50	80	100	200	50	50
1,3-Dichloropropane	2	5	10	20	50	80	100	200	50	50
1,4-Dichlorobenzene	2	5	10	20	50	80	100	200	50	50
1-Chlorohexane	2	5	10	20	50	80	100	200	50	50
2,2-Dichloropropane	2	5	10	20	50	80	100	200	50	50
2-Butanone (MEK)	10	25	50	100	250	400	500	1000	250	250
2-Chloroethyl vinyl ether	2	5	10	20	50	80	100	200	50	50
2-Chlorotoluene	2	5	10	20	50	80	100	200	50	50
2-Hexanone	10	25	50	100	250	400	500	1000	250	250
4-Chlorotoluene	2	5	10	20	50	80	100	200	50	50
4-Methyl-2-pentanone (MIBK)	10	25	50	100	250	400	500	1000	250	250
Acetone	10	25	50	100	250	400	500	1000	250	250
Acrolein	10	25	50	100	250	400	500	1000	250	250
Acrylonitrile	10	25	50	100	250	400	500	1000	250	250
Benzene	2	5	10	20	50	80	100	200	50	50
Bromobenzene	2	5	10	20	50	80	100	200	50	50
Bromochloromethane	2	5	10	20	50	80	100	200	50	50
Bromodichloromethane	2	5	10	20	50	80	100	200	50	50
Bromoform	2	5	10	20	50	80	100	200	50	50
Bromomethane	2	5	10	20	50	80	100	200	50	50
Carbon disulfide	2	5	10	20	50	80	100	200	50	50
Carbon tetrachloride	2	5	10	20	50	80	100	200	50	50
Chlorobenzene	2	5	10	20	50	80	100	200	50	50
Chloroethane	2	5	10	20	50	80	100	200	50	50
Chloroform	2	5	10	20	50	80	100	200	50	50
Chloromethane	2	5	10	20	50	80	100	200	50	50
cis-1,2-Dichloroethene	2	5	10	20	50	80	100	200	50	50
cis-1,3-Dichloropropene	2	5	10	20	50	80	100	200	50	50
Dibromochloromethane	2	5	10	20	50	80	100	200	50	50
Dibromomethane	2	5	10	20	50	80	100	200	50	50
Dichlorodifluoromethane	2	5	10	20	50	80	100	200	50	50
Diisopropyl ether (DIPE)	2	5	10	20	50	80	100	200	50	50
Ethyl Methacrylate	2	5	10	20	50	80	100	200	50	50
Ethylbenzene	2	5	10	20	50	80	100	200	50	50
Ethyl-tert-butyl ether (ETBE)	2	5	10	20	50	80	100	200	50	50
Hexachlorobutadiene	2	5	10	20	50	80	100	200	50	50
Iodomethane	2	5	10	20	50	80	100	200	50	50
Isopropylbenzene	2	5	10	20	50	80	100	200	50	50

Table 5 (cont.) **TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS**

	ICAL ANALYTE CONCENTRATIONS (µg/L) 5-ml Purge									
Analytes	1	2	3	4	5	6	7	8	ICV/DCC	LCS/MS
m/p-Xylene	4	10	20	40	100	160	200	400	100	100
Methylene chloride	2	5	10	20	50	80	100	200	50	50
Methyl-t-butyl ether (MTBE)	2	5	10	20	50	80	100	200	50	50
Naphthalene	2	5	10	20	50	80	100	200	50	50
n-Butylbenzene	2	5	10	20	50	80	100	200	50	50
n-Propylbenzene	2	5	10	20	50	80	100	200	50	50
o-Xylene	2	5	10	20	50	80	100	200	50	50
p-Isopropyltoluene	2	5	10	20	50	80	100	200	50	50
sec-Butylbenzene	2	5	10	20	50	80	100	200	50	50
Styrene	2	5	10	20	50	80	100	200	50	50
tert-Amylmethyl ether (TAME)	2	5	10	20	50	80	100	200	50	50
tert-Butanol	10	25	50	100	250	400	500	1000	250	250
tert-Butylbenzene	2	5	10	20	50	80	100	200	50	50
Tetrachloroethene	2	5	10	20	50	80	100	200	50	50
Toluene	2	5	10	20	50	80	100	200	50	50
trans-1,2-Dichloroethene	2	5	10	20	50	80	100	200	50	50
trans-1,3-Dichloropropene	2	5	10	20	50	80	100	200	50	50
trans-1,4-Dichloro-2-butene	2	5	10	20	50	80	100	200	50	50
Trichloroethene	2	5	10	20	50	80	100	200	50	50
Trichlorofluoromethane	2	5	10	20	50	80	100	200	50	50
Vinyl acetate	2	5	10	20	50	80	100	200	50	50
Vinyl chloride	2	5	10	20	50	80	100	200	50	50
1,2-Dichloroethane-d4	2	5	10	20	50	80	100	200	50	50
Bromofluorobenzene	2	5	10	20	50	80	100	200	50	50
Toluene-d8	2	5	10	20	50	80	100	200	50	50

Table 6: BFB KEY ION ABUNDANCE CRITERIA

M/z	Required Intensity (relative abundance)
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	Less than 2% of m/z 174
174	Greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	Greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

Table 7: ESTABLISHED DL, LOD AND LOQ

PARAMETER	Water (5mL Purge)			Water (25mL Purge)			Soil		
	DL	LOD	LOQ	DL	LOD	LOQ	DL	LOD	LOQ
Acetone	2.5	5	10	2.6	5	10	3	5	10
Acrolein	2.5	5	10	2.5	5	10	2.5	5	10
Acrylonitrile	2.5	5	10	2.5	5	10	2.5	5	10
Benzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Bromobenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Bromochloromethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Bromodichloromethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Bromoform	0.5	1	5	0.2	0.3	0.5	1	2	5
Bromomethane	1.1	2	5	0.2	0.3	0.5	1.8	2	5
tert-Butyl alcohol	7	10	25	2.5	5	10	9	10	20
2-Butanone (MEK)	2.5	5	10	2	4	10	2.5	5	10
n-Butylbenzene	0.7	1	5	0.2	0.2	0.5	0.7	1	5
sec-Butylbenzene	0.5	1	5	0.1	0.2	0.5	0.7	1	5
tert-Butylbenzene	0.5	1	5	0.1	0.2	0.5	0.6	1	5
Carbon disulfide	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Carbon tetrachloride	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Chlorobenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
2-Chloroethyl vinyl ether	1	2	5	0.5	1	2	1	2	5
Chloroethane	1	2	5	0.3	0.3	0.5	1	2	5
Chloroform	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1-Chlorohexane	0.5	1	5	0.1	0.2	0.5	0.6	1	5
Chloromethane	1	2	5	0.2	0.3	0.5	1	2	5
2-Chlorotoluene	0.5	1	5	0.1	0.2	0.5	0.8	1	5
4-Chlorotoluene	0.6	1	5	0.1	0.2	0.5	0.7	1	5
Isopropyl ether (DIPE)	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Dibromochloromethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2-Dibromo-3-chloropropane	1	2	5	0.25	0.5	1	1	2	5
1,2-Dibromoethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Dibromomethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1-Dichloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2-Dichloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2-Dichlorobenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,3-Dichlorobenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
trans-1,4-Dichloro-2-Butene	1	2	5	0.5	1	2	1	2	5
1,4-Dichlorobenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Dichlorodifluoromethane	1.3	2	5	0.2	0.3	0.5	1.2	2	5
1,1-Dichloroethene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
cis-1,2-Dichloroethene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
trans-1,2-Dichloroethene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Dichlorofluoromethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1-Dichloropropene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2-Dichloropropane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,3-Dichloropropane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
2,2-Dichloropropane	1	2	5	0.2	0.2	0.5	1	2	5
cis-1,3-Dichloropropene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
trans-1,3-Dichloropropene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
tert-Butyl ethyl ether (ETBE)	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Ethyl Methacrylate	1	2	5	0.25	0.5	1	1	2	5
Ethylbenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
2-Hexanone (MBK)	2.5	5	10	2	4	5	2.9	5	10

Table 7 (cont): **ESTABLISHED DL, LOD AND LOQ**

PARAMETER	Water (5mL Purge)			Water (25mL Purge)			Soil		
	DL	LOD	LOQ	DL	LOD	LOQ	DL	LOD	LOQ
Hexachlorobutadiene	0.5	1	5	0.2	0.3	0.5	1	2	5
Iodomethane	0.5	1	5	0.15	0.3	0.5	1	2	5
Isopropylbenzene	0.5	1	5	0.1	0.2	0.5	0.6	1	5
p-Isopropyltoluene	0.6	1	5	0.1	0.2	0.5	0.6	1	5
Methylene Chloride	0.5	1	5	0.3	0.5	1	1	2	5
4-Methyl-2-pentanone (MIBK)	2.5	5	10	2	4	5	2.8	5	10
tert-Butyl methyl ether	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Naphthalene	1	2	5	0.25	0.5	1	1	2	5
n-Propylbenzene	0.5	1	5	0.1	0.2	0.5	0.65	1	5
Styrene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
tert-Amyl methyl ether (TAME)	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1,1,2-Tetrachloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1,2,2-Tetrachloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Tetrachloroethene	0.5	1	5	0.15	0.2	0.5	0.5	1	5
Toluene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1,1-Trichloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1,2-Trichloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2,3-Trichlorobenzene	0.5	1	5	0.15	0.3	0.5	1	2	5
1,2,4-Trichlorobenzene	0.5	1	5	0.15	0.3	0.5	1	2	5
Trichloroethene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Trichlorofluoromethane	0.9	1	5	0.2	0.3	0.5	1.1	2	5
1,2,3-Trichloropropane	1	2	5	0.25	0.5	1	1	2	5
1,1,2-Trichloro1,2,2-trifluoroethane	1	2	5	0.2	0.3	0.5	1	2	5
1,2,4-Trimethylbenzene	0.5	1	5	0.1	0.2	0.5	0.6	1	5
1,3,5-Trimethylbenzene	0.5	1	5	0.1	0.2	0.5	0.6	1	5
Vinyl Acetate	1	2	5	0.25	0.5	1	1	2	5
Vinyl Chloride	0.6	1	5	0.1	0.2	0.5	1	2	5
m-Xylene & p-xylene	1	2	10	0.2	0.4	1	1	2	10
o-Xylene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2-Dichloroethane-d4	1	2	5	0.5	1	2	1	2	5
Toluene-d8	1	2	5	0.5	1	2	1	2	5
4-Bromofluorobenzene	1	2	5	0.5	1	2	1	2	5
Dibromofluoromethane	1	2	5	0.5	1	2	0.5	1	5

Table 8: CHARACTERISTIC IONS

ANALYTE	PRIMARY CHARACTERISTIC ION(S)	SECONDARY CHARACTERISTIC ION(S)
Acetone	43	58
Acetonitrile	41	40,39
Acrolein	56	55
Acrylonitrile	53	52, 51
Benzene	78	77, 52
Benzyl Chloride	91	126, 65, 125
Bromobenzene	156	51, 158
Bromochloromethane	49	128, 130
Bromoform	173	171, 175
Bromomethane	94	96
n-Butylbenzene	91	92, 134
sec-Butylbenzene	105	134
tert-Butylbenzene	119	91, 134
Carbon Disulfide	76	78
Carbon Tetrachloride[6]	119	117
Chlorobenzene	112	51, 77, 114
Chloroethane	64	49, 66
2-Chloroethyl vinyl ether	63	65, 106
Chloroform	83	85, 47
Chloromethane	50	52
2-Chlorotoluene	91	126
4-Chlorotoluene	91	126
1,2-Dibromo-3-chloropropane	157	155, 175
Dibromochloromethane	129	127. 131
1,2-Dibromoethane	107	109
Dibromomethane	93	95, 174
1,2-Dichlorobenzene	146	111, 148
1,3-Dichlorobenzene	146	111, 148
1,4-Dichlorobenzene	146	111, 148
cis-1,4-Dichloro-2-butene	75	53, 77, 124, 89
trans-1,4-Dichloro-2-butene	53	88
Dichlorodifluoromethane	85	87, 50
1,1-Dichloroethane	63	65, 83
1,2-Dichloroethane	62	98, 64
1,1-Dichloroethene	61	63, 96
cis-1,2-Dichloroethene	96	61, 98
trans-1,2-Dichloroethene	61	96, 98
1,2-Dichloropropane	63	41, 76
1,3-Dichloropropane	76	63, 78
2,2-Dichloropropane	77	97, 79, 41

[6] Quantitation ion was changed due to co-elution (Carbon tetrachloride – 117 to 119)

Table 8 (cont): CHARACTERISTIC IONS

ANALYTE	PRIMARY CHARACTERISTIC ION(S)	SECONDARY CHARACTERISTIC ION(S)
1,1-Dichloropropene[7]	77	110, 75
cis-1,3-Dichloropropene	75	77, 39, 110
trans-1,3-Dichloropropene	75	77, 39, 110
Ethylbenzene	91	106
Hexachlorobutadiene	225	223, 227
Hexachloroethane	201	166, 199, 203
2-Hexanone	43	58, 100
Iodomethane	142	127, 141
Isopropyltoluene	105	120, 79, 103
Methyl-t-butyl ether	73	57
Methylene chloride	49	84, 86
Methyl ethyl ketone	43	72
4-Methyl-2-pentanone	43	58, 85, 100
Naphthalene	128	127
n-Propylbenzene	91	65, 120
Styrene	104	78, 103
1,2,3-Trichlorobenzene	180	182, 145
1,2,4-Trichlorobenzene	180	182, 145
1,1,1,2-Tetrachloroethane	131	133, 119, 117
1,1,2,2-Tetrachloroethane	83	131, 85
Tetrachloroethene	164	129, 131, 166
Toluene	92	91
1,1,1 -Trichloroethane	97	99, 61
1,1,2 -Trichloroethane	97	83, 85, 99
Trichloroethene	130	97, 132, 95
Trichlorofluoromethane	101	103
1,2,3-Trichloropropane	75	61, 77
1,2,4-Trimethylbenzene	105	120
1,3,5-Trimethylbenzene	105	120, 119
Vinyl acetate	43	86
Vinyl chloride	62	64
o-Xylene	91	106
m-Xylene	91	106
p-Xylene	91	106
INTERNAL STANDARDS / SURROGATES		
1,4-Difluorobenzene	114	88
Chlorobenzene-d5	117	82, 119
1,2-Dichlorobenzene-d4	152	150
4-Bromofluorobenzene	95	174, 176
1,2-Dichloroethane-d4	65	102
Toluene-d8	98	100

[7] Quantitation ion was changed due to co-elution (1,1-Dichloropropene – 75 to 77)

Table 9: INTERNAL STANDARDS WITH CORRESPONDING TARGET COMPOUNDS AND SURROGATES ASSIGNED FOR QUANTITATION

1,4-DIFLUOROBENZENE	**CHLOROBENZENE-D_5**	**1,2-DICHLOROBENZENE-D_4**
Dichlorodifluoromethane	1,1-Dichloropropene	Bromoform
Chloromethane	Carbon Tetrachloride	Isopropyl Benzene
Vinyl Chloride	Benzene	Bromofluorobenzene
Bromomethane	1,2-Dichloroethane	Bromobenzene
Chloroethane	Trichloroethene	1,1,2,2-Tetrachloroethane
Trichlorofluorometh	1,2-Dichloropropane	1,2,3-Trichloropropane
1,1-Dichloroethene	Bromodichloromethane	1,4-Dichloro-2-butene
1,1,2-Trichloro-1,2,2-trifluoroethane	Dibromomethane	n-Propylbenzene
Acetone	2-Chloroethyl Vinyl Ether	2-Chlorotoluene
Iodomethane	cis-1,3-Dichloropropene	4-Chlorotoluene
Carbon Disulfide	4-Methyl-2-Pentanone	1,3,5-Trimethylbenzene
Methylene Chloride	Toluene-d_8	tert-Butylbenzene
Acrylonitrile	Toluene	124-Trimethylbenzen
trans-1,2-Dichloroe	trans-1,3-Dichloropropene	Sec-Butylbenzene
Acrolein	Ethyl Methacrylate	1,3-Dichlorobenzene
MTBE	1,1,2-trichloroethane	1,4-Dichlorobenzene
1,1-Dichloroethane	Tetrachloroethene	p-Isopropyltoluene
Vinyl Acetate	1,3-Dichloropropane	1,2-Dichlorobenzene
2,2-Dichloropropane	2-Hexanone	n-Butylbenzene
cis-1,2-Dichloroeth	Dibromochloromethane	1,2-Dibromo-3-Chlorpropane
2-Butanone	1,2-Dibromoethane	1,2,4-Trichlorobenzene
Bromochloromethane	Chlorobenzene	Hexachlorobutadiene
Chloroform	1-Chlorohexane	Naphthalene
1,1,1-Trichloroetha	1,1,1,2-Tetrachloroethane	1,2,3-Trichlorobenzene
1,2-Dichloroethane-d_4	Ethylbenzene	
	m/p-Xylenes	
	o-Xylene	
	Styrene	

Appendix 1: **SUMMARY OF QUALITY CONTROL PROCEDURES**

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in Table 6	Retune instrument and verify		
Minimum of 6-point initial calibration(ICAL)	Initially; as needed	SPCCs : RF ≥ 0.1 for Bromoform, Chloromethane and 1,1-Dichloroethane RF ≥ 0.3 for Chlorobenzene and 1,1,2,2-Tetrachloroethane CCCs: Chloroform, 1,1-DCE, 1,2-DCP, Ethylbenzene, Toluene and Vinyl Chloride. RFs for CCCs: RSD≤30% and one option below: 1). For analytes with RSD ≤ 15%, use RRFm 2). For analytes with RSD>15% and r ≥0..995, use either Inverse Weighting Factor or Linear Least Squares 3). For analytes with RSD>15% and COD ≥0.99, use non-linear regression (6 pts for second order, 7 pts for third order).	Check for outliers. Otherwise, optimize the instrument then repeat initial calibration.		
Initial calibration verification (ICV)	After initial calibration	In the absence of PSR All analytes within ± 20% of expected value except for the following compounds due to erratic chromatographic behavior: Bromomethane, Chloroethane, Chloromethane, Dichlorodifluoromethane within ± 35% of expected value.	Verify second source standard. Prepare fresh standard and rerun ICV. If that fails, Optimize instrument and repeat ICAL.		
Evaluation of relative retention times (RRT)	Each sample	Within ± 0.06 RRT units	Correct the problem then reanalyze all samples analyzed since the last retention time check		
Continuing Calibration verification (CCV)	Daily, before sample analysis and every 12 hours of analysis time	SPCCs: Min. RF same as ICAL CCC : %Diff ≤ 20% (when using RFs) or drift (when using least squares regression or non-linear calibration)	Correct the problem then repeat initial calibration		
Internal Standard (IS)	All samples	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning		
Method blank (MB)	One per preparation batch	No analytes detected >½ LOQ	Determine the source of contamination and correct the problem. Re-prep and re-analyze MB and all associated samples. Otherwise, apply "B" to specific analyte(s) on associated samples		
LCS	One LCS per preparation	Within project QC Limits	Re-prep and re-analyze the LCS and all associated samples		
MS/MSD	One MS/MSD per every 20 project samples per matrix	Within project QC Limits	Check if sample was properly spiked. If indicative of matrix interference, discuss in case narrative, otherwise re-prep and re-analyze the sample		
Surrogate	Every Sample, MB, LCS, MS/MSD, DCC	Within project QC Limits	Correct the problem then re-analyze		
Comments: Refer to PSR for Flagging Criteria. Report values between LOD and LOQ.			Reviewed by:		
			Date:		

Appendix 2: **DEMONSTRATION OF CAPABILITY**

Final Report - Soil / Hazardous Waste PT

Study: HW0110

Opening Date: January 18, 2010 - Closing Date: March 4, 2010

Laboratory: EMAX Laboratories
1825 205th Street
Torrance, CA 90501

Contact: Kenette Pimentel, Quality Assurance Manager
310-618-8889 ext. 205

EPA Lab ID: CA00291

Volatiles (PT-VOA-SOIL)								Lot #: 7039-12
NELAC Code	Analyte	Method Code	Method Description	Units	Assigned Value	Result	Acceptance Limits	Evaluation
4315	Acetone	10184802	SW 5035/SW 8260 B	µg/kg	303	240	103 - 495	Acceptable
4375	Benzene	10184802	SW 5035/SW 8260 B	µg/kg	105	94.4	62.6 - 144	Acceptable
4395	Bromodichloromethane	10184802	SW 5035/SW 8260 B	µg/kg	111	104	72.1 - 153	Acceptable
4400	Bromoform	10184802	SW 5035/SW 8260 B	µg/kg	<9.3	<5		Acceptable
4410	2-Butanone (MEK)	10184802	SW 5035/SW 8260 B	µg/kg	255	213	51.9 - 397	Acceptable
4455	Carbon tetrachloride	10184802	SW 5035/SW 8260 B	µg/kg	<9.9	<5		Acceptable
4475	Chlorobenzene	10184802	SW 5035/SW 8260 B	µg/kg	179	176	102 - 248	Acceptable
4575	Chlorodibromomethane	10184802	SW 5035/SW 8260 B	µg/kg	58.8	55.8	34.3 - 82.2	Acceptable
4505	Chloroform	10184802	SW 5035/SW 8260 B	µg/kg	110	111	66.4 - 153	Acceptable
4610	1,2-Dichlorobenzene	10184802	SW 5035/SW 8260 B	µg/kg	131	129	63.4 - 185	Acceptable
4615	1,3-Dichlorobenzene	10184802	SW 5035/SW 8260 B	µg/kg	50.5	48	17.6 - 74.7	Acceptable
4620	1,4-Dichlorobenzene	10184802	SW 5035/SW 8260 B	µg/kg	97.0	95	33.5 - 138	Acceptable
4630	1,1-Dichloroethane	10184802	SW 5035/SW 8260 B	µg/kg	44.0	43.9	24.4 - 64.2	Acceptable
4635	1,2-Dichloroethane	10184802	SW 5035/SW 8260 B	µg/kg	45.0	54	26.7 - 63.9	Acceptable
4655	1,2-Dichloropropane	10184802	SW 5035/SW 8260 B	µg/kg	80.8	79.9	47.5 - 109	Acceptable
4765	Ethylbenzene	10184802	SW 5035/SW 8260 B	µg/kg	<9.0	<5		Acceptable
4975	Methylene chloride	10184802	SW 5035/SW 8260 B	µg/kg	108	100	50.4 - 157	Acceptable
5000	Methyl-tert-butyl ether (MTBE)	10184802	SW 5035/SW 8260 B	µg/kg	144	142	60.9 - 213	Acceptable
4995	4-Methyl-2-pentanone (MIBK)	10184802	SW 5035/SW 8260 B	µg/kg	232	176	102 - 337	Acceptable
5005	Naphthalene	10184802	SW 5035/SW 8260 B	µg/kg	93.3	78.3	52.8 - 134	Acceptable
5105	1,1,1,2-Tetrachloroethane	10184802	SW 5035/SW 8260 B	µg/kg	52.5	52.5	33.7 - 73.7	Acceptable
5110	1,1,2,2-Tetrachloroethane	10184802	SW 5035/SW 8260 B	µg/kg	152	133	78.9 - 220	Acceptable
5115	Tetrachloroethene	10184802	SW 5035/SW 8260 B	µg/kg	51.5	47.5	22.7 - 74.1	Acceptable
5140	Toluene	10184802	SW 5035/SW 8260 B	µg/kg	47.4	44.5	26.7 - 67.1	Acceptable
5155	1,2,4-Trichlorobenzene	10184802	SW 5035/SW 8260 B	µg/kg	151	133	75.2 - 190	Acceptable
5160	1,1,1-Trichloroethane	10184802	SW 5035/SW 8260 B	µg/kg	44.8	44.9	23.6 - 63.5	Acceptable
5165	1,1,2-Trichloroethane	10184802	SW 5035/SW 8260 B	µg/kg	32.2	29.9	20.1 - 47.2	Acceptable
5170	Trichloroethene	10184802	SW 5035/SW 8260 B	µg/kg	113	99.6	58.1 - 162	Acceptable
5180	1,2,3-Trichloropropane	10184802	SW 5035/SW 8260 B	µg/kg	61.0	53.9	42.5 - 72.3	Acceptable
5260	Xylenes, total	10184802	SW 5035/SW 8260 B	µg/kg	157	155	76.8 - 233	Acceptable
NELAC Experimental Analytes								
4385	Bromobenzene	10184802	SW 5035/SW 8260 B	µg/kg	68.7	69.1	48.2 - 85.0	Acceptable
4950	Bromomethane	10184802	SW 5035/SW 8260 B	µg/kg	100	74.7	20.0 - 137	Acceptable
4485	Chloroethane	10184802	SW 5035/SW 8260 B	µg/kg	100	88.5	20.0 - 149	Acceptable
4960	Chloromethane	10184802	SW 5035/SW 8260 B	µg/kg	<20	7.35		Acceptable
4570	1,2-Dibromo-3-chloropropane (DBCP)	10184802	SW 5035/SW 8260 B	µg/kg	124	97.6	71.2 - 161	Acceptable
4585	1,2-Dibromoethane (EDB)	10184802	SW 5035/SW 8260 B	µg/kg	181	163	121 - 219	Acceptable
4625	Dichlorodifluoromethane	10184802	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4640	1,1-Dichloroethene	10184802	SW 5035/SW 8260 B	µg/kg	110	98.2	63.3 - 161	Acceptable
4645	cis-1,2-Dichloroethene	10184802	SW 5035/SW 8260 B	µg/kg	<10	<5		Acceptable
4700	trans-1,2-Dichloroethene	10184802	SW 5035/SW 8260 B	µg/kg	74.7	69.1	41.4 - 102	Acceptable
4680	cis-1,3-Dichloropropene	10184802	SW 5035/SW 8260 B	µg/kg	60.5	60.2	40.6 - 78.9	Acceptable
4685	trans-1,3-Dichloropropene	10184802	SW 5035/SW 8260 B	µg/kg	<10	<5		Acceptable
4860	2-Hexanone	10184802	SW 5035/SW 8260 B	µg/kg	177	145	67.6 - 257	Acceptable
4900	Isopropylbenzene	10184802	SW 5035/SW 8260 B	µg/kg	88.0	85.6	45.5 - 124	Acceptable
5100	Styrene	10184802	SW 5035/SW 8260 B	µg/kg	83.2	82	54.1 - 111	Acceptable
5175	Trichlorofluoromethane	10184802	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
5235	Vinyl chloride	10184802	SW 5035/SW 8260 B	µg/kg	140	85.6	60.9 - 181	Acceptable
Additional State Specific Analytes								
4320	Acetonitrile	10184802	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4325	Acrolein	10184802	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4340	Acrylonitrile	10184802	SW 5035/SW 8260 B	µg/kg	76.0	70	22.7 - 129	Acceptable
4390	Bromochloromethane	10184802	SW 5035/SW 8260 B	µg/kg	136	135	40.9 - 232	Acceptable

Appendix 2 (Cont.): **DEMONSTRATION OF CAPABILITY**

Volatiles (PT-VOA-SOIL) cont'd								Lot #: 7039-12
NELAC Code	Analyte	Method Code	Method Description	Units	Assigned Value	Result	Acceptance Limits	Evaluation
Additional State Specific Analytes cont'd								
4435	n-Butylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	65.9	62	19.8 - 112	Acceptable
4440	sec-Butylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	144	137	43.3 - 245	Acceptable
4445	tert-Butylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	180	172	54.0 - 306	Acceptable
4450	Carbon disulfide	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4465	Chloroacetaldehyde	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
5765	bis(2-Chloroethyl)ether	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
5760	bis(2-Chloroethoxy)methane	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
5780	bis(2-Chloroisopropyl)ether	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4500	2-Chloroethylvinylether	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4535	2-Chlorotoluene	10184902	SW 5035/SW 8260 B	µg/kg	40.8	51	12.2 - 69.4	Acceptable
4540	4-Chlorotoluene	10184902	SW 5035/SW 8260 B	µg/kg	153	151	45.9 - 260	Acceptable
4595	Dibromomethane	10184902	SW 5035/SW 8260 B	µg/kg	52.5	50.7	16.2 - 91.8	Acceptable
4660	1,3-Dichloropropane	10184902	SW 5035/SW 8260 B	µg/kg	147	137	44.1 - 250	Acceptable
4665	2,2-Dichloropropane	10184902	SW 5035/SW 8260 B	µg/kg	84.7	85.1	25.4 - 144	Acceptable
4670	1,1-Dichloropropene	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
9375	DIPE	10184902	SW 5035/SW 8260 B	µg/kg	113	108	34.0 - 193	Acceptable
4840	Hexachloroethane	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4835	Hexachlorobutadiene	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4835	Hexachlorobutadiene	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4910	p-Isopropyltoluene	10184902	SW 5035/SW 8260 B	µg/kg	40.4	39	12.1 - 68.7	Acceptable
5090	n-Propylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	36.4	34.9	10.9 - 61.9	Acceptable
4370	TAME	10184902	SW 5035/SW 8260 B	µg/kg	56.1	54.8	16.8 - 95.4	Acceptable
5150	1,2,3-Trichlorobenzene	10184902	SW 5035/SW 8260 B	µg/kg	99.1	91.1	29.7 - 168	Acceptable
5210	1,2,4-Trimethylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	155	149	46.4 - 263	Acceptable
5215	1,3,5-Trimethylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	42.8	42	12.9 - 72.8	Acceptable
5225	Vinyl acetate	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
5250	o-Xylene	10174908	SW 5035/SW 8021 B	µg/kg	62.6	67.8	18.8 - 106	Acceptable
5250	o-Xylene	10184902	SW 5035/SW 8260 B	µg/kg	62.6	61.1	18.8 - 106	Acceptable
5240	m+p-Xylene	10184902	SW 5035/SW 8260 B	µg/kg	94.8	93.6	28.4 - 161	Acceptable

Final Report - Water Pollution Proficiency Testing

Study: WP0110

Opening Date: January 4, 2010 - Closing Date: February 18, 2010

Laboratory: EMAX Laboratories
1825 205th Street
Torrance, CA 90501

Contact: Kenette Pimentel, Quality Assurance Manager
310-618-8889 ext. 205

EPA Lab ID: CA00291

Volatiles (PT-VOA-WP) **Lot #: 8094-26**

NELAC Code	Analyte	Method Code	Method Description	Units	Assigned Value	Result	Acceptance Limits	Evaluation
4375	Benzene	10184902	SW 5030 C/SW 8260 B	µg/L	17.1	16	11.4 - 22.8	Acceptable
4395	Bromodichloromethane	10184902	SW 5030 C/SW 8260 B	µg/L	61.1	67	43.2 - 82.5	Acceptable
4400	Bromoform	10184902	SW 5030 C/SW 8260 B	µg/L	88.1	82.4	56.1 - 119	Acceptable
4950	Bromomethane	10184902	SW 5030 C/SW 8260 B	µg/L	30.0	21.4	12.0 - 48.0	Acceptable
4455	Carbon tetrachloride	10184902	SW 5030 C/SW 8260 B	µg/L	22.4	25.5	12.7 - 31.0	Acceptable
4475	Chlorobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	64.7	63.2	46.6 - 81.0	Acceptable
4485	Chloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	90.5	80.3	36.2 - 145	Acceptable
4505	Chloroform	10184902	SW 5030 C/SW 8260 B	µg/L	80.8	82.4	56.0 - 104	Acceptable
4960	Chloromethane	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
4575	Dibromochloromethane	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
4610	1,2 Dichlorobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	85.9	82.1	59.8 - 111	Acceptable
4615	1,3 Dichlorobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	62.1	60.2	42.0 - 79.2	Acceptable
4620	1,4 Dichlorobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	25.0	24.9	16.5 - 32.4	Acceptable
4635	1,2 Dichloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	21.5	21.8	14.9 - 29.2	Acceptable
4640	1,1-Dichloroethene	10184902	SW 5030 C/SW 8260 B	µg/L	25.3	26.1	13.4 - 37.0	Acceptable
4700	trans-1,2-Dichloroethene	10184902	SW 5030 C/SW 8260 B	µg/L	23.2	22.1	12.3 - 34.6	Acceptable
4655	1,2-Dichloropropane	10184902	SW 5030 C/SW 8260 B	µg/L	61.1	59.2	40.0 - 80.7	Acceptable
4685	trans-1,3-Dichloropropene	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
4765	Ethylbenzene	10174908	SW 5030 C/SW 8021 B	µg/L	12.6	12.8	8.31 - 16.8	Acceptable
4765	Ethylbenzene	10184902	SW 5030 C/SW 8260 B	µg/L	12.6	12.1	8.31 - 16.8	Acceptable
4835	Hexachlorobutadiene	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
4975	Methylene Chloride	10184902	SW 5030 C/SW 8260 B	µg/L	106	110	65.0 - 148	Acceptable
4995	4-Methyl-2-pentanone (MIBK)	10184902	SW 5030 C/SW 8260 B	µg/L	36.9	31.9	13.5 - 58.0	Acceptable
5005	Naphthalene	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
5100	Styrene	10184902	SW 5030 C/SW 8260 B	µg/L	35.4	36.1	23.2 - 47.9	Acceptable
5110	1,1,2,2-Tetrachloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	140	120	83.3 - 202	Acceptable
5115	Tetrachloroethene	10184902	SW 5030 C/SW 8260 B	µg/L	19.1	19.1	9.61 - 25.3	Acceptable
5140	Toluene	10184902	SW 5030 C/SW 8260 B	µg/L	38.6	37.3	26.8 - 48.7	Acceptable
5155	1,2,4-Trichlorobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
5160	1,1,1-Trichloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	77.3	85.4	48.1 - 101	Acceptable
5165	1,1,2-Trichloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	32.9	31.2	23.0 - 43.5	Acceptable
5170	Trichloroethene	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
5175	Trichlorofluoromethane	10184902	SW 5030 C/SW 8260 B	µg/L	60.6	75.4	24.2 - 96.9	Acceptable
5235	Vinyl chloride	10184902	SW 5030 C/SW 8260 B	µg/L	36.5	31.2	14.6 - 58.4	Acceptable
5260	Xylenes, total	10184902	SW 5030 C/SW 8260 B	µg/L	204	204	117 - 272	Acceptable
NELAC Experimental Analytes								
4630	1,1-Dichloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	73.7	72.9	50.7 - 101	Acceptable
4645	cis-1,2-Dichloroethene	10184902	SW 5030 C/SW 8260 B	µg/L	110	93.9	80.8 - 145	Acceptable
4680	cis-1,3-Dichloropropylene	10184902	SW 5030 C/SW 8260 B	µg/L	67.2	69.1	47.0 - 87.4	Acceptable
4860	2-Hexanone	10184902	SW 5030 C/SW 8260 B	µg/L	154	203	79.7 - 226	Acceptable
5000	Methyl tert-butyl ether (MTBE)	10184902	SW 5030 C/SW 8260 B	µg/L	89.4	87.5	57.2 - 125	Acceptable
Additional State Specific Analytes								
4315	Acetone	10184902	SW 5030 C/SW 8260 B	µg/L	295	358	110 - 575	Acceptable
4320	Acetonitrile	10184902	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4325	Acrolein	10184902	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4340	Acrylonitrile	10184902	SW 5030 C/SW 8260 B	µg/L	108	101	43.2 - 173	Acceptable
4385	Bromobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4390	Bromochloromethane	10184902	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4410	2-Butanone (MEK)	10184902	SW 5030 C/SW 8260 B	µg/L	18.3	21.5	3.36 - 36.6	Acceptable
4435	n-Butylbenzene	10184902	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable

Appendix 2 (Cont.): **DEMONSTRATION OF CAPABILITY**

Volatiles (PT-VOA-WP) cont'd								Lot #: 8094-26
NELAC Code	Analyte	Method Code	Method Description	Units	Assigned Value	Result	Acceptance Limits	Evaluation
Additional State Specific Analytes cont'd								
4440	sec-Butylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4445	tert-Butylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4450	Carbon disulfide	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4500	2-Chloroethylvinylether	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4535	2-Chlorotoluene	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4540	4-Chlorotoluene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4570	1,2-Dibromo-3-chloropropane (DBCP)	10184802	SW 5030 C/SW 8260 B	µg/L	102	96.7	40.8 - 163	Acceptable
4585	1,2-Dibromoethane (EDB)	10184802	SW 5030 C/SW 8260 B	µg/L	110	103	44.0 - 176	Acceptable
4595	Dibromomethane	10184802	SW 5030 C/SW 8260 B	µg/L	119	114	47.6 - 190	Acceptable
4625	Dichlorodifluoromethane	10184802	SW 5030 C/SW 8260 B	µg/L	6.00	<5	0.00 - 10.8	Acceptable
-	Dichlorofluoromethane	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4660	1,3-Dichloropropane	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4665	2,2-Dichloropropane	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4670	1,1-Dichloropropene	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4900	Isopropylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4910	p-Isopropyltoluene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
5090	n-Propylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
5105	1,1,1,2-Tetrachloroethane	10184802	SW 5030 C/SW 8260 B	µg/L	43.1	46.9	17.2 - 69.0	Acceptable
5150	1,2,3-Trichlorobenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
5180	1,2,3-Trichloropropane	10184802	SW 5030 C/SW 8260 B	µg/L	62.4	59.6	25.0 - 99.8	Acceptable
5210	1,2,4-Trimethylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<20	<5		Acceptable
5215	1,3,5-Trimethylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<20	<5		Acceptable
5225	Vinyl acetate	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
5240	m+p-Xylene	10184802	SW 5030 C/SW 8260 B	µg/L	136	137	54.4 - 218	Acceptable
5250	o-Xylene	10184802	SW 5030 C/SW 8260 B	µg/L	67.5	66.9	27.0 - 108	Acceptable

EMAX LABORATORIES, INC.

Page 1

ANALYSIS LOG FOR VOLATILES

SOP ☐ EMAX-8260 Rev.No. 4 ☐ EMAX-524.2 Rev.No. 4 ☐ EMAX-CLP-VOA ☐ EMAX 624 Rev.No. 2 ☐

Start Date: ☐ 5-ml Purge ☐ 25-ml Purge Book # AD3 -019

BATCH _____

Sample Prep. ID	Data File Name	Lab Sample ID	Sample Amount	DF	Matrix W pH	Matrix W Cl_2	Matrix S	Notes
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Instrument No.		D3
INITIAL CALIBRATION REFERENCE		
DATE		
ICAL ID		
STANDARDS		
NAME	ID	CONC. (mg/L)
DCC		
DCC		
DCC		
BFB		
IS/SURR.		
LCS		
LCS		
LCS		
SOLVENT	ID	
METHANOL		
DATA FILE		
Electronic Data Archival		
Location		Date
HPCHEM_VOA/TOD3		

Comments:

Analyzed By:

Date Disposed:

Disposed By:

8260FM: **INSTRUMENT MAINTENANCE LOG**

EMAX LABORATORIES, INC.

Page 1

INSTRUMENT MAINTENANCE LOG

Instrument No: 05 Month: Year: 201_ Book # : MD3-005

DATE						
Bake Trap (210°C-260°C)						
Column Head Pressure (2-60 psi)						
Injector Port Temperature (160°C-220°C)						
Interface Temperature (250°C-280°C)						
Verify Computer Date and Time						
Check Gas Pressure (Daily)						
Check IS/Surrogate auto injection vial as appropriate (Daily)						
Check the foreline pump oil level (Weekly)						
AutoTune the MSD (As needed)						
Analyst's initial						
Trouble Shooting						
Problem(s) Encountered						
Return-to-Control (Analyst Initial)						

Code	Problems Encountered	Code	Corrrective Action

STANDARD OPERATING PROCEDURES

SEMIVOLATILE ORGANICS BY GC/MS

SOP No.:	EMAX-8270	Revision No.	4	Date:	15-May-10
Prepared By:	Khoa Vu			Date:	15 May 10
Approved By:	Kenette Pimentel QA Manager			Date:	05.15.10
Approved By:	Caspar Pang Laboratory Director			Date:	15-May 2010.

Control Number: **8270-04-**

1.0 SCOPE AND APPLICATION

1.1. This method is used to determine the concentration of semivolatile organic compounds extracted from many types of solid waste matrices, soils, air sampling media and water samples. Analytes that are listed in Table 7 were determined when this SOP was established. Additional analytes may be added upon completion of similar validation as the analytes that are listed in Table 7. This SOP is an adaptation of method SW846 8270D. Since 8270D is an update and enhancement of 8270C, this SOP is also applicable to 8270C.

2.0 SUMMARY OF METHOD

2.1. Samples are extracted with methylene chloride. Extracts are concentrated and appropriate cleanup procedure is applied if necessary.

2.2. Internal standards are added to an aliquot of the final extract and are qualitatively and quantitatively analyzed by gas chromatography equipped with mass spectrometry (GC/MS).

2.3. **Interference**

2.3.1. Solvents, reagents, glassware, and other sample processing devices are all possible sources of artifacts and/or interferences to sample analysis. Hence, quality control of chemicals and proper decontamination of reusable glassware and proofing the analytical instrument to be free from contamination shall be observed.

2.3.2. Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interference. Determine source of interference in the preparation and/or cleanup of the samples and Perform corrective action to eliminate the problem.

2.3.3. Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, rinse the sample syringe with solvent between sample injections. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross-contamination.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point. All samples analyzed above this concentration are considered "over-range" and shall require dilution for proper quantitation.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required for proper quantitation.

4.3. The dynamic range established for this method are:

Water (µg/L)	Soil (µg/kg)
10 - 160 µg/L	330 - 5300 µg/kg

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Sample Preservation**

5.1.1. Store water and soil samples at ≤6°C away from light.

5.1.2. Store all extracts at ≤6°C.

5.2. **Holding Time**

5.2.1. Extract water samples within 7 days from sampling date.

5.2.2. Extract soil samples within 14 days from sampling date.

5.2.3. Analyze all extracts within 40 days from extraction completion date.

6.0 ASSOCIATED SOPs

6.1. EMAX-1311 TCLP for Organic and Inorganic Analysis

6.2. EMAX-3510 Extraction of Organic Compounds by Separatory Funnel

6.3. EMAX-3520 Extraction of Organic Compounds by Continuous Liquid/Liquid Extraction

6.4. EMAX-3540 Soxhlet Extraction

6.5. EMAX-3550 Extraction of Organic Compounds from Solid Samples by Pulse Sonication

6.6. EMAX-3580 Waste Dilution

6.7. EMAX-3640 Clean Up, GPC

6.8. EMAX-DM01 Data Flow and Review

6.9. EMAX-QA04 Detection Limit Study

6.10. EMAX-QA08 Corrective Action

6.11. EMAX-QC01 Quality Control for Chemicals

6.12. EMAX-QC02 Analytical Standard Preparation

6.13. EMAX-QC07 Glassware Cleaning

6.14. EMAX-SM03 Waste Management

6.15. EMAX-SM04 Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all MSDS for all chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure. Perform all sample and standard handling in the fume hood.

7.3. Place all wastes generated during analytical process in the designated satellite waste containers. Endorse these wastes to the waste disposal section for proper disposal.

7.4. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatography	Agilent Technologies 7890A with split/splitless injection, Shimadzu GC-17A, or equivalent
Mass Spectrometer	Agilent Technologies 5975C MSD or Shimadzu GCMS – GP 5000 capable of scanning from 1.6 to 1050 amu every 1 second using 70 volts electrode energy in the electron impact ionization mode or equivalent
GC/MS Interface	Capillary-direct into the mass spectrometer source or equivalent
Chromatographic Column	ZB-5MS (20m x 0.18mm x 0.32 μm) or equivalent
Data System	MS-ChemStation with Enviroquant software or equivalent
GC Autosampler	Agilent Technologies 7683B series injector or Shimadzu AOC-20i capable of direct injection of 1 μl and 10 μl of extract.
Gases	Ultra high purity helium
Syringes	10 μl, 25 μl, 50 μl , 100 μl, 250 μl, 500 μl and 1000 μl syringe Hamilton 202N or equivalent
Vials	Autosampler vials with teflon lined septa

8.2. **Chemicals and Reagents**

Solvents	Methylene chloride pesticides grade, high purity methanol
Reagents	Na_2SO_4 reagent grade

9.0 STANDARDS

9.1. Standard Preparation

9.1.1. Follow procedures for all standard preparations and labeling as described in EMAX-QC02 and EMAX-SM04, respectively.

9.1.2. Other concentration levels may be prepared to meet the data quality objective of a project.

9.2. Stock Standard

9.2.1. Purchase stock standards as certified solutions from Accustandard or other reputable vendor (refer to Table 1 for the listing of all certified solutions). The standard is expected to be at 96% purity. Read vendor's note if correction has been applied to certified values otherwise corrections must be applied.

9.2.2. Transfer the stock standard solutions into 2-ml amber vial with Teflon lined screw caps and store at -10°C to -20°C.

9.3. Intermediate Standard

9.3.1. Prepare a 10-ml 200 µg/mL intermediate standard (refer to Table 1 for details). Transfer the solution in a properly labeled 10-ml amber vial and store at -10°C to -20°C.

9.4. Internal Standard

9.4.1. The internal standard shall include 1,4-Dichlorobenzene-d_4, Naphthalene-d_8, Acenaphthalene-d_{10}, Phenanthrene-d_{10}, Chrysene-d_{12} and Perylene-d_{12} in methylene chloride solution.

9.4.2. Purchase internal standard solutions as certified solution from AccuStandard or other reputable vendor at 4,000 µg/ml.

9.4.3. Prepare a 10-ml of 2,000 µg/ml of working internal standard from 9.4.2. Transfer the solution in a properly labeled 10-ml amber vial and store in -10°C to -20°C.

9.5. GC/MS Tuning

9.5.1. The tuning standard shall include decafluorotriphenylphosphine (DFTPP), 4,4-DDT, Pentachlorophenol, and Benzidine.

9.5.2. Purchase tuning standard solution as certified standard at 1000 µg/ml.

9.5.3. Prepare a 10-ml of 50,000 µg/L of working standard tuning solution. Transfer the solution in a properly labeled 10-ml amber vial and store in -10°C to -20°C.

9.6. Surrogate Standard

9.6.1. Purchase surrogate stock standards as certified standard.

9.6.1.1. The acid surrogate mixture includes Phenol-d_5, 2-Fluorophenol, and 2,4,6-Tribromophenol at 150 µg/ml.

9.6.1.2. The basic neutral surrogate mixture includes Nitrobenzene-d_5, 2-Fluorobiphenyl, Terphenyl-d_{14}, and 1,2-Dichlorobenzene-d_4 at 50 µg/ml.

9.6.2. For typical extraction [soil: 30g-2ml or water: 1000ml-2ml], add 0.4 ml of surrogate spiking standard to the sample prior to extraction. Spike volume may be adjusted to normalize with

the final extract and yield the same concentration.

9.7. **Calibration Standard**

9.7.1. Prepare working standard solutions for initial calibration and daily calibration (refer to Table 2 for details). Transfer the solutions in 1-ml amber vial and store them at ≤6°C.

9.8. **ICAL Verification Standard (Second Source Verification) (ICV)**

9.8.1. Purchase a certified ICV standard from a different vendor. The ICV standard contains the same list of compounds as the stock standard (refer to Table 1-B for the standard mix and the corresponding vendors).

9.8.2. Prepare a 10-ml of 200-mg/L check standard solution. Transfer the solution in a properly labeled 10-ml amber vial and store at ≤6°C.

9.9. **LCS/MS Spiking Standards**

9.9.1. Purchase spiking standards as certified solutions. The spiking solution may be from the same source as the initial calibration standard[1].

9.9.2. Spike MS/MSD/LCS/LCD samples with 0.4 ml of full spiking solution prior to sample extraction.

9.9.3. Spike volume may be adjusted to normalize with the final extract volume and yield the same concentration.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. For aqueous samples (including TCLP leachates), refer to EMAX-3510 or EMAX-3520 or EMAX-1311. Check the extraction log for presence of residual chlorine.

10.1.2. For solid samples, refer to EMAX-3550 or EMAX-3540.

10.1.3. For waste samples, refer to EMAX-3580.

10.1.4. After extraction, examine the color and consistency of the extract. If the extract appears to be opaque and/or viscous, it is advisable to perform extract cleanup preferably GPC. Refer to EMAX-3640.

10.2. **Instrument Parameters**

10.2.1. Set the instrument parameters as suggested in Table 3. Fine tune the instrument to obtain optimum instrument condition.

10.2.2. Print and display current condition on the instrument for easy access when performing daily instrument routine check.

10.2.3. In the event that instruments parameters necessitate a changed, replace the instrument parameter printout with the new parameter setup and archive the previous instrument parameters in the instrument maintenance log.

[1] SW846 Method 8270D, Section 7.9

10.2.4. Set injection volume to 1 µl to 2 µl.

10.3. **Calibration**

10.3.1. Set GC/MS operating condition as described in Section 10.2.

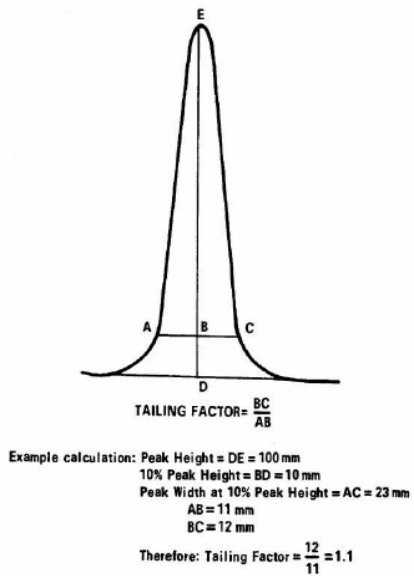
10.3.2. Perform Tune Check

10.3.2.1. Analyze a solution containing 50-µg/ml of tuning standard working solution, DDT , benzidine and pentachlorophenol.

10.3.2.2. Evaluate the tune check by averaging of three scans (the peak apex scan and the scan immediately preceding and the scan immediately following the apex). Apply a background subtraction using a single scan no more than 20 scans prior to the elution of DFTPP. Do not subtract part of the DFTPP peak or any other discrete peak that does not coelute with DFTPP. Use the DFTPP mass intensity criteria in the manufacturer's instructions as primary tuning acceptance criteria otherwise refer to Table 4 for acceptance criteria.

10.3.2.3. Evaluate column performance and injection port inertness using the data acquisition software.

- Degradation of DDT to DDE and DDD must be less than 20% based on area obtained from the total ion chromatogram.
- Benzidine and Pentachlorophenol must be present at their normal responses. Evaluate the tailing factor of benzidine and pentachlorophenol. Tailing factor should not be >2. Refer to Figure-2 for peak evaluation.



10.3.2.4. If tune check is non-compliant, refer to Section 12 for corrective action.

10.3.3. Initial Calibration (ICAL)

10.3.3.1. Perform ICAL when one of the conditions occurs.

- Instrument is new
- Instrument undergoes a major repair
- DCC failed to meet the acceptance criteria

10.3.3.2. Optimize the instrument condition prior to ICAL.

- Ensure that instrument parameters are set up properly
- Ensure that there is no evidence of leak
- Ensure that instrument maintenance as scheduled is performed

- Ensure that instrument tune check and column performance is not indicative that it is at the threshold of failing the acceptance criteria.

10.3.3.3. Analyze a 5 to 9-point initial calibration curve as suggested in Figure 4 after a valid tune check.

10.3.3.4. Generate a summary of Relative Response Factors for each analyte at each concentration. Calculate the Average Relative Response Factor (RRFm), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to Eq-10.6.1.1, Eq-10.6.1.2, Eq-10.6.1.5 and Eq-10.6.1.6, respectively.

10.3.3.5. Evaluate the ICAL Acceptance

10.3.3.5.1. Check for completeness of target compound list. If there is/are missing compound(s), perform the following:

- Check the established retention time window
- Check the relative intensity of major ions
- Adjust accordingly if necessary.

10.3.3.5.2. Evaluate retention time of each analyte with respect to the nearest internal standard. The relative retention time (RRT) of each analyte should agree within $\pm$0.06 RRT units.

10.3.3.5.3. Check the response factors for each analyte as suggested in Table 6. Meeting the minimum response factor is indicative that the analytes are behaving as expected.

10.3.3.5.4. Check RSD and correlation coefficient. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit and do not meet the minimum correlation coefficient (0.99) for alternate curve fits, then the chromatographic system is considered too reactive for analysis to begin. Perform necessary instrument maintenance and repeat calibration. Refer to 10.3.3.2., Section 12 for corrective action.

10.3.3.6. Application of ICAL Curve for Quantitation

10.3.3.6.1. If RSD is $\leq$20% average response factor may be applied.

10.3.3.6.2. Apply Inverse Weighting Factor (1/y or $1/y^2$; y being the instrument response) if it is determined to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of $\leq$20% and correlation coefficient of $\geq$0.99.

10.3.3.6.3. Apply linear least squares regression if past experience or priori knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of $\leq$20% and correlation coefficient of $\geq$0.99.

10.3.3.6.4. It may be appropriate to force the regression through zero for specific analytes.[2] When exercising this option [as included in the data acquisition

[2] SW846 Method 8000B, Section 7.5.3

software], make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.3.6.5. Requant the calibration point near or at LOQ and calculate for percent recovery. Percent recovery within ±30%[3] of their expected values is indicative that calibration accuracy at the lower calibration range is good.

10.3.3.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.4. Initial Calibration Verification (ICV)

10.3.4.1. Verify the concentration of the ICAL by analyzing the ICV from a second source (See Table 2 for standard preparation). Result should be within ±30% of expected value unless otherwise specified by the project.

10.3.4.2. Evaluate the ICV for minimum response factor, internal standard retention time and internal standard response as described in 10.3.5.2.

10.3.5. Daily Continuing Calibration (DCC)

10.3.5.1. Analyze DCC (See Table 2 for standard preparation) to check the validity of the ICAL every 12 hour shift unless otherwise specified by the project.

10.3.5.2. DCC Evaluation

- Check that RF is ≥ minimum response factor listed in Table 6.
- Check that all analytes are ≤20 %D (% Difference for ARF and %Drift for other quantitation technique) unless otherwise specified by the project.
- Check Internal Standard Retention time. Expected retention time is within 30 sec from that of the midpoint of the ICAL.
- Check Internal Standard Response. Expected response of extracted ion current profile (EICP) is no greater that a factor of two (-50% to +100%).
- If any of the above criteria is non-compliant, refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. **Extract Preparation**

10.4.1.1. Allow extracts to equilibrate with room temperature.

10.4.1.2. Measure 300 µL of extract, transfer into an autosampler vial.

10.4.1.3. Add 6 µL of 2000-ng/µL of internal standard (refer to 9.4.3).

10.4.1.4. Seal the vial with Teflon-lined septa cap.

10.4.2. **Analytical Sequence**

10.4.2.1. Analyze instrument blank.

[3] SW846 Method 8270D, Section 11.4.5.6

10.4.2.2. Analyze DFTPP and evaluate tuning.

10.4.2.3. Analyze DCC and check ICAL validity.

10.4.2.4. Analyze Method Blank.

10.4.2.5. Analyze Lab Control Sample and Lab Control Sample Duplicate (optional).

10.4.2.6. Analyze matrix spikes (MS/MSD) as per project requirement.

10.4.2.7. Analyze samples to a maximum number of 12-hour from the time of DFTPP injection.

10.4.3. **Sample Result Evaluation**

10.4.3.1. Check QC criteria

- Check surrogate recoveries against PSR. In the absence of PSR, default to EMAX QC limits.
- Check concentration of target analytes. Dilute and re-analyze samples having result(s) exceeding calibration range unless otherwise specified by the project. Maintain IS concentration on diluted samples.
- Check Internal Standard Response. Expected response of EICP is no greater that a factor of two (-50% to +100%).
- Check Internal Standard Retention Time. Expected retention time is within 30 seconds of the ICAL midpoint.
- If any of the above checkpoints indicate a problem, re-analysis is required.

10.4.3.2. Qualitative Identification

- The intensities of the characteristic ions must maximize in the same scan or within one scan of each other.
- The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
- The relative intensity of the characteristic ions agrees within 30% of the relative intensity of these ions in the reference spectrum.
- Check the chromatogram for possible misidentified analytes. Manually integrate the peak if necessary in accordance to EMAX-DM01, Section 4.4.3.
- Investigate visible peaks in the chromatogram that were not identified in the data output. For samples containing components not associated with the calibration standards, perform a library search for purposes of tentative identification[4] (TIC).
- Visually inspect each extracted mass ion chromatograph to determine the identification of the unknown before final reporting.

10.4.3.3. Quantitation

[4] Library search is performed only when indicated in the PSR.

- Apply the appropriate quantitation method (Section 10.6.3) to calculate the concentration of any positively identified target analyte. Apply the sample preparation and dilution factor to calculate for the final concentration of the sample.

10.4.3.4. Manual Integration

10.4.3.4.1. Refer to EMAX-DM01 for details of manual integration.

10.4.3.5. Dealing with Carryover

- Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.
- If there was no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction. Otherwise, clean up the system and re-analyze the sample suspected to contain carryover.

10.5. **Data Reduction**

10.5.1. Make a copy of the analytical run log and highlight the data to be reported.

10.5.2. Collate the reportable raw data separating the QC results from the sample results.

10.5.3. Keep all other data generated with the analytical folder marked with “For Record Only”.

10.5.4. Proceed to report generation.

10.6. **Calculations**

10.6.1. Initial Calibration

10.6.1.1. Calculate for Relative Response Factor (RRF)

$$RRF = \frac{(AX)(CIS)}{(AIS)(CX)} \qquad \textit{Eq.-10.6.1.1}$$

where:

AX – Area of characteristic ion for the compound being measured

AIS – Area of characteristic ion for the specific internal standard

CX – Concentration of the compound being measured

CIS – Concentration of the specific internal standard

10.6.1.2. Calculate for Average Relative Response Factor (RRFm).

$$RRFm = \frac{\sum RRF}{n} \qquad \textit{Eq-10.6.1.2}$$

where:

RRFm – average response factor

$\sum RRF$ – summation of response factors

n – number of measurements

10.6.1.3. Calculate for Least Square Linear Regression

$$y = ax + b \qquad \textit{Eq.-10.6.1.3}$$

where:

y = Response Ratio *(AX/AIS)*

x = Amount Ratio (CX/CIS)

a = x1 = slope of the line

$$a = \frac{\sum (x - \bar{x})(y - \bar{y})}{(x - \bar{x})^2}$$

where:

$\bar{x}$ = Average of amount ratios

$\bar{y}$ = Average of response ratios

b = x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.6.1.4. Calculate for Inverse Weighting Factor

$$y = ax + b \qquad \textit{Eq.-10.6.1.4}$$

where:

y = Response Ratio *(AX/AIS)*

x = Amount Ratio *(CX/CIS)*

a = x1 = slope of the line

$$a = \frac{\sum [(x - x_a)(y - y_a)]}{\sum (x - x_a)^2}$$

where:

$x_a = \Sigma\ [x(1/x)/\ \Sigma(1/x)]$

$y_a = \Sigma\ [y(1/x)/\ \Sigma(1/x)]$ or

$x_a = \Sigma\ [x(1/x^2)/\ \Sigma(1/x^2)]$

$y_a = \Sigma\ [y(1/x^2)/\ \Sigma(1/x^2)]$

b = x0 = intercept of the line

$$b = y_a - a * x_a$$

10.6.1.5. Calculate for Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n - 1}} \qquad \textit{Eq.-10.6.1.5}$$

where:

SD – standard deviation

x_i – result at i^{th} measurement

$\bar{x}$ – mean

n – number of measurements

10.6.1.6. Calculate for % relative standard deviation (%RSD).

$$\%RSD = \frac{SD}{RRF_m} * 100\% \qquad \textit{Eq-10.6.1.6}$$

where:

SD – standard deviation

RRFm – average response factor

10.6.2. Calibration Check/Continuing Calibration

10.6.2.1. Calculate Percent Difference (%D) when RRFm is used for quantitation

$$\%D = \frac{[RRF_c - RRF_m]}{RRF_m} * 100\% \qquad \textit{Eq-10.6.2.1}$$

where:

RRFc – response factor from continuing calibration standard

RRFm – average response factor

10.6.2.2. Calculate Percent Deviation ($\%D_t$) when applied calculation is other than ARF

$$\%D_t = \frac{|T_t - T_f|}{T_t} * 100\% \qquad \textit{Eq-10.6.2.2}$$

where:

T_t – true value of standard in µg/L

T_f – found value of standard in µg/L

10.6.3. Calculation of Sample Concentration (Water and Soil/Sediment Samples). When a compound is identified, the quantitation of that compound shall be based on the integrated abundance from the EICP of the primary characteristic ion.

10.6.3.1. Water Samples

$$Concentration\ (ug/L) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(V_t)} \qquad \textit{Eq-10.6.3.1}$$

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard added

V_e – extract final volume from sample extraction, usually 1-ml

DF – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

A_{is} – area of characteristic ion for the internal standard

RRF_m – average response factor

V_i – volume of extract injected in µl, usually 1-µL

V_t – volume of water extracted in ml, usually 1000-ml

10.6.3.2. Soil/Sediment Samples (Dry weight basis)

$$Concentration(\mu g/Kg) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(W_s)(DW)} \quad Eq\text{-}10.6.3.2$$

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard injected in ng

V_e – volume of extract in ml, usually 1-ml[5]

DF – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

A_{is} – area of characteristic ion for the internal standard

RRF_m – average response factor

V_i – volume of extract injected in µl, usually 1-µL

W_s – wet soil weight in kg

DW – % solid = $\frac{100 - \%moisture}{100}$

10.6.3.3. Calculation for results subjected to cleanup by GPC

$$Concentration(\mu g/Kg) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(W_s)(DW)} * \frac{V_{bg}}{V_{ig}} \quad Eq\text{-}10.6.3.3$$

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard injected in ng

V_e – volume of extract in ml

DF – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

A_{is} – area of characteristic ion for the internal standard

RF_m – average response factor

[5] For extracts subjected to GPC V_i=0.5-ml

V_i – volume of extract injected in µl, usually 1-µL

W_s – wet soil weight in kg

DW – % solid = $\frac{100 - \%moisture}{100}$

V_{bg} – total volume of extract before GPC clean-up in mL

V_{ig} – injected volume of extract to GPC in mL

10.6.4. Base all sample result calculations on the ICAL curve, e.g., area ratio of Ax/Ais versus concentration using inverse weighting factor fitted to the initial calibration is also used for determination of sample concentration.

10.6.5. Concentration of TIC is estimated by the same method as target compounds with the following assumptions:

10.6.5.1. The area "Ax" and "Ais" are derived from total ion chromatogram. "Ais" refers to the closest internal standard (IS) free of interference.

10.6.5.2. RRF of the TIC is 1.

10.6.6. Accuracy and Precision

10.6.6.1. Percent Recovery

$$\%\ Recovery = \frac{Cf - C}{Cs} * 100 \qquad Eq\text{-}10.6.6.1$$

where:

Cf – concentration found

C – concentration of sample

Cs – concentration of spike

10.6.6.2. Relative Percent Difference (%RPD)

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad Eq\text{-}10.6.6.2$$

where:

RPD – Relative Percent Difference

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.6.7. DDT Degradation

$$\%B = \frac{A_{DDD} + A_{DDE}}{A_{DDT} + A_{DDD} + A_{DDE}}(100) \qquad \textit{Eq-10.6.7}$$

where:

%B	- percent breakdown
ADDD	- area of DDD
ADDE	- area of DDE
ADDT	- area of DDT

10.7. **Report Generation And Data Reduction & Review**

10.7.1. Generate the method.txt file using WDB1C.exe

10.7.2. Generate Lab Chronicle using Labchron1.exe

10.7.3. Generate the sample results using F1V3C.exe

10.7.4. Generate the QC summary using QCV3C.exe

10.7.5. Generate the Case Narrative using CN1.exe

10.7.6. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration and re-analyses.

- Case Narrative
- Lab Chronicle
- Sample Results
- LCS Summary
- MS/MSD Summary
- DCC Summary
- ICV Summary
- ICAL Summary

10.7.7. Perform a 100% data review in accordance to EMAX-DM01 and the PSR. Review the case narrative and edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.7.8. Submit the analysis package for secondary review.

10.8. **Preventive Maintenance**

10.8.1. Refer to form 8270FM for daily routine maintenance check points.

10.8.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back to control.

10.8.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating

under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

Maintenance Activity	Description	Frequency
Autosampler	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis
Vacuum System Verification	Verify pressure. Perform system tune check	Daily prior to analysis
Verification	Check instrument parameters to ensure normal operating conditions. Check instrument performance (e.g., Daily calibration check, instrument blank, DDT/Endrin breakdown).	Daily prior to analysis
Source Cleaning	Remove and clean the Mass Spec ion source	Every 6 months or as necessary
Vacuum System Maintenance	Inspect vacuum pumps, and replace mechanical/diffusion pump oil	Every 6 months
Documentation	Record maintenance in instrument service logs	Daily prior to analysis to include services done by third party.

11.0 QUALITY CONTROL

11.1. Preparative Batch

11.1.1. A preparative batch shall consist of a method blank, LCS, MS/MSD (when required by the project) and a maximum of 20 field samples of similar matrix.

11.1.2. In the absence of MS/MSD, prepare LCS/LCD to check for precision.

11.2. Analytical Batch QC

11.2.1. The GC/MS tuning standard must be analyzed at the beginning of every 12-hour shift. GC/MS tuning criteria is listed in Table 4 and Section 10.3.2.

11.2.2. A continuing calibration shall be performed before any other analysis is done, and after analysis of tuning standard. The continuing calibration procedure and the acceptance criteria are discussed in Section 10.3.5.

11.3. Method QC

11.3.1. Analyst demonstration of proficiency is a must prior to performing this analysis.

11.3.2. A valid MDL must exist prior to sample analysis.

11.3.3. A valid ICAL must exist prior to sample analysis.

11.3.4. Instrument performance must be checked prior to sample analysis.

11.3.5. Check Appendix 1 for acceptance criteria.

11.3.6. Prepare and analyze QC samples, to include, method blank, LCS (LCD), and MS/MSD. QC

Control Limits shall follow the Project Specific Requirement (PSR) in each analytical folder.

11.3.7. Surrogate standard shall be added to all samples, including method blank LCS/LCD and MS/MSD. Check PSR for QC Control Limits.

12.0 CORRECTIVE ACTIONS

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures in Appendix 1. Document out-of-control event and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. If the tune is non-compliant, consider the following suggestions to correct the problem:

- Check the instrument settings and make sure that the instrument parameters are properly set up.
- Check gas flow.
- Perform autotune or visual optimization.
- If the problem persists, inform the supervisor.

12.3. If instrument performance is non-compliant, consider the following suggestions to correct the problem:

- Excessive degradation of DDT and/or poor chromatography demonstrated by too much tailing are indications of dirty injection port. Clean or replace the injection port. If problem persist, cut off the first 6-12 inches of the capillary column.

12.4. If initial calibration is non-compliant, consider the following suggestions to correct the problem:

12.4.1. If %RSD is out of acceptance criteria, review result and identify presence of an outlier.

12.4.2. If one of the standard returns a bias-low or bias-high on all of the analytes, then that point is considered an outlier, prepare a standard at that ICAL point and reanalyze.

12.4.3. If the highest ICAL point appears to be saturated, drop the highest point.

12.4.4. If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

Note: The lowest calibration point identifies the reporting limit (RL). Therefore, check that the RL is in conformance to the current projects where the ICAL will be used.

12.4.5. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

12.4.5.1. Check the connections and make sure they are air-tight and perform maintenance as needed.

12.4.5.2. Check the gas flow

12.4.5.3. Retune the MS

12.4.5.4. Prepare a fresh standard and repeat calibration

12.4.5.5. Clean the MS source and repeat the calibration

12.4.6. If the problem persists, inform the supervisor.

12.5. If the ICV is non-compliant, consider the following suggestions to correct the problem:

12.5.1. Reanalyze ICV (to rule out poor injection)

12.5.2. If ICV is still out of acceptance criteria, prepare a fresh standard and reanalyze to rule out any preparation error

12.5.3. If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration

12.5.4. If the problem persists, inform the supervisor

12.6. If the instrument blank is non-compliant, consider the following suggestions to correct problem:

12.6.1. Rule out instrument contamination by performing the instrument daily maintenance , such as changing septum, cleaning liner, cleaning or using new autosampler syringe.

12.6.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.6.3. Rule out preparation contamination by preparing a new instrument blank

12.6.4. If the problem persists, inform the supervisor.

12.7. If Continuing Calibration is non-compliant, consider the following suggestions to correct the problem:

12.7.1. Change the liner

12.7.2. Clean injection port

12.7.3. Prepare new standard

12.7.4. Cut or replace column

12.7.5. Rule out leaks by checking all connections

12.7.6. If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL

12.8. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

12.8.1. Rule out instrument contamination by checking instrument blank

12.8.2. Rule out reagent contamination by testing each reagent used for extraction as described in EMAX-QC01

12.8.3. Rule out glassware contamination used for extraction as described in EMAX-QC07

12.8.4. Re-extract MB and the associated samples with reagents free of contamination or with newly opened reagents

12.8.5. If the problem persists, inform the supervisor

12.9. If LCS is non-compliant, perform the following suggestions to correct the problem:

12.9.1. If result is bias-high or bias-low, check the LCS Standard by analyzing at the spike level

12.9.2. If LCS check is within 80-120% of expected value, check calibration of the micropipette or syringe used for spiking. Re-extract and reanalyze the LCS and the associated samples.

12.9.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS Standard, re-extract and re-analyze LCS and the associated samples.

12.10. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.10.1. If corrective action needs the function of other department; eg, if the sample needs to be re-extracted, refer to EMAX-QA08 for details of completing an NCR.

12.10.2. If corrective action needs the assistance of the project manager; eg. If the sample is non-compliant to the technical holding time requirement, insufficient amount of sample, or other non-conforming issues.

12.11. For other problems encountered, inform the supervisor immediately for further instructions.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other wastes generated during the analytical process, endorsed to WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents. **Preparation batch** is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate. **Analytical batch** is compose of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Duplicate Sample – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.4. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.5. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.6. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to

the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.7. Lab Control Sample Duplicate (LSD) – is a replicate of LCS analyzed to monitor precision when MS/MSD samples are not analyzed.

15.1.8. Matrix – is a component or form of a sample.

15.1.9. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.10. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.11. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.12. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.13. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing semivolatile analysis by GC/MS unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluation of Solid Wastes", EPA SW846, Methods 8000B and 8270D.

16.2. EMAX Quality Systems Manual (EMAX-QS00), as updated.

17.0 FIGURES, TABLES AND APPENDICES

17.1. **Figures**

17.1.1. Figure 1 Peak Evaluation Technique

17.1.2. Figure 2 Typical Chromatogram

17.1.3. Figure 3 Typical ICAL Summary

17.1.4. Figure 4 Typical DFTPP Tune Summary

17.1.5. Figure 5 Typical Continuing Summary

17.1.6. Figure 6 Typical Sample Result Summary

17.1.7. Figure 7 Typical LCS Report Summary

17.1.8. Figure 8 Typical MS/MSD Report Summary

17.1.9. Figure 9 Typical Case Narrative

17.2. **Tables**

17.2.1. Table 1 Intermediate Standard Preparation

17.2.2. Table 2 Working Standard Preparation

17.2.3. Table 3 Instrument Parameters

17.2.4. Table 4 DFTPP Key Ions and Ion Abundance Criteria

17.2.5. Table 5 Analyte Lists, Quantitation Ions, Internal Standards & Surrogates

17.2.6. Table 6 Minimum Response Factor

17.2.7. Table 7 Established LOD & LOQ

17.3. **Appendices**

17.3.1. Appendix 1 Summary of In-House Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.4. **Forms**

17.4.1. 8270FA Analytical Run Log

17.4.2. 8270FS Sample Preparation Log

17.4.3. 8270FM Instrument Maintenance Log

Figure 1: **PEAK EVALUATION TECHNIQUE**

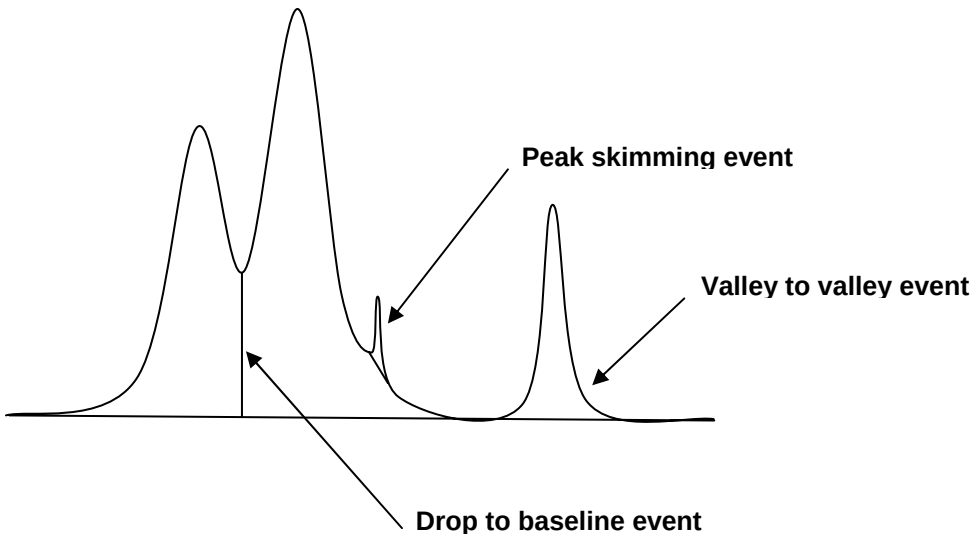
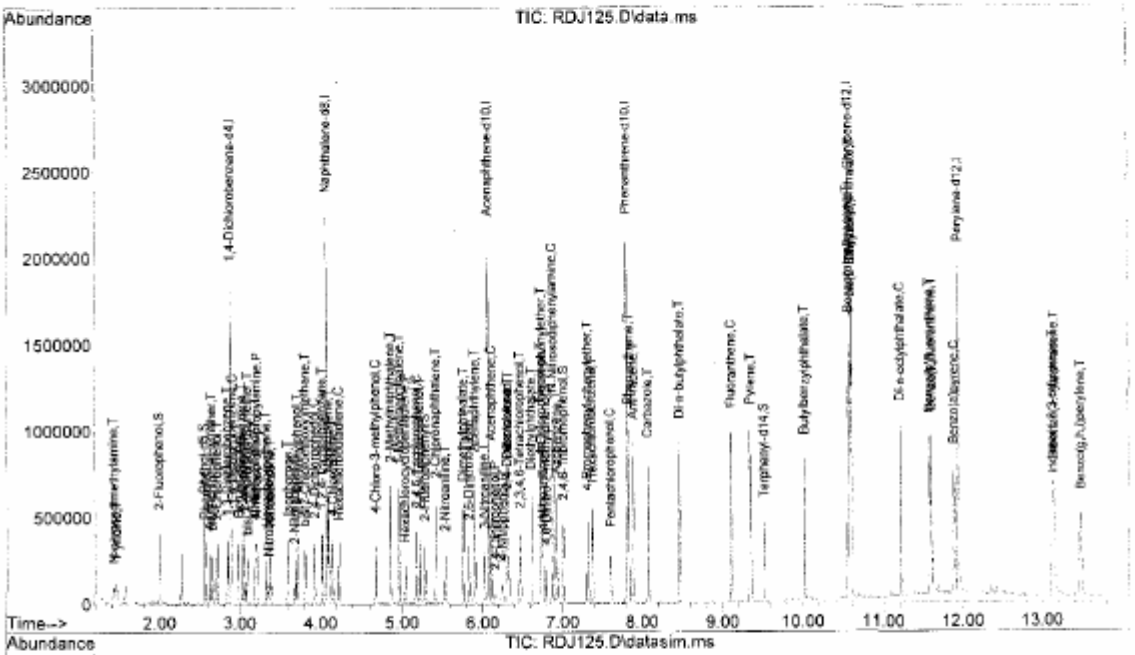


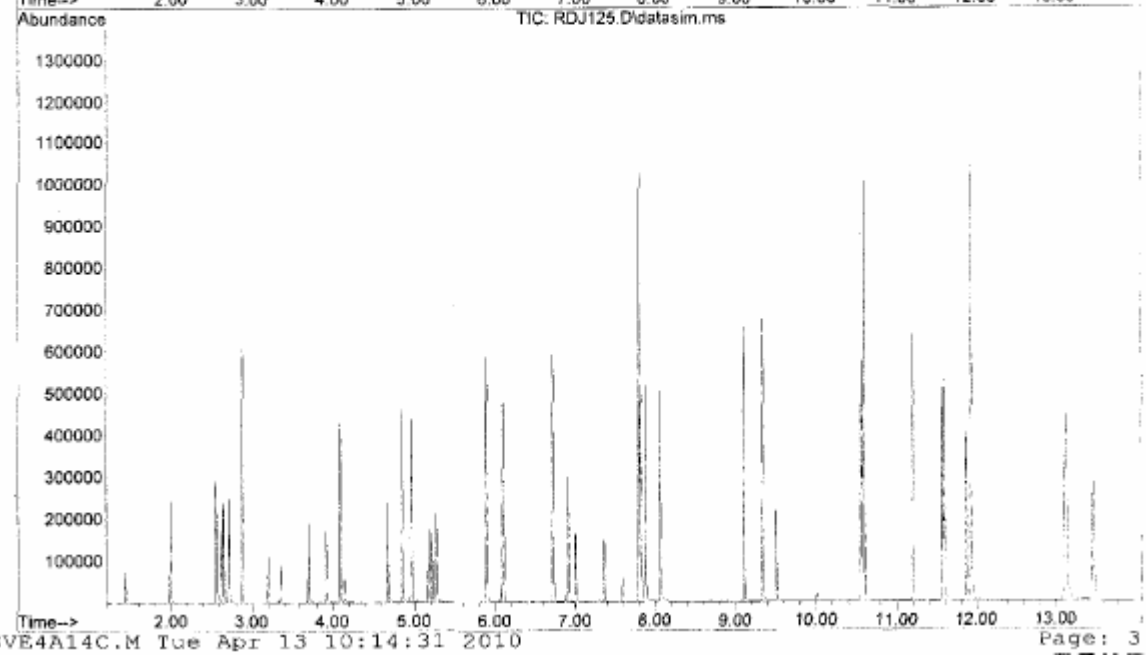
Figure 2: **TYPICAL CHROMATOGRAM**

Quantitation Report (QT Reviewed)

Data File : D:\DATA\10D12\RDJ125.D
Acq On : 12 Apr 2010 15:38
Sample : 10D048-01S
Misc :
Integrator: RTE
Quant Time: Apr 13 10:14:26 2010
Quant Results File: SVE4A14C.RES
Quant Method : C:\msdchem\1\METHODS\SVE4A14C.M
Quant Title : SEMIVOLATILES 8270D
QLast Update : Fri Jan 15 10:17:54 2010
Response via : Initial Calibration
DataAcq Meth:SVE4A08S.M

Vial: 10
Operator: KV
Inst : E4
Multiplr: 1.00





SVE4A14C.M Tue Apr 13 10:14:31 2010 Page: 3

Figure 3: TYPICAL ICAL SUMMARY

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E4
Beginning DateTime :01/14/10 15:00
Spike Units :PPM
IC File :RAJ049

Column Spec :ZB-5MS ID :0.18MM
Ending DateTime :01/14/10 17:43
HPChem Method :SVE4A14C

IDX	Parameters	5 / 15:00 RAJ045	10 / 15:18 RAJ046	20 / 15:36 RAJ047	30 / 15:54 RAJ048	50 / 16:13 RAJ049	60 / 16:31 RAJ050	80 / 16:49 RAJ051	100 / 17:07 RAJ052	120 / 17:25 RAJ053	160 / 17:43 RAJ054	Av_RRF	%_RSD	Av_Rt_M
1	1,4-Dichlorobenzene-d4	1	1	1	1	1	1	1	1	1	1	1	0	2.8745
2	N-nitrosodimethylamine	0.473	0.500	0.513	0.496	0.500	0.508	0.523	0.506	------	------	0.503	2.92	1.3867
3	Pyridine	0.835	0.903	1.010	0.982	0.986	0.998	1.024	1.007	------	------	0.968	6.71	1.4174
4	2-Fluorophenol	1.002	1.034	1.051	1.054	1.055	1.061	1.085	1.066	1.006	1.029	1.044	2.53	1.9654
5	Phenol-d5	1.122	1.164	1.188	1.172	1.188	1.205	1.230	1.200	1.147	1.175	1.179	2.61	2.5351
6	Phenol	1.158	1.198	1.208	1.200	1.204	1.216	1.227	1.204	------	------	1.202	1.66	2.5459
7	Aniline	1.421	1.481	1.505	1.510	1.492	1.519	1.555	1.510	------	------	1.499	2.56	2.6123
8	bis(2-chloroethyl)ether	0.937	0.951	0.948	0.934	0.929	0.947	0.957	0.924	------	------	0.941	1.22	2.6418
9	2-Chlorophenol	1.253	1.261	1.296	1.291	1.421	1.412	1.437	1.412	------	------	1.348	5.88	2.7030
10	1,3-Dichlorobenzene	1.426	1.498	1.457	1.452	1.442	1.454	1.476	1.428	------	------	1.454	1.65	2.8310
11	1,2-Dichlorobenzene-d4	0.933	0.970	0.943	0.931	0.924	0.924	0.932	0.904	0.886	0.886	0.923	2.78	3.0055
12	1,4-Dichlorobenzene	1.466	1.512	1.484	1.496	1.469	1.490	1.494	1.456	------	------	1.483	1.24	2.8884
13	Benzyl alcohol	0.628	0.667	0.685	0.686	0.698	0.709	0.717	0.700	------	------	0.686	4.10	2.9672
14	1,2-Dichlorobenzene	1.367	1.412	1.404	1.382	1.368	1.382	1.403	1.348	------	------	1.383	1.59	3.0185
15	2-Methylphenol	0.814	0.875	0.888	0.898	0.897	0.892	0.907	0.880	------	------	0.881	3.31	3.0418
16	bis(2-chloroisopropyl)ether	2.052	2.122	2.088	2.349	2.329	2.392	2.419	2.338	------	------	2.261	6.54	3.0824
17	4-Methylphenol	1.058	1.112	1.152	1.150	1.157	1.180	1.185	1.172	------	------	1.146	3.68	3.1792
18	N-Nitroso-di-n-propylamine	0.535	0.595	0.600	0.598	0.596	0.609	0.619	0.600	------	------	0.594	4.21	3.2031
19	Hexachloroethane	0.533	0.548	0.543	0.541	0.539	0.551	0.562	0.543	------	------	0.545	1.61	3.3203
20	Naphthalene-d8	1	1	1	1	1	1	1	1	1	1	1	0	4.0727
21	Nitrobenzene-d5	0.243	0.262	0.272	0.272	0.276	0.281	0.287	0.278	0.276	0.278	0.273	4.46	3.3542
22	Nitrobenzene	0.245	0.261	0.266	0.260	0.263	0.269	0.272	0.263	------	------	0.262	3.10	3.3721
23	Isophorone	0.440	0.471	0.484	0.476	0.479	0.493	0.496	0.477	------	------	0.477	3.58	3.5968
24	2-Nitrophenol	0.125	0.146	0.159	0.167	0.171	0.176	0.180	0.176	------	------	0.162	11.59	3.6769
25	2,4-Dimethylphenol	0.288	0.298	0.303	0.297	0.300	0.309	0.307	0.298	------	------	0.300	2.20	3.6964
26	Benzoic acid	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
27	bis(2-Chloroethoxy)methane	0.319	0.329	0.324	0.323	0.323	0.330	0.331	0.320	------	------	0.325	1.44	3.8049
28	2,4-Dichlorophenol	0.250	0.279	0.283	0.287	0.284	0.297	0.295	0.286	------	------	0.283	5.17	3.9096
29	1,2,4-Trichlorobenzene	0.339	0.344	0.339	0.335	0.327	0.335	0.335	0.321	------	------	0.334	2.18	4.0094
30	3,4-Dimethylphenol	0.337	0.365	0.366	0.364	0.364	0.369	0.371	0.357	------	------	0.361	2.97	4.0078
31	Naphthalene	1.026	1.029	1.005	0.992	0.977	1.000	0.994	0.959	------	------	0.998	2.33	4.0964
32	4-Chloroaniline	0.377	0.414	0.416	0.419	0.413	0.426	0.426	0.409	------	------	0.412	3.75	4.1434
33	Hexachlorobutadiene	0.196	0.201	0.196	0.192	0.192	0.197	0.199	0.189	------	------	0.195	1.94	4.2212
34	Hydroquinone	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
35	4-Chloro-3-methylphenol	0.206	0.243	0.246	0.243	0.246	0.254	0.260	0.246	------	------	0.243	6.56	4.6627
36	2-Methylnaphthalene	0.633	0.645	0.654	0.641	0.635	0.648	0.649	0.617	------	------	0.640	1.83	4.8538
37	1-Methylnaphthalene	0.640	0.649	0.641	0.635	0.631	0.636	0.638	0.606	------	------	0.634	1.97	4.9656
38	Acenaphthene-d10	1	1	1	1	1	1	1	1	1	1	1	0	6.0693
39	Hexachlorocyclopentadiene	0.404	0.443	0.453	0.468	0.492	0.510	0.510	0.517	------	------	0.475	8.38	5.0305
40	2,3,5-Trichlorophenol	0.346	0.408	0.417	0.469	0.490	0.499	0.502	0.497	------	------	0.454	12.57	5.0382
41	2,4,6-Trichlorophenol	0.385	0.434	0.441	0.445	0.455	0.467	0.472	0.458	------	------	0.445	6.14	5.1686
42	2,4,5-Trichlorophenol	0.401	0.459	0.462	0.468	0.481	0.490	0.488	0.484	------	------	0.467	6.23	5.2047
43	2,3,4-Trichlorophenol	0.338	0.396	0.376	0.383	0.391	0.390	0.394	0.380	------	------	0.381	4.90	5.2798
44	2-Fluorobiphenyl	1.573	1.588	1.578	1.561	1.544	1.562	1.521	1.496	1.501	1.549	1.547	2.07	5.2785
45	Biphenyl	1.707	1.732	1.690	1.675	1.701	1.711	1.685	1.660	------	------	1.695	1.34	5.3938
46	2-Chloronaphthalene	1.343	1.342	1.337	1.324	1.344	1.353	1.331	1.306	------	------	1.335	1.11	5.4136
47	2-Nitroaniline	0.208	0.269	0.275	0.286	0.302	0.314	0.327	0.317	------	------	0.287	13.30	5.5339
48	2,6-Dimethylnaphthalene	1.177	1.195	1.198	1.189	1.190	1.206	1.177	1.162	------	------	1.187	1.19	5.5768
49	1,4-Dinitrobenzene	0.111	0.138	0.160	0.169	0.184	0.195	0.208	0.199	------	------	0.171	19.51	5.7039
50	Dimethylphthalate	1.423	1.517	1.473	1.461	1.462	1.493	1.536	1.468	------	------	1.479	2.40	5.7654
51	1,3-Dinitrobenzene	0.136	0.194	0.194	0.204	0.216	0.222	0.236	0.223	------	------	0.203	15.18	5.7890
52	2,6-Dinitrotoluene	0.244	0.297	0.305	0.308	0.321	0.322	0.338	0.325	------	------	0.308	9.38	5.8289
53	1,2-Dinitrobenzene	0.107	0.131	0.132	0.134	0.139	0.143	0.147	0.139	------	------	0.134	9.01	5.8857
54	Acenaphthylene	2.094	2.184	2.173	2.172	2.167	2.213	2.183	2.118	------	------	2.163	1.78	5.9015
55	3-Nitroaniline	0.264	0.332	0.328	0.335	0.349	0.362	0.381	0.361	------	------	0.339	10.42	6.0218
56	Acenaphthene	1.379	1.408	1.398	1.375	1.381	1.388	1.393	1.344	------	------	1.383	1.38	6.1090
57	2,4-Dinitrophenol	------	0.098	0.120	0.140	0.170	0.184	0.207	0.199	------	------	0.160	25.81	6.1465
58	4-Nitrophenol	------	0.143	0.143	0.149	0.158	0.168	0.184	0.172	------	------	0.160	9.81	6.2191
59	2,4-Dinitrotoluene	0.290	0.378	0.375	0.389	0.408	0.416	0.436	0.409	------	------	0.388	11.48	6.3066
60	Dibenzofuran	1.849	1.943	1.874	1.863	1.857	1.885	1.884	1.815	------	------	1.871	1.95	6.3160
61	2,3,5,6-Tetrachlorophenol	0.236	0.284	0.288	0.295	0.305	0.315	0.327	0.314	------	------	0.295	9.55	6.4071
62	2,3,4,6-Tetrachlorophenol	0.321	0.384	0.367	0.367	0.442	0.390	0.472	0.472	------	------	0.402	13.59	6.4586
63	2,3,5-Trimethylnaphthalene	1.080	1.116	1.089	1.079	1.076	1.095	1.094	1.052	------	------	1.085	1.71	6.5713
64	Diethylphthalate	1.444	1.605	1.545	1.519	1.539	1.569	1.622	1.535	------	------	1.547	3.55	6.6153
65	Fluorene	1.467	1.539	1.480	1.463	1.469	1.476	1.506	1.423	------	------	1.478	2.28	6.7289
66	4-Chlorophenyl-phenylether	0.694	0.732	0.704	0.684	0.684	0.697	0.696	0.662	------	------	0.694	2.88	6.7402
67	4-Nitroaniline	0.238	0.319	0.312	0.328	0.341	0.357	0.388	0.356	------	------	0.330	13.49	6.7551

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E4
Beginning DateTime :01/14/10 15:00
Spike Units :PPM
IC File :RAJ049

Column Spec :ZB-5MS ID :0.18MM
Ending DateTime :01/14/10 17:43
HPChem Method :SVE4A14C

IDX	Parameters	5 15:00 RAJ045	10 15:18 RAJ046	20 15:36 RAJ047	30 15:54 RAJ048	50 16:13 RAJ049	60 16:31 RAJ050	80 16:49 RAJ051	100 17:07 RAJ052	120 17:25 RAJ053	160 17:43 RAJ054	Av_RRF	%_RSD	Av_Rt_M
68	Phenanthrene-d10	1	1	1	1	1	1	1	1	1	1	1	0	7.8077
69	4,6-Dinitro-2-methylphenol	------	0.090	0.107	0.114	0.142	0.136	0.155	0.154	------	------	0.128	19.54	6.7937
70	N-Nitrosodiphenylamine	0.810	0.824	0.801	0.798	0.787	0.777	0.760	0.756	------	------	0.789	3.00	6.8825
71	Azobenzene	0.594	0.602	0.626	0.619	0.616	0.632	0.631	0.623	------	------	0.618	2.20	6.9287
72	2,4,6-Tribromophenol	0.093	0.105	0.108	0.111	0.116	0.118	0.120	0.118	0.110	0.112	0.111	7.13	7.0115
73	4-Bromophenyl-phenylether	0.219	0.223	0.223	0.226	0.226	0.231	0.231	0.228	------	------	0.226	1.83	7.3132
74	Hexachlorobenzene	0.257	0.258	0.252	0.253	0.251	0.254	0.256	0.251	------	------	0.254	1.12	7.3660
75	Pentachlorophenol	0.094	0.128	0.139	0.146	0.152	0.157	0.165	0.162	------	------	0.143	16.37	7.5907
76	Phenanthrene	1.240	1.256	1.222	1.209	1.201	1.231	1.225	1.198	------	------	1.223	1.61	7.8349
77	Dinoseb	0.068	0.107	0.134	0.158	0.181	0.193	0.211	0.211	------	------	0.158	32.65	7.8141
78	Anthracene	1.181	1.237	1.223	1.216	1.217	1.248	1.238	1.213	------	------	1.222	1.70	7.8921
79	Carbazole	1.068	1.159	1.118	1.109	1.116	1.157	1.178	1.139	------	------	1.130	3.09	8.0743
80	Di-n-butylphthalate	1.105	1.290	1.346	1.359	1.403	1.429	1.467	1.423	------	------	1.353	8.46	8.4765
81	1-Methylphenanthrene	0.831	0.863	0.852	0.832	0.841	0.849	0.863	0.838	------	------	0.846	1.49	8.5061
82	Fluoranthene	1.173	1.242	1.224	1.230	1.322	1.258	1.309	1.246	------	------	1.251	3.79	9.1128
83	Chrysene-d12	1	1	1	1	1	1	1	1	1	1	1	0	10.5840
84	Benzidine	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
85	Pyrene	1.173	1.242	1.239	1.246	1.268	1.274	1.248	1.228	------	------	1.240	2.49	9.3489
86	Terphenyl-d14	0.642	0.678	0.698	0.699	0.707	0.707	0.696	0.685	0.678	0.701	0.689	2.85	9.5214
87	Butylbenzylphthalate	0.301	0.408	0.465	0.496	0.526	0.554	0.561	0.554	------	------	0.483	18.74	10.0306
88	bis(2-ethylhexyl)adipate	0.258	0.361	0.420	0.441	0.467	0.483	0.492	0.484	------	------	0.426	18.88	10.1126
89	3,3'-Dichlorobenzidine	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
90	Benzo(a)anthracene	0.963	1.045	1.067	1.064	1.086	1.111	1.127	1.093	------	------	1.069	4.72	10.5738
91	Chrysene	1.054	1.116	1.078	1.067	1.055	1.072	1.061	1.025	------	------	1.066	2.43	10.6108
92	bis(2-Ethylhexyl)phthalate	0.512	0.654	0.722	0.748	0.765	0.793	0.793	0.776	------	------	0.720	13.28	10.6096
93	Perylene-d12	1	1	1	1	1	1	1	1	1	1	1	0	11.9556
94	Di-n-octylphthalate	0.679	1.042	1.201	1.312	1.405	1.443	1.483	1.465	------	------	1.254	22.10	11.2310
95	Benzo(b)fluoranthene	0.992	1.053	1.074	1.075	1.070	1.121	1.131	1.087	------	------	1.075	3.96	11.5883
96	Benzo(k)fluoranthene	1.295	1.361	1.364	1.411	1.424	1.411	1.422	1.417	------	------	1.388	3.25	11.6150
97	Benzo(e)pyrene	0.987	1.033	1.018	1.039	1.034	1.056	1.047	1.032	------	------	1.031	2.02	11.8481
98	Benzo(a)pyrene	0.946	1.029	1.040	1.071	1.068	1.084	1.090	1.060	------	------	1.048	4.41	11.9013
99	Perylene	1.099	1.087	1.074	1.083	1.084	1.117	1.104	1.088	------	------	1.092	1.26	11.9832
100	Indeno(1,2,3-cd)pyrene	0.953	1.039	1.100	1.113	1.146	1.173	1.189	1.167	------	------	1.110	7.19	13.1623
101	Dibenzo(a,h)anthracene	0.799	0.876	0.909	0.928	0.947	0.957	0.968	0.945	------	------	0.916	6.08	13.1841
102	Benzo(g,h,i)perylene	0.858	0.927	0.955	0.965	0.986	0.996	1.003	0.986	------	------	0.959	4.97	13.5220

Ave_%RSD : 6.1 Max_%RSD : 32.7

Use Least Square Linear Regression with weighting factor of inverse concentration for comps with %_RSD > 15
Resp_Ratio = xo + x1 * Amt_Ratio

IDX	Parameter	x0	x1	CCF
49	1,4-Dinitrobenzene	-0.01528	0.20439	0.9984
51	1,3-Dinitrobenzene	-0.01247	0.23069	0.9990
57	2,4-Dinitrophenol	-0.03744	0.21167	0.9957
69	4,6-Dinitro-2-methylphenol	-0.02259	0.15949	0.9971
75	Pentachlorophenol	-0.00998	0.16486	0.9995
77	Dinoseb	-0.02447	0.21189	0.9963
87	Butylbenzylphthalate	-0.03887	0.56916	0.9995
88	bis(2-ethylhexyl)adipate	-0.03317	0.49913	0.9998
94	Di-n-octylphthalate	-0.11621	1.51085	0.9997

Figure 4: **TYPICAL DFTPP TUNE SUMMARY**

5B
SEMIVOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: RAJ030
Instrument ID: TOE4

Project: GARDEN GROVE PROJECT
SDG No.: 10D048
DFTPP Injection Date: 01/14/10
DFTPP Injection Time: 10:33

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	10.0 - 80.0% of mass 198	43.62
68	Less than 2% of mass 69	0.54(1.6)1
69	Relative abundance of mass 198	34.08
70	Less than 2.0% of mass 69	0.17(0.5)1
127	10.0 - 80.0% of mass 198	51.93
197	Less than 2.0% of mass 198	0.48
198	Base Peak, 100% relative abundance	100.00
199	5.0 - 9.0% of mass 198	6.91
275	10.0 - 30.0% of mass 198	21.02
365	Greater than 1.00% of mass 198	2.44
441	Present, but less than 24% of mass 442	13.07
442	Greater than 50.0% of mass 198	77.57
443	15.0 - 24.0% of mass 442	16.39(21.1)2

1-Value is % mass 69 2-Value is % mass 442

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD,BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
1	SSTD005	SVE4A14B6	RAJ045	01/14/10	15:00
2	SSTD010	SVE4A14B7	RAJ046	01/14/10	15:18
3	SSTD020	SVE4A14B8	RAJ047	01/14/10	15:36
4	SSTD030	SVE4A14B9	RAJ048	01/14/10	15:54
5	SSTD050	SVE4A14B10	RAJ049	01/14/10	16:13
6	SSTD060	SVE4A14B11	RAJ050	01/14/10	16:31
7	SSTD080	SVE4A14B12	RAJ051	01/14/10	16:49
8	SSTD100	SVE4A14B13	RAJ052	01/14/10	17:07
9	SSTD120	SVE4A14B14	RAJ053	01/14/10	17:25
10	SSTD160	SVE4A14B15	RAJ054	01/14/10	17:43
11	SSTD050	ISVE4A14B1	RAJ055	01/14/10	18:01

Figure 5: **TYPICAL CONTINUING CALIBRATION SUMMARY**

CONTINUE_CALIBRATION - CALIBRATION VERIFICATION

Instrument ID :E4
IC_Beginning DateTime :01/14/10 15:00
Spike Amount :50 PPM
CC/CV File :RAJ055
IC File :RAJ049

Column Spec :ZB-5MS ID :0.18MM
IC_Ending DateTime :01/14/10 17:43
HPChem Method :SVE4A14C
Date_Time :01/14/10 18:01

M IDX	Parameters	CC_Con	CC%_D	CC_Resp	CCRRF	AvRRF	CC_Rtm	AvRtm	%_RSD	Co_X0	Co_X1	Co_X2	Co_Cor
1	1,4-Dichlorobenzene-d4	40.000	0	224421	1	1	2.872	2.875	0				
2	N-nitrosodimethylamine	53.207	6.4	150014	0.535	0.503	1.384	1.387	2.92				
3	Pyridine	51.294	2.6	278646	0.993	0.968	1.414	1.417	6.71				
4	2-Fluorophenol												
5	Phenol-d5												
6	Phenol	51.462	2.9	347033	1.237	1.202	2.544	2.546	1.66				
7	Aniline	46.952	-6.1	394893	1.408	1.499	2.610	2.612	2.56				
8	bis(2-chloroethyl)ether	50.403	0.8	266120	0.949	0.941	2.639	2.642	1.22				
9	2-Chlorophenol	54.013	8.0	408505	1.456	1.348	2.701	2.703	5.88				
10	1,3-Dichlorobenzene	51.425	2.9	419498	1.495	1.454	2.830	2.831	1.65				
11	1,2-Dichlorobenzene-d4												
12	1,4-Dichlorobenzene	50.775	1.5	422565	1.506	1.483	2.886	2.888	1.24				
13	Benzyl alcohol	55.201	10.4	212543	0.758	0.686	2.968	2.967	4.10				
14	1,2-Dichlorobenzene	51.344	2.7	398485	1.420	1.383	3.017	3.019	1.59				
15	2-Methylphenol	50.691	1.4	250607	0.893	0.881	3.043	3.042	3.31				
16	bis(2-chloroisopropyl)ether	52.760	5.5	669332	2.386	2.261	3.080	3.082	6.54				
17	4-Methylphenol	52.478	5.0	337328	1.202	1.146	3.178	3.179	3.68				
18	N-Nitroso-di-n-propylamine	52.372	4.7	174518	0.622	0.594	3.202	3.203	4.21				
19	Hexachloroethane	51.207	2.4	156549	0.558	0.545	3.321	3.320	1.61				
20	Naphthalene-d8	40.000	0	827811	1	1	4.074	4.073	0				
21	Nitrobenzene-d5												
22	Nitrobenzene	50.988	2.0	276687	0.267	0.262	3.373	3.372	3.10				
23	Isophorone	51.605	3.2	509585	0.492	0.477	3.597	3.597	3.58				
24	2-Nitrophenol	53.676	7.4	180386	0.174	0.162	3.675	3.677	11.59				
25	2,4-Dimethylphenol	51.363	2.7	318920	0.308	0.300	3.697	3.696	2.20				
26	Benzoic acid												
27	bis(2-Chloroethoxy)methane	49.750	-0.5	334530	0.323	0.325	3.805	3.805	1.44				
28	2,4-Dichlorophenol	52.698	5.4	308288	0.298	0.283	3.910	3.910	5.17				
29	1,2,4-Trichlorobenzene	49.053	-1.9	339475	0.328	0.334	4.009	4.009	2.18				
30	3,4-Dimethylphenol	48.331	-3.3	361478	0.349	0.361	4.009	4.008	2.97				
31	Naphthalene	49.931	-0.1	1031149	0.997	0.998	4.095	4.096	2.33				
32	4-Chloroaniline	50.416	0.8	430247	0.416	0.412	4.144	4.143	3.75				
33	Hexachlorobutadiene	50.926	1.9	205720	0.199	0.195	4.221	4.221	1.94				
34	Hydroquinone												
35	4-Chloro-3-methylphenol	52.065	4.1	261757	0.253	0.243	4.662	4.663	6.56				
36	2-Methylnaphthalene	53.135	6.3	703866	0.680	0.640	4.852	4.854	1.83				
37	1-Methylnaphthalene	49.729	-0.5	652965	0.631	0.634	4.966	4.966	1.97				
38	Acenaphthene-d10	40.000	0	387443	1	1	6.071	6.069	0				
39	Hexachlorocyclopentadiene	41.702	-16.6	191718	0.396	0.475	5.028	5.030	8.38				
40	2,3,5-Trichlorophenol	50.971	1.9	223897	0.462	0.454	5.038	5.038	12.57				
41	2,4,6-Trichlorophenol	51.339	2.7	221068	0.456	0.445	5.169	5.169	6.14				
42	2,4,5-Trichlorophenol	53.361	6.7	241133	0.498	0.467	5.202	5.205	6.23				
43	2,3,4-Trichlorophenol	50.777	1.6	187444	0.387	0.381	5.279	5.280	4.90				
44	2-Fluorobiphenyl												
45	Biphenyl	47.391	-5.2	778058	1.607	1.695	5.393	5.394	1.34				
46	2-Chloronaphthalene	51.238	2.5	662540	1.368	1.335	5.415	5.414	1.11				
47	2-Nitroaniline	53.751	7.5	149496	0.309	0.287	5.535	5.534	13.30				
48	2,6-Dimethylnaphthalene	47.922	-4.2	550918	1.138	1.187	5.576	5.577	1.19				
49	1,4-Dinitrobenzene	50.911	1.8	94871	0.196	0.171	5.789	5.704	19.51	-0.0153	0.2044		0.9984
50	Dimethylphthalate	50.265	0.5	720098	1.487	1.479	5.765	5.765	2.40				
51	1,3-Dinitrobenzene	44.620	-10.8	94871	0.196	0.203	5.789	5.789	15.18	-0.0125	0.2307		0.9990
52	2,6-Dinitrotoluene	53.228	6.5	158635	0.328	0.308	5.830	5.829	9.38				
53	1,2-Dinitrobenzene												
54	Acenaphthylene	51.234	2.5	1073327	2.216	2.163	5.899	5.902	1.78				
55	3-Nitroaniline	53.026	6.1	174011	0.359	0.339	6.023	6.022	10.42				
56	Acenaphthene	49.793	-0.4	667209	1.378	1.383	6.109	6.109	1.38				
57	2,4-Dinitrophenol	47.855	-4.3	83611	0.173	0.160	6.146	6.147	25.81	-0.0374	0.2117		0.9957
58	4-Nitrophenol	52.866	5.7	81818	0.169	0.160	6.219	6.219	9.81				
59	2,4-Dinitrotoluene	53.319	6.6	200192	0.413	0.388	6.305	6.307	11.48				
60	Dibenzofuran	49.172	-1.7	891276	1.840	1.871	6.315	6.316	1.95				
61	2,3,5,6-Tetrachlorophenol	52.312	4.6	149677	0.309	0.295	6.459	6.407	9.55				
62	2,3,4,6-Tetrachlorophenol	47.577	-4.8	185187	0.382	0.402	6.459	6.459	13.59				
63	2,3,5-Trimethylnaphthalene	48.542	-2.9	510258	1.054	1.085	6.568	6.571	1.71				
64	Diethylphthalate	50.218	0.4	752564	1.554	1.547	6.615	6.615	3.55				
65	Fluorene	50.318	0.6	720268	1.487	1.478	6.730	6.729	2.28				
66	4-Chlorophenyl-phenylether	49.077	-1.8	329931	0.681	0.694	6.739	6.740	2.88				
67	4-Nitroaniline	52.172	4.3	166692	0.344	0.330	6.758	6.755	13.49				

CONTINUE_CALIBRATION - CALIBRATION VERIFICATION

Instrument ID :E4
IC_Beginning DateTime :01/14/10 15:00
Spike Amount :50 PPM
CC/CV File :RAJ055
IC File :RAJ049

Column Spec :ZB-5MS ID :0.18MM
IC_Ending DateTime :01/14/10 17:43
HPChem Method :SVE4A14C
Date_Time :01/14/10 18:01

M IDX	Parameters	CC_Con	CC%_D	CC_Resp	CCRRF	AvRRF	CC_Rtm	AvRtm	%_RSD	Co_X0	Co_X1	Co_X2	Co_Cor
68	Phenanthrene-d10	40.000	0	671822	1	1	7.806	7.808	0				
69	4,6-Dinitro-2-methylphenol	58.659	17.3	141952	0.169	0.128	6.792	6.794	19.54	-0.0226	0.1595		0.9971
70	N-Nitrosodiphenylamine	37.979	-24.0	503304	0.599	0.789	6.879	6.883	3.00				
71	Azobenzene	52.948	5.9	549299	0.654	0.618	6.929	6.929	2.20				
72	2,4,6-Tribromophenol												
73	4-Bromophenyl-phenylether	50.804	1.6	192821	0.230	0.226	7.315	7.313	1.83				
74	Hexachlorobenzene	50.713	1.4	216280	0.258	0.254	7.368	7.366	1.12				
75	Pentachlorophenol	52.350	4.7	138247	0.165	0.143	7.593	7.591	16.37	-0.0100	0.1649		0.9995
76	Phenanthrene	49.067	-1.9	1007658	1.200	1.223	7.835	7.835	1.61				
77	Dinoseb	45.794	-8.4	146532	0.174	0.158	7.814	7.814	32.65	-0.0245	0.2119		0.9963
78	Anthracene	50.528	1.1	1036803	1.235	1.222	7.894	7.892	1.70				
79	Carbazole	51.479	3.0	977399	1.164	1.130	8.073	8.074	3.09				
80	Di-n-butylphthalate	53.153	6.3	1207669	1.438	1.353	8.476	8.476	8.46				
81	1-Methylphenanthrene	47.750	-4.5	678612	0.808	0.846	8.505	8.506	1.49				
82	Fluoranthene	51.041	2.1	1072114	1.277	1.251	9.112	9.113	3.79				
83	Chrysene-d12	40.000	0	722068	1	1	10.583	10.584	0				
84	Benzidine												
85	Pyrene	50.728	1.5	1135206	1.258	1.240	9.348	9.349	2.49				
86	Terphenyl-d14												
87	Butylbenzylphthalate	51.682	3.4	502925	0.557	0.483	10.028	10.031	18.74	-0.0389	0.5692		0.9995
88	bis(2-ethylhexyl)adipate	45.706	-8.6	387872	0.430	0.426	10.110	10.113	18.88	-0.0332	0.4991		0.9998
89	3,3'-Dichlorobenzidine												
90	Benzo(a)anthracene	52.331	4.7	1010275	1.119	1.069	10.573	10.574	4.72				
91	Chrysene	49.476	-1.0	952228	1.055	1.066	10.610	10.611	2.43				
92	bis(2-Ethylhexyl)phthalate	56.317	12.6	732413	0.811	0.720	10.610	10.610	13.28				
93	Perylene-d12	40.000	0	670682	1	1	11.955	11.956	0				
94	Di-n-octylphthalate	49.956	-0.1	1187566	1.417	1.254	11.231	11.231	22.10	-0.1162	1.5108		0.9997
95	Benzo(b)fluoranthene	51.469	2.9	927967	1.107	1.075	11.587	11.588	3.96				
96	Benzo(k)fluoranthene	50.550	1.1	1176470	1.403	1.388	11.611	11.615	3.25				
97	Benzo(e)pyrene	47.989	-4.0	829383	0.989	1.031	11.846	11.848	2.02				
98	Benzo(a)pyrene	51.114	2.2	898599	1.072	1.048	11.900	11.901	4.41				
99	Perylene	46.161	-7.7	845189	1.008	1.092	11.982	11.983	1.26				
100	Indeno(1,2,3-cd)pyrene	51.986	4.0	967418	1.154	1.110	13.161	13.162	7.19				
101	Dibenzo(a,h)anthracene	52.414	4.8	805107	0.960	0.916	13.183	13.184	6.08				
102	Benzo(g,h,i)perylene	51.722	3.4	831961	0.992	0.959	13.522	13.522	4.97				

Figure 6: **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 3550B/8270D
SEMI VOLATILE ORGANICS BY GC/MS

Client	: BEST SERVICES, INC.	Date Collected:	04/05/10
Project	: GARDEN GROVE PROJECT	Date Received:	04/05/10
Batch No.	: 10D048	Date Extracted:	04/09/10 10:45
Sample ID:	DSW-G2-B3	Date Analyzed:	04/12/10 15:57
Lab Samp ID:	D048-01	Dilution Factor:	.97
Lab File ID:	RDJ126	Matrix :	SOIL
Ext Btch ID:	SVD013S	% Moisture :	3.2
Calib. Ref.:	RAJ049	Instrument ID :	T-OE4

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
1,2,4-TRICHLOROBENZENE	ND	0.33	0.17
1,2-DICHLOROBENZENE	ND	0.33	0.17
1,3-DICHLOROBENZENE	ND	0.33	0.17
1,4-DICHLOROBENZENE	ND	0.33	0.17
2,4,5-TRICHLOROPHENOL	ND	0.33	0.17
2,4,6-TRICHLOROPHENOL	ND	0.33	0.18
2,4-DICHLOROPHENOL	ND	0.33	0.17
2,4-DIMETHYLPHENOL	ND	0.33	0.17
2,4-DINITROPHENOL	ND	0.66	0.17
2,4-DINITROTOLUENE	ND	0.33	0.17
2,6-DINITROTOLUENE	ND	0.33	0.17
2-CHLORONAPHTHALENE	ND	0.33	0.17
2-CHLOROPHENOL	ND	0.33	0.17
2-METHYLNAPHTHALENE	ND	0.33	0.17
2-METHYLPHENOL	ND	0.33	0.17
2-NITROANILINE	ND	0.33	0.17
2-NITROPHENOL	ND	0.33	0.17
3,3'-DICHLOROBENZIDINE	ND	0.33	0.17
3-NITROANILINE	ND	0.33	0.17
4,6-DINITRO-2-METHYLPHENOL	ND	0.66	0.17
4-BROMOPHENYL-PHENYL ETHER	ND	0.33	0.17
4-CHLORO-3-METHYLPHENOL	ND	0.33	0.17
4-CHLOROANILINE	ND	0.33	0.17
4-CHLOROPHENYL-PHENYL ETHER	ND	0.33	0.17
4-METHYLPHENOL (1)	ND	0.33	0.17
4-NITROANILINE	ND	0.33	0.17
4-NITROPHENOL	ND	0.66	0.17
ACENAPHTHENE	ND	0.33	0.17
ACENAPHTHYLENE	ND	0.33	0.17
ANTHRACENE	ND	0.33	0.17
BENZO(A)ANTHRACENE	ND	0.33	0.17
BENZO(A)PYRENE	ND	0.33	0.17
BENZO(B)FLUORANTHENE	ND	0.33	0.17
BENZO(K)FLUORANTHENE	ND	0.33	0.17
BENZO(G,H,I)PERYLENE	ND	0.33	0.17
BIS(2-CHLOROETHOXY)METHANE	ND	0.33	0.17
BIS(2-CHLOROETHYL)ETHER	ND	0.33	0.17
BIS(2-CHLOROISOPROPYL)ETHER	ND	0.33	0.17
BIS(2-ETHYLHEXYL)PHTHALATE	ND	0.33	0.17
BUTYLBENZYLPHTHALATE	ND	0.33	0.17
CHRYSENE	ND	0.33	0.17
DI-N-BUTYLPHTHALATE	ND	0.33	0.17
DI-N-OCTYLPHTHALATE	ND	0.33	0.17
DIBENZO(A,H)ANTHRACENE	ND	0.33	0.17
DIBENZOFURAN	ND	0.33	0.17
DIETHYLPHTHALATE	ND	0.33	0.17
DIMETHYLPHTHALATE	ND	0.33	0.17
FLUORANTHENE	ND	0.33	0.17
FLUORENE	ND	0.33	0.17
HEXACHLOROBENZENE	ND	0.33	0.17
HEXACHLOROBUTADIENE	ND	0.33	0.19
HEXACHLOROCYCLOPENTADIENE	ND	0.33	0.17
HEXACHLOROETHANE	ND	0.33	0.17
INDENO(1,2,3-CD)PYRENE	ND	0.33	0.17
ISOPHORONE	ND	0.33	0.17
N-NITROSO-DI-N-PROPYLAMINE	ND	0.33	0.17
N-NITROSODIPHENYLAMINE (2)	ND	0.33	0.17
NAPHTHALENE	ND	0.33	0.17
NITROBENZENE	ND	0.33	0.17
PENTACHLOROPHENOL	ND	0.66	0.18
PHENANTHRENE	ND	0.33	0.17
PHENOL	ND	0.33	0.17
PYRENE	ND	0.33	0.17

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	76	20-140
2-FLUOROBIPHENYL	52	30-130
2-FLUOROPHENOL	52	20-130
NITROBENZENE-D5	46	20-130
PHENOL-D5	58	20-130
TERPHENYL-D14	101	40-130

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

Figure 7: **TYPICAL LCS REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: BEST SERVICES, INC.
PROJECT: GARDEN GROVE PROJECT
BATCH NO.: 10D048
METHOD: METHOD 3550B/8270D

MATRIX:	SOIL			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	MBLK1S				
LAB SAMP ID:	SVD013SB	SVD013SL	SVD013SC		
LAB FILE ID:	RDJ121	RDJ122	RDJ123		
DATE EXTRACTED:	04/09/1010:45	04/09/1010:45	04/09/1010:45	DATE COLLECTED:	NA
DATE ANALYZED:	04/12/1014:24	04/12/1014:43	04/12/1015:01	DATE RECEIVED:	04/09/10
PREP. BATCH:	SVD013S	SVD013S	SVD013S		
CALIB. REF:	RAJ049	RAJ049	RAJ049		

ACCESSION:

PARAMETER	BLNK RSLT (mg/kg)	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	SPIKE AMT (mg/kg)	BSD RSLT (mg/kg)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
1,2,4-Trichlorobenzene	ND	1.33	0.991	74	1.33	0.928	70	7	30-130	50
1,2-Dichlorobenzene	ND	1.33	1.01	76	1.33	0.934	70	8	40-130	50
1,3-Dichlorobenzene	ND	1.33	1.01	76	1.33	0.914	69	10	40-130	50
1,4-Dichlorobenzene	ND	1.33	1.01	76	1.33	0.905	68	11	30-130	50
2,4,5-Trichlorophenol	ND	1.33	1.06	79	1.33	1.05	79	1	50-130	50
2,4,6-Trichlorophenol	ND	1.33	0.997	75	1.33	0.949	71	5	50-130	50
2,4-Dichlorophenol	ND	1.33	1.01	75	1.33	0.953	71	5	50-130	50
2,4-Dimethylphenol	ND	1.33	1.01	76	1.33	0.962	72	5	40-130	50
2,4-Dinitrophenol	ND	1.33	1.01	76	1.33	1.06	80	5	40-130	50
2,4-Dinitrotoluene	ND	1.33	1.22	91	1.33	1.21	90	1	30-130	50
2,6-Dinitrotoluene	ND	1.33	1.10	83	1.33	1.09	82	1	60-130	50
2-Chloronaphthalene	ND	1.33	1.07	81	1.33	1.04	78	3	50-130	50
2-Chlorophenol	ND	1.33	1.11	83	1.33	0.964	72	14	30-130	50
2-Methylnaphthalene	ND	1.33	1.11	83	1.33	1.05	79	5	40-130	50
2-Methylphenol	ND	1.33	1.08	81	1.33	0.985	74	9	40-130	50
2-Nitroaniline	ND	1.33	1.10	82	1.33	1.11	83	1	50-130	50
2-Nitrophenol	ND	1.33	1.08	81	1.33	1.03	77	5	50-130	50
3,3'-Dichlorobenzidine	ND	1.33	1.30	98	1.33	1.31	99	1	60-130	50
3-Nitroaniline	ND	1.33	1.17	88	1.33	1.15	87	2	60-130	50
4,6-Dinitro-2-Methylphenol	ND	1.33	1.34	100	1.33	1.42	106	6	50-130	50
4-Bromophenyl-phenyl ether	ND	1.33	1.17	88	1.33	1.13	84	4	50-130	50
4-Chloro-3-Methylphenol	ND	1.33	1.03	78	1.33	1.00	75	3	30-130	50
4-Chloroaniline	ND	1.33	1.05	79	1.33	1.01	76	4	40-130	50
4-Chlorophenyl-phenyl ether	ND	1.33	1.07	81	1.33	1.04	78	3	50-130	50
4-Methylphenol	ND	1.33	1.14	86	1.33	1.04	78	9	40-130	50
4-Nitroaniline	ND	1.33	1.29	96	1.33	1.27	95	1	60-130	50
4-Nitrophenol	ND	1.33	0.824	62	1.33	0.841	63	2	20-130	50
Acenaphthene	ND	1.33	1.08	81	1.33	1.05	79	2	30-130	50
Acenaphthylene	ND	1.33	1.09	82	1.33	1.05	79	4	30-130	50
Anthracene	ND	1.33	1.14	86	1.33	1.14	85	1	30-130	50
Benzo(a)anthracene	ND	1.33	1.25	93	1.33	1.24	93	1	40-130	50
Benzo(a)pyrene	ND	1.33	1.21	91	1.33	1.20	90	1	40-130	50
Benzo(b)fluoranthene	ND	1.33	1.26	95	1.33	1.25	94	1	50-130	50
Benzo(k)fluoranthene	ND	1.33	1.21	91	1.33	1.12	84	8	40-130	50
Benzo(g,h,i)perylene	ND	1.33	1.29	96	1.33	1.28	96	0	40-140	50
bis(2-Chloroethoxy)methane	ND	1.33	1.22	91	1.33	1.03	78	16	40-130	50
bis(2-Chloroethyl)ether	ND	1.33	1.12	84	1.33	1.03	77	9	40-130	50
bis(2-Chloroisopropyl)ether	ND	1.33	1.06	79	1.33	0.973	73	8	40-130	50
bis(2-Ethylhexyl)phthalate	ND	1.33	1.42	106	1.33	1.43	107	1	50-130	50
Butylbenzylphthalate	ND	1.33	1.33	100	1.33	1.35	101	2	60-130	50
Chrysene	ND	1.33	1.23	92	1.33	1.24	93	1	40-130	50
Di-n-butylphthalate	ND	1.33	1.28	96	1.33	1.28	96	0	50-130	50
Di-n-octylphthalate	ND	1.33	1.33	100	1.33	1.31	98	1	50-130	50
Dibenzo(a,h)anthracene	ND	1.33	1.31	98	1.33	1.30	97	1	40-130	50
Dibenzofuran	ND	1.33	1.07	80	1.33	1.04	78	3	50-130	50
Diethylphthalate	ND	1.33	1.08	81	1.33	1.09	82	1	60-130	50
Dimethylphthalate	ND	1.33	1.13	85	1.33	1.11	83	2	60-130	50
Fluoranthene	ND	1.33	1.25	94	1.33	1.21	91	4	40-130	50
Fluorene	ND	1.33	1.08	81	1.33	1.07	80	1	30-130	50
Hexachlorobenzene	ND	1.33	1.19	89	1.33	1.13	85	5	30-130	50
Hexachlorobutadiene	ND	1.33	0.893	67	1.33	0.824	62	8	40-130	50
Hexachlorocyclopentadiene	ND	1.33	0.574	43	1.33	0.545	41	5	10-130	50
Hexachloroethane	ND	1.33	0.959	72	1.33	0.872	65	9	40-130	50
Indeno(1,2,3-cd)pyrene	ND	1.33	1.29	97	1.33	1.29	96	0	30-140	50
Isophorone	ND	1.33	1.06	80	1.33	1.00	75	6	50-130	50
n-Nitroso-di-n-propylamine	ND	1.33	1.12	84	1.33	1.04	78	8	30-130	50
n-Nitrosodiphenylamine	ND	1.33	0.845	63	1.33	0.823	62	3	30-140	50
Naphthalene	ND	1.33	1.03	77	1.33	0.955	72	8	30-130	50
Nitrobenzene	ND	1.33	1.01	76	1.33	0.952	71	6	40-130	50
Pentachlorophenol	ND	1.33	1.04	78	1.33	1.06	79	2	20-130	50
Phenanthrene	ND	1.33	1.15	86	1.33	1.13	85	1	30-130	50
Phenol	ND	1.33	1.12	84	1.33	1.00	75	11	30-130	50
Pyrene	ND	1.33	1.20	90	1.33	1.21	91	1	30-130	50

SURROGATE PARAMETER	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	SPIKE AMT (mg/kg)	BSD RSLT (mg/kg)	BSD % REC	QC LIMIT (%)
2,4,6-Tribromophenol	2.00	1.87	94	2.00	1.79	90	40-130
2-Fluorobiphenyl	0.667	0.526	79	0.667	0.491	74	30-130
2-Fluorophenol	2.00	1.58	79	2.00	1.35	67	30-130
Nitrobenzene-d5	0.667	0.479	72	0.667	0.434	65	30-130
Phenol-d5	2.00	1.67	83	2.00	1.48	74	30-130
Terphenyl-d14	0.667	0.710	107	0.667	0.709	106	40-130

Figure 8: **TYPICAL MS/MSD REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: BEST SERVICES, INC.
PROJECT: GARDEN GROVE PROJECT
BATCH NO.: 10D048
METHOD: METHOD 3550B/8270D

MATRIX: SOIL % MOISTURE: 3.2

DILUTION FACTOR:	.97	.97	.98
SAMPLE ID:	DSW-G2-B3		
LAB SAMP ID:	D048-01	D048-01M	D048-01S
LAB FILE ID:	RDJ126	RDJ124	RDJ125
DATE EXTRACTED:	04/09/1010:45	04/09/1010:45	04/09/1010:45
DATE ANALYZED:	04/12/1015:57	04/12/1015:20	04/12/1015:38
PREP. BATCH:	SVD013S	SVD013S	SVD013S
CALIB. REF:	RAJ049	RAJ049	RAJ049

DATE COLLECTED: 04/05/10
DATE RECEIVED: 04/05/10

ACCESSION:

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
1,2,4-Trichlorobenzene	ND	1.34	0.679	51	1.35	0.647	48	6	10-130	50
1,2-Dichlorobenzene	ND	1.34	0.657	49	1.35	0.646	48	2	30-130	50
1,3-Dichlorobenzene	ND	1.34	0.628	47	1.35	0.612	45	4	30-130	50
1,4-Dichlorobenzene	ND	1.34	0.634	47	1.35	0.627	46	2	10-130	50
2,4,5-Trichlorophenol	ND	1.34	0.999	75	1.35	0.931	69	8	40-130	50
2,4,6-Trichlorophenol	ND	1.34	0.839	63	1.35	0.803	59	7	40-130	50
2,4-Dichlorophenol	ND	1.34	0.754	56	1.35	0.746	55	2	30-130	50
2,4-Dimethylphenol	ND	1.34	0.602	45	1.35	0.615	46	2	30-130	50
2,4-Dinitrophenol	ND	1.34	0.839	63	1.35	0.781	58	8	20-130	50
2,4-Dinitrotoluene	ND	1.34	1.23	92	1.35	1.09	80	14	20-130	50
2,6-Dinitrotoluene	ND	1.34	1.06	80	1.35	0.974	72	11	50-130	50
2-Chloronaphthalene	ND	1.34	0.825	62	1.35	0.826	61	2	40-130	50
2-Chlorophenol	ND	1.34	0.745	56	1.35	0.745	55	2	20-130	50
2-Methylnaphthalene	ND	1.34	0.816	61	1.35	0.800	59	3	30-130	50
2-Methylphenol	ND	1.34	0.722	54	1.35	0.744	55	2	30-130	50
2-Nitroaniline	ND	1.34	1.10	82	1.35	1.00	74	10	40-130	50
2-Nitrophenol	ND	1.34	0.764	57	1.35	0.741	55	4	30-130	50
3,3'-Dichlorobenzidine	ND	1.34	1.03	77	1.35	0.971	72	7	40-130	50
3-Nitroaniline	ND	1.34	1.17	88	1.35	1.04	77	13	50-130	50
4,6-Dinitro-2-Methylphenol	ND	1.34	1.19	89	1.35	1.09	80	11	40-130	50
4-Bromophenyl-phenyl ether	ND	1.34	1.09	82	1.35	1.02	76	8	50-130	50
4-Chloro-3-Methylphenol	ND	1.34	0.944	71	1.35	0.883	65	9	30-130	50
4-Chloroaniline	ND	1.34	0.770	58	1.35	0.772	57	2	30-130	50
4-Chlorophenyl-phenyl ether	ND	1.34	0.991	74	1.35	0.947	70	6	50-130	50
4-Methylphenol	ND	1.34	0.781	58	1.35	0.802	59	2	30-130	50
4-Nitroaniline	ND	1.34	1.32	99	1.35	1.14	85	15	50-130	50
4-Nitrophenol	ND	1.34	0.888	66	1.35	0.747	55	18	20-130	50
Acenaphthene	ND	1.34	0.909	68	1.35	0.909	67	1	20-130	50
Acenaphthylene	ND	1.34	0.892	67	1.35	0.892	66	2	30-130	50
Anthracene	ND	1.34	1.10	82	1.35	1.03	76	8	30-130	50
Benzo(a)anthracene	ND	1.34	1.19	89	1.35	1.10	82	8	40-130	50
Benzo(a)pyrene	ND	1.34	1.12	84	1.35	1.03	76	10	40-130	50
Benzo(b)fluoranthene	ND	1.34	1.15	86	1.35	1.07	80	7	50-130	50
Benzo(k)fluoranthene	ND	1.34	1.15	86	1.35	1.09	81	6	40-130	50
Benzo(g,h,i)perylene	ND	1.34	1.22	92	1.35	1.13	84	9	40-130	50
bis(2-Chloroethoxy)methane	ND	1.34	0.848	63	1.35	0.843	62	2	30-130	50
bis(2-Chloroethyl)ether	ND	1.34	0.757	57	1.35	0.751	56	2	20-130	50
bis(2-Chloroisopropyl)ether	ND	1.34	0.688	51	1.35	0.694	51	0	20-130	50
bis(2-Ethylhexyl)phthalate	ND	1.34	1.40	105	1.35	1.35	100	5	50-130	50
Butylbenzylphthalate	ND	1.34	1.38	103	1.35	1.35	100	3	50-130	50
Chrysene	ND	1.34	1.17	88	1.35	1.10	81	8	40-130	50
Di-n-butylphthalate	ND	1.34	1.25	94	1.35	1.19	88	7	50-130	50
Di-n-octylphthalate	ND	1.34	1.36	102	1.35	1.35	100	2	50-130	50
Dibenzo(a,h)anthracene	ND	1.34	1.23	92	1.35	1.16	86	7	40-130	50
Dibenzofuran	ND	1.34	0.942	71	1.35	0.908	67	6	40-130	50
Diethylphthalate	ND	1.34	1.11	83	1.35	0.998	74	11	50-130	50
Dimethylphthalate	ND	1.34	1.08	81	1.35	1.00	74	9	50-130	50
Fluoranthene	ND	1.34	1.20	90	1.35	1.12	83	8	40-130	50
Fluorene	ND	1.34	1.01	76	1.35	0.953	71	7	30-130	50
Hexachlorobenzene	ND	1.34	1.12	84	1.35	1.06	79	6	10-160	50
Hexachlorobutadiene	ND	1.34	0.594	44	1.35	0.575	43	2	30-130	50
Hexachlorocyclopentadiene	ND	1.34	0.410	31	1.35	0.407	30	3	10-130	50
Hexachloroethane	ND	1.34	0.580	43	1.35	0.570	42	2	30-130	50
Indeno(1,2,3-cd)pyrene	ND	1.34	1.24	93	1.35	1.15	85	9	40-130	50
Isophorone	ND	1.34	0.777	58	1.35	0.784	58	0	40-130	50
n-Nitroso-di-n-propylamine	ND	1.34	0.762	57	1.35	0.768	57	0	20-130	50
n-Nitrosodiphenylamine	ND	1.34	0.765	57	1.35	0.731	54	5	20-140	50
Naphthalene	ND	1.34	0.719	54	1.35	0.705	52	4	20-130	50
Nitrobenzene	ND	1.34	0.700	52	1.35	0.701	52	0	30-130	50
Pentachlorophenol	ND	1.34	0.997	75	1.35	0.930	69	8	20-130	50
Phenanthrene	ND	1.34	1.12	84	1.35	1.04	77	9	30-130	50
Phenol	ND	1.34	0.766	57	1.35	0.795	59	3	20-130	50
Pyrene	ND	1.34	1.15	86	1.35	1.10	81	6	10-160	50

SURROGATE PARAMETER	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	QC LIMIT (%)
2,4,6-Tribromophenol	2.00	1.84	92	2.02	1.79	88	20-140
2-Fluorobiphenyl	0.668	0.397	59	0.675	0.408	60	30-130
2-Fluorophenol	2.00	1.05	52	2.02	1.10	54	20-130
Nitrobenzene-d5	0.668	0.340	51	0.675	0.349	52	20-130
Phenol-d5	2.00	1.14	57	2.02	1.23	61	20-130
Terphenyl-d14	0.668	0.663	99	0.675	0.675	100	40-130

Figure 9: **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : BEST SERVICES, INC.

Project : GARDEN GROVE PROJECT

SDG : 10D048

METHOD 3550B/8270D
SEMI VOLATILE ORGANICS BY GC/MS

A total of nine (9) soil samples were received on 04/05/10 for Semi Volatile Organics by GC/MS analysis, Method 3550B/8270D in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument tune check was performed prior to calibration. Instrument mass ratios as well as DDT breakdown were evaluated. Results were within acceptance criteria. Tailing factor for Benzidine and Pentachlorophenol were also verified and results were ≤ 2. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source (ICV). Continuing calibration (CCV) was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms for ICAL, ICV and CCV for details.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for SVD013SL/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for D048-01M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Table 1: INTERMEDIATE STANDARD PREPARATION

A. Primary Source: AccuStandard, Restek or equivalent

Compound Name	Stock / Internal Soln. Conc. (µg/ml)	Source	Preparation			Final Conc. (mg/L)
			Aliquot (µL)	Dil. Solution	Final Vol. (ml)	
Base/Neutral Composite Mix	2000	Accu Standard	1000	MeCl2	10	200
Toxic Substance Mix #1	2000	Accu Standard	1000	MeCl2	10	200
Phenol Mix	2000	Accu Standard	1000	MeCl2	10	200
Composite Mix 3	2000	Accu Standard	1000	MeCl2	10	200
Benzidine and 3,3'dichlorobenzidine	2000	Accu Standard	1000	MeCl2	10	200
Acid Surrogate Mix	7500	Restek Standard	267	MeCl2	10	200
Base/Neutral Surrogate Mix	5000	Restek Standard	400	MeCl2	10	200

B. Secondary Source: Supelco, Ultra Scientific or equivalent

Compound Name	Stock Soln. Conc. (µg/ml)	Source	Preparation			Final Conc. (mg/L)
			Aliquot (ml)	Solvent	Final Vol. (ml)	
Base/Neutral Mix 1	2000	Ultra Scientific	1	MeCl2	10	200
Base/Neutral Mix 2	2000	Ultra Scientific	1	MeCl2	10	200
Toxic Substance Mix 1	2000	Ultra Scientific	1	MeCl2	10	200
Toxic Substance Mix 2	2000	Ultra Scientific	1	MeCl2	10	200
Phenol Mix	2000	Ultra Scientific	1	MeCl2	10	200
PAH Mixture	2000	Ultra Scientific	1	MeCl2	10	200
Benzidine	2000	Ultra Scientific	1	MeCl2	10	200
Carbazol	2000	Supelco	1	MeCl2	10	200
Pyridine	2000	Supelco	1	MeCl2	10	200

Table 2: **WORKING STANDARD CALIBRATION**

Standard Name	Intermediate Standard µl of 200 mg/L	Internal Standard µl of 2000 mg/L	Amount of $MeCl_2$(µl)	Final Volume (µl)	Final Conc.
Standard 1 5 mg/L Calib. Std	12.5	10	477.5	500	5 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 2 10 mg/L Calib. Std	25	10	465	500	10 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 3 20 mg/L Calib. Std	50	10	440	500	20 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 4 40 mg/L Calib. Std	100	10	390	500	40 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 5 50 mg/L Calib. Std	125	10	365	500	50 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 6 80 mg/L Calib. Std	200	10	290	500	80 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 7 100 mg/L Calib. Std	250	10	240	500	100 mg/L of Cal Std 40mg/L of Internal Std.
Standard 8 120 mg/L Calib. Std	300	10	190	500	120 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 9 160 mg/L Calib. Std	400	10	90	500	160 mg/L of Cal. Std. 40mg/L of Internal Std.

WORKING SECONDARY SOURCE STANDARD

Standard Name	Intermediate Standard µl of 200 mg/L	Internal Standard µl of 2000 mg/L	Amount of $MeCl_2$(µl)	Final Volume (µl)	Final Conc.
Secondary Source Std. Mix(see Table 1)	125	10	365	500	50 mg/L of Cal. Ver. Std. 40 mg/L of Internal Std.

Table 3: INSTRUMENT PARAMETERS

	Inst. E4 / Inst. E7	Inst. 052
Carrier Gas	Helium at 90 psi at outlet	Helium at 90 psi at outlet
Column head pressure	15 - 35 psi at 40°C	15-35 psi at 50°C
Injection port temperature	280-300°C	280-300°C
Interface	Direct column interference at 280-300°C	Direct column interference at 2 80-300°C
Valve time	Split 0.2 minute	Split 0.2 minutes
Oven Temperature Program		
Initial Temperature	50°C/min; hold for 0min.	50°C/min; hold for 0.2min.
Rate	30°C/min to 100°C; hold for 0.0 min.; 20ºC/min to 200ºC; hold for 0.0 min.; 25ºC/min to 320ºC; hold for 2.53 min.	10°C/min to 100°C; hold for 0 min. 38°C/min to 280°C; hold for 0 min.
Run Time	14 minutes	9.94 minutes
Scan Parameters		
Scan start time	After solvent peak	After solvent peak
Mass range	10 to 1050 AMU	40 to 500 AMU
Multiplier voltage	1000-3000	0.7-3
Number of sampling rate	1	0.4
Threshold	300	500-1500
Tuning File	DFTPP	DFTPP

Table 4: DFTPP KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
51	10 – 80% of mass 198
68	< 2.0% of mass 69
70	< 2.0% of mass 69
127	10 – 80% of mass 198
197	<2% of mass 198
198	Base peak, 100% relative abundance (See Note), or >50% of mass 442
199	5 to 9% of mass 198
275	10 to 60% of mass 198
365	> 1% of mass 198
441	Present but <24% of mass 442
442	Base peak or >50% of mass 198
443	15 to 24% of mass 442

NOTE: All ion abundance MUST be normalized to m/z 198, the nominal base peak.

Table 5: ANALYTE LISTS, QUANTITATION IONS, INTERNAL STANDARDS & SURROGATES

Analyte	Type	Quantitation Ions	
		Primary	Secondary
1,4-Dichlorobenzene-d_4	**IS**	152	150,154
Phenol	T	94	65,66
Bis(2-Chloroethyl)ether	T	93	63,95
2-Chlorophenol	T	128	64,130
1,3-Dichlorobenzene	T	146	148,111
1,4-Dichlorobenzene	T	146	148,111
1,2-Dichlorobenzene	T	146	148,111
2-Methylphenol	T	107	108,77,79,90
4-Methylphenol	T	107	108,77,79,90
N-Nitroso-di-n-propylamine	T	70	42,101,130
Hexachloroethane	T	117	201,199
Aniline	T	93	66,65
Benzyl Alcohol	T	108	79,77
Bis(2-chloroisopropyl)ether	T	45	77,121
N-Nitrosodimethylamine	T	42	74,44
2-Fluorophenol	S	112	64
Phenol-d5	S	99	42,71
1,2-Dichlorobenzene-d4	S	152	150,115
Acenaphthene-d_{10}	**IS**	164	162,160
Hexachlorocyclopentadiene	T	237	235,272
2,4,6-Trichlorophenol	T	196	198,200
2,4,5-Trichlorophenol	T	196	198,97,132,99
2-Chloronaphthalene	T	162	127,164
2-Nitroaniline	T	65	92,138
Dimethylphthalate	T	163	194,164
Acenaphthylene	T	152	151,153
3-Nitroaniline	T	138	108,92
Acenaphthene	T	154	153,152
2,4-Dinitrophenol	T	184	63,154
4-Nitrolphenol	T	139	109,65
Dibenzofuran	T	168	139
2,4-Dinitrotoluene	T	165	63,89
2,6-Dinitrotoluene	T	165	63,89
Diethylphthalate	T	149	177,150
4-Chlorophenylphenylether	T	204	206,141
Fluorene	T	166	165,167
4-Nitroaniline	T	138	65,108,92,80,39
Azobenzene	T	77	105,182
2-Fluorobiphenyl	S	172	171
2,4,6-Tribromophenol	S	330	332, 141

Analyte	Type	Quantitation Ions	
		Primary	Secondary
Naphthalene-d_8	**IS**	136	68
Nitrobenzene	T	77	123,65
Isophorone	T	82	95,138
2-Nitrophenol	T	139	109,65
2,4-Dimethylphenol	T	122	107,121
Bis(2-Chloroethoxy)methane	T	93	95,123
2,4-Dichlorophenol	T	162	164,98
1,2,4-Trichlorobenzene	T	180	182,145
Naphthalene	T	128	129,127
4-Chloroaniline	T	127	129,65,92
Hexachlorobutadiene	T	225	223,227
4-Chloro-3-methylphenol	T	107	144,142
2-Methylnaphthalene	T	142	141
Benzoic Acid	T	122	105,77
Hydroquinone	T	110	81,53,55
Nitrobenzene-d5 (surr)	S	82	128,545
Chrysene-d_{12}	**IS**	240	120,236,
Pyrene	T	202	200,203
Butylbenzylphthalate	T	149	91,206
3,3'-Dichlorobenzidine	T	252	254,126
Benzo(a)anthracene	T	228	229,226
Bis(2-ethylhexyl)phthalate	T	149	167,279
Chrysene	T	228	226,229
Benzidine	T	184	92,185
Terphenyl-d14 (surr)	S	244	122,212
Phenanthrene-d_{10}	**IS**	188	94,80
4,6-Dinitro-2-methylphenol	T	198	51,105
n-Nitrosodiphenylamine	T	169	168, 164
4-Bromophenyl phenyl ether	T	248	250,141
Hexachlorobenzene	T	284	142249
Pentachlorophenol	T	266	264,268
Carbazole	T	167	166,168
Phenanthrene	T	178	179,176
Anthracene	T	178	176,179
Di-n-butylphthalate	T	149	150,104
Fluoranthene	T	202	101,203
Perylene-d_{12}	**IS**	264	260,265
Di-n-octyl-phthalate	T	149	167,43
Benzo(b)fluoranthene	T	252	253,125
Benzo(k)fluoranthene	T	252	253,125
Benzo(a)pyrene	T	252	25,3125
Indeno(1,2,3-cd)pyrene	T	276	138,227
Benzo(g,h,I)perylene	T	276	138,277
Dibenzo(a,h)anthracene	T	278	139,279

Notes: T – target compound

S – surrogate

IS –internal standard

Table 5 con't.: ADDITIONAL ANALYTE LISTS, QUANTITATION IONS, INTERNAL STANDARDS & SURROGATES

Analyte	Type	Quantitation Ions	
		Primary	Secondary
1,4-Dichlorobenzene-d_4	**IS**	152	150,154
Ethyl methanesulfonate	T	79	109,97,45,65
Methyl methanesulfonate	T	80	79,65,95
2-Picoline	T	93	66,92
Naphthalene-d_8	**IS**	136	68
Acetophenone	T	106	71,51,120
2,6-Dichlorophenol	T	162	164,98
a,a-Dimethylphenethylamine	T	58	91,65,134,42
n-Nitrosodi-n-butylamine	T	84	57,41,116,158
N-Nitrosopiperidine	T	114	42,55
Acenaphthene-d_{10}	**IS**	164	162,160
1-Chloronaphthalene	T	162	127,164
2-Chloronaphthalene	T	162	127,164
1-Naphthylamine	T	143	115,89,63
2-Naphthylamine	T	143	115,116
Pentachlorobenzene	T	250	252,108,248
1,2,4,5-Tetrachlorobenzene	T	216	214,179,108
2,3,4,6-Tetrachlorophenol	T	232	131,230,166

Analyte	Type	Quantitation Ions	
		Primary	Secondary
Phenanthrene-d_{10}	**IS**	188	94,80
4-Aminophenyl	T	169	168,170,115
Phenacetin	T	108	180,179,109
Pronamide	T	173	175,145,109
Chrysene-d_{12}	**IS**	240	120,236,
p-Dimethylaminoazobenzene	T	225	120,77,105
Perylene-d_{12}	**IS**	264	260,265
Dibenzo(a,j)acridine	T	279	280,277,250
7,12-Dimethylbenz(a)anthracene	T	256	241,239,120
3-Methylcholanthrene	T	268	252,253,126

Notes: T – target compound

S – surrogate

IS –internal standard

Table 6: RECOMMENDED MINIMUM RESPONSE FACTOR

ANALYTE	Minimum ResponseFactor(RF)	ANALYTE	Minimum ResponseFactor(RF)
Benzaldehyde	0.010	4-Nitrophenol	0.010
Phenol	0.800	Dibenzofuran	0.800
Bis(2-chloroethyl)ether	0.700	2,4-Dinitrotoluene	0.200
2-Chlorophenol	0.800	Diethyl phthalate	0.010
2-Methylphenol	0.700	1,2,4,5-Tetrachlorobenzene	0.010
2,2'-Oxybis-(1-chloropropane)	0.010	4-Chlorophenyl-phenyl ether	0.400
Acetophenone	0.010	Fluorene	0.900
4-Methylphenol	0.600	4-Nitroaniline	0.010
N-Nitroso-di-n-propylamine	0.500	4,6-Dinitro-2-methylphenol	0.010
Hexachloroethane	0.300	4-Bromophenyl-phenyl ether	0.100
Nitrobenzene	0.200	N-Nitrosodiphenylamine	0.010
Isophorone	0.400	Hexachlorobenzene	0.100
2-Nitrophenol	0.100	Atrazine	0.010
2,4-Dimethylphenol	0.200	Pentachlorophenol	0.050
Bis(2-chloroethoxy)methane	0.300	Phenanthrene	0.700
2,4-Dichlorophenol	0.200	Anthracene	0.700
Naphthalene	0.700	Carbazole	0.010
4-Chloroaniline	0.010	Di-n-butyl phthalate	0.010
Hexachlorobutadiene	0.010	Fluoranthene	0.600
Caprolactam	0.010	Pyrene	0.600
4-Chloro-3-methylphenol	0.200	Butyl benzyl phthalate	0.010
2-Methylnaphthalene	0.400	3,3'-Dichlorobenzidine	0.010
Hexachlorocyclopentadiene	0.050	Benzo(a)anthracene	0.800
2,4,6-Trichlorophenol	0.200	Chrysene	0.700
2,4,5-Trichlorophenol	0.200	Bis-(2-ethylhexyl)phthalate	0.010
1,1'-Biphenyl	0.010	Di-n-octyl phthalate	0.010
2-Chloronaphthalene	0.800	Benzo(b)fluoranthene	0.700
2-Nitroaniline	0.010	Benzo(k)fluoranthene	0.700
Dimethyl phthalate	0.010	Benzo(a)pyrene	0.700
2,6-Dinitrotoluene	0.200	Indeno(1,2,3-cd)pyrene	0.500
Acenaphthylene	0.900	Dibenz(a,h)anthracene	0.400
3-Nitroaniline	0.010	Benzo(g,h,i)perylene	0.500
Acenaphthene	0.900	2,3,4,6-Tetrachlorophenol	0.010
2,4-Dinitrophenol	0.010		

Notes:

1. PSR supersedes Table 6.
2. Other analytes not listed above must have a minimum response factor of 0.01.
3. Table 6 is from SW846 Method 8270D, Table 4.

Table 7: ESTABLISHED LIMIT OF DETECTION (LOD) & LIMIT OF QUANTITATION (LOQ)

PARAMETER	DL	LOD	LOQ	Unit
Acenaphthene	1.52	5	10	ug/L
Acenaphthylene	1.42	5	10	ug/L
Aniline	5.26	5	10	ug/L
Anthracene	2.32	5	10	ug/L
Azobenzene	1.52	5	10	ug/L
Benzidine	0.00			ug/L
Benzo(a)anthracene	1.55	5	10	ug/L
benzo(a)pyrene	2.20	5	10	ug/L
Benzo(b)fluoranthene	2.58	5	10	ug/L
Benzo(e)pyrene	1.81	5	10	ug/L
Benzo(g,h,i)perylene	1.61	5	10	ug/L
Benzo(k)fluoranthene	2.00	5	10	ug/L
Benzoic Acid	7.63	20	40	ug/L
Benzyl Alcohol	2.42	5	10	ug/L
Biphenyl	1.34	5	10	ug/L
bis(2-chloroethoxy)methane	1.75	5	10	ug/L
bis(2-chloroethyl)ether	1.81	5	10	ug/L
bis(2-chloroisopropyl)ether	1.98	5	10	ug/L
bis(2-Ethylhexyl)adipate	1.51	5	10	ug/L
bis(2-Ethylhexyl)phthalate	1.60	5	10	ug/L
4-Bromophenyl-phenylether	1.78	5	10	ug/L
Butylbenzylphthalate	1.16	5	10	ug/L
Carbazole	2.05	5	10	ug/L
4-Chloro-3-methylphenol	1.99	5	10	ug/L
4-Chloroaniline	4.20	5	10	ug/L
2-Chloronaphthalene	1.69	5	10	ug/L
2-Chlorophenol	2.10	5	10	ug/L
4-Chlorophenyl-phenylether	1.61	5	10	ug/L
Chrysene	1.64	5	10	ug/L
Dibenzo(a,h)anthracene	1.85	5	10	ug/L
Dibenzofuran	1.40	5	10	ug/L
1,2-Dichlorobenzene	2.12	5	10	ug/L
1,3-Dichlorobenzene	2.09	5	10	ug/L
1,4-Dichlorobenzene	2.28	5	10	ug/L
3,3'-Dichlorobenzidine	1.56	5	10	ug/L
2,4-Dichlorophenol	2.23	5	10	ug/L
Diethylphthalate	2.35	5	10	ug/L
2,6-Dimethylnaphthalene	1.64	5	10	ug/L
2,4-Dimethylphenol	2.58	5	10	ug/L
Dimethylphthalate	2.02	5	10	ug/L
Di-n-butylphthalate	1.44	5	10	ug/L
4,6-Dinitro-2-methylphenol	2.25	5	10	ug/L
2,4-Dinitrophenol	1.32	5	10	ug/L
2,4-Dinitrotoluene	1.59	5	10	ug/L
2-6-Dinitrotoluene	1.34	5	10	ug/L
Di-n-octylphthalate	1.76	5	10	ug/L
1,2-Diphenylhydrazine	0.00	5	10	ug/L
Fluoranthene	1.81	5	10	ug/L
Fluorene	1.60	5	10	ug/L
Hexachlorobenzene	1.59	5	10	ug/L
Hexachlorobutadiene	2.33	5	10	ug/L
Hexachlorocyclopentadiene	1.42	5	10	ug/L
Hexachloroethane	2.40	5	10	ug/L
Indeno(1,2,3-cd)pyrene	1.80	5	10	ug/L
Isophorone	1.77	5	10	ug/L
1-Methylnaphthalene	1.91	5	10	ug/L
2-Methylnaphthalene	2.06	5	10	ug/L
1-Methylphenanthrene	1.38	5	10	ug/L
2-Methylphenol	1.97	5	10	ug/L
4-Methylphenol	1.87	5	10	ug/L
Naphthalene	1.97	5	10	ug/L

PARAMETER	DL	LOD	LOQ	Unit
Acenaphthene	53	167	333	ug/Kg
Acenaphthylene	57	167	333	ug/Kg
Aniline	41	167	333	ug/Kg
Anthracene	60	167	333	ug/Kg
Azobenzene	96	167	333	ug/Kg
Benzidine	863	667	1333	ug/Kg
Benzo(a)anthracene	56	167	333	ug/Kg
benzo(a)pyrene	53	167	333	ug/Kg
Benzo(b)fluoranthene	86	167	333	ug/Kg
Benzo(e)pyrene	59	167	333	ug/Kg
Benzo(g,h,i)perylene	87	167	333	ug/Kg
Benzo(k)fluoranthene	71	167	333	ug/Kg
Benzoic Acid	186	667	1333	ug/Kg
Benzyl Alcohol	72	167	333	ug/Kg
Biphenyl	59	167	333	ug/Kg
bis(2-chloroethoxy)methane	57	167	333	ug/Kg
bis(2-chloroethyl)ether	59	167	333	ug/Kg
bis(2-chloroisopropyl)ether	45	167	333	ug/Kg
bis(2-Ethylhexyl)adipate	87	167	333	ug/Kg
bis(2-Ethylhexyl)phthalate	115	167	333	ug/Kg
4-Bromophenyl-phenylether	90	167	333	ug/Kg
Butylbenzylphthalate	54	167	333	ug/Kg
Carbazole	89	167	333	ug/Kg
4-Chloro-3-methylphenol	83	167	333	ug/Kg
4-Chloroaniline	71	167	333	ug/Kg
2-Chloronaphthalene	54	167	333	ug/Kg
2-Chlorophenol	48	167	333	ug/Kg
4-Chlorophenyl-phenylether	71	167	333	ug/Kg
Chrysene	47	167	333	ug/Kg
Dibenzo(a,h)anthracene	65	167	333	ug/Kg
Dibenzofuran	59	167	333	ug/Kg
1,2-Dichlorobenzene	45	167	333	ug/Kg
1,3-Dichlorobenzene	38	167	333	ug/Kg
1,4-Dichlorobenzene	45	167	333	ug/Kg
3,3'-Dichlorobenzidine	84	167	333	ug/Kg
2,4-Dichlorophenol	52	167	333	ug/Kg
Diethylphthalate	52	167	333	ug/Kg
2,6-Dimethylnaphthalene	54	167	333	ug/Kg
2,4-Dimethylphenol	50	167	333	ug/Kg
Dimethylphthalate	63	167	333	ug/Kg
Di-n-butylphthalate	97	167	333	ug/Kg
4,6-Dinitro-2-methylphenol	64	167	333	ug/Kg
2,4-Dinitrophenol	86	167	333	ug/Kg
2,4-Dinitrotoluene	58	167	333	ug/Kg
2-6-Dinitrotoluene	75	167	333	ug/Kg
Di-n-octylphthalate	97	167	333	ug/Kg
1,2-Diphenylhydrazine	0	167	333	ug/Kg
Fluoranthene	126	167	333	ug/Kg
Fluorene	60	167	333	ug/Kg
Hexachlorobenzene	68	167	333	ug/Kg
Hexachlorobutadiene	52	167	333	ug/Kg
Hexachlorocyclopentadiene	47	167	333	ug/Kg
Hexachloroethane	48	167	333	ug/Kg
Indeno(1,2,3-cd)pyrene	68	167	333	ug/Kg
Isophorone	68	167	333	ug/Kg
1-Methylnaphthalene	62	167	333	ug/Kg
2-Methylnaphthalene	71	167	333	ug/Kg
1-Methylphenanthrene	64	167	333	ug/Kg
2-Methylphenol	61	167	333	ug/Kg
4-Methylphenol	68	167	333	ug/Kg
Naphthalene	43	167	333	ug/Kg

Table 7: ESTABLISHED LIMIT OF DETECTION (LOD) & LIMIT OF QUANTITATION (LOQ)

PARAMETER	DL	LOD	LOQ	Unit	PARAMETER	DL	LOD	LOQ	Unit
2-Nitroaniline	1.36	5	10	ug/L	2-Nitroaniline	56	167	333	ug/Kg
3-Nitroaniline	1.35	5	10	ug/L	3-Nitroaniline	74	167	333	ug/Kg
4-Nitroaniline	2.19	5	10	ug/L	4-Nitroaniline	120	167	333	ug/Kg
Nitrobenzene	2.19	5	10	ug/L	Nitrobenzene	51	167	333	ug/Kg
2-Nitrophenol	2.12	5	10	ug/L	2-Nitrophenol	64	167	333	ug/Kg
4-Nitrophenol	2.03	5	10	ug/L	4-Nitrophenol	106	167	333	ug/Kg
n-Nitrosodimethylamine	1.62	5	10	ug/L	n-Nitrosodimethylamine	47	167	333	ug/Kg
n-Nitroso-di-n-propylamine	2.18	5	10	ug/L	n-Nitroso-di-n-propylamine	70	167	333	ug/Kg
n-Nitrosodiphenylamine	0.98	5	10	ug/L	n-Nitrosodiphenylamine	153	167	333	ug/Kg
Pentachlorophenol	2.33	5	10	ug/L	Pentachlorophenol	62	167	333	ug/Kg
Perylene	2.09	5	10	ug/L	Perylene	86	167	333	ug/Kg
Phenanthrene	1.70	5	10	ug/L	Phenanthrene	49	167	333	ug/Kg
Phenol	1.89	5	10	ug/L	Phenol	39	167	333	ug/Kg
Pyrene	2.22	5	10	ug/L	Pyrene	160	167	333	ug/Kg
Pyridine	11.42	20	40	ug/L	Pyridine	220	667	1333	ug/Kg
2,3,4,6-Tetrachlorophenol	3.61	5	10	ug/L	2,3,4,6-Tetrachlorophenol	104	167	333	ug/Kg
1,2,4-Trichlorobenzene	2.24	5	10	ug/L	1,2,4-Trichlorobenzene	44	167	333	ug/Kg
2,3,4-Trichlorophenol	2.02	5	10	ug/L	2,3,4-Trichlorophenol	64	167	333	ug/Kg
2,3,5-Trichlorophenol	1.66	5	10	ug/L	2,3,5-Trichlorophenol	165	167	333	ug/Kg
2,4,5-Trichlorophenol	1.57	5	10	ug/L	2,4,5-Trichlorophenol	91	167	333	ug/Kg
2,4,6-Trichlorophenol	1.64	5	10	ug/L	2,4,6-Trichlorophenol	61	167	333	ug/Kg
2,3,5-Trimethylnaphthalene	1.36	5	10	ug/L	2,3,5-Trimethylnaphthalene	69	167	333	ug/Kg
2-Fluorophenol	1.52	3	5	ug/L	2-Fluorophenol	37	100	167	ug/Kg
Phenol-d5	1.44	3	5	ug/L	Phenol-d5	45	100	167	ug/Kg
2-Fluorobiphenyl	0.41	1	2	ug/L	2-Fluorobiphenyl	16	33	167	ug/Kg
Nitrobenzene-d5	0.59	1	2	ug/L	Nitrobenzene-d5	22	33	167	ug/Kg
2,4,6-Tribromophenol	1.20	3	5	ug/L	2,4,6-Tribromophenol	60	100	167	ug/Kg
Terphenyl-d14	0.54	1	2	ug/L	Terphenyl-d14	39	33	167	ug/Kg

Note:

1. PSR supersedes Table 7
2. LOD and LOQ were established at the time this SOP is written.

Appendix 1: **SUMMARY OF QUALITY CONTROL PROCEDURES**

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
DFTPP Tune Check	Prior to calibration (ICAL, ICV or CCV)	Refer to criteria listed in the method description (Table 4)	Retune instrument and verify		
Breakdown Check	Prior to calibration (ICAL, ICV or CCV)	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Clean the injection port and repeat breakdown check. If problem persist cut or replace column.		
ICAL: At least 6-point calibration for all analytes	Initially; as needed	Min. RF: Refer to Table 6 %RSD ≤ 20% or r=0.99 with a min. of 6 ICAL points	Rule out outlier(s)/ bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
ICV: Second-source calibration verification	After initial calibration	Min. RF: Refer to Table 6 All analytes within ±30% of expected value	Rule out bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
DCC: Calibration Check	Daily, before sample analysis and every 12 hours of analysis time	Min. RF: Refer to Table 6 All analytes ≤ 20% diff.	Rule out bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
Retention time window calculated for each analyte	Each sample	Relative retention time (RRT) of the analyte within ± 0.06 RRT units of the RRT	Correct the problem then reanalyze all samples analyzed since the last retention time check		
Internal Standard	Every sample, spiked sample, standard, and method blank	Retention time ±30 seconds from retention time of the mid-point std. In the ICAL. EICP area within -50% to +100% of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning		
Method blank	One per preparation batch (≤ 20 samples per matrix)	In the absence of PSR apply No analytes detected > ½ LOQ	Rule out instrument contamination by re-analyzing the MB. If problem persist refer to PSR. In the absence of PSR, report NDs and results >10X of the MB concentration. Otherwise, cure contamination source, reprep and reanalyze method blank and all associated samples.		
LCS	One LCS per preparation (≤ 20 samples per matrix)	In the absence of PSR default to EMAX QC Limits	Cure probable source of LCS failure, reprep and reanalyze the LCS and all associated samples		
MS/MSD	One MS/MSD per every 20 project samples per matrix	In the absence of PSR default to EMAX QC Limits	Ensure that spike concentration and spike addition was accurate. If chromatogram exhibits matrix interference narrate observation in the case narrative.		
Surrogate spike	Every sample, spiked sample, standard, and method blank	In the absence of PSR default to 2 out of 3 Acid and 2 out of 3 BN surrogates should be within EMAX QC Limits.	If non-compliant and no apparent matrix interference is observed, re-extract and analyze sample. Otherwise inform the client for further instruction.		
Comments: Project specific requirements (PSR) supersede EMAX QCP. In the absence of PSR, apply "J" flag to results between LOD and LOQ, "B" flag to results associated with MB contamination. *Analytes known to have erratic chromatographic behavior: Benzidine, 4,6-dinitro-2-methylphenol, 4-chroanaline, benzyl alcohol, n-Nitrosodimethylamine, 4-nitrophenol, 2-nitroaniline, Pyridine, Benzoic Acid, and 3-nitroaniline					

Appendix 2: **DEMONSTRATION OF CAPABILITY**

PT # **WP0110 Water Pollution Proficiency Testing** **PT Study Closing Date: 2/18/2010**

Method: SW 3520 C/SW 8270 D **Analyst:** Vu Khoa

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
1	1,2,4,5-Tetrachlorobenzene	<10 ug/L	<10	-	Acceptable
2	1,2,4-Trichlorobenzene	68.9 ug/L	78.5	16.6-95	Acceptable
3	1,2-Dichlorobenzene	<10 ug/L	0.00	-	Acceptable
4	1,3-Dichlorobenzene	<10 ug/L	0.00	-	Acceptable
5	1,4-Dichlorobenzene	90.2 ug/L	108	10.8-129	Acceptable
6	1-Chloronaphthalene	<10 ug/L	<10	-	Acceptable
7	1-Methylnaphthalene	109 ug/L	119	23.8-214	Acceptable
8	2,3,4,6-Tetrachlorophenol	<20 ug/L	<50	-	Acceptable
9	2,4,5-Trichlorophenol	78.9 ug/L	85.6	31.2-111	Acceptable
10	2,4,6-Trichlorophenol	56.9 ug/L	63.5	20.3-82	Acceptable
11	2,4-Dichlorophenol	82.2 ug/L	95.1	30.2-118	Acceptable
12	2,4-Dimethylphenol	78.3 ug/L	92.9	19.1-122	Acceptable
13	2,4-Dinitrophenol	106 ug/L	137	13.7-189	Acceptable
14	2,4-Dinitrotoluene	73.1 ug/L	83.9	30.6-105	Acceptable
15	2,6-Dichlorophenol	85.1 ug/L	92.8	30.9-117	Acceptable
16	2,6-Dinitrotoluene	<10 ug/L	0.00	-	Acceptable
17	2-Chloronaphthalene	76.5 ug/L	88.0	26.8-107	Acceptable
18	2-Chlorophenol	94.1 ug/L	99.7	29.2-126	Acceptable
19	2-Methyl-4,6-Dinitrophenol	78.6 ug/L	94.7	29.2-132	Acceptable
20	2-Methylnaphthalene	84.9 ug/L	89.0	17-105	Acceptable
21	2-Methylphenol	78.9 ug/L	89.8	17-112	Acceptable
22	2-Nitroaniline	<10 ug/L	<10	-	Acceptable
23	2-Nitrophenol	71.7 ug/L	79.0	21.5-101	Acceptable
24	3,3'-Dichlorobenzidine	<10 ug/L	0.00	-	Acceptable
25	3-Nitroaniline	<10 ug/L	<10	-	Acceptable
26	3-Nitrophenol	<10 ug/L	<10	-	Acceptable
27	4-Bromophenyl-phenylether	87.6 ug/L	88.7	29.2-119	Acceptable
28	4-Chloro-3-methylphenol	78.6 ug/L	83.9	32.1-108	Acceptable
29	4-Chloroaniline	<10 ug/L	<50	-	Acceptable
30	4-Chlorophenyl-phenylether	73.4 ug/L	77.9	29.4-97	Acceptable
31	4-Methylphenol (and/or 3-Methylphenol)	92.2 ug/L	94.3	9.43-123	Acceptable
32	4-Nitroaniline	70.1 ug/L	83.1	16.6-150	Acceptable
33	4-Nitrophenol	122 ug/L	131	13.1-176	Acceptable
34	Acenaphthene	87.2 ug/L	95.1	37.8-113	Acceptable
35	Acenaphthylene	67 ug/L	74.2	29.2-90	Acceptable
36	Aniline	<20 ug/L	<10	-	Acceptable
37	Anthracene	86.3 ug/L	89.1	37.6-111	Acceptable
38	Benzidine	<50 ug/L	0.00	-	Acceptable
39	Benzo(a)anthracene	87.6 ug/L	82.9	37.6-105	Acceptable
40	Benzo(a)pyrene	70.5 ug/L	70.2	20.9-89	Acceptable

Appendix 2 con't.: **DEMONSTRATION OF CAPABILITY**

PT # **WP0110 Water Pollution Proficiency Testing** **PT Study Closing Date: 2/18/2010**

Method: SW 3520 C/SW 8270 D **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
41	Benzo(b)fluoranthene	<10 ug/L	0.00	-	Acceptable
42	Benzo(g,h,i)perylene	<10 ug/L	0.00	-	Acceptable
43	Benzo(k)fluoranthene	56 ug/L	59.0	14.2-86	Acceptable
44	Benzoic acid	78.8 ug/L	76.3	0-130	Acceptable
45	Benzyl alcohol	<10 ug/L	<50	-	Acceptable
46	bis(2-Chloroethoxy)methane	88.3 ug/L	90.9	35.8-108	Acceptable
47	bis(2-Chloroethyl)ether	65.6 ug/L	73.1	20.6-91	Acceptable
48	bis(2-Chloroiospropyl) ether	89.8 ug/L	98.5	24.7-121	Acceptable
49	bis(2-ethylhexyl) phthalate	68.9 ug/L	66.8	20.1-94	Acceptable
50	Butyl benzyl phthalate	65.1 ug/L	71.2	10-105	Acceptable
51	Carbazole	<10 ug/L	<10	-	Acceptable
52	Chrysene	<10 ug/L	0.00	-	Acceptable
53	Dibenzo(a,h)anthracene	58.9 ug/L	59.9	16.5-84	Acceptable
54	Dibenzofuran	108 ug/L	115	39.9-142	Acceptable
55	Diethyl phthalate	85.1 ug/L	93.1	16.6-130	Acceptable
56	Dimethyl phthalate	131 ug/L	138	13.8-199	Acceptable
57	Di-n-butylphthalate	77 ug/L	79.2	26.3-105	Acceptable
58	Di-n-octylphthalate	93.4 ug/L	99.3	22-147	Acceptable
59	Fluoranthene	84.8 ug/L	84.6	37.8-103	Acceptable
60	Fluorene	<10 ug/L	0.00	-	Acceptable
61	Hexachlorobenzene	<10 ug/L	0.00	-	Acceptable
62	Hexachlorobutadiene	94.8 ug/L	96.5	10.8-116	Acceptable
63	Hexachlorocyclopentadiene	<10 ug/L	0.00	-	Acceptable
64	Hexachloroethane	82.8 ug/L	93.3	9.7-110	Acceptable
65	Indeno(1,2,3, cd)pyrene	<10 ug/L	0.00	-	Acceptable
66	Isophorone	94.5 ug/L	103	40.5-133	Acceptable
67	Naphthalene	77.3 ug/L	85.3	23.4-103	Acceptable
68	Nitrobenzene	<10 ug/L	0.00	-	Acceptable
69	N-Nitrosodiethylamine	<10 ug/L	<10	-	Acceptable
70	N-Nitrosodimethylamine	88.2 ug/L	97.0	9.7-115	Acceptable
71	N-Nitroso-di-n-propylamine	83.3 ug/L	92.0	26.8-118	Acceptable
72	N-Nitrosodiphenylamine	51 ug/L	74.0	17.1-102	Acceptable
73	o-Toluidine	<10 ug/L	<10	-	Acceptable
74	p-Dioxane	<10 ug/L	<10	-	Acceptable
75	Pentachlorobenzene	<10 ug/L	<10	-	Acceptable
76	Pentachlorophenol	103 ug/L	108	27.9-149	Acceptable
77	Phenanthrene	<10 ug/L	0.00	-	Acceptable
78	Phenol	112 ug/L	103	10.3-139	Acceptable
79	Pyrene	80.6 ug/L	83.1	27.5-114	Acceptable
80	Pyridine	<40 ug/L	<10	-	Acceptable

Appendix 2 con't.: **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil / Hazardous Waste PT** **PT Study Closing Date: 3/4/2010**

Method: **SW 3550 C/SW 8270 D** **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
1	1,2,3,4-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
2	1,2,3,5-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
3	1,2,3-Trichlorobenzene	<330 ug/kg	<500	-	Acceptable
4	1,2,4,5-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
5	1,2,4-Trichlorobenzene	1000 ug/kg	1790	300-2070	Acceptable
6	1,2-Dichlorobenzene	<330 ug/kg	<300	-	Acceptable
7	1,3,5-Trichlorobenzene	<330 ug/kg	<500	-	Acceptable
8	1,3-Dichlorobenzene	<330 ug/kg	<300	-	Acceptable
9	1,4-Dichlorobenzene	1000 ug/kg	1920	300-2120	Acceptable
10	1-Chloronaphthalene	<330 ug/kg	<500	-	Acceptable
11	2,3,4,5-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
12	2,3,4,6-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
13	2,3,4-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
14	2,3,5,6-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
15	2,3,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
16	2,3,6-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
17	2,3-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
18	2,4,5-Trichlorophenol	1130 ug/kg	1900	300-2300	Acceptable
19	2,4,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
20	2,4,6-Trichlorophenol	958 ug/kg	1800	300-2240	Acceptable
21	2,4,6-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
22	2,4-Dibromophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
23	2,4-Dichlorophenol	962 ug/kg	1800	300-2260	Acceptable
24	2,4-Dichlorophenyl-3-methyl-4-nitrophenyle	<330 ug/kg	<500	-	Acceptable
25	2,4-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
26	2,4-Dimethylphenol	1080 ug/kg	3790	505-4170	Acceptable
27	2,4-Dinitrophenol	<660 ug/kg	<600	-	Acceptable
28	2,4-Dinitrotoluene	1240 ug/kg	1820	300-2570	Acceptable
29	2,5-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
30	2,6-Dichlorophenol	1160 ug/kg	2110	523-2330	Acceptable
31	2,6-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
32	2,6-Dinitrotoluene	<330 ug/kg	<300	-	Acceptable
33	2-Amino-1-methylbenzene	<330 ug/kg	<500	-	Acceptable
34	2-Chloronaphthalene	613 ug/kg	1120	200-1350	Acceptable
35	2-Chlorophenol	1190 ug/kg	2300	300-2870	Acceptable
36	2-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
37	2-Methyl-4,6-Dinitrophenol	<660 ug/kg	<600	-	Acceptable
38	2-Methylnaphthalene	961 ug/kg	1620	426-1780	Acceptable
39	2-Methylphenol	2470 ug/kg	5190	600-5710	Acceptable

Appendix 2 con't.: **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil / Hazardous Waste PT** **PT Study Closing Date: 3/4/2010**

Method: SW 3550 C/SW 8270 D **Analyst:** Vu Khoa

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
40	2-Nitroaniline	<330 ug/kg	<500	-	Acceptable
41	2-Nitrophenol	1510 ug/kg	3630	600-3990	Acceptable
42	3,3'-Dichlorobenzidine	<330 ug/kg	<500	-	Acceptable
43	3,4,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
44	3,4-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
45	3,5-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
46	3-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
47	3-Nitroaniline	<330 ug/kg	<500	-	Acceptable
48	3-Nitrophenol	<330 ug/kg	<500	-	Acceptable
49	4-Bromophenyl-phenylether	2300 ug/kg	3040	836-3580	Acceptable
50	4-Chloro-3-methylphenol	<330 ug/kg	<300	-	Acceptable
51	4-Chloroaniline	655 ug/kg	815	0-1960	Acceptable
52	4-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
53	4-Chlorophenyl-phenylether	2370 ug/kg	3390	842-3930	Acceptable
54	4-Methylphenol (and/or 3-Methylphenol)	2400 ug/kg	4600	1200-5060	Acceptable
55	4-Nitroaniline	1200 ug/kg	1070	107-4210	Acceptable
56	4-Nitrophenol	1830 ug/kg	5500	600-6600	Acceptable
57	4-Nitrophenylphenylether	<330 ug/kg	<500	-	Acceptable
58	Acenaphthene	870 ug/kg	1420	200-1820	Acceptable
59	Acenaphthylene	863 ug/kg	1500	228-1930	Acceptable
60	Aniline	<660 ug/kg	<500	-	Acceptable
61	Anthracene	1380 ug/kg	1850	343-2420	Acceptable
62	Benzidine	<1300 ug/kg	<500	-	Acceptable
63	Benzo(a)anthracene	1240 ug/kg	1400	364-1890	Acceptable
64	Benzo(a)pyrene	1110 ug/kg	1340	319-1840	Acceptable
65	Benzo(b)fluoranthene	<330 ug/kg	<200	-	Acceptable
66	Benzo(g,h,i)perylene	<330 ug/kg	<200	-	Acceptable
67	Benzo(k)fluoranthene	1330 ug/kg	1760	444-2240	Acceptable
68	Benzoic acid	<1300 ug/kg	<500	-	Acceptable
69	Benzotrichloride	<330 ug/kg	<500	-	Acceptable
70	Benzyl alcohol	<330 ug/kg	<500	-	Acceptable
71	Benzyl chloride	<330 ug/kg	<500	-	Acceptable
72	Bis(2-chloroethoxy)methane	993 ug/kg	1710	300-2120	Acceptable
73	bis(2-Chloroethyl)ether	977 ug/kg	1840	229-2020	Acceptable
74	Bis(2-chloroisopropyl) ether	<330 ug/kg	<300	-	Acceptable
75	Bis(2-ethylhexyl)phthalate	1600 ug/kg	1690	300-2660	Acceptable
76	bis(2-methoxyethyl)phthalate	<330 ug/kg	<500	-	Acceptable
77	Butyl benzyl phthalate	1790 ug/kg	2130	446-2840	Acceptable
78	Carbazole	<330 ug/kg	<500	-	Acceptable

Appendix 2 con't.: **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil / Hazardous Waste PT** **PT Study Closing Date: 3/4/2010**

Method: **SW 3550 C/SW 8270 D** **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
79	Chrysene	<330 ug/kg	<200	-	Acceptable
80	Diamylphthalate	<330 ug/kg	<500	-	Acceptable
81	Dibenzo(a,h)anthracene	1110 ug/kg	1260	200-1910	Acceptable
82	Dibenzofuran	1660 ug/kg	2520	648-2990	Acceptable
83	Dicyclohexylphthalate	<330 ug/kg	<500	-	Acceptable
84	Diethylphthalate	1200 ug/kg	1830	300-2420	Acceptable
85	Dimethylphthalate	1270 ug/kg	1970	300-2550	Acceptable
86	Di-n-butylphthalate	1530 ug/kg	1900	300-2730	Acceptable
87	Di-n-octylphthalate	1750 ug/kg	1950	300-2900	Acceptable
88	Dinonylphthalate	<330 ug/kg	<500	-	Acceptable
89	Fluoranthene	2000 ug/kg	2360	720-3040	Acceptable
90	Fluorene	1260 ug/kg	1820	349-2340	Acceptable
91	Hexachlorobenzene	<330 ug/kg	<300	-	Acceptable
92	Hexachlorobutadiene	1140 ug/kg	1900	300-2400	Acceptable
93	Hexachlorocyclohexane	<330 ug/kg	<500	-	Acceptable
94	Hexachlorocyclopentadiene	<330 ug/kg	<300	-	Acceptable
95	Hexachloroethane	895 ug/kg	1840	71.8-2050	Acceptable
96	Hexyl-2-ethylhexylphthalate	<330 ug/kg	<500	-	Acceptable
97	Indeno(1,2,3-cd)pyrene	<330 ug/kg	<200	-	Acceptable
98	Isophorone	814 ug/kg	1740	423-1920	Acceptable
99	Maleic anhydride	<330 ug/kg	<500	-	Acceptable
100	Naphthalene	1050 ug/kg	1830	218-2160	Acceptable
101	Nitrobenzene	1040 ug/kg	1920	300-2430	Acceptable
102	N-Nitrosodiethylamine	<330 ug/kg	<1500	-	Acceptable
103	N-Nitrosodimethylamine	653 ug/kg	1860	0-2040	Acceptable
104	N-Nitroso-di-n-propylamine	<330 ug/kg	<300	-	Acceptable
105	N-Nitrosodiphenylamine	1000 ug/kg	1700	422-1990	Acceptable
106	Pentachlorobenzene	<330 ug/kg	<500	-	Acceptable
107	Pentachlorohexane	<330 ug/kg	<500	-	Acceptable
108	Pentachlorophenol	2550 ug/kg	5790	600-6370	Acceptable
109	Phenanthrene	1360 ug/kg	1810	372-2330	Acceptable
110	Phenol	1930 ug/kg	3800	380-4280	Acceptable
111	Pyrene	1390 ug/kg	1720	497-2270	Acceptable
112	Pyridine	<1300 ug/kg	<500	-	Acceptable

8270FA: **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

Page 1

ANALYSIS LOG FOR SEMIVOLATILES

SOP ☐ EMAX-8270 Rev. No. 4 ☐ EMAX-8270SIM Rev. No. 1 ☐ EMAX-CLPSVOA ☐ EMAX-M8270SIM Rev. No. 1 ☐ Book #AE4 -007

Method File: Tune File: Start Date/Time: End Date/Time:

ANALYTICAL BATCH : _____

Preparative Batch	Data File Name	Run ID	DF	Matrix		Notes
				S	W	

Instrument No:	E4
INITIAL CALIBRATION REFERENCE	
Date	
ICAL ID	

Standards		
Name	ID	Conc. (mg/L)
DFTPP		
INT. STD.		
ICV		
DCC		
BENZIDINE		
APP 9		
APP 9 ADD		

Solvent	ID	
CH_2Cl_2		

DATA FILE	

Electronic Data Archival	
Location	Date
HPCHEM_SVOA/TOE4	

Comments: _____

Analyzed By: _____

Date Disposed: _____

Disposed By: _____

This page is checked during data review.

8270FS: **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

Page 1

EXTRACTION LOG FOR SEMIVOLATILES

SOP ☐ EMAX-3540 Rev. No.: 0 ☐ EMAX-3510 Rev. No.: 1 ☐ EMAX-3550 Rev. No.: 2 ☐ EMAX-3520 Rev. No.: 2 ☐ EMAX-CLP-SVOA ☐ Book # ESV-058

Matrix: Init.Start Date/Time: End Date/Time: Final Start Date/Time: End Date/Time:

PREPARATION BATCH: * _____

Sample Prep ID	Lab Sample ID	Sonicator Number	Sample Amount (g/ml)	pH	Extract Volume (ml)	Clean-up [G] [F] [A] [S]	Notes
*01							
*02							
*03							
*04							
*05							
*06							
*07							
*08							
*09							
*10							
*11							
*12							
*13							
*14							
*15							
*16							
*17							
*18							
*19							
*20							
*21							
*22							
*23							
*24							
*25							
*26							
*27							
*28							

Standards	ID	Amount Added (ml)
Surrogate		
LCS/MS		
Micropipette Check		

Reagent	Lot# / ID
CH_2Cl_2	
Na_2SO_4	
H_2SO_4	
NaOH	
Silica Sand	

TUNING

Sonicator #	Reading

Concentrator	Water Bath Temperature Setting (°C)	Thermometer Reading (°C)
1		
2		
3		
4		
5		
6		

Comments: Thermometer ID = T_1

Prepared By: Witnessed By:

Standard Added By:

Checked By:

Extract Received by: Location:

Disposed by: Disposed on:

Clean-up Legend :[G]=GPC [A]=Acid [F]=Florisil [S]=Silica

8270FM: INSTRUMENT MAINTENANCE LOG

Page 1

EMAX LABORATORIES, INC.

INSTRUMENT MAINTENANCE LOG

Instrument No: E4 Month: Year: 201_ Book #: ME4 -003

Date							
Column Head Pressure: 70 - 100 (KPa)							
Run Instrument Blank							
Column Temperature							
Autosampler							
Calibration curve updated							
Verify computer date & clock							
Check printer paper							
Change Septa							
Clean Linear							
Analyst Initial							
TroubleShooting							
Problems Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

STANDARD OPERATING PROCEDURE
SAMPLE MANAGEMENT

SOP No.:	EMAX-SM01	Revision No.	5	Effective Date:	03-Mar-10
Prepared By:	Jonathan Luna			Date:	03-03-10
Approved By:	Kenette J. Pimentel QA Manager			Date:	03.03.10
Approved By:	Caspar Pang Laboratory Director			Date:	3/3/10
				Control Number:	**SM01-05**

1.0 PURPOSE

1.1. To describe EMAX's sample management, its internal control and work order distribution.

1.2. To ensure that samples and extracts under EMAX's custody shall be traceable at all times.

1.3. To maintain the internal sample custody to stand legally defensible by documenting the history of a sample, assuring that it has always been under the custody of an authorized individual, and that no sample is accidentally or purposely tampered.

2.0 POLICIES

2.1. Any sample processed for analysis must be handled under the chain-of-custody protocol. A sample is under custody when one of the following conditions is met:

- It is in your possession.
- It is in your view after being in your possession.
- It was in your possession and you locked or sealed it up to prevent tampering.
- It is in a designated secure area. The secured area is one, which is accessible only to authorized personnel.
- All EMAX personnel associated with the analytical process should understand the requirements for the chain-of-custody protocol and shall comply with the provisions of this procedure.

2.2. The Sample Custodian or designee shall be responsible for relinquishing the samples from the sample control room and receiving the samples back when returned. The Sample Custodian is also responsible to make sure that the ICOC is properly filled-out.

2.3. Any analyst having a sample in his/her possession is responsible for its custody and integrity. He/she shall be responsible in returning the samples to their designated storage area, under the supervision of the Sample Custodian.

2.4. The Department Supervisor shall be responsible for enforcing the policies set forth in this SOP.

2.5. Change orders shall be initiated by the Project Manager (PM). In the absence of the PM, the Laboratory director or the Operations Manager may act on behalf of the PM and will leave a copy of the change order on the PM's mailbox.

2.6. All discrepancies/anomalies related to sample management shall be forwarded to the PM to obtain proper resolution.

2.7. The QA Manager shall be responsible to ensure that the activities performed in this Section is in compliance to all requirements of the different programs EMAX is currently in participation.

3.0 ASSOCIATED SOP

3.1. EMAX-SM02 - Sample Receiving

3.2. EMAX-QC03 - Refrigerator Control

3.3. EMAX-QC04 - Balance Calibration

3.4. EMAX-RS02 - Receiving Radioactive Material

3.5. EMAX-RS03 - Control of Radioactive Samples

4.0 SAFETY

4.1. All sample compositing and sub-sampling must be done under a fume hood.

4.2. Sample Chain-of-Custody (COC) comment section shall be read prior to starting sample inspection. Any information that may cause hazard to those that will handle, process and/or analyze the sample(s) shall be disseminated in advanced by the Sample Custodian.

4.3. All samples shall be treated as potential hazards. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves, shall be worn at all times when performing this procedure.

5.0 PROCEDURES

5.1. EMAX Control Number (ECN)

5.1.1. Generate an ECN to uniquely identify every group of samples received from one project on the same day (refer to Section 6.1 for definition) using the convention below.

YYMNNN

Where:

YY -Last two digits of the calendar year. (i.e., 00, 01, 03, etc)

M -The month in which the sample is brought in (A-Jan., B-Feb. … L-Dec.)

NNN -The sequential number that resets to 001for the first group of samples received every month

Example: The ECN for the first group of samples received from project XYZ on January of 2008 shall be ***08A001.***

5.2. **Lab Sample ID (LSID) and Lab Sample Container ID (LSCID)**

5.2.1. Assign a LSID to uniquely identify each sample received using the ECN followed by a two digit sequential number that resets to "01" in every ECN. This number corresponds with each client sample ID.

5.2.2. Assign a LSCID to uniquely identify each sample container received using the LSID followed by a three digit sequential number that resets to "001" in every ECN.

Example: The first group of sample received for the month of January 2008 were two vials for volatile bearing the same ID and two other samples bearing different IDs for metals analysis. The control numbers and sample labels shall read as follows:

ECN	*LSID*	*LSCID*	*Sample Containers*
08A001	*A001-01*	*A001-01-001* *A001-01-002*	*2*
08A001	*A001-02*	*A001-02-003*	*1*
08A001	*A001-03*	*A001-03-004*	*1*

5.3. **Sample Delivery Group1 (SDG)**

5.3.1. Group samples received within 14 days or less not to exceed 20 per analysis, per matrix.

5.3.2. If an SDG is composed of more than one delivery, assign the first ECN as the SDG number. The ECN number is the SDG number if SDG is completed in one delivery.

5.4. **Sample Receiving**

[1] This system of sample grouping shall only be applicable when it is specified by the project. Refer to 6.1 for definition.

5.4.1. Check that samples received have Project Specific Requirement (PSR) ready. If not, check with the Operations Manager for further advice. For samples from DOE refer to EMAX-RS01 and EMAX-RS03.

5.4.2. Login every group of samples received in the ECN Log (see Appendix 1).

5.4.3. Follow the procedures detailed in SOP EMAX-SM02 – Sample Receiving.

5.4.4. Drop a copy of the COC on each box mounted in front of the Sample Login Office.

5.4.5. The PM scans the COC, and drops it at: EMAX Network/ScanJobsonScanstation/SampleReceivingDocument, using the SDG as its filename (e.g. 08D129.pdf).

5.4.6. If discrepancies are found at this stage, the PM resolves the issue(s) and provides a copy of the resolution where applicable.

5.5. **Processing Work Orders**

5.5.1. Prepare Master Folder to contain the following:

- Original COC
- Airbill (if any)
- Original Sample Receipt Forms (SRF1 & SRF2)
- Copy of the Project Specific Requirement (PSR)

5.5.2. Prepare Analytical Folders for each analysis requested in the COC.

5.5.2.1. Choose the type of folder to be used.

- Use Manila folders for samples with regular turn around time (more than five working days).
- Use green folders for all samples with RUSH (seven working days or less) turn around time.
- Use specified folder color for projects with designated color code.

5.5.2.2. The folder tab shall contain the following information:

- Analysis
- Client/Project
- EMAX Control Number (ECN)

5.5.2.3. The analytical folders shall contain the following:

- Copy of the Work Order

- Copy of the PSR
- Summary of QC Procedures (PSR)
- RL & QC Limits
- Other pertinent instructions/information for the analytical and/or reporting process, e.g. SRFs with discrepancies/corrective actions, change orders, etc.

5.5.3. Routing the Work Order

5.5.3.1. Endorse the Master Folder and the analytical folders to the Project Manager (PM) for review.

5.5.3.2. The PM reviews the Master Folder

5.5.3.3. After which the PM drops the analytical folders to the supervisor's work order boxes and the master folder to Data Processing.

5.5.3.4. Department Supervisors distributes the workload to analysts.

5.6. **Project Management**

5.6.1. Review of SRF

5.6.1.1. Sample Management reviews the SRFs to make sure that the form is properly filled and discrepancies (if any) are described properly and accurately.

5.6.1.2. The Project Manager reviews the SRF and resolves discrepancies (if any) contained in the SRF. Resolutions shall be documented/attached in the SRF and the PM shall inform all parties affected.

5.6.2. Electronic Sample Login

5.6.2.1. Using LabWorks LIMS, login the following:

- Client Information [name, project, address, recipient of report]
- Sample Information [client sample ID, collection date / time, receiving / due dates, EMAX control number]

5.6.2.2. Refer to LabWorks User's Manual for software operation procedures.

5.6.2.3. Generate review sheet and submit the review sheet to the PM.

5.6.2.4. The PM reviews the login and initials and dates the review sheet. If corrections are necessary, the review sheet with corrections is returned to the LIMS login for correction. Repeat the process until all information is correctly logged-in.

5.6.2.5. The PM attaches the review sheet(s) in the Master Folder and all pertinent records to the Master Folder and forwards the Master Folder to the LIMS login.

5.6.2.6. LIMS login generates the Analytical Record, attach it to the Master Folder and drops it to the Data Processing Master Folder box.

5.7. **Sample Storage**

5.7.1. Place the water samples for volatile analysis in refrigerators designated for volatile water sample storage only.

5.7.2. Place the soil samples for volatile analysis in refrigerators designated for volatile samples only, if the samples are received with separate container for volatiles.

5.7.3. Whenever possible, place the samples from the same project in one refrigerator.

5.7.4. Samples known to have high concentrations, pure products, and samples for leaching (TCLP, WET, etc.) shall be placed in double zipped locked bags before placing them inside the refrigerator.

5.7.5. Store samples for metal analysis in the same condition as they are received. Samples for Mercury must be stored at $\leq 6^{o}C$.

5.7.6. Place samples from overseas in refrigerator designated for overseas samples only.

5.7.7. Record the sample location on the ECN log, COC and Internal COC (ICOC).

5.8. **Internal Chain-of-Custody (ICOC)**

5.8.1. Fill-out the ICOC (see Appendix 2) and request for the sample release from the Sample Custodian.

5.8.2. When returning samples in the Sample Control Room, fill-out the return portion of the ICOC and endorse the samples to the Sample Custodian.

5.8.3. After the Sample Custodian has verified the returned samples, place the samples to its original location.

5.9. **Processing Change Orders**

5.9.1. Fill-out change order form (see Appendix 3)

5.9.2. Attach the information re-change order (i.e. written correspondence from the client, telephone log, etc.)

5.9.3. Endorse to Sample Custodian.

- If change order happens prior to release of Master Folder and analytical folders, incorporate the change order into the routing of work order.
- If change order involves additional analysis request after the original report has been generated, add a suffix letter to the ECN, sequential to the change orders (i.e. 00A001A, 00A001B...), then process the change order as a regular work order.
- If the change order involves cancellation of work order, make copies of the cancellation order and distribute to the Sections listed in COC Receipt form. Obtain the recipients' initials on the original change order form. File the original form with the Master Folder.

5.9.4. Recipients of change orders direct the implementation change order.

5.10. **Extract Storage and Custody**

5.10.1. Store the extracts in the designated extract refrigerator sequentially, in the order of the preparation batch, separating each batch by an empty slot.

5.10.2. Custody of extracts shall remain on the recipient until endorse for disposal.

5.11. **Sample Shipping**

5.11.1. Provide a COC and shipping instruction (PM or designee) to the Sample Custodian for the samples to be shipped.

5.11.2. Withdraw the samples from the storage and line them up according to the COC order.

5.11.3. Have the Sample Custodian or the alternate Sample Custodian to countercheck for completeness of the samples requested for shipping.

5.11.4. Wrap each sample with bubble pack and place it in a zip-locked bag. Make sure that it is properly sealed.

5.11.5. Pack the samples in a cooler and place adequate ice to maintain $\leq 6\ ^{o}C$ for at least 48 hours.

5.11.6. Label the cooler(s) and if it shall be shipped through a third party courier (FEDEX, UPS, etc.) weigh the cooler(s). Labels shall, at a minimum contain:

- Name of Company/Project
- Attention Line
- Street Address
- City, State, Zip Code
- Telephone Number of Contact Person/Recipient

5.11.7. Inform the Supervisor or a designee that the sample shipment is ready for checking. The Supervisor or a designee shall check for the following:

- Verify that all samples were checked for completeness.
- Check that each sample was properly packed.
- Check that it is going to where it is intended.

5.11.8. Give a copy of the signed/dated COC to the PM.

5.12. **Composite Samples**

5.12.1. For soil samples, discard the top half-inch and any artifacts (e.g., vegetation, rocks, wood, etc) of each sample to be composited.

5.12.2. Place a clean 32-oz jar in a balance and tare-off.

5.12.3. Transfer 30-g to the jar from the first sample, then tare-off. Repeat this process until all samples to be composited is aliquoted.

Note: Sample amount may be adjusted to conform to the required analyses, as long as equal amounts shall be taken from each sample.

5.12.4. Using a clean stainless steel spatula, thoroughly mix the sample contained in the composite jar.

5.12.5. Label the jar using EMAX labeling convention corresponding to client composite sample ID.

5.12.6. Document the activity done on the COC comment section, sign and date it.

5.13. **Sub-Sampling**

5.13.1. The sub-sample procedure detailed below is applicable to all samples received at EMAX unless otherwise other specific sub-sampling instruction is stipulated in the project specific requirement (PSR).

5.13.2. Solid Samples

5.13.2.1. For soil samples, discard the top half-inch of the sample and any artifacts (e.g., vegetations, rocks, wood, etc.). Homogenize the sample and bring to room temperature.

5.13.2.2. For other solid matrices (e.g., concrete, roofing material, building debris, etc.), refer to project specific instruction. In the absence of project specific instruction, perform particle size reduction to pass through #10 sieve.

5.13.2.3. Check that the balance to be used was check for the days use.

5.13.2.4. Place the labeled subsample container on the balance and tare it off.

5.13.2.5. Scoop subsample and transfer the entire content of the scoop into subsample container. Repeat this process until the approximate weight is achieved (e.g., if subsample needed is 30g and the sample weighs is 29.67g or 32.24g after the last scoop was added, then you have achieved the desired weight). Record the reading as it appears on the balance display screen.

Note: Do not target exact weights (e.g., 30.00 ± 0.01g).

5.13.3. For projects requiring sectorial splitting or multi-incremental subsampling, perform sectorial splitting procedure for soil samples.

5.13.4. Sectorial Splitting[2]

5.13.4.1. If the sample is relatively wet (unworkable to sieve through #10 sieve), spread the soil sample into a pan and air dry until it appears to be surface dry and manageable to pass through #10 sieve. Otherwise proceed to the next step.

5.13.4.2. Note presence of vegetation, rocks, wood or any other artifacts in the internal chain of custody and discard them.

5.13.4.3. Pass the sample through #10 sieve.

- Store the sample passing through the sieve on clean properly labeled sample jar where further subsampling is obtained.
- Put the sample retained in the sieve back to the original container. When possible return this portion to the client.

5.13.4.4. Obtain subsample following the steps below.

5.13.4.4.1. Position a subsample receptacle on each valley of paper cone sectorial splitter.

5.13.4.4.2. Pour the sample on funnel situated above the sectorial splitter.

5.13.4.4.3. Open the funnel so that the sample will freely fall above the sectorial splitter approximately distributing the same amount of sample on each receptacle.

[2] EPA's Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples (EPA/600/R-03/027)

5.13.4.4.4. If there is a need for smaller quantity of sample then repeat the process using one of the subsamples collected until the approximate desired amount is obtained. Record the balance reading as observed.

Note: Do not target exact weights (e.g., 30.00 ± 0.01g).

5.13.5. Aqueous Samples

5.13.5.1. Bring the sample to equilibrate with the room temperature.

5.13.5.2. For samples requiring chemical preservatives to be maintained at a certain pH level, shake the container and verify the pH (refer to EMAX-SM02, Section 5.2.8, 4th check mark.) and record the observation in the sample preparation or analytical log (e.g., pH<2 or pH>12).

5.13.5.3. Shake the sample container to obtain matrix homogeneity (unless the analytical procedure prevents sample agitation during sub-sampling), measure the representative sub-sample using a Class A or verified volumetric measuring device and transfer to a properly labeled sub-sample container.

5.13.6. Uniquely identify the sub-sample with the sample preparation ID.

5.14. **Sample Disposal**

5.14.1. Endorse all unused samples that are stored in the sample control room to Waste Management Unit upon getting an approval from the PM.

5.14.2. Samples from overseas have to be identified properly when endorsing to ensure proper treatment prior to disposal.

5.14.3. Endorse all unused extracts/digestates to Waste Management Unit after 60 days from date of extraction/digestion unless otherwise specified by the project.

6.0 QUALITY CONTROL

6.1. Storage refrigerators for volatile samples shall be monitored to ensure that no cross contamination happens during the storage period.

6.2. Electronic login shall be reviewed by the PM or his/her designee, for correctness and completeness.

6.3. All samples withdrawn/returned shall be acknowledged with initials of both the receiver and the Sample Custodian or his/her designee.

6.4. All extracts received shall be acknowledged with the initial and date of receipt.

6.5. All samples/extracts, except leachates for metals analyses, shall be stored at $\leq 6\ ^{o}C$, unless otherwise specified by the project.

6.6. All samples shall be traceable from the time it is received to the date it is disposed. Records shall be maintained at all stations.

6.7. Labels used for samples to extracts shall be durable.

6.8. All label markings shall be legible and only indelible ink shall be used.

6.9. Refrigerators used to store samples must be maintained and monitored as described in EMAX-QC03– Refrigerator Control.

6.10. In case of power failure, maintain all refrigerators closed for a maximum of two hours to maintain the temperature $\leq 6\ ^{o}C$. If power does not come back within two hours, place ice bags in the refrigerators sufficient enough to maintain the required temperature. Monitor the refrigerators every two hours until the power is restored. Record the readings in the temperature/freezer log.

7.0 SUPPLEMENTARY NOTES

7.1. Definition of Terms

7.1.1. Chain-of-Custody (COC) – is a record where sample custody transfer is documented. At a minimum the COC shall contain the project ID, sample ID, sampling location, date/time of collection, chemical preservatives (if any) dated signatures of individuals involved in the sample transfer.

7.1.2. Composite Sample – is an equal amount of sample aliquot combined together from specified sample containers.

7.1.3. Corrective Action - Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

7.1.4. EMAX Control Number (ECN) – is an identification given to a group of samples received from a project that arrived on the same day accompanied by a chain-of-custody (COC). Grouping of samples is determined by either the project or the Project Manager's discretion.

7.1.5. Internal COC (ICOC) – is a record used by the laboratory to document when samples are withdrawn from the sample control room. This record shall contain the Lab Sample IDs and Lab Sample Container IDs of samples withdrawn, the intended analysis, the initials of the custodian and recipients, and the date and time of sample turn over.

7.1.6. Lab Sample ID (LSID) – is EMAX sample identification to uniquely identify each sample.

7.1.7. Lab Sample Container ID (LSCID) – is EMAX sample container identification to uniquely identify each sample container.

7.1.8. Sample Receipt Form 1 (SRF1)- is a record where to logged-in the type of delivery, who delivered the samples, the packaging condition, temperature upon receipt and the conditions or any discrepancies of samples during receiving.

7.1.9. Sample Receipt Form 2 (SRF2)- is a record where to logged-in the container type, any chemical preservative and conditions per container of samples upon receipt.

7.1.10. Non-conformance - An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

7.1.11. Preservative – is a chemical added to a sample to maintain its integrity prior to analysis.

7.1.12. Project Specific Requirement (PSR) – is a document containing the summary of project requirements, the QC references and other information needed to complete the work order.

7.1.13. Sample – is a specimen received in the laboratory bearing a unique client sample ID traceable to the accompanying COC. Each unique client sample ID shall have a corresponding unique Lab Sample ID, unless otherwise specified by the project. Hence, samples collected in different containers having the same client sample ID are labeled with the same corresponding Lab Sample ID.

7.1.14. Sample Delivery Group (SDG) – is a group of samples received over a period of 14 days or less, not exceeding 20 samples per analysis per matrix.

7.1.15. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

7.1.16. Trip Blank – is a target-analyte-free sample, which travels with the sample to monitor possible contamination during sample transport. This sample is analyzed for volatiles.

7.2. Sample management described in this SOP shall be applicable to all projects. In instances where there is project or program specific requirement, the project specification shall take precedence over this SOP.

8.0 FIGURES & FORMS

8.1. Figures

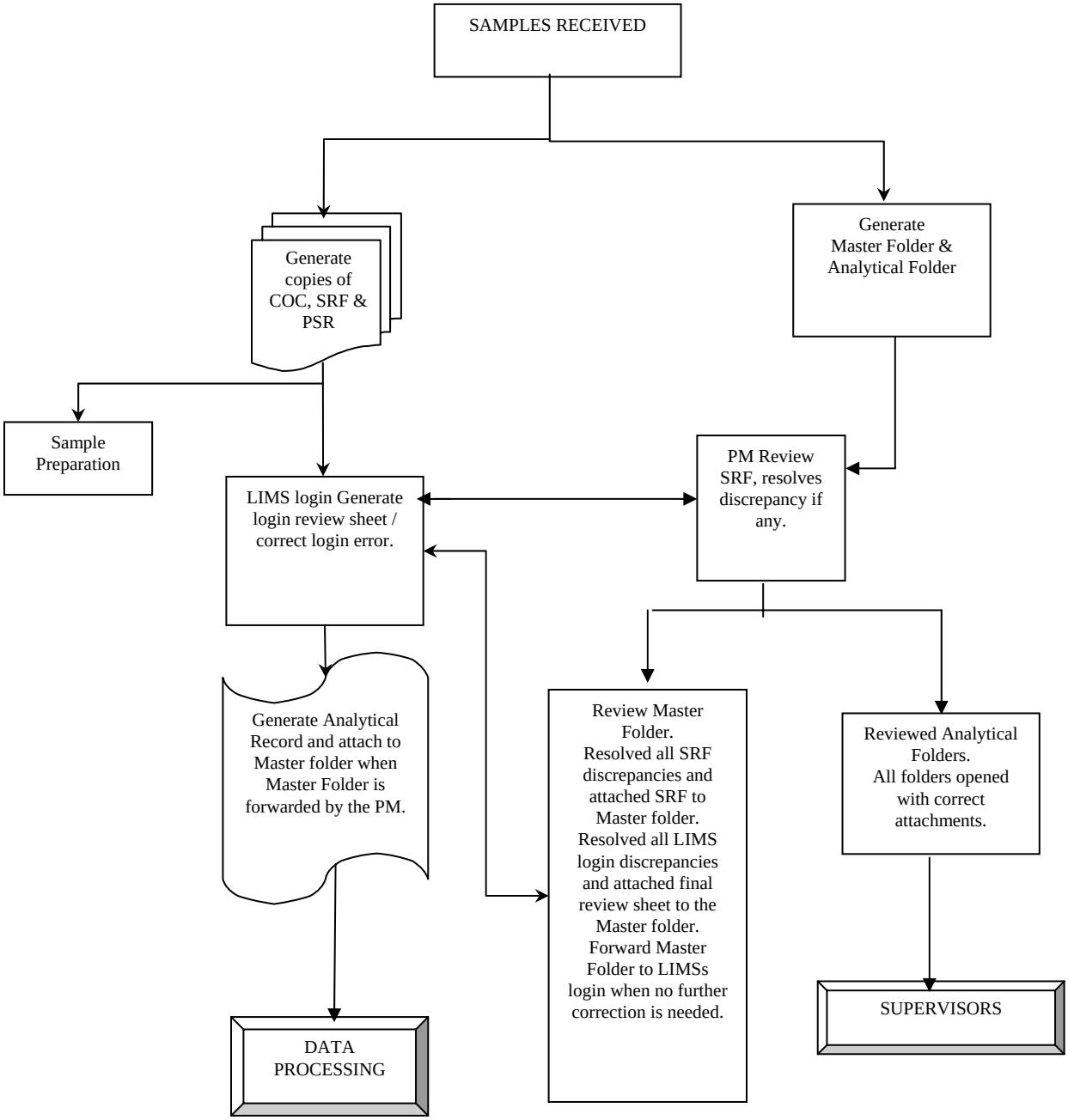
8.1.1. Figure 1 - Work Order System Flow

8.2. Forms

8.2.1. SM01F1 – EMAX Control Number Log

8.2.2. SM01F2 – Internal Chain-of-Custody

FIGURE I: **WORK ORDER SYSTEM FLOW**



SM01F1:

EMAX LABORATORIES, INC.

EMAX CONTROL NUMBER LOG

Book # ECNL-2010 A-F

YEAR 2010 MONTH JANUARY CODE A

Date		Batch	Client	Project	Delivery /	Sample Location					Recipient	
MM	DD	Number			Pick-up	S	W	Vs	Vw	O	Initials	COMMENTS
01		10A001										
01		10A002										
01		10A003										
01		10A004										
01		10A005										
01		10A006										
01		10A007										
01		10A008										
01		10A009										
01		10A010										
01		10A011										
01		10A012										
01		10A013										
01		10A014										
01		10A015										
01		10A016										
01		10A017										
01		10A018										
01		10A019										
01		10A020										
01		10A021										
01		10A022										
01		10A023										
01		10A024										
01		10A025										

S=SOIL W=WATER
V = VOLATILES
O = OTHER

Residual samples disposed by:_____

on:_____

SM01F2:

EMAX LABORATORIES, INC.

Page 1

INTERNAL CHAIN OF CUSTODY

ECN BOOK # ICOC-10-02

SAMPLE LOCATION								
SOIL	WATER WITH NO CHEMICAL PRESERVATIVE		WATER WITH CHEMICAL PRESERVATIVE					OTHERS
	AMBER	PLASTIC	HNO_3	HCl	H_2SO_4	NaOH [+Zn(Ac)$_2$]	O&G	

RELINQUISHED				LSID (*)	LSCID	ANALYSIS	MATRIX			RETURNED				REMARKS
BY	TO	DATE	TIME				S	W	OTHER	BY	TO	DATE	TIME	
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									

*LSID - Lab Sample ID
LSCID - Lab Sample Container ID

Disposed by: _____
Disposal Date: _____

PRINT DRF

STANDARD OPERATING PROCEDURE

SAMPLE RECEIVING

SOP No.:	EMAX-SM02	Revision No.	5	Effective Date:	2-Mar-09
Prepared By:	Tu Nisamaneepong			Date:	03-02-09
Approved By:	Kenette Pimentel QA Manager			Date:	03.02.09
Approved By:	Caspar Pang Laboratory Director			Date:	3/2/09

Control Number: SM02-05-

1.0 PURPOSE

1.1. To describe sample acceptance policy, sample receiving and sample storage procedures.

2.0 POLICIES

2.1. Any sample received by EMAX Laboratories Inc. must be processed as described in this procedure to ensure that inspection is thorough, the documentation is complete and the chain of custody is maintained.

2.2. The Sample Custodian shall be responsible for implementing the procedures set forth in this SOP and shall adhere to the QC procedures as described in Appendix 1.

2.3. The Department Supervisor shall be responsible for checking and overseeing that the process is properly enforced and are effectively applicable for the functions it is designed for.

2.4. The Project Manager shall be responsible to make sure that the activities performed in this Section are in compliance to project specific requirements. The PM shall also obtain and relay resolution(s) of discrepancies on a timely manner.

2.5. All samples under the custody of EMAX Laboratories shall be stored in a properly maintained and secured Sample Control Room.

2.6. All refrigerators used for sample storage shall be maintained as described in EMAX-QC03.

3.0 ASSOCIATED SOP

3.1. EMAX-SM01 - Sample Management

3.2. EMAX-QC03 - Refrigerator Control

3.3. EMAX-RS02 - Receiving Radioactive Material

3.4. EMAX-RS03 - Control of Radioactive Samples

4.0 SAFETY

4.1. Read all MSDS of preservatives listed in this SOP.

4.2. Post the list of projects from superfund sites and projects requiring leaching procedures in the sample control room. All sample coolers from these projects must be opened under a fume hood.

4.3. Sample Chain of Custody comment section shall be reviewed prior to starting sample inspection. Any information related to proper sample handling should be disseminated in advanced by the Sample Custodian.

4.4. All samples shall be treated as potential hazards. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves shall be worn at all times when performing this procedure.

5.0 PROCEDURES

5.1. Accepting Sample Custody

5.1.1. Samples Delivered by a Third Party (FedEx, UPS, etc.)

5.1.1.1. Check for the following:

- ✓ Presence of airbill/delivery receipt.
- ✓ Check if the delivery is for EMAX

5.1.1.2. Sign the third party delivery form and accept the cooler(s).

5.1.1.3. If samples were received from DOE site, refer to EMAX-RS02 and EMAX-RS03.

5.1.1.4. If more than one cooler is received, place a numeric mark on the coolers starting from #1. If coolers are numbered as received, use the existing number. Proceed to 5.2

5.1.2. Samples Delivered by the Client

5.1.2.1. Check the COC for the presence of the following:

- ✓ Client Name
- ✓ Client Address, Telephone #, and Fax #
- ✓ Project Name and Contact Person
- ✓ Turn Around Time
- ✓ Sampler Name and Signature
- ✓ Sample ID Number for Each Sample
- ✓ Sampling Time and Date
- ✓ Sample Container Type/Size

- ✓ Sample Matrix
- ✓ Analysis Required/Requested
- ✓ Signature of the courier with date and time

5.1.2.2. If discrepancies are found, notify the PM to resolve the issue with the client representative. If it can not be resolved, note it in the SRF.

5.1.2.3. Sign the COC, and write the date and time of receipt.

5.1.2.4. If more than one cooler is received, place a numeric mark on the coolers. Proceed to 5.2.

5.1.3. Samples Picked-up by EMAX Courier

5.1.3.1. Check that the coolers are intact.

5.1.3.2. If coolers are not sealed, check that samples are packed properly to prevent any breakage during transport

5.1.3.3. If coolers are sealed prior to accepting the COC, note on COC comments section that coolers are sealed.

5.1.3.4. Follow steps 5.1.2

5.1.3.5. Sign the COC with date and time upon arrival at the laboratory

5.1.3.6. Endorse the coolers and the COC to the Laboratory Sample Custodian. If more than one cooler is received, place a numeric mark on the coolers.

5.1.3.7. Sample Custodian shall inspect/accept the custody of the COC and the coolers as described by 5.1.2. Proceed to 5.2

5.2. Sample Inspection

5.2.1. Bring the cooler(s) to the fume hood. Turn on the fume hood.

5.2.2. Check the COC for any warning regarding safety issues.

5.2.3. Open the coolers and check presence of cooler thermometer[1] or temperature blank. If both are not present proceed to 5.2.4

5.2.3.1. If cooler thermometer is present, proceed to 5.2.5.

5.2.3.2. If a temperature blank is present, open the container and submerge the thermometer into the liquid. Proceed to 5.2.5.

5.2.4. Place the thermometer in between or near the sample(s).

5.2.5. Close the cooler and let it stand by for at least 5 minutes.

5.2.6. Read the thermometer and record the temperature for each cooler, in the

[1] Clients providing cooler thermometers are expected to have valid calibration prior to use.

COC(s) and SRF. ADD

5.2.6.1. If all coolers are received with designated COC, record the temperature of each cooler in the associated COC.

5.2.6.2. If COC is not specific to each cooler, identify which samples are contained in each cooler in the comment section of the COC and correspondingly record the temperatures of each cooler.

Example: Three coolers were received accompanied by one COC. Cooler number one temperature reading is 3 ^{o}C, and contains samples, 1,3, 7 and 12. Cooler number two temperature reading is 4 ^{o}C and contains 2,4,5 and 6. Cooler number three-temperature reading is 4 ^{o}C and contains 8, 9, 10 and 11. The comment section of the COC should read:

1 - 3 ^{o}C – samples 1, 3, 7, 12

2 - 4 ^{o}C – samples 2, 4, 5, 6

3 - 4 ^{o}C –samples 8 to 11

5.2.7. Line-up the samples according to the COC sequence and check for agreement with the sample tag. At a minimum check for the following information:

- ✓ Client Sample ID
- ✓ Sampling Date/Time
- ✓ Analysis Requested
- ✓ Preservative
- ✓ Sample Container
- ✓ Matrix

5.2.8. Check for the sample integrity.

- ✓ Custody seal and sample container is intact
- ✓ Initial of sampler is present
- ✓ Check for sample holding time/preservation. Refer to Table 1.
- ✓ Check for pH if required
  - Ensure that the sample cap is sealed properly.
  - Shake the sample, open the cap and pour a small amount of sample into the cap. Trickle the transferred sample into an appropriate pH strip indicator.
  - Compare the pH strip with the pH indicator table. Where readings are not distinguishable between the increments of pH readings, use a

narrow pH strip (0-3 or 9-12 pH strips) to distinctively identify sufficiency of sample preservation.

- Record the pH and any discrepancy on the SRF.

✓ Check for Sample Adequacy

5.2.9. Check for sample sufficiency (refer to Table 1)

✓ Sample(s) received is enough for all the analyses requested.

✓ Sample(s) for MS/MSD is enough for all analyses requested and if more than one container is sent, check visually the consistency of samples and label of containers; e.g. do all container labels agree, do the samples contained look the same.

5.3. **Assigning EMAX Control Number (ECN)**

5.3.1. Write the next available ECN[2] into the COC. Record the date, the project and sample location into the ECN log corresponding to the ECN taken.

5.3.2. Assign a unique Lab Sample ID (LSID) and Lab Sample Container ID (LSCID) to each sample received as described in EMAX-SM01.

5.4. **Labeling the Samples**

5.4.1. Line-up the samples according to the COC sequence.

5.4.2. Using the labeling gun, position the characters of the first line to agree with the LSID and the second line to agree with the LSCID.

5.4.3. Counter-check the COC sample label and ensure agreement with the sample tag.

5.4.4. Press the labeler trigger and attach the printed label on a free space of the sample label. Press the trigger again and attach on the sample cover.

5.4.5. Repeat steps 5.4.2 to 5.4.4 until all samples are labeled.

5.4.6. Have the sample labeling reviewed by the Supervisor or his/her designee and document review in the SRF.

5.4.7. Store samples as described in EMAX-SM01- Sample Management.

5.5. **Sample Receipt Form (SRF)**

5.5.1. Complete the SRF1 and SRF2 to have all the information pertinent to the sample(s) received (see Appendix 2).

5.5.2. For conformance to requirement of sample condition, refer to Table 1.

5.5.3. Write all discrepancies found in the SRF1.

[2] Refer to EMAX-SM01 for generating ECN.

5.5.4. Have the SRFs reviewed by the supervisor or his/her designee.

5.5.5. Make three copies of the SRFs and the COC(s) and distribute one set of copies to the PM, the Sample Preparation Dept. and the Operations Manager. The PM shall provide one set of copies of the SRF and COCs to the log-in after checking.

5.5.6. The PM resolves discrepancies with the Client.

6.0 QUALITY CONTROL

6.1. All samples shall be counter checked by a second person after labeling prior to sample storage.

6.2. All SRFs shall be reviewed by the Sample Management Supervisor or his/her designee.

6.3. All anomalies reported shall require closures before work orders commence.

6.4. All reviews shall be initialed and dated.

6.5. Where sample preservatives are added in the lab as instructed by the client, observed preservation requirements prior to sample analysis. For aqueous samples requested for metals analysis preserved with HNO3 to pH $\leq$ 2, allow a minimum of 24 hours to dissolved metals adsorb into the walls of the sample container prior to sample analysis.

7.0 CORRECTIVE ACTION

7.1. The requirements for sample containers, preservations, holding time and minimum amount of sample is listed in Table 1. Acceptance criteria and corrective actions for samples are listed in Appendix 1.

7.2. The PM shall follow-up all resolutions to issues and discrepancies in a timely manner and shall document all correspondence.

7.3. The PM shall then relay the resolutions in writing [resolution on SRF1 and/or email/fax attached to the SRF1], to the Sample Management Dept. and all other affected departments for appropriate action.

8.0 SUPPLEMENTARY NOTES

8.1. **Definition Of Terms**

8.1.1. Chain-of-Custody (COC) – is a record where sample custody transfer is documented. At a minimum the COC shall contain the project ID, sample ID, sampling location, date/time of collection, chemical preservatives (if any) dated signatures of individuals involved in the sample transfer.

8.1.2. Composite Sample – is an equal amount of sample aliquot combined together from specified sample containers.

8.1.3. Corrective Action - Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

8.1.4. EMAX Control Number (ECN) – is an identification given to a group of samples received from a project that arrived on the same day accompanied by a chain-of-custody (COC). Grouping of samples is determined by either the project or the Project Manager's discretion.

8.1.5. Internal COC (ICOC) – is a record used by the laboratory to document when samples are withdrawn from the sample control room. This record shall contain the Lab Sample IDs of samples withdrawn, the intended analysis, the initials of the custodian and recipients, and the date and time of sample turn over.

8.1.6. Lab Sample ID – is EMAX sample identification to uniquely identify each sample.

8.1.7. Lab Sample Container ID (LSCID) – is EMAX sample container identification to uniquely identify each sample container.

8.1.8. Sample Receipt Form 1 (SRF1)- is a record where to logged-in the type of delivery, who delivered the samples, the packaging condition, temperature upon receipt and the conditions or any discrepancies of samples during receiving.

8.1.9. Sample Receipt Form 2 (SRF2)- is a record where to logged-in the container type, any chemical preservative and conditions per container of samples upon receipt.

8.1.10. Nonconformance - An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

8.1.11. Preservative – is a chemical added to a sample to maintain its integrity prior to analysis.

8.1.12. Project Specific Requirement (PSR) – is a document containing the summary of project requirements, the QC references and other information needed to complete the work order.

8.1.13. Sample – is a specimen received in the laboratory bearing a unique client sample ID traceable to the accompanying COC. Each unique client sample ID shall have a corresponding unique Lab Sample ID, unless otherwise specified by the project. Hence, samples collected in different containers having the same client sample ID are labeled with the same corresponding Lab Sample ID.

8.1.14. Sample Delivery Group (SDG) – is a group of samples received over a period of 14 days or less, not exceeding 20 samples per analysis per matrix.

8.1.15. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

8.1.16. Trip Blank – is a target-analyte-free sample, which travels with the sample to monitor possible contamination during sample transport. This sample is analyzed for volatiles.

9.0 APPENDICES, TABLES & FORMS

9.1. Table 1 - Required Sample Condition

9.2. Appendix 1 - Summary of Quality Control Procedures

9.3. Forms - Sample Receipt Forms (SRF1 & SRF2)

TABLE 1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Parameter	Applicable Methods	Container[3]	Preservation[4]	Maximum holding time	Min. Sample Amount (ml)
Acidity	SM 2310B 4(a) 18th , 20th , Online	P, FP, G	Cool, ≤6 °C	14 days	50
Alkalinity	SM 2320B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	14 days	50
Ammonia	EPA 350.1, Rev. 2.0 (1993) SM 4500–NH3 C 18th (Neslerization) SM 4500-NH3 C 20th (Titration) SM 4500–NH3 F/G 18th (Electrode) SM 4500–NH3 D/E 20th (Electrode)	P, FP, G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	25
Anions (Bromide, Chloride, Fluoride, Sulfate)	EPA 300.0 SM 4110B 18th, 20th, Online SW 9056	P, FP, G	Cool, ≤6 °C	28 days	25
Biochemical oxygen demand	SM 5210 B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	1000
Chemical oxygen demand	EPA 410.4 Rev. 2 1993 SM 5220 D 18th, 20th, Online	P, FP, G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	5
Chloride	SM 44500-Cl B 18th, 20th, Online (Titrimetric – Silver Nitrate)	P, FP, G	None required	28 days	25
Chlorine, total residual	SM 4500-Cl B 18th, 20th, Online	P, G	None required	Analyze within 15 minutes	200
Color	SM 2120 B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	50
Cyanide, total	SM 4500-CN E 18th, 20th, Online	P, FP, G	Cool, ≤6 °C, NaOH to pH>12, reducing agent	14 days	25
Cyanide, available	SM 4500-CN G 18th, 20th, Online	P, FP, G	Cool, ≤6 °C, NaOH to pH>12, reducing agent	14 days	25
Fluoride	SM 4500-F B 18th, 20th, Online (Electrode) SM 4500-F D 18th, 20th, Online (Colorimetric - SPADNS)	P	None required	28 days	25
Hardness	SM 2340 B/C 18th, 20th, Online	P, FP, G	HNO_3 or H_2SO_4 to pH<2	6 months	50
Hydrogen ion (pH)	SM 4500-H^+ B 18th, 20th, Online SW 9040B, SW9045C	P, FP, G	None required	Analyze within 15 minutes	20

[3] ‘‘P’’ is polyethylene; ‘‘FP’’ is fluoropolymer (polytetrafluoroethylene (PTFE; Teflon), or other fluoropolymer, unless stated otherwise in this Table 1; ‘‘G’’ is glass; ‘‘PA’’ is any plastic that is made of a sterilizable material (polypropylene or other autoclavable plastic); ‘‘LDPE’’ is low density polyethylene.

[4] Samples received are expected to have been properly preserved by the field samplers. Checking of sample preservation is only based on Temperature reading and/or pH measurements specified in this SOP. Cool, ≤6 °C – means cooled at ≤6 °C but samples must not be frozen.

TABLE 1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Parameter	Applicable Methods	Container[3]	Preservation[4]	Maximum holding time	Min. Sample Amount (ml)
Kjeldahl and Organic N	SM 4500-N_{org} C 18th, 20th, Online	P, FP, G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	50
Chromium VI	EPA 218.6, SW 7199 SM 3500-Cr E 18th, C 20th, Online (Ion Chromatography) SW 7196A SM 3500-Cr D 18th, 20th, Online (Colorimetric)	P, FP, G	Cool, ≤6 °C, Ammonium Sulfate pH = 9.3–9.7	28 days (Preserved) 24 hours (Unpreserved)	20
Mercury (CVAA)	EPA 245.2 SM 3112B 18th, Online SW 7470A	P, FP, G	HNO_3 to pH<2	28 days	50
Metals, [5] except chromium VI, and mercury	EPA 200.7 EPA 200.8 SW 6010B SW6020A	P, FP	HNO_3 to pH<2	6 months	50
Nitrate	EPA 352.1 (Brucine sulfate) EPA 300.0 SM 4110B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	25
Nitrate-nitrite	EPA 353.2 (Cadmium Reduction) SM 4500-NO_3 E 18th, 20th, Online EPA 300.0 SM 4110B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	25
Nitrite	EPA 300.0 SM 4110B 18th, 20th, Online SM 4500-NO_2 B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	25
Oil and grease	SW 1664A SM 5520 B 20th, Online	G	Cool to ≤6 °C, HCl or H_2SO_4 to pH<2	28 days	25
Organic Carbon , total	SM 5310 B/C/D 18th, 20th, Online SW 9060A	P, FP, G	Cool to ≤6 °C, HCl, H_2SO_4, or H_3PO_4 to pH<2	28 days	25
Orthophosphate	EPA 365.1 Rev. 2 1993 EPA 356.3 1978 EPA 300.0 SM 4110B 18th, 20th, Online SM 4500-P E 18th, 20th	P, FP, G	Cool, ≤6 °C	Filter within 15 minutes; Analyze within 48 hours	25

[5] Aqueous sample received without acid preservation may be preserve in the lab upon client instruction. When acid is added allow at least 24 hours before sample analysis to dissolve any metals that adsorb to the container walls.

TABLE 1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Parameter	Applicable Methods	Container[3]	Preservation[4]	Maximum holding time	Min. Sample Amount (ml)
Oxygen, Dissolved	SM 4500-O C 18th, 20th, Online	G	None required	Analyze within 15 minutes after filtration	25
Phenols	EPA 420.1 1978 SW 9065	G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	25
Phosphorous, total	EPA 365.3 SM 4500-P E 18th, 20th	P, FP, G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	50
Residue, total	SM 2540 B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	7 days	100
Residue, Filterable	SM 2540 C 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	7 days	100
Residue, Nonfilterable (TSS)	SM 2540 D 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	7 days	100
Residue, Settleable	SM 2540 F 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	1000
Silica, Dissolved	SM 4500-Si C 18th SM 4500-SiO_2 D 20th, Online	P or Quartz	Cool, ≤6 °C	28 days	50
Specific conductance	EPA 120.1 1982 SM 2510B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	28 days	20
Sulfate	EPA 300.0 SM 4110B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	28 days	50
Sulfide	SM 4500-S^2 D 18th, 20th, Online SM 4500-S^2 E 18th, F 20th, Online SW 9034	P, FP, G	Cool, ≤6 °C, add zinc acetate plus NaOH to pH>9	7 days	100
Sulfite	SM 4500-SO_3 B 18th, 20th, Online	P, FP, G	None required	Analyze within 15 minutes	
Surfactants	SM 5540 C 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	100
Turbidity	EPA 180.1 Rev. 2 1993 SM 2130 B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	40
Purgeables VOCs	EPA 524 EPA 624 SW 8260B	G, FP-lined septum	Cool, ≤6 °C, 0.008% $Na_2S_2O_3$, HCl to pH ≤2	14 days (Preserved) 7 days (Unpreserved)	40
Purgeable Hydrocarbons	SW 8015B AK101	G, FP-lined septum	Cool, ≤6 °C, 0.008% $Na_2S_2O_3$, HCl to pH ≤2	14 days (Preserved) 7 days (Unpreserved)	40
Acrolein and acrylonitrile	EPA 624 SW 8260B	G, FP-lined septum	Cool, ≤6 °C, 0.008% $Na_2S_2O_3$, pH to 4-5	14 days (Preserved) 3 days (Unpreserved)	40
Extractable BNAs	EPA 625 SW 8270C	G, FP-lined cap	Cool, ≤6 °C, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction	1000

TABLE 1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Parameter	Applicable Methods	Container[3]	Preservation[4]	Maximum holding time	Min. Sample Amount (ml)
Extractable Hydrocarbons	SW 8015B LUFT AK102 AK 103	G, FP-lined cap	Cool, ≤6 °C, store in dark, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction	1000
PCBs	EPA 608 SW 8082	G, FP-lined cap	Cool, ≤6 °C	1 year until extraction, 1 year after extraction	1000
Pesticides	EPA 608 SW 8081A	G, FP-lined cap	Cool, ≤6 °C, pH 5–9	7 days until extraction, 40 days after extraction	1000
Extractable Organics	SW 8141A SW 8151A	G, FP-lined cap	Cool, ≤6 °C	7 days until extraction, 40 days after extraction	1000

TABLE 2
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR SOLID SAMPLES

Parameters	Applicable Methods	Sample Container	Preservative	Holding Time	Min. Sample Amount (g)
Volatile Organics	SW 8260B	Encore Tube (or equivalent)	Cool, ≤6 °C	48 hours	5
Volatile Organics	SW8260B	Encore Tube (or equivalent)	Cool, ≤6 °C $Na_2S_2O_3$ solution or Methanol	14 days	5
Purgeable TPH	SW 8015B	Encore Tube 2-4 oz Jar/ Shelby Tube	Cool, ≤6 °C	14 days	5

TABLE 2
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR SOLID SAMPLES

Parameters	Applicable Methods	Sample Container	Preservative	Holding Time	Min. Sample Amount (g)
Extractable Organics	SW 8015B SW 8081A SW 8082 SW 8141A SW 8151A SW 8270B	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	14 days (extract 40 days)	30
Ignitability	SW 1010	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	ASAP (24 hours from receipt)	100
Perchlorate	EPA 314.0	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	28 days	10
Metals	SW6010B SW 6020A	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	180 days	5
Chromium VI	EPA 218.6 SW 9076A SW 7199	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	24 hours	10
Mercury	SW 7471A	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	28 days	5
Cyanide	SW 9010B/9014	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	14 days	10
Sulfide	SW 9030 SW9034	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	7 days	10
pH	SW 9040C SW 9045C	4-8 oz Jar/Shelby Tube	None	ASAP (24 hours from receipt)	10
Anions (Br, Cl, F, NO_3/NO_2, SO_4)	SW 9056	4-8 oz Jar/Shelby Tube	None	28 days	10

TABLE 2
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR SOLID SAMPLES

Parameters	Applicable Methods	Sample Container	Preservative	Holding Time	Min. Sample Amount (g)
Nitrate-N	SW 9056	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	48 hours	10
TOC	SW 9060A	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	28 days	10
Phenols	SW 9065	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	28 days	10

APPENDIX 1: **SUMMARY OF QUALITY CONTROL PROCEDURES**

Parameter	Acceptance Criteria	Corrective Action
Cooler/Sample Custody Seal	To maintain sample integrity at all time, custody seal must be intact when samples are received.	• Take cooler temperature reading • Inform the client immediately. • Wait for the client response before proceeding.
Integrity Of Sample Container	All samples shall be protected from any form of contamination. Samples received must be intact.	• Place sample(s) in a double zipped locked bag. • Inform the client immediately • Wait for Client response before proceeding
Cooler Temperature	Samples must be received at required temperature. Refer to Table 1	• Take the cooler temperature reading. • Inform the client immediately • Wait for Client response before proceeding
Sample Holding Time	Samples must be analyzed within holding time. Refer to Table 1	• Check COC if special instruction is present. • Inform the client immediately. • Wait for Client response before proceeding.
Preservation	Samples must be received with proper and adequate preservative. Refer to Table 1.	• Inform the client immediately • Wait for Client response before proceeding
Volatile Samples	Water samples for volatile analyses requires zero headspace Presence of air bubble must not to exceed 6mm. Samples must be accompanied with Trip Blank in the same cooler.	• Check the number of sample containers. If more than one is submitted, and the other sample is okay, note the discrepancy on the SRF and proceed with sample receiving. • Corresponding to the sample container ID, write "Bubble >6mm" as discrepancy in the SRF. If all vials for a sample have bubble >6mm, inform the PM immediately so that client can be notified promptly. • If there is only one sample container received, inform the client immediately. • If Trip Blank is misplaced or lacking, inform the client immediately.
Sample Amount	Refer to Table 1 for appropriate sample container for specific analysis.	• Inform the Client immediately • Wait for the response before proceeding.
Sample Label	COC and sample tag must agree.	• Document the discrepancy following the convention below: Sample Control #XXXXXX-XX Client sample ID XXXXXXXXX COC reads …… Field sample tag reads …….. • Submit copy to SRFs and COCs to PM for proper action.
Others (any other parameters observed that is not listed above.)	Must be verified.	• Report to the Supervisor

SRF1

EMAX LABORATORIES, INC.

SAMPLE RECEIPT FORM 1

Type of Delivery	Delivered By/Airbill	ECN
☐ EMAX Courier		Receipient
☐ Client Delivery		Date
☐ Third Party		Time

COC Inspection

☐ Client Name	☐ Client PM/FC	☐ Sampler Name	☐ Sampling Date/Time/Location	☐ Sample ID	☐ Matrix
☐ Address	☐ Tel # / Fax #	☐ Courier Signature	☐ Analysis Required	☐ Preservative (if any)	☐ TAT
Safety Issues	☐ None	☐ High concentrations expected	☐ Superfund Site samples	☐ Rad screening required	

Comments:

Packaging Inspection

Container	☐ Cooler	☐ Box	☐ Other		
Condition	☐ Custody Seal	☐ Intact	☐ Damaged		
Packaging	☐ Bubble Pack	☐ Styrofoam	☐ Popcorn	☐ Sufficient	☐ _____
Temperatures (Cool, ≤6 °C but not frozen)	☐ Cooler 1_____ °C	☐ Cooler 2_____ °C	☐ Cooler 3_____ °C	☐ Cooler 4_____ °C	☐ Cooler 5_____ °C
	☐ Cooler 6_____ °C	☐ Cooler 7_____ °C	☐ Cooler 8_____ °C	☐ Cooler 9_____ °C	☐ Cooler 10_____ °C

Thermometer: *A - S/N 101541371* *B - S/N 101541382*

Comments: ☐ **PM was informed on non-compliant coolers immediately.**

DISCREPANCIES

LSID	LSCID	Sample Label ID/COC ID	Discrepancy Code	Corrective Action Code

REVIEWS

Sample Labeling _____ SRF _____ PM _____

Date _____ Date _____ Date _____

LEGEND:

Code	Description- Sample Management	Code	Description-Sample Management	Code	Description-Project Management
A1	Analysis is not indicated in COC	D1	Date and/or time is not indicated in COC	R1	Hold sample(s); wait for further instructions
A2	Analysis is not indicated in label	D2	Date and/or time is not indicated in label	R2	Proceed as indicated in COC
A3	Analysis is inconsistent in COC vis-à-vis label	D3	Date and/or time is inconsistent in COC vis-à-vis label	R3	Refer to attached instruction
A4	_____	E1	Insufficient preservative	R4	Cancel the analysis
B1	Sample ID is not indicated in COC	E2	Improper preservation	R5	_____
B2	Sample ID is not indicated in label	F1	Insufficient Sample	R6	_____
B3	Sample ID is inconsistent in COC vis-à-vis label	F2	Bubble is> 6mm		_____
B4	_____	G1	Temperature is out of range		_____
C1	Wrong container	G2	Out of Holding Time		_____
C2	Broken container	G3	>20 % solid particle		_____
C3	Leaking container	H1	_____		_____
C4	_____	H2	_____		_____

SRF2

EMAX LABORATORIES, INC.

EMAX-SM02
Rev.5

SAMPLE RECEIPT FORM 2

SAMPLES RECEIVED FOR ECN:

ECN (*)	SAMPLE CONTAINER ID	COOLER#	CONTAINER TYPE								CHEMICAL PRESERVATIVE											Filtered	
			Jar	Amber	HDPE	Encore	Vial	Tube	Bag	Other	NONE	HCl (pH<2)	HNO_3 (pH<2)	H_2SO_4 (pH<2)	Zn(Ac)+NaOH (pH>12)	NaOH (pH>12)	$Na_2S_2O_3$	Methanol	NaHSO4	Other	Other	Yes	No
	* 1																						
	* 2																						
	* 3																						
	* 4																						
	* 5																						
	* 6																						
	* 7																						
	* 8																						
	* 9																						
	* 0																						
	* 1																						
	* 2																						
	* 3																						
	* 4																						
	* 5																						
	* 6																						
	* 7																						
	* 8																						
	* 9																						
	* 0																						
	* 1																						
	* 2																						
	* 3																						
	* 4																						
	* 5																						
	* 6																						
	* 7																						
	* 8																						
	* 9																						
	* 0																						

WASTE DISPOSAL

SOP No.:	EMAX-SM03	Revision No.	4	Effective Date:	09/10/07
Prepared By:	Richard Beauvil			Date:	09/10/07
Approved By:	Kenette Pimentel QA Manager			Date:	09.10.07
Approved By:	Sing Pang RSO			Date:	09/10/07

Control Number: SM03-03-

1.0 PURPOSE

1.1. To establish waste disposal policies in accordance to all applicable Local, State and Federal requirements.

1.2. To describe the specific steps required to assure compliance to the requirements for disposing laboratory generated waste.

2.0 POLICIES

2.1. All wastes shall be disposed in accordance to all applicable Local, State and Federal requirements.

2.2. All wastes shall be separated according to different waste streams as described in this SOP.

2.3. The Safety Officer shall be responsible to make sure that waste streams are analyzed or waste process history is used prior to disposal and all analytical results shall be maintained accordingly.

2.4. The Waste Management Unit shall be responsible for waste disposal handling and all members shall be duly trained and certified to perform this activity. They shall also be responsible for ensuring that all wastes streams are properly labeled in all laboratory areas and be responsible for maintaining orderliness in the waste storage area.

2.5. Satellite waste disposal units will be maintained in all laboratory areas, and will be clearly labeled in accordance to labeling requirements.

2.6. The waste storage area shall bear the caution sign:

"HAZARDOUS WASTE STORAGE AREA"

"UNAUTHORIZED PERSONS KEEP OUT"

2.7. The Safety Officer shall be responsible for conducting weekly inspection of the waste storage area (See appendix 2) to ensure that:

- The area is safe and clean.
- There is no evidence of container leakage and/or deterioration.
- There are no substance incompatibilities.
- There are no other related issues that may cause a danger to any personnel.

2.8. All hazardous waste will only be stored on-site for no more than 90 days, from the accumulation start date of the waste stream.

3.0 ASSOCIATED SOP

3.1. EMAX-SM01 Sample Management

4.0 SAFETY

4.1. Employees performing any waste disposal activity shall be done under the direct supervision of a certified waste disposal employee.

4.2. Safety goggles, gloves and protective clothing shall be worn at all times during the entire course of waste disposal. Respirators shall be worn when disposing solvent waste.

4.3. Incompatible wastes shall not be mixed together or stored on the same secondary container.

5.0 INSTRUMENTS, CHEMICALS AND MATERIALS

5.1. Hazardous waste containers - DOT approved containers

5.2. Non-hazardous waste containers - Non-reactive material to waste stored

6.0 PROCEDURES

6.1. Identify waste streams and handle each independently.

Waste Stream	EPA Waste No.	State Waste Code	Disposal Sites
1. Mixed Flammable Liquid	D001	214/741	CAD 044429835 (Clean Harbor)
2. Soil and Debris	None	181	NVT330010000 (US Ecology)
3. Acid Waste pH < 2	D002	791	CAT 080033681 (Phibro Tech)
4. Cyanide Waste pH > 10	P030	711	CAD 044429835 (Clean Harbor)
5. Methylene Chloride Waste	F001	211	CAD 008302903 (Veolia)
6. Wastewater w/ trace of Methylene Chloride	F001	135	CAD 008302903 (Veolia)
7. Waste Flammable Solids; PCB < 50 ppm	D001,F003 F005	214/741	ARD981057870 (Rineco.)
8. Wastewater; PCB ≥ 5	F005	741	CAD 044429835

mg/L			(Clean Harbor)
9. Non-RCRA Wastewater pH 4 – 10	None	135	CAT 080033681 (Phibro Tech)
10. Chromium VI Waste	D002, D007	171	CAD 044429835 (Clean Harbor)
11. Universal Waste (Electronic Devices, Monitors, Empty Printer Cartridges)	None	None	Offlease Clearinghouse
12. Universal Waste (Batteries, Fluorescent tubes, Mercury wastes, Aerosal cans)	None	None	AZD 982434185 (EPSI, AZ) CAD088504881 (Kinsbursky, CA)

6.2. Handling Satellite Waste

6.2.1. Collect all analytical waste generated in a satellite waste container.

Note: ***Residual samples, digestates or extracts incorporated in the analytical wastes are traceable through the analytical run log.***

6.2.2. Place satellite waste containers in a cart and move them to the 90-day waste storage area.

6.2.3. Transfer satellite waste into the appropriate 55 gallons waste stream drum as identified in section 6.1.

6.2.4. Record the activity into the satellite waste disposal logbook. (See Appendix 1).

6.2.5. Return the satellite containers to their appropriate location. Affix a label with the accumulation start date on the containers.

6.3. Digestates and extracts Disposal

6.3.1. Dispose digestates and extracts once the holding time is past or by approval of the client.

6.3.2. Place digestates and extracts in a cart and move them to the 90-day waste storage area.

6.3.3. Transfer the satellite waste into the appropriate 55 gallons waste stream drum as identified in section 6.1.

6.3.4. Record their disposal in the digestion or extraction logbook.

6.4. Sample Residue disposal

6.4.1. Dispose samples after three (3) months and/or with the client consent.

6.4.2. Dispose samples past holding time unless directed otherwise by the client.

6.4.3. Transfer the samples into a 5 gallon pal and check the pH before placing it into the appropriate 55 gallons waste stream drum as identified in section 6.1.

6.4.4. Record the activity into the corresponding SDG pages of the internal chain of custody (ICOC).

6.4.5. Glass containers remaining after disposal of the water and soil waste will be broken or crushed whenever possible. Place glass containers in a strong cardboard box, cover and brake them with a heavy long metal rod.

6.5. Other Waste Streams

6.5.1. Separate soil samples having concentrations higher than 50 ppm of Polychlorinated Biphenyls (PCBs) and dispose as PCB contaminated soil.

6.5.2. Separate water samples having concentration higher than 5 ppm of Polychlorinated Biphenyls (PCBs) and dispose as PCB contaminated wastewater.

6.5.3. Dilute all PCB standards > 50 ppm and dispose into the mixed flammable liquid waste stream drum.

6.5.4. Separate all oil samples and product samples and dispose them into the mixed flammable liquid waste stream drum.

6.5.5. Collect all Chemical Oxygen Demand (COD) vials and bulk into a 5 gallon drum for disposal as Chromium VI waste Stream.

6.6. Waste Stream Records

6.6.1. Create and maintain a file for each waste stream to include:

- Description of waste stream and/or generating process.
- Classification of waste stream based on DOT and EPA regulations.
- Profile reports from TSD facility where the waste is shipped.
- And other pertinent information.

6.7. Management of Containers

6.7.1. Fill the waste containers to a maximum of 95% of their capacity to allow for expansion within the container.

6.7.2. For wastes characterized as hazardous wastes:

- Use containers approved by DOT only.
- Use DOT approved labels only
- Labels shall include “HAZARDOUS WASTE” in addition to other information required to be in the label.

6.7.3. For wastes characterized as non-hazardous, use a container that will not react with the substance stored.

6.7.4. Maintain the containers closed except when wastes are being added or removed from them.

6.7.5. Maintain the exteriors of waste containers free from dirt, sludge or liquids.

6.8 Universal Waste

6.8.1 Universal waste will be collected in 55 gallon drum and will be disposed as identified in section 6.1.

7.0 REFERENCES

7.1. California Title 22

7.2. 40 CFR 261 Subpart C

8.0 APPENDICES

8.1. Appendix 1 - Satellite Waste Disposal Log

8.2. Appendix 2 - Weekly Satellite Inspection Checklist

9.0 SUPPLEMENTARY NOTES

9.1 Satellite wastes are wastes generated from the instruments or various analytical processes.

9.2 Digestates or extracts are stored aliquot of liquid or solvent generated from analytical digestion or extraction processes.

9.3 Sample residues are stored samples aliquot remaining after its use from analyses.

SATELLITE WASTE DISPOSAL LOG

DATE	SIGNATURE	DESCRIPTION	VOLUME	REMARKS

SATELLITE WASTE DISPOSAL LOG

WEEKLY

SATELLITE/WASTE ACCUMULATION AREA

INSPECTION CHECKLIST

INVESTIGATOR:_____

Date	Lab Area	Container Closed? Y/N	Container Labeled? Y/N	Container in Good Condition? Y/N	Signs of Spills/Leaks? Y/N	Secondary Containment? Y/N	Accumulation Start Date? Y/N	Date of Correction?	Initials
	EXTRACTION								
	DOE METALS								
	STD ROOM								
	FUEL/WETCHEM								
	METALS								
	WEIGHING ROOM								

UNCONTROLLED WHEN PRINTED

Columbia Analytical Services

SOP CHANGE FORM

SOP Title: Method 8290: Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans by High Resolution Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS)
SOP Code: HMS-8290
SOP Revision No.: 9
SOP Date: 08/12/2010
SOP Section(s) Affected by Change:

Description of Change:

13.2.3.3 – *Current language is replaced by the following:*
When the laboratory operates the instrument during a single 12-hour shift, the beginning of the shift is defined by the GC Performance (Window Define) Solution. Beginning and ending calibration checks must be analyzed within this 12-hour shift. Mass resolution checks are required prior to, and immediately following the 12-hour shift. Refer to figure 2a for further details.

13.2.3.4 – *Current language is replaced by the following:*
When the laboratory operates the instrument during consecutive 12-hour shifts, the initial shift must follow the sequence scheme outlined in section13.2.3.3. The second shift begins at the injection of the ending calibration check, which is immediately followed by a mass resolution check and a GC Performance (Window Define) Solution. The closing calibration check must be analyzed within 12 hours of the previous calibration check, and must be followed by a mass resolution check. Refer to figure 2b for further details.

13.2.3.5 – *The following changes apply*
The analysis of at least one analysis of the GC column performance (Window Define) solution and of two routine calibration checks must be performed *and reported* within the 12-hour period. *A mass resolution check must also be performed immediately before and after the 12-hour period. Failure to meet these frequency criteria requires reinjection of the sequence.*

Figure 2 – *Current figure is replaced by Figures 2a and 2b, attached.*

Reason(s) for Change(s):
Change is in response to NCAR20110412, requiring a more definitive discussion of the 12-hour period.

Change(s) Submitted by: R. Pierrot	Date: 4/26/2011

Approvals:

Technical Reviewer Signature: Xiangqi Liang	Date: 4/26/11
QA PM Signature: Rebecca Pierrot	Date: 4/26/11

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

Uncontrolled Copy
Will not be updated

Department Supervisor/Manager Signature:	Date:

Change(s) Effective Date: 4/28/2011

Uncontrolled Copy
Will not be updated

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

FIGURE 2a

ANALYTICAL SEQUENCE FOR A TYPICAL 12-HOUR SHIFT

Time	Analysis
Hour 0	PFK HRMS Tune
Beginning of 12-hr shift	GC Performance (Window Define) Solution
	Beginning HRCC3
	Method Blank
	Samples and Batch QC
End of 12-hr shift	Closing HRCC3
	PFK HRMS Tune

*Note: The PFK Tune must be performed immediately before, and immediately following the 12-hour shift, but does not define the beginning or end of the shift.

Uncontrolled Copy
Will not be updated

FIGURE 2b

ANALYTICAL SEQUENCE FOR A TYPICAL 12-HOUR SHIFT

Time	**Analysis**
Hour 0	PFK HRMS Tune
Beginning of 1st 12-hr shift	GC Performance (Window Define) Solution
	Beginning HRCC3
	Method Blank
	Samples and Batch QC
End of 1st 12-hr shift/Beginning of 2nd 12-hr shift	Closing HRCC3
	PFK HRMS Tune
	GC Performance (Window Define) Solution
	Method Blank
	Samples and Batch QC
End of 2nd 12-hour shift	Closing HRCC3
	PFK HRMS Tune

*Note: The PFK Tune must be performed immediately before, and immediately following the 12-hour shift, but does not define the beginning or end of the shift.

Uncontrolled Copy
Will not be updated

Columbia Analytical Services

SOP CHANGE FORM

SOP Title: Analysis of Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans by High Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)
SOP Code: HMS-8290
SOP Revision No.: 9
SOP Date: 09-Aug-10 (Effective 20-Aug-2010)
SOP Section(s) Affected by Change: 1.2; 2.7; 3.5; 8.16; 12.2.3; 12.2.5; 12.2.10; 12.3.1

Description of Change:

1.2 (Paragraph 2) The sensitivy of this method is dependant on the level of interferences within a given matrix (see Table 1). The calibration range of the method for a 1L water sample is 10 to *20,000 ppq* for TCDD/TCDF and PeCDD/PeCDF, and 1.0 to *2,000 ppt* for a 10-g soil, sediment, ash, or tissue sample. Analysis of a one tenth aliquot of the sample permits measurement of concentrations up to 10 times the upper MCL

2.7 Quantitation of the individual congeners, total PCDDs, and total PCDFs, is achieved in conjunction with the establishment of a multipoint (seven point) calibration curve for each homolog, during which each calibration solution is analyzed once.

3.5 **Calibration Solutions** – solutions containing known amounts of unlabeled PCDDs/PCDFs and labeled standards (Table 4). The set of *7* solutions is used to determine the instrument response of the unlabeled analytes relative to the C13 labeled standard

8.16 **High-Resolution Concentration Calibration *Stock* Solutions** – *7* nonane solutions containing unlabeled and carbon-labeled PCDDs and PCDFs at known concentrations are used to calibrate the instrument. The concentrations ranges are homolog dependent (Table 4). These solutions are *prepared from a purchased certified stock solution.*

12.2.3 Initial Calibration – Initial calibration is required before any samples may be analyzed for PCDDs and PCDFs. Initial calibration is also required if any routine calibration does not meet the required criteria. All *seven* high-resolution concentration calibration solutions must be used for the initial calibration. Tune the instrument with PFK.

12.2.5 By using the same GC and MS conditions that produced acceptable results with the Window Define solution, analyze a 1 µL portion of each of the *seven* concentration calibration solutions once with the ~~*following*~~ mass spepectometer operating procedures *outlined in section 12.1.*

12.2.10 Calculate the mean response factors for the *seven* calibration solutions:… $\overline{RF_m}$ = calculated mean relative response factor of a particular labeled standard (m) relative to an appropriate recovery standard as determined from the *seven* initial calibration injections (j)

Uncontrolled Copy
Will not be updated

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

Columbia Analytical Services™

SOP CHANGE FORM

SOP Title: Analysis of Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)
SOP Code: HMS-8290
SOP Revision No.: 9
SOP Date: 08/09/10 (effective 2/4/2010)
SOP Section(s) Affected by Change: 11.3.2.10 and 12.3.1

Description of Change:
11.3.2.10. *Deleted*

12.3.1 "Remove the sample or QC extract from storage. Add 10 µL of recovery standard at 50 ng/mL (Table 9) to the final extract.

Reason(s) for Change(s):
The final extract volume for this procedure is being updated so as not to elevate the MRL.

Change(s) Submitted by: R. Pierrot	Date: 1/31/2011

Approvals:

Technical Reviewer Signature:	Date:
QA PM Signature: Rebecca Pierrot	Date: 1/31/11
Department Supervisor/Manager Signature: [illegible]	Date: 1/31/11

Change(s) Effective Date: 2/4/2011

Uncontrolled Copy
Will not be updated

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

Columbia Analytical Services™

SOP CHANGE FORM

SOP Title: Analysis of Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)
SOP Code: HMS-8290
SOP Revision No.: 9
SOP Date: 08/09/10 (effective 08/20/10)
SOP Section(s) Affected by Change: 13.2.3.8

Description of Change: 13.2.3.8 If either one of the criteria in Section 13.2.3.7 is not satisfied, the end of sequence routine calibration should be injected once more. If these criteria are still not satisfied, reanalysis of all positive sample extracts is required. It is realized that it may not always be possible to achieve all RF criteria. For example, it has occurred that the RF criteria for 13C-HpCDD and 13C-OCDD were not met, however, the RF values for the corresponding unlabeled compounds were routinely within the criteria established in the method. In these cases, 24 of the 26 RF parameters have met the QC criteria, and the data quality for the unlabeled HpCDD and OCDD values were not compromised as a result of the calibration event.

In these situations, the analyst must assess the effect on overall data quality as required for the data quality objectives and decide on appropriate action. Corrective action would be in order, for example, if the compounds for which the RF criteria were not met included both the unlabeled and corresponding internal standard compounds. However, the ion abundance ratio must meet acceptance criteria.

13.2.3.9 A new initial calibration (new RFs) is required immediately following the analysis of the samples, whenever the RPD from the next routine calibration exceeds 25% or 35%, respectively. Failure to perform a new initial calibration immediately following the analysis of the samples will automatically require reanalysis of all positive sample extracts analyzed before the failed end-of-shift continuing calibration check.

Reason(s) for Change(s):
EPA Method 8290 allows for this change, as most of the language is taken directly from Section 7.7.4.4. This is standard practice and the SOP needed to be updated to match this practice.

Change(s) Submitted by: Xiaoqi Liang	Date: 11/19/10

Approvals:

Technical Reviewer Signature:	Date: 11/19/10
QA PM Signature:	Date: 11/19/10
Department Supervisor/Manager Signature: Xiaoqi Liang	Date: 11/19/10

Change(s) Effective Date: 11/19/10

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

Uncontrolled Copy
Will not be updated

Columbia Analytical Services™

SOP CHANGE FORM

SOP Title: Analysis of Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)
SOP Code: HMS-8290
SOP Revision No.: 9
SOP Date: 08/09/20 (effective 08/20/10)
SOP Section(s) Affected by Change: 11.2.2.1-11.2.2.3, 11.2.3.2, 11.2.4.1-11.2.4.3

Description of Change:
Spiking will now occur prior to mixing solid and tissue samples with sodium sulfate.

11.2.2.1 Add 10-20g anhydrous sodium sulfate to each thimble containing the sample and mix thoroughly to evenly distribute the sodium sulfate. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained.

11.2.2.2 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet. Allow the samples to equilibrate for 1 to 2 hours.

11.2.2.3 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2.3.2 Rather than adding sample/spiking solution to a clean thimble, instead add sample to a clean beaker to record weight. Add 10-20g sodium sulfate and mix thoroughly to evenly distribute the sodium sulfate. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained. Spike with 100µL internal standard spiking solution at 10-50ng/mL (Table 9). Record the standard addition on the bench sheet. Transfer sample to ASE cell. Top with sodium sulfate.

11.2.4.1 Add 20-30g anhydrous sodium sulfate to each thimble containing the sample and mix thoroughly to evenly distribute the sodium sulfate. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained.

Uncontrolled Copy
Will not be updated

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

11.2.4.2 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet. If lipid determination is to be performed on a sample, spike 200µL of the internal standard spiking solution. 11.2.4.3 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

Reason(s) for Change(s): After some recent investigation, the EPA ORCR released a memo recommending that the recently updated language in some EPA 3500 series methods regarding standard addition should not be followed, and that addition of internal standards to solid samples should occur following mixture with sodium sulfate to minimize potential low percent recovery issues.

Change(s) Submitted by: Andrew Biddle	Date: 08/17/10

Approvals:

Technical Reviewer Signature:	Date: 8/17/10
QA PM Signature:	Date: 08/17/10
Department Supervisor/Manager Signature:	Date: 8/17/10

Change(s) Effective Date: 08/17/10

Uncontrolled Copy
Will not be updated

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

Uncontrolled Copy
Will not be updated

STANDARD OPERATING PROCEDURE

ANALYSIS OF POLYCHLORINATED DIBENZO-*p*-DIOXINS AND POLYCHLORINATED DIBENZOFURANS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)

SOP Code: HMS-8290

Revision: 9

Effective: 08/20/10

Approved by: _____ 8/9/10
Xiangqiu 'Sam' Liang, Laboratory Director Date

_____ 08/09/10
Dr. Lan Le, Technical Director Date

_____ 08/09/10
Andrew Biddle, Quality Assurance Program Manager Date

© Columbia Analytical Services, Inc., 2010
19408 Park Row, Suite 320
Houston, TX 77084

Annual review of this SOP has been performed; this SOP reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

DOCUMENT CONTROL

NUMBER: _____

Initials: _____ Date: _____

TABLE OF CONTENTS

Section		Page Number
1.	SCOPE AND APPLICATION	3
2.	METHOD SUMMARY	4
3.	DEFINITIONS	5
4.	INTERFERENCES	6
5.	SAFETY	7
6.	SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE	8
7.	APPARATUS AND EQUIPMENT	8
8.	STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS	11
9.	PREVENTIVE MAINTENANCE	16
10.	RESPONSIBILITIES	17
11.	PROCEDURE FOR SAMPLE PREPARATION, EXTRACTION, CONCENTRATION AND CLEAN UP	17
12.	PROCEDURE FOR HRGC/HRMS ANALYSIS AND CALIBRATION	26
13.	QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS	33
14.	DATA REDUCTION AND REPORTING	40
15.	METHOD PERFORMANCE	45
16.	POLLUTION PREVENTION AND WASTE MANAGEMENT	45
17.	CORRECTIVE ACTIONS FOR OUT-OF-CONTROL DATA	45
18.	CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA	47
19.	REFERENCES	47
20.	TRAINING PLAN	47
21.	METHOD MODIFICATIONS	48
22.	INSTRUMENT SPECIFIC ADDENDUM	49
23.	CHANGES FROM PREVIOUS REVISION	49
24.	ATTACHMENTS	49

Uncontrolled Copy
Will not be updated

Standard Operating Procedure

ANALYSIS OF POLYCHLORINATED DIBENZO-*p*-DIOXINS AND POLYCHLORINATED DIBENZOFURANS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)

Uncontrolled Copy
Will not be updated

1.0 SCOPE AND APPLICATION

1.1 This standard operating procedure (SOP) provides the procedures for the detection and quantitative measurement of polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in a variety of environmental matrices and at part-per-trillion to part-per-quadrillion concentrations and applies to EPA SW-846 Method 8290. The following compounds can be determined by this method:

Analyte	CAS Registry No
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD)	1746-01-6
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin (PeCDD)	40321-76-4
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin (HxCDD)	39227-28-6
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin (HxCDD)	57653-85-7
1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin (HxCDD)	19408-74-3
1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin (HpCDD)	35822-46-9
1,2,3,4,6,7,8,9-Octachlorodibenzo-*p*-dioxin (OCDD)	3268-87-9
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	70648-26-9
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	72918-21-9
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-0
Total Tetrachlorodibenzo-*p*-dioxin (TCDD)	41902-57-5
Total Pentachlorodibenzo-*p*-dioxin (PeCDD)	36088-22-9
Total Hexachlorodibenzo-*p*-dioxin (HxCDD)	34465-46-8
Total Heptachlorodibenzo-*p*-dioxin (HpCDD)	37871-00-4
Total Tetrachlorodibenzofuran (TCDF)	55722-27-5
Total Pentachlorodibenzofuran (PeCDF)	30402-15-4
Total Hexachlorodibenzofuran (HxCDF)	55684-94-1
Total Heptachlorodibenzofuran (HpCDF)	38998-75-3

1.2 The analytical method calls for the use of high-resolution gas chromatography and high-resolution mass spectrometry (HRGC/HRMS) on purified sample extracts. Table 1 lists the various sample types covered by this analytical protocol, the 2,3,7,8-TCDD-based

method calibration limits (MCLs), and other pertinent information. A calculation for reporting the analytical results using a 2,3,7,8-TCDD toxicity equivalency factor (TEF) to obtain a total toxicity equivalence quotient (Total TEQ) is described.

The sensitivity of this method is dependent upon the level of interferences within a given matrix (see Table 1.) The calibration range of the method for a 1L water sample is 10 to 2000ppq for TCDD/TCDF and PeCDD/PeCDF, and 1.0 to 200ppt for a 10g soil, sediment, ash, or tissue sample. Analysis of a one tenth aliquot of the sample permits measurement of concentrations up to 10 times the upper MCL.

2.0 METHOD SUMMARY

2.1 This procedure uses matrix specific extraction, analyte specific clean up, and HRGC/HRMS analysis techniques. If interferences are encountered, the method provides selected clean up procedures to aid the analyst in their elimination.

2.2 A specified amount of soil, sediment, ash, water, sludge, paper pulp, fuel oil, chemical reactor residue, fish or plant tissue is spiked with a solution containing specified amounts of each of the nine isotopically labeled PCDDs/PCDFs. The sample is then extracted according to a matrix specific extraction procedure. Aqueous samples that are judged to contain 1% or more solids are filtered. The solid phase (including the filter) and the aqueous phase are extracted separately. The extracts are then combined before clean up.

The extraction procedures are:

2.2.1 Toluene: Soxhlet and ASE extractions for soil, ash, and paper pulp samples;
2.2.2 Dichloromethane: Jar/Separatory Funnel extraction for water samples;
2.2.3 Toluene: Soxhlet for sediment and sludge samples; and
2.2.4 Hexane/Dichloromethane: Soxhlet extraction for tissue samples.

2.3 The extracts may be submitted to a sulfuric acid washing treatment and dried. Following a solvent exchange step, compounds that interfere are removed by column chromatography using silica gel and activated carbon.

2.4 The preparation of the final extract for HRGC/HRMS analysis is accomplished by adding 20µL of a nonane solution containing 50pg/µL of the recovery standards C13-1,2,3,4-TCDD and C13-1,2,3,7,8,9-HxCDD. The former is used to determine the percent recoveries of tetra- and pentachlorinated PCDD/PCDF congeners, while the latter is used to determine the percent recoveries of the hexa-, hepta- and octachlorinated PCDD/PCDF congeners.

2.5 One µL of the concentrated extract is injected into a HRGC/HRMS system capable of performing selected ion monitoring at resolving powers of at least 10,000 (10 percent valley definition).

Uncontrolled Copy
Will not be updated

2.6 The congeners associated directly with C13 labeled standards are identified based on the elution of the congeners at the same retention times as their respective labeled standards. The remaining congeners for which C13 labeled standards are not present are identified when their retention times fall within the windows established during routine calibration. All congeners are also identified based on the simultaneous detection of the two most abundant ions as well as the comparison of the ratio of these two ions with theoretical ion abundance ratios.

2.7 Quantitation of the individual congeners, total PCDDs, and total PCDFs is achieved in conjunction with the establishment of a multipoint (five point) calibration curve for each homolog, during which each calibration solution is analyzed once.

3.0 DEFINITIONS

3.1 Abbreviations

PCDD	=	Polychlorinated dibenzo-*p*-dioxin
PCDF	=	Polychlorinated dibenzofuran
TCDD	=	Tetrachlorodibenzo-*p*-dioxin
PeCDD	=	Pentachlorodibenzo-*p*-dioxin
HxCDD	=	Hexachlorodibenzo-*p*-dioxin
HpCDD	=	Heptachlorodibenzo-*p*-dioxin
OCDD	=	Octachlorodibenzo-*p*-dioxin
TCDF	=	Tetrachlorodibenzofuran
PeCDF	=	Pentachlorodibenzofuran
HxCDF	=	Hexachlorodibenzofuran
HpCDF	=	Heptachlorodibenzofuran
OCDF	=	Octachlorodibenzofuran
PFK	=	Perfluorokerosene
CS	=	Clean up standard
IS	=	Internal standard
RS	=	Recovery standard
HRGC	=	High-resolution gas chromatography
HRMS	=	High-resolution mass spectrometry
TEF	=	Toxicity equivalence factor
TEQ	=	Toxicity equivalent

3.2 Polychlorinated dibenzo-p-dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) – compounds that contain from 1 to 8 chlorine atoms, resulting in a total of 75 PCDDs and 135 PCDFs. The structures are shown in Figure 1. The fifteen 2,3,7,8-

Uncontrolled Copy
Will not be updated

substituted PCDDs/PCDFs are shown in Table 2. The number of isomers at different chlorination levels are shown in Table 3.

3.3 **Isomer –** compounds having the same number and type of chlorine atoms, but substituted in different positions.

3.4 **Internal Standard Solution–** a solution containing the isotopically labeled analogs that is added to all samples, including method blanks and quality control samples, before extraction. The labeled standards are used along with response factors to measure the concentrations of the analytes. Nine PCDD/PCDF internal standards are used in this method (Table 9).

3.5 **Calibration Solutions** – solutions containing known amounts of unlabeled PCDDs/PCDFs and labeled standards (Table 4). The set of 5 solutions is used to determine the instrument response of the unlabeled analytes relative to the C13 labeled standards.

3.6 **Recovery Standard Solution** – a solution containing the recovery standards that are added to the extract after final concentration for HRGC/HRMS analysis to determine the recovery efficiencies achieved for the C13 labeled standards (Table 9).

3.7 **Clean Up Standard Solution** – a solution containing one Cl37 labeled standard that is to be spiked to the sample extract prior to performing any clean up procedures (Table 9).

3.8 **Matrix Spike Solution –** a solution of native (unlabeled) PCDDs and PCDFs that are spiked into the laboratory control samples or matrix spike samples prior to extraction (Table 9).

3.9 **Method Blank (MB)** – represents the background contributions from glassware, extraction and clean up solvents. An MB is spiked with a solution of C13 labeled internal standards, extracted, cleaned up, and analyzed by HRGC/HRMS in exactly the same manner as the test samples.

4.0 INTERFERENCES

4.1 Solvents, reagents, glassware and other sample processing hardware may yield discrete artifacts or elevated baselines that may cause misinterpretation of the chromatographic data. All materials used during the extraction procedure must be demonstrated to be free from interferences under the conditions of analysis by performing laboratory method blanks. Analysts should avoid using polyvinylchloride gloves.

4.2 The use of high purity reagents and solvents helps minimize interference problems. Solvent lots are tested for the absence of PCDDs and PCDFs prior to use by the laboratory.

Uncontrolled Copy
Will not be updated

4.3 Interferences co-extracted from the sample will vary considerably from matrix to matrix. PCDDs and PCDFs are often associated with other interfering chlorinated substances such as polychlorinated biphenyls (PCBs), polychlorinated diphenyl ethers (PCDPEs), polychlorinated naphthalenes, and polychlorinated alkyldibenzofurans that may be found at concentrations several orders of magnitude higher than the analytes of interest. Retention times of target analytes must be verified using reference standards. These values must correspond to the established retention time windows. While clean up techniques are provided as part of this method, unique samples may require additional clean up steps to achieve lower detection limits.

4.4 A high-resolution capillary column (60m DB-5, J&W Scientific) is used in this method. However, no single column is known to resolve all isomers. The 60m DB-5 GC column is capable of 2,3,7,8-TCDD isomer specificity. In order to determine the concentration of the 2,3,7,8-TCDF (if detected on the DB-5 column), the sample extract must be reanalyzed on a column capable of 2,3,7,8-TCDF isomer specificity (30m DB-225).

5.0 SAFETY

5.1 The 2,3,7,8-TCDD and other 2,3,7,8-chlorine substituted isomers are toxic and can pose health hazards if handled improperly. Only highly trained individuals who are thoroughly versed in appropriate laboratory procedures and familiar with the hazards of dioxins should handle these substances.

5.2 The laboratory will ensure that all analysts receive adequate safety training prior to working with the chemicals and compounds associated with this method.

5.3 The solvents and acids in use in the laboratory may be hazardous and should be treated as such. See the *Environmental Health and Safety Manual*, ***CHP*** (Chemical Hygiene Plan), Section 5, for more information.

5.4 Finely divided dry soils contaminated with PCDDs and PCDFs are particularly hazardous due to the potential for inhalation and ingestion. Samples of this nature should be processed under a fume hood. Additionally, particulate masks should be worn to further protect these routes of entry.

5.5 The toxicity or carcinogenicity of each reagent used in this method is not precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be kept to a minimum.

5.6 A useful method for determining cleanliness of work surfaces and tools is to wipe the surface with a piece of filter paper, extract the filter paper and analyze the extract.

5.7 Thorough washing of hands and forearms after each handling of samples or extracts and before breaks (coffee, lunch, and shift) is recommended. Workers must be trained in the

Uncontrolled Copy
Will not be updated

proper method of removing contaminated gloves and clothing without contacting the exterior surfaces. Gloves must be one time use only.

5.8 Care must be taken when handling compressed gas tanks in the laboratory. All cylinders must be properly secured at all times. See Section 6 of the ***CHP*** for more information.

5.9 Plastic backed absorbent paper must be used on all bench tops.

5.10 Low-level contamination is always a possibility for HRGC/HRMS analysis due to the chemical properties of dioxins/furans and the low detection limits of the instruments.

6.0 SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1 Samples are typically delivered by a standard shipping service or by the client.

6.2 Samples are logged in to CAS LIMS and labeled for tracking through the laboratory. A cooler receipt form is filled out, cataloging any non-conformances associated with the receipt of the sample containers. See the SOP for *Sample Receiving*, ***SMO-WET,*** for a more detailed explanation.

6.3 **Storage and Holding Times -** All samples, except tissue samples, must be stored at 4°C in the dark, extracted within 30 days and completely analyzed within 45 days of extraction. Tissue samples must be stored at -20 to -10°C in the dark, extracted within 30 days and completely analyzed within 45 days of collection. Whenever samples are analyzed after the holding time expiration date, the results should be considered to be minimum concentrations and should be identified as such.

NOTE: The holding times listed in this method are recommendations. PCDDs and PCDFs are very stable in a variety of matrices, and holding times may be as high as a year for certain matrices. Sample extracts, however, should always be analyzed within 45 days of extraction.

6.4 Tissue samples must be shipped on dry ice and arrive at <0°C.

6.5 Before extraction, a visual inspection of a sample is done. Aqueous samples deemed to have greater than 1% solids are filtered unless otherwise specified by the client. Solid samples are homogenized thoroughly prior to aliquotting. See the SOP for *Subsampling and Compositing Aqueous and Soil Samples*, ***WET-SSMP***, for more information.

7.0 APPARATUS AND EQUIPMENT

7.1 **High-Resolution Gas Chromatograph/High-Resolution Mass Spectrometer/Data System (HRGC/HRMS/DS) –** The GC must be equipped for temperature programming, and all required accessories must be available, such as syringes, gases, and capillary columns.

Uncontrolled Copy
Will not be updated

7.1.1 GC Injection Port – The GC injection port must be designed for capillary columns. The use of splitless injection techniques is recommended. On column 1µL injections can be used on the 60m DB-5 column. The use of a moving needle injection port is also acceptable. When using the method described in this protocol, a 1µL injection volume is used consistently (i.e., the injection volumes for all extracts, blanks, calibration solutions and the performance check samples are 1µL).

7.1.2 Gas Chromatograph/Mass Spectrometer (GC/MS) Interface – The GC/MS interface components should withstand 350°C. The interface must be designed so that the separation of 2,3,7,8-TCDD from the other TCDD isomers achieved in the gas chromatographic column is not appreciably degraded. Cold spots or active surfaces (adsorption sites) in the GC/MS interface can cause peak tailing and peak broadening. It is recommended that the GC column be fitted directly into the mass spectrometer ion source without being exposed to the ionizing electron beam.

7.1.3 Mass Spectrometer – The static resolving power of the instrument must be maintained at a minimum of 10,000 (10 percent valley).

7.1.4 Data System – A dedicated data system is employed to control the rapid multiple-ion monitoring process and to acquire the data. Quantitation data (peak areas or peak heights) and selected ion monitoring (SIM) traces (displays of intensities of each ion signal being monitored including the lock-mass ion as a function of time) must be acquired during the analyses and stored. Quantitations may be reported based upon computer generated peak areas or upon measured peak heights (chart recording). The data system must be capable of acquiring data at a minimum of 10 ions in a single scan. It is also recommended to have a data system capable of switching to different sets of ions (descriptors) at specified times during an HRGC/HRMS acquisition. The data system should be able to provide hard copies of individual ion chromatograms for selected gas chromatographic time intervals. It should also be able to acquire mass spectral peak profiles and provide hard copies of peak profiles to demonstrate the required resolving power. The data system should permit the measurement of noise on the base line.

7.1.5 Micromass MassLynx (Version 4.1) is used to obtain all data from the HRMS system. CAS/Houston employs the following HRGC/HRMS systems:

7.1.5.1 An Agilent 6890N Gas Chromatograph with a CTC A200S Autosampler interfaced to a Micromass Autospec Ultima High Resolution Mass Spectrometer.

7.1.5.2 An Agilent 6890N GC with a CTC A200S Autosampler interfaced to a Micromass Autospec Ultima HRMS.

Uncontrolled Copy
Will not be updated.

7.1.5.3 An Agilent 7890A GC with a CTC A200S Autosampler interfaced to a Micromass Autospec Premier HRMS.

7.1.5.4 An Agilent 7890A GC with a CTC A200S Autosampler interfaced to a Micromass Autospec Premier HRMS.

7.2 GC Columns

7.2.1 In order to have an isomer specific determination for 2,3,7,8-TCDD and to allow the detection of OCDD/OCDF within a reasonable time interval in one HRGC/HRMS analysis, use of the 60m DB-5 fused silica capillary column is recommended (J&W Scientific, Agilent 122-5062 or equivalent). Minimum acceptance criteria must be demonstrated and documented. At the beginning of each 12 hour period (after mass resolution and GC resolution are demonstrated) during which sample extracts or concentration calibration solutions will be analyzed, column operating conditions must be attained for the required separation on the column to be used for samples. Isomer specificity for all 2,3,7,8-substituted PCDDs/PCDFs cannot be achieved on the 60m DB-5 GC column alone. In order to determine the proper concentrations of the individual 2,3,7,8-substituted congeners, the sample extract must be reanalyzed on another GC column that resolves the isomers (30m DB-225 fused silica capillary column, J&W Scientific, Agilent 122-2232 or equivalent).

7.3 Soxhlet/ASE Apparatus – The laboratory will be equipped with a macro and/or micro soxhlet apparatus. CAS/Houston uses a series of four (4) Combo Mantles (Glas-Col, 100D RJ30012, with Glas-Col, 104A RL3612 controllers) and a series of twenty-four (24) individual mantles (Glas-Col, TM106, with Glas-Col 104A PL120 PowrTrol and PL-312 and PL-3122 MiniTrol controllers) for the soxhlet apparatus. The combination mantles are designed for 250mL flasks (24/40, VWR, 89000-330), soxhlets (24/40 and 45/50, HGF Scientific), and condensers (45/50, HGF Scientific). The individual mantles are designed for 500mL flasks (24/40, VWR, 89000-334), soxhlets (24/40 and 55/50, HGF Scientific), and condensers (55/50, HGF Scientific). The condensers are connected to a chiller capable of maintaining a chilled temperature to ensure proper solvent reflux. Additionally, if an ASE apparatus (Dionex, ASE200) is to be employed, it must be capable of being pre-programmed to allow for automatic sample extraction at temperature and pressure settings unique to the extraction solvent. Other EPA approved extractors may be used instead.

7.4 Miscellaneous Equipment and Materials – The following list of items does not necessarily constitute an exhaustive compendium of the equipment needed for this analytical method (CAS/Houston equipment in parentheses).

7.4.1 Balances capable of accurately weighing to 0.001g (Denver, XE Series 300, Mettler, AJ100, and Mettler Toledo, PG603-S)
7.4.2 Centrifuge (Clay Adams Dynac, 0101)

Uncontrolled Copy
Will not be updated

7.4.3 Drying oven (VWR Utility Oven, Model 1305U and Blue M Electric, C4855Q)
7.4.4 250mL polypropylene beaker (Fisher, 01-291-5)
7.4.5 20mL scintillation vials (VWR, 66022-004)
7.4.6 Laboratory fume hoods
7.4.7 Pipets, disposable, Pasteur, 150mm long x 5mm ID (VWR, 14673-010)
7.4.8 Pipets, disposable, serological, 10mL (Fisher, 13-676-34D)
7.4.9 Pipet tips, 2-200uL and 10-1000uL (Eppendorf, 022492039 and 022492055, respectively)
7.4.10 Commercial food preparation machine (Hobart, HCM62)
7.4.11 PTFE boiling chips (VWR, 36397-103)

NOTE: Teflon boiling chips may float in methylene chloride, may not work in the presence of any water phase, and may be penetrated by nonpolar organic compounds.

7.4.12 Glass fiber filters, Whatman filter grade (Whatman Grade 1 90mm, 1001 090, VWR 110mm, 28310-081, and other varying sizes and particle retentions)
7.4.13 2-liter screw top clear jars (C&G Containers, LFW0642000)
7.4.14 Rotary evaporator with a temperature controlled water bath (Buchi, Rotavapor R-200 with Heating Bath B-490 and Rotavapor 201 with Heating Bath B-491)
7.4.15 Glass wool (EMD, EM-GX0090-2)
7.4.16 Jars, clear glass, 250mL, with Teflon lined screw caps (C&G, LFA0082000)
7.4.17 Volumetric flasks, Class A – 5mL to 10mL
7.4.18 Auto sampler vials with 150µL inserts (Restek, 24653)
7.4.19 Glass columns – 12mm diameter x 12in long (HGF Scientific specialty product)
7.4.20 Glass columns – 20mm diameter x 12in long with one tapered end (HGF Scientific specialty product)
7.4.21 Shaker (for 2L jar, Eberbach Model 6000)
7.4.22 GC Gooseneck Splitless Liners, 2mm inner diameter (Restek, 20797)
7.4.23 Thermogreen™ LB-2 11mm Septa (Supelco, 20654)
7.4.24 Autosampler Vial Caps, Seal with PTFE Liner, 11mm (Supelco, 27102-U)
7.4.25 Carrier Gas, Ultra High Purity Helium (Airgas)
7.4.26 Perfluorokerosene (PFK) (SynQuest, SpectraSynQ PKF-H, PN 1200-2-20)
7.4.27 Tumbler
7.4.28 Ultrasonicator (Bransonic Ultrasonic Cleaner, 5510R-MT)
7.4.29 Supeltex™ M-2A Ferrules 0.4mm ID (Supelco, 22474)
7.4.30 Nitrogen Evaporator with a temperature controlled heating mantle (Zanntek, ZipVap #109A Custom)
7.4.31 OASIS HLB 3cc (60mg) SPE Cartridges (Waters, WAT094226)
7.4.32 Vacuum Manifold Apparatus
7.4.33 Muffle Furnace (Blue-M/Lindberg, LGO Element Box Furnace, BF51842-P-BC)

8.0 STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

Uncontrolled Copy
Will not be updated

8.1 All standards, reagents, and consumable materials must be logged in and numbered when delivered. Details of all dilutions of standards must also be entered in the Dioxin Standards Logbook. Store standards in the dark at room temperature.

8.2 **Organic-free reagent water** – All references to water in this method refer to organic-free reagent water. CAS/Houston uses the water supplied from our bottled water supplier as the source of the organic-free reagent water used in the preparation of quality control samples and standards.

8.3 **Carbon 120-440 mesh (Supelco Envi-Carb, 57210-U, or equivalent)** – weigh 0.400 – 0.425g into 20mL scintillation vials and activate by heating at or above 140°C for three hours.

8.4 **Silica gel, high purity grade, type 60, 70-230 mesh (JT Baker, JT3405-05)** – Activate overnight at a minimum temperature of 120°C. Store in a glass bottle sealed with Teflon lined screw cap.

8.5 **Silica gel impregnated with Sodium Hydroxide** – Add one part (by weight) of 1M NaOH solution to two parts (by weight) activated silica gel in a Teflon lined screw cap bottle and mix with a glass rod until free of lumps.

8.6 **Silica gel impregnated with Sulfuric Acid** – Add one part (by weight) concentrated sulfuric acid to two parts (by weight) activated silica gel in a Teflon lined screw cap bottle and mix with a glass rod until free of lumps.

8.7 **Extraction thimbles, 43mm x 123mm and 33mm x 80mm (VWR, 28320-510 and 27730-128, respectively)**

8.8 **Sulfuric Acid, concentrated, ACS grade (EMD, EM-SX1244-75)**

8.9 **Sand, quartz (VWR, BDH0274-2.5kg)**

8.10 **Sodium Sulfate, granular, anhydrous (EMD, EM-SX0760E-20) –** Activate for four hours at a temperature of 400°C. Store in a glass bottle sealed with a Teflon lined screw cap.

8.10.1 Fill ceramic crucibles with sodium sulfate and place in the muffle furnace. Add 5-10g sand to an empty crucible and place in the muffle furnace.

8.10.2 The temperature program is set to ramp up to 400°C then hold that temperature for four hours. Start the program by holding the "**P**" button until "**Pnr 4**" appears on the controller. Press "**Run/Hold**." To cancel a program, press the up and down arrows simultaneously. At the end of the program the furnace will cool by convection.

Uncontrolled Copy
Will not be updated

8.10.3 When the sodium sulfate is ready to remove, transfer it to 2-liter jars and label them with the preparation date, analyst name, and lot number of the sodium sulfate. Make an entry into the Semi-Volatile Na_2SO_4 Preparation Logbook containing the preparation date, analyst name, quantity prepared, sodium sulfate lot number, and whether the run passed or failed (as indicated by a color change in the sand from gray to pink/orange).

8.10.4 If the sodium sulfate has a noticeable grayish cast, it must be discarded.

8.11 Sodium Chloride, analytical reagent grade, 5 percent (w/v) in water (VWR, VW6430-5)

8.12 Sodium Hydroxide, 1N (VWR, 3222-4)

8.13 Solvents

8.13.1 Methylene Chloride – 99.9% minimum Assay (HPLC Grade, EMD, TXEMDX0831-1CA)
8.13.2 Hexane – 99.9% minimum Assay (HPLC Grade, EMD, TXEMH0296-1CA)
8.13.3 Methanol – 99.9% minimum Assay (HPLC Grade, EMD, MX0488P-1)
8.13.4 Nonane – 99.9% minimum Assay (HPLC Grade, Sigma, N29406-500mL)
8.13.5 Toluene – 99.9% minimum Assay (HPLC Grade, EMD, TX0737-1)
8.13.6 Tridecane – 99.9% minimum Assay (HPLC Grade, Sigma, T57401-100g)
8.13.7 Ethyl Acetate – 99.9% minimum Assay (HPLC Grade, EMD, EX0241-1)
8.13.8 Acetone – 99.9% minimum Assay (HPLC Grade, EMD, AX0116-1)

8.14 Standards Suppliers

8.14.1 Cambridge Isotope Laboratories (CIL) – Primary standards supplier

8.14.2 Wellington Laboratories – Secondary standards supplier

8.15 Purchase, Receipt, and Handling of Standards

8.15.1 All standards purchased from CAS/Houston must have an appropriate purchase request form filled out and have approval from the Laboratory Director or other qualified individual. They must then go through the CAS/Corporate Purchasing Department. Standards are considered consumable and do not need an Expenditure Authorization Request (EAR) even if the cost exceeds the threshold. See the SOP for *Purchasing and Approval of Vendors*, ***ADM-PUR***, for more information

8.15.2 Upon arrival, all packages containing high concentrations must be checked for damage. If any damage is present, consult with CAS/Houston Health and Safety

Uncontrolled Copy
Will not be updated

Officer before further steps are taken. Proper safety practices should be followed when handling received standards.

8.15.3 All received standards must be assigned a Dioxin Standards Logbook identification number. Copy the solution description from the certificate of analysis and attach to the space provided for the next entry in the logbook. The following format is applied: D(ioxin)[Logbook number]-[page number]-[entry number][method descriptor]. An example would be D11-32-1A, where the A indicates 8290.

8.15.4 Assign each standard an expiration date as noted by the supplier. This is usually ten years after the manufacture date. Record this in the standards logbook. A standard must be disposed of after this date unless its validity can be verified (Section 8.24.)

8.15.5 Record the identification number on the received vial label. Transfer the standard from the received ampoule to a 2mL amber vial, keeping the supplier label intact. Seal the vial with Teflon tape. This will ensure no deterioration will occur.

8.15.6 Record the identification number on the certificate of analysis received from the supplier and store this documentation in the "Standards" binder for future reference. Certificates of analysis are also available through the Cerilliant website, CIL's manufacturer.

8.15.7 All solutions must be adequately labeled with the logbook identification code, method, short solution description, preparation date, initials of person performing preparation, expiration date, volume and concentration. Logbook entries shall include all of the above with the addition of the list of components, the components' logbook identification code, description and concentration, plus the initials of the person witnessing the dilution steps.

8.16 High-Resolution Concentration Calibration Solutions – Five nonane solutions containing unlabeled and carbon-labeled PCDDs and PCDFs at known concentrations are used to calibrate the instrument. The concentration ranges are homolog dependent (Table 4). These are purchased pre-made and are assigned the manufacturer's expiration dates.

8.17 Window Defining/GC Column Performance Mix Solution – This solution contains the first and last eluting isomers for each homologous series from tetra- through heptachlorinated congeners. The solution also contains a series of other TCDD isomers for the purpose of documenting the chromatographic resolution. The labeled 2,3,7,8-TCDD and TCDF are also present (Table 6). This is purchased pre-made at 200ng/mL and is assigned the manufacturer's expiration date.

Uncontrolled Copy
Will not be updated

8.18 **Internal Standard Solution** – Individual labeled analytes are combined to make an internal standard stock solution. This stock solution is diluted with nonane to make the internal standard spiking solution (Table 9). Store at room temperature in the dark.

8.18.1 For making a stock solution; use an appropriately sized volumetric flask specific for the target compounds and add nonane. Add each individual analyte in succession, making sure to not cross-contaminate analytes or affect analyte concentrations. Assign the solution a logbook identification code and label the solution according to Section 8.15.7. When done, vortex for homogeneity and submit a 20µL aliquot to HRGC/HRMS for analysis. All analytes must be validated against an acceptance requirement of 20% of the target value. Document this analysis in the "Stock Solution Analysis" binder for future reference.

8.18.2 After stock solution verification, perform an additional dilution on the stock solution to create the working solution. This can be performed in a properly labeled 20mL amber vial. Use a certified Eppendorf pipet for volume measurements requiring precision below 0.1mL. No verification of the working solution is necessary. Document all steps in the standards logbook. Since dioxin and furan compounds are highly stable in controlled environments, it is acceptable to assign a five (5) year expiration date to all created stock solutions and a one (1) year expiration date to all created working standard solutions.

8.19 **Recovery Standard Solution** – Individual labeled analytes are combined to make a recovery standard stock solution. Perform an additional dilution on the stock solution to make a recovery standard working solution (Table 9). Store at room temperature in the dark.

8.20 **Clean Up Standard Solution** – The individual labeled analyte is used to make the clean up standard stock solution. Perform an additional dilution on the stock solution to make a clean up standard working solution (Table 9). Store at room temperature in the dark.

8.21 **Matrix Spiking Solution (target compounds)** – Individual target compounds are combined to make a matrix compound stock solution. Perform an additional dilution on the stock solution to make a matrix standard working solution (Table 9). Store at room temperature in the dark.

8.22 Reference Standards are to be purchased from a supplier other than the primary standard supplier. All reference standards must be segregated from primary standards during storage. Reference standards can only be used to verify primary standards and must not be used for samples. All reference standards must be documented in the standards logbook following Sections 8.15.3 – 8.15.7.

8.23 Research standards must be adequately labeled as such. In addition to Sec. 8.15.7, all labels for standards designated for research must also state specifically the intended

Uncontrolled Copy
Will not be updated

research to be done, along with an appropriate qualifier, such as "For research purposes only."

8.24 Standards approaching expiration can be verified for validity by following the requirements in the CAS *Policy for Standards and Reagents Expiration Dates*, (Sept. 28th, 2009).

9.0 PREVENTIVE MAINTENANCE

9.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument.

9.2 **Carrier gas -** Inline purifiers or scrubbers must be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.

9.3 Gas Chromatograph

9.3.1 Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, o-ring, septum, column ferrule, and auto sampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. Liners and seals may be cleaned and re-used.

9.3.2 Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column-cutting tool.

9.3.3 Over time, the column will exhibit poorer overall performance. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

9.4 Mass Spectrometer

9.4.1 Tune the MS as needed to result in consistent and acceptable performance.

9.4.2 The source should be cleaned, as needed, depending on the performance of the instrument.

9.5 Preventive maintenance is performed annually by the service engineer for instruments under a service contract.

Uncontrolled Copy
Will not be updated

10.0 RESPONSIBILITIES

It is the responsibility of the analyst to perform the analysis according to the instructions in this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are only to be performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data. Problems that require corrective action are to be documented by the analyst, and brought to the attention of the Operations Manager.

11.0 PROCEDURE FOR SAMPLE PREPARATION, EXTRACTION, CONCENTRATION AND CLEAN UP

11.1 Sample Preparation

11.1.1 Sample preparation involves modifying the physical form of the sample so that the dioxins/furans can be extracted efficiently. In general, the samples must be in a liquid form or in the form of finely divided solids in order for efficient extractions to take place. Table 1 lists the phases and suggested quantities for extraction of various sample matrices.

For all samples, the blank, Ongoing Precision and Recovery (OPR), and other QC sample aliquots must be processed through the same steps as the sample to check for contamination and losses in the preparation process.

11.1.2 Aqueous Sample Preparation – Preparation of samples assigned to the aqueous matrix class.

11.1.2.1 Aqueous samples are prepared using the procedure below and extracted using the extraction techniques in Section 11.2.1. This procedure is applicable for samples and QC aliquots.

11.1.2.2 Transfer the sample to the ½ gal. extraction vessel. Mark the original level of the sample on the sample container for reference.

11.1.2.3 For each batch of up to 20 samples to be extracted in the same shift, place three 1L aliquots of reagent water into clean ½ gal. extraction vessels. One of these will serve as the Method Blank, and the other two will serve as the Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS, if applicable).

11.1.3 Solid (Soil, Sediment, Paper Pulp) Sample Preparation – Preparation of samples assigned to the solid matrix class.

Uncontrolled Copy
Will not be updated

11.1.3.1 Solid samples are prepared using the procedure below and extracted using the extraction techniques in Section 11.2.2-3. This procedure is applicable for samples and QC aliquots.

11.1.3.2 Weigh a well-mixed aliquot of each sample sufficient to provide 10g of dry solids into a clean thimble.

11.1.3.3 For each batch of up to 20 samples to be extracted in the same shift, weigh three 10g aliquots of the reagent grade quartz sand (or sodium sulfate, if no sand is available) into clean thimbles. One of these will serve as the Method Blank, and the other two will serve as the Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS, if applicable).

11.1.3.4 Total Solids Determination. Record the weight of an empty, labeled scintillation vial on the bench sheet. Add 5-10g (wet weight) of the solid sample to the scintillation vial and record the new, combined weight. Place the vial in an oven at or above 110±5°C for a minimum of 24 hours. Finally, record the dry weight of the combination on the bench sheet. Calculate the percent solids using the following formula:

$$\%solids = \frac{w_a}{w_b} \times 100$$

Where: w_a = combined weight after drying, in g, minus the empty vial weight.
w_b = combined weight before drying, in g, minus the empty vial weight.

11.1.4 <u>Fish and Other Tissues</u> – Most tissue samples are received previously homogenized. If a sample is received that is not, however, the portion of the sample to be used for dioxin/furan determination must be established and the following procedure used for homogenization.

11.1.4.1 Tissue samples are prepared using the procedure below and extracted using the extraction techniques in Section 11.2.4. This procedure is applicable for samples and QC aliquots.

11.1.4.2 A minimum of 30g of tissue must be homogenized to ensure there is enough sample for dioxin/furan and lipid determination (with enough left over in case re-extraction is necessary). Additionally, the weight should be increased for samples requiring additional analyses.

11.1.4.3 Homogenize the sample according to the procedures in the SOP for *Tissue Preparation*, ***WET-TISP***. Transfer to a new, labeled sample

Uncontrolled Copy
Will not be updated

container with a Teflon-lined cap. Store at -20 to -10°C and in the dark until analysis.

11.1.4.4 Weigh approximately 10g (20g if lipid analysis is requested) of the homogenized tissue into a clean thimble.

11.1.4.5 For each batch of up to 20 samples to be extracted in the same shift, weigh three 10g aliquots of contaminant free tissue or corn oil into clean thimbles. One of these will serve as the Method Blank, and the other two will serve as the Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS, if applicable).

To ensure the material used for QC samples is free of target compounds, homogenize and extract the material following the steps in Sections 11.1.4.1-11.1.4.4 and 11.2.4. Analyze the extracts on the HRGC/HRMS machines to verify no dioxins/furans are present. Once determined, the blank material can be used for QC samples. If contamination is present, however, the entire lot of material must be properly disposed of and another lot obtained.

11.1.5 Fuel Oil/Chemical

11.1.5.1 Fuel Oil/Chemical samples are prepared using the procedure below and cleaned up using the techniques in Section 11.3. This procedure is applicable for samples and QC aliquots.

11.1.5.2 Extract sample by weighing 1g of sample into a tared 250mL jar and combining with 60mL hexane. Sample is ready for clean up.

11.1.5.3 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet.

11.1.5.4 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2 Extraction and Concentration

11.2.1 Extraction of Aqueous Samples – Aqueous samples are to be extracted using a modified separatory funnel procedure. The primary difference is that the vessel is a glass jar with a Teflon-lined cap that is disposable. This greatly reduces cross-contamination.

Uncontrolled Copy
Will not be updated

11.2.1.1 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet.

11.2.1.2 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS or MS/DMS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2.1.3 If the sample contains greater than 1% suspended solids, it must be filtered using a Buchner funnel and vacuum apparatus. The filter and solids must be extracted following Sections 11.2.2.4-11.2.2.5 and combined with the filtrate extraction from Sections 11.2.1.4-11.2.1.5.

11.2.1.4 Add 100mL dichloromethane to the spiked sample in the ½ gal. extraction vessel. Vent the vapors under a fume hood by shaking for a few seconds then unsealing the cap. Repeat this process until pressure no longer builds in the vessel. Extract the sample by shaking the jar manually or on an automatic shaker for 3 minutes. Allow the layers to separate for 10 minutes and transfer the dichloromethane layer (bottom) into an appropriately labeled 250mL jar. If an emulsion layer forms, employ mechanical techniques (ultrasonic bath, centrifugation) to complete the phase separation.

11.2.1.5 Extract the sample with an additional 50mL aliquot of dichloromethane. Following extraction, remove any excess water from the dichloromethane portion by swirling the sample extract and removing the water that collects on top.

11.2.1.6 Add 750µL of tridecane and let evaporate until near dryness under a fume hood utilizing a fan. An alternate evaporation technique is to transfer the extract to a 500mL boiling flask, add boiling chips and 750µL of tridecane, and concentrate the extract using a rotary evaporator (with heating bath at 45-50°C) to near dryness. Add 60mL hexane. Sample is now ready for clean up.

11.2.1.7 Sample Volume Determination. Following extraction, using tap water, refill the sample container to the line marked in Section 11.1.2.2. Measure the volume of this water using a calibrated graduated cylinder and record on the extraction bench sheet.

11.2.2 <u>Soxhlet Extraction of Solid Samples</u> – Solid samples are to be extracted using either a soxhlet extraction apparatus or an Accelerated Solvent Extractor (ASE). Choosing which apparatus to use is at the discretion of the analyst; however, the ASE should only be used for low percent moisture samples.

Uncontrolled Copy
Will not be updated

11.2.2.1 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet. Allow the samples to equilibrate for 1 to 2 hours.

11.2.2.2 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2.2.3 Add 10-20g anhydrous sodium sulfate to each thimble containing the sample and mix thoroughly to evenly distribute the sodium sulfate. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained.

11.2.2.4 Transfer thimble to soxhlet extractor fitted with a 500mL boiling flask containing 240mL toluene and boiling chips. Alternatively, the micro-soxhlet apparatus utilizes a smaller set up, thus requiring only 125mL toluene and boiling chips to be added to a 250mL boiling flask.

11.2.2.5 Place the soxhlet apparatus onto a boiling mantle/condenser combination and reflux overnight (16-24 hours). Solvent must cycle 5 times per hour minimum (controller set at “6” or “60%”).

11.2.2.6 Cool the extraction apparatus. Transfer to a 250mL jar, add 750µL of tridecane, and let evaporate until near dryness under a fume hood utilizing a fan. An alternate evaporation technique is to keep the extract in the 500mL boiling flask, add boiling chips and 750µL of tridecane, and concentrate the extract using a rotary evaporator (with heating bath at 65°C) to near dryness. Add 60mL hexane. Sample is now ready for clean up.

11.2.3 <u>ASE Extraction of Solid Samples</u> – Solid samples are to be extracted using either a soxhlet extraction apparatus or an Accelerated Solvent Extractor (ASE). Choosing which apparatus to use is at the discretion of the analyst; however, the ASE should only be used for low percent moisture samples.

CAS/Houston uses a Dionex ASE200 Extractor. Other EPA approved extractors may be used instead.

11.2.3.1 Label stainless steel ASE cells accordingly. Add a frit to each cell and cover with a small amount of sodium sulfate.

11.2.3.2 Rather than adding sample/spiking solution to a clean thimble, instead add sample to a clean beaker to record weight. Add 10-20g sodium

Uncontrolled Copy
Will not be updated

sulfate, spike with 100µL internal standard spiking solution at 10-50ng/mL (Table 9), and mix thoroughly to evenly distribute the sodium sulfate. Record the standard addition on the bench sheet. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained. Transfer sample to ASE cell. Top with sodium sulfate.

11.2.3.3 Label 60mL collection vials and position both the cell and 60mL collection vial in corresponding locations on the trays. Double check to ensure each cell position matches their respective vial position.

11.2.3.4 Check the toluene reservoir and fill if low. Check the nitrogen tank level. If low, replace the tank. Use safety precautions when handling the gas tanks.

11.2.3.5 To start the ASE: Press "Menu," "Load Method," "Number 1," and "Start" on the screen. All methods and schedules are pre-programmed based on Dionex recommendations for the solvents used, and can be found in the appropriate maintenance logbook.

11.2.3.6 Transfer to a 250mL jar, add 750µL of tridecane and let evaporate until near dryness under a fume hood utilizing a fan. An alternate evaporation technique is to transfer the extract to a 500mL boiling flask, add boiling chips and 750µL of tridecane, and concentrate the extract using a rotary evaporator (with heating bath at 65°C) to near dryness. Add 60mL hexane. Sample is now ready for clean up.

11.2.4 Soxhlet Extraction of Tissue Samples – Tissue samples are to be extracted using a soxhlet extraction apparatus.

11.2.4.1 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet. If lipid determination is to be performed on a sample, spike 200µL of the internal standard spiking solution.

11.2.4.2 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2.4.3 Add 20-30g anhydrous sodium sulfate to each thimble containing the sample and mix thoroughly to evenly distribute the sodium sulfate. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained.

Uncontrolled Copy
Will not be updated

11.2.4.4 Transfer thimble to soxhlet extractor fitted with a 500mL boiling flask containing boiling chips and 300mL of a 1:1 mixture of hexane/dichloromethane. Alternatively, the micro-soxhlet apparatus utilizes a smaller set up, thus requiring only 150mL of the 1:1 mixture to be added to a 250mL boiling flask.

11.2.4.5 Place the soxhlet apparatus onto a boiling mantle/condenser combination and reflux overnight (16-24 hours). Solvent must cycle 5 times per hour minimum (controller set at “4” or “40%”).

11.2.4.6 Cool the extraction apparatus. If lipid determination is to be performed, follow these steps, else, continue to Section 11.2.4.7. Weigh one 250mL jar and record on the bench sheet. Split the extract into two 250mL jars (with the extract for lipids determination added to the pre-weighed jar). Be sure to split the extracts evenly so as to ensure one half of the final extract is in each container. Dry the extract in the pre-weighed jar to complete dryness and record the weight on the bench sheet. Calculate the percent lipids using the following equation:

$$\%lipid = \frac{w_r}{w_t} \times 100$$

Where: w_r = weight of residue, in g, measured as the difference in the jar prior to adding the sample and following concentration.
w_t = weight of tissue, in g.

The un-weighed jar and extract is to be used for target compound determination and should be concentrated following the procedure in Section 11.2.4.7 below.

11.2.4.7 Cool the extraction apparatus. Transfer to a 250mL jar, add 750µL of tridecane, and let evaporate until near dryness under a fume hood utilizing a fan. An alternate evaporation technique is to keep the extract in the 500mL boiling flask, add boiling chips and 750µL of tridecane, and concentrate the extract using a rotary evaporator (with heating bath at 45-50°C) to near dryness. Add 60mL hexane. Sample is now ready for clean up.

11.2.5 Solid Phase Extraction (SPE) of Blood Serum – Blood serum samples are to be extracted using SPE cartridges. Handle denatured blood only. If blood does not arrive denatured, consult the Health and Safety Officer prior to proceeding.

11.2.5.1 Measure the volume of the sample and record on the bench sheet. For each batch of up to 20 samples to be extracted in the same shift, measure three 45mL aliquots of the reagent grade water into clean 50mL

Uncontrolled Copy
Will not be updated

centrifuge vials. One of these will serve as the Method Blank, and the other two will serve as the Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS, if applicable).

11.2.5.2 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet. If lipid determination is to be performed on a sample, spike 200µL of the internal standard spiking solution.

11.2.5.3 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2.5.4 Assemble the vacuum manifold apparatus and attach one appropriately labeled SPE cartridge per sample. Turn the vacuum on to approximately 5-10psi. Activate the cartridges by filling with methanol twice, then reagent grade water twice. Discard methanol and water rinses, and turn the vacuum off.

11.2.5.5 Pour the samples and QCs into the cartridges and rinse with 5mL reagent grade water. Add rinses to cartridges. Rinse the cartridges two additional times with 5mL reagent grade water.

11.2.5.6 Turn the vacuum on and allow the cartridges to dry for a minimum of sixty minutes. Elute the target compounds and labeled standards with approximately 20mL hexane into scintillation vials. Samples are ready for silica gel clean up (Section 11.3.2).

11.3 Extract Clean Up – For some aqueous samples and all tissue and solid samples, back extraction with sulfuric acid is necessary to remove the presence of interferences. The presence of color in an aqueous sample determines if back extraction is necessary. If it is not, proceed directly to the silica gel clean up procedure in Section 11.3.2. Spike all samples, including QC samples, with 100µL of the labeled clean up standard spiking solution at 8ng/mL (Table 9) prior to performing any extract clean up procedures.

11.3.1 <u>Sulfuric Acid Clean Up</u>

11.3.1.1 Partition the extract against 10mL sulfuric acid. Shake for 30 seconds minimum with periodic venting into a hood. Remove and discard the acid (bottom) layer. Repeat the acid washings until no color is visible in the hexane layer, up to a maximum of four washings.

Uncontrolled Copy
Will not be updated

11.3.1.2 Partition the extract against 10mL sodium chloride solution and shake in the same way as with the acid. Remove and discard the aqueous (bottom) layer.

11.3.1.3 Add 750µL of tridecane and concentrate the extract by air drying under a fume hood to near dryness. Proceed with the silica gel and carbon clean up procedure.

11.3.2 Silica Gel and Carbon Clean Up

11.3.2.1 Pack the 12mm glass column as follows: Insert a ~1cm (approximately 1cm) long glass wool plug to a depth of ~10cm into the column. Remove the pre-weighed, activated carbon from the oven, and add ~5mL toluene. Cool-down is not necessary. Transfer the slurry to the glass column and allow the carbon to settle. Allow the toluene to completely drain. Insert another ~1cm long glass wool plug into the column. Push the carbon/glass wool combination down until there is ~10cm of free space. Elute with ~10mL dichloromethane then ~10mL hexane. Check the column for channeling. If channeling is observed, discard the column. Do not tap a wetted column. Flip the column 180 degrees so that the smaller end is facing down.

11.3.2.2 Pack the tapered glass column as follows: Insert a glass wool plug into the bottom of the column. Place ~2g activated neutral silica gel into the column. Add ~3g activated sodium hydroxide infused silica gel, ~6g activated sulfuric acid infused silica gel, and ~3g anhydrous sodium sulfate. Tap the column gently after each addition to settle the silica gel. Elute with ~30mL hexane. Check the column for channeling. If channeling is observed, discard the column. Do not tap a wetted column.

11.3.2.3 Place the silica gel column in the upper clamp of the clean up apparatus and the carbon column on the lower clamp. Gently connect the two columns, making sure to not create a seal. The column is now ready to load the sample extract. Do not allow the column to go dry at any time throughout this process.

11.3.2.4 Add ~2mL hexane to the sample extract. Transfer the 2mL extract to the silica gel column and allow the solvent to elute until the extract level is at the top of the sodium sulfate.

11.3.2.5 Rinse the 250mL jar containing the extract with ~25mL hexane and load the rinsate onto the silica gel column. Allow the hexane to elute until the solvent level is at the top of the sodium sulfate.

Uncontrolled Copy
Will not be updated

11.3.2.6 Slowly add ~25mL hexane to the silica gel column, allowing the hexane to pass through the column using a gravity feed. Add three more ~25mL portions to each column, as space permits. The total volume of hexane eluant is ~100mL per column clean up.

11.3.2.7 Remove and discard the used silica gel column when the drip from the carbon column stops. Flip the carbon column. Elute the column with ~10mL dichloromethane, then ~10mL of 1:1 ethyl acetate/hexane. Dispose all solvents used up until this point.

11.3.2.8 Place a labeled 20mL scintillation vial in the rack under the carbon column and elute with a total of ~20mL toluene. Be sure to collect the toluene, as this eluant contains the target compounds. Allow the extract to evaporate to complete dryness under the hood.

11.3.2.9 Add 400µL hexane to the scintillation vial. Add 20µL toluene to the auto sampler vial. Shake and transfer the extract to the auto sampler vial. Allow to evaporate halfway to dryness, under the fume hood. Add another 400µL hexane to the scintillation vial. Cap, vortex, and transfer to the respective auto sampler vial. Repeat this process once more, for a total of three rinses. Allow the sample to evaporate to near dryness under the fume hood. An optional evaporation technique is to concentrate using a nitrogen evaporator with the heating mantle set at 55-60°C.

11.3.2.10 The sample extract is ready to be spiked with 20µL of the recovery standard at 50ng/mL (Table 9.)

12.0 PROCEDURE FOR HRGC/HRMS ANALYSIS AND CALIBRATION

12.1 Chromatographic/Mass Spectrometric Conditions and Data Acquisition Parameters

12.1.1 Gas Chromatograph

Column coating: DB-5
Film thickness: 0.25µm
Column dimension: 60 m x 0.25mm
Injector temperature: 300°C
Splitless valve time: 1 min
Interface temperature: 300°C
Temperature program:

Uncontrolled Copy
Will not be updated

DB-5 STAGE	INITIAL TEMP °C	INITIAL HOLD TIME, MIN	TEMPERATURE RAMP, °C/MIN	FINAL TEMP °C	FINAL HOLD TIME, MIN
1	150	5	35	215	5
2			1.5	230	6
3			7	315	5

Column coating: DB-225
Film thickness: 0.25µm
Column dimension: 30 m x 0.25mm
Injector temperature: 290°C
Splitless valve time: 1 min
Interface temperature: 300°C
Temperature program:

DB-225 STAGE	INITIAL TEMP °C	INITIAL HOLD TIME, MIN	TEMPERATURE RAMP, °C/MIN	FINAL TEMP °C	FINAL HOLD TIME, MIN
1	130	2.5	40	170	0
2			5	210	1
3			3	240	13

12.1.2 Mass Spectrometer

12.1.2.1 The mass spectrometer must be operated in a selected ion monitoring (SIM) mode with a total cycle time (including the voltage-reset time) of one second or less. At a minimum, the ions listed in Table 5 for each of the five SIM descriptors must be monitored. Note that with the exception of the last descriptor (OCDD/OCDF), all descriptors contain 10 ions. The selection (Table 5) of the molecular ions M and M+2 for $^{13}C_{12}$-HxCDF and $^{13}C_{12}$-HpCDF rather than ^{13}M+2 and ^{13}M+4 (for consistency) was made to eliminate, even under high-resolution mass spectrometric conditions, interferences occurring in these two ion channels for samples containing high levels of native HxCDDs and HpCDDs. It is important to maintain the same set of ions for both calibration and sample extract analyses. The selection of the lock-mass ion is left to the analyst.

NOTE: At the option of the analyst, the tetra- and pentachlorinated dioxins and furans can be combined into a single descriptor.

12.1.2.2 The recommended mass spectrometer tuning conditions are based on the groups of monitored ions shown in Table 5. By using a PFK molecular leak, tune the instrument to meet the minimum required resolving power of 10,000 (10% valley) at m/z 304.9824 (PFK) or any other reference signal close to m/z 303.9016 (from TCDF). By using peak matching

Uncontrolled Copy
Will not be updated

conditions and the aforementioned PFK reference peak, verify that the exact mass of m/z 380.9760 (PFK) is within 5 ppm of the required value. Note that the selection of the low mass and high mass ions must be such that they provide the largest voltage jump performed in any of the five mass descriptors.

12.2 Data Acquisition/Calibration

12.2.1 The total cycle time for data acquisition must be <1 second. The total cycle time includes the sum of all the dwell times and voltage reset times.

12.2.2 Acquire SIM data for all the ions listed in the five descriptors.

12.2.3 Initial Calibration – Initial calibration is required before any samples may be analyzed for PCDDs and PCDFs. Initial calibration is also required if any routine calibration does not meet the required criteria. All five high-resolution concentration calibration solutions must be used for the initial calibration. Tune the instrument with PFK.

12.2.4 Inject 1µL of the GC Window Define solution and acquire SIM mass spectral data. The laboratory must not perform any further analysis until it is demonstrated and documented that the column performance check criterion was met (Section 13.1.1.2).

12.2.5 By using the same GC and MS conditions that produced acceptable results with the Window Define solution, analyze a 1µL portion of each of the five concentration calibration solutions once with the following mass spectrometer operating parameters.

12.2.6 The ratio of integrated ion current (homologous series quantitation ions) must be within the indicated control limits (set for each homologous series) for all unlabeled calibration standards.

12.2.7 The ratio of integrated ion current for the ions belonging to the carbon-labeled internal and recovery standards must be within the acceptable control limits.

12.2.8 For each selected ion current profile (SICP) and for each GC signal corresponding to the elution of a target analyte and of its labeled standards, the signal-to-noise ratio (S/N) must be better than or equal to 10.0.

12.2.9 Calculate the 17 relative response factors (RF) for the target analytes [RF_n; n = 1-17, Table 10]. The response factors are relative to the target analytes and the RFs for the internal standards [RF_{is}; is = 18 to 26]. The response factors for the clean up standard [RF_{cs}, cs = 29] is also related to the recovery standard using the following equations:

Uncontrolled Copy
Will not be updated

$$RF_n = \frac{(A_n^1 + A_n^2) \times Q_{is}}{(A_{is}^1 + A_{is}^2) \times Q_n} \qquad RF_{is} = \frac{(A_{is}^1 + A_{is}^2) \times Q_{rs}}{(A_{rs}^1 + A_{rs}^2) \times Q_{is}}$$

$$RF_{cs} = \frac{A_{cs} \times Q_{rs}}{(A_{rs}^1 + A_{rs}^2) \times Q_{cs}}$$

Where:

A_n^1 and A_n^2 = sum of the integrated ion abundances of the quantitation ions for unlabeled PCDDs/PCDFs.

A_{is}^1 and A_{is}^2 = sum of the integrated ion abundances of the quantitation ions for the internal standard PCDDs/PCDFs.

A_{rs}^1 and A_{rs}^2 = sum of the integrated ion abundances of the quantitation ions for the labeled recovery standards.

A_{cs} = integrated ion abundance of the quantitation ion for the labeled clean up standard.

Q_{is} = quantity of the internal standard injected (pg).

Q_{rs} = quantity of the recovery standard injected (pg).

Q_{cs} = quantity of the clean up standard injected (pg).

Q_n = quantity of the unlabeled PCDD/PCDF analyte injected (pg).

The RF values are dimensionless quantities; the units used to express Q_{is}, Q_{rs}, Q_{cs} and Q_n must be the same.

12.2.10 Calculate the mean response factors for the five calibration solutions:

$$\overline{RF_n} = \frac{\sum_{j=1}^{5} RF_{n(j)}}{5} \qquad \overline{RF_m} = \frac{\sum_{j=1}^{5} RF_{m(j)}}{5}$$

Where:

n = The particular native congener (*n* = 1 to 17)

m = The particular labeled congener (*m* = 18 to 26)

j = The injection number (or calibration solution number; *j* = 1 to 5)

RF_n = relative response factor of a particular native compound (*n*) relative to an appropriate internal standard, as determined from each injection

$\overline{RF_n}$ = calculated mean relative response factor of a particular native compound (*n*) relative to an appropriate internal standard, as determined from the five initial calibration injections (*j*)

Uncontrolled Copy
Will not be updated

RF_m = relative response factor of a particular internal standard (*m*) relative to an appropriate recovery standard, as determined from each injection

$\overline{RF_m}$ = calculated mean relative response factor of a particular labeled standard (*m*) relative to an appropriate recovery standard, as determined from the five initial calibration injections (*j*)

12.2.12 The relative response factors to be used for the determination of the concentration of total isomers in a homologous series are calculated as follows:

12.2.12.1 For congeners that belong to a homologous series with only one isomer (e.g., OCDD and OCDF) or only one 2,3,7,8-substituted isomer (TCDD, PeCDD, HpCDD, and TCDF), the mean RF used will be the same as the mean RF for that single isomer.

NOTE: The calibration solutions do not contain $^{13}C_{12}$-OCDF as an internal standard. This is because a minimum resolving power of 12,000 is required to resolve the M+6 ion of $^{13}C_{12}$-OCDF from the M+2 ion of OCDD (and M+4 from $^{13}C_{12}$-OCDF with M of OCDD). Therefore, the RF for OCDF is calculated relative to $^{13}C_{12}$-OCDD.

12.2.12.2 For congeners that belong to a homologous series containing more than one 2,3,7,8-substituted isomer, the mean RF used for those homologous series will be the mean of the RFs calculated for all individual 2,3,7,8-substituted congeners using the equation below:

$$\overline{RF_k} = \frac{1}{t}\sum_{n=1}^{t} RFn$$

Where: k=27 to 30; with 27=PeCDF; 28=HxCDF; 29=HxCDD; and 30=HpCDF (Table 11)
t=total number of 2,3,7,8-substituted isomers present in the calibration solutions for each homologous series (e.g., two for PeCDF, four for HxCDF, three for HxCDD, two for HpCDF).

NOTE: Presumably, the HRGC/HRMS response factors of different isomers within a homologous series are different. However, this analytical protocol will make the assumption that the HRGC/HRMS responses of all isomers in a homologous series that do not have the 2,3,7,8-substitution pattern are the same as the responses of one or more of the 2,3,7,8-substituted isomer(s) in that homologous series.

12.2.13 <u>Criteria for Acceptable Calibration</u> – The criteria listed below for acceptable calibration must be met before sample analyses are performed.

Uncontrolled Copy
Will not be updated

12.2.13.1 The percent relative standard deviations for the mean response factors [$\overline{RF_n}$ and $\overline{RF_m}$] from the 17 unlabeled standards must not exceed ±20 percent, and those for the nine labeled reference compounds must not exceed ±30 percent.

12.2.13.2 The S/N for the GC signals present in every SICP (including the ones for the labeled standards) must be $\geq$10.

12.2.13.3 The ion abundance ratios must be within the specified control limits.

NOTE: If the criterion for acceptable calibration is met, the analyte specific RF can then be considered independent of the analyte quantity for the calibration concentration range. The mean *RF* values will be used for all calculations until the routine calibration criteria are no longer met. At such time, new mean *RF* values will be calculated from a new set of injections of the calibration solutions.

12.2.14 Secondary Source Verification – Immediately following the analysis of the five calibration solutions, analyze another standard at the midpoint of the calibration. This standard must be obtained from a secondary vendor. Calculate the response factors of all compounds and verify against the initial calibration results.

12.2.15 Routine Calibration (Continuing Calibration Check) – Routine calibrations must be performed at the beginning of a 12-hour period after successful mass resolution and GC resolution performance checks. A routine calibration is also required at the end of a 12-hour shift. Inject 1µL of the concentration calibration solution HRCC3 standard. By using the same HRGC/HRMS conditions, determine and document an acceptable calibration.

12.2.16 Criteria for Acceptable Routine Calibration - The following criteria must be met before further analysis is performed.

12.2.16.1 The measured response factors obtained during the routine calibration runs must be within the limits specified in Table 12.

12.2.16.2 The measured response factors for the internal and clean up standards obtained during the routine calibration runs must be within the specified limits in Table 12.

12.2.16.3 The ion abundance ratios must be within the allowed control limits (Table 7.)

12.2.16.4 If any one these criteria is not satisfied, perform corrective actions and repeat one more time. Document all maintenance in the instrument

Uncontrolled Copy
Will not be updated

maintenance logbook. If these criteria are still not satisfied, the entire routine calibration process must be reviewed and a root cause analysis must be performed. If the resulting corrective actions produce an acceptable calibration, sample analysis may continue. If the subsequent ending routine calibration passes, calibration is verified, else, all samples must be reanalyzed and further corrective action must be taken. Another initial calibration must be performed.

NOTE: While samples requiring Minnesota Department of Health (MDH) certification are in the laboratory, an HRCC1 must be analyzed monthly at a minimum to verify the reporting limit (Table 12).

Uncontrolled Copy
Will not be updated

12.3 Analysis

12.3.1 Remove the sample or QC extract from storage. Add 20µL of recovery standard at 50ng/mL (Table 9) to the final extract.

12.3.2 Inject a 1µL aliquot of the extract into the GC, operated under the conditions that have been established to produce acceptable results with the performance check solution.

12.3.3 Acquire SIM data – Use the same acquisition and mass spectrometer operating conditions previously used to determine the relative response factors.

NOTE: The acquisition period must at least encompass the PCDD/PCDF overall retention time window previously determined. Selected ion current profiles (SICP) for the lock-mass ions (one per mass descriptor) must also be recorded and included in the data package. These SICPs must be true representations of the evolution of the lock-mass ions amplitudes during the HRGC/HRMS run. The analyst may be required to monitor a PFK ion, not as a lock-mass, but as a regular ion, in order to meet this requirement. It is recommended to examine the lock-mass ion SICP for obvious basic sensitivity and stability changes of the instrument during the HRGC/HRMS run that could affect the measurements. Report any discrepancies in the case narrative.

12.3.4 Identification Criteria – For a gas chromatographic peak to be identified as a PCDD or PCDF, it must meet all of the following criteria:

12.3.4.1 Retention Times.

12.3.4.1.1 For 2,3,7,8-substituted congeners which have an isotopically labeled internal standard present in the sample extract, the retention time (RRT; at maximum peak height) of the sample components must be within -1 to +3 seconds of the internal standard. Congeners without an internal standard are identified

based on their retention time relative to the internal standard for that level of chlorination, within 0.005 retention time units, as determined by the routine calibration.

12.3.4.1.2 Identification of OCDF is based on its retention time relative to $^{13}C_{12}$-OCDD as determined from the daily routine calibration results.

12.3.4.1.3 For non-2,3,7,8-substituted compounds the retention time must be within the corresponding homologous retention time windows established by analyzing the GC Window Define solution.

12.3.4.1.4 The ion current responses for both ions used for quantitative purposes (e.g., for TCDDs: m/z 319.8965 and 321.8936) must reach maximum simultaneously (±2 seconds).

12.3.4.1.5 The ion current responses for both ions used for the labeled standards (e.g., for $^{13}C_{12}$-2,3,7,8-TCDD: m/z 331.9368 and m/z 333.9339) must reach maximum simultaneously (±2 seconds).

NOTE: The analyst is required to verify the presence of 1,2,8,9-TCDD and 1,3,4,6,8-PeCDF in the SICPs in the window defining mix. Should either one compound be missing, the analyst is required to take corrective action as it may indicate a potential problem with the ability to detect all the PCDDs/PCDFs.

12.3.4.2 Abundance Ratios. The integrated ion currents for the two ions used for quantitation purposes must have a ratio between the lower and upper limits established for the homologous series to which the peak is assigned (Table 7.)

12.3.4.3 Signal-to-Noise Ratio. All ion current intensities must be ≥2.5 times noise level for positive identification of a PCDD/PCDF compound or a group of coeluting isomers.

12.3.4.4 Polychlorinated Diphenyl Ether Interferences. In addition to the above criteria, the identification of a GC peak as a PCDF can only be made if no signal having a S/N≥2.5 is detected at the same retention time (±2 seconds) in the corresponding polychlorinated diphenyl ether channel. Compounds associated with a corresponding ether peak are assigned data qualifier flags to indicate the possible interference.

13.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

Uncontrolled Copy
Will not be updated

13.1 System Performance Criteria – System performance criteria are presented below. It must be documented that all applicable system performance criteria were met before analysis of any sample is performed. Figure 2 provides a typical 12-hour analysis sequence, whereby the response factors and mass spectrometer resolving power checks must be performed at the beginning and the end of each 12-hour period of operation. A GC column performance check is only required at the beginning of each 12-hour period during which samples are analyzed. An HRGC/HRMS method blank run is required between a calibration run and the first sample run. The same method blank extract may be analyzed more than once.

13.1.1 GC Column Performance (Window Define)

13.1.1.1 Inject 1µL of the column performance check solution and acquire selected ion monitoring (SIM) data within a total cycle time of ≤1 second.

13.1.1.2 The chromatographic separation between 2,3,7,8-TCDD and the peaks representing any other unlabeled TCDD isomers must be resolved with a valley of ≤25%, where:

$$\text{Valley percent} = \frac{(X)}{(Y)} \times 100$$

Where: X = the trough height measured between 2,3,7,8-TCDD and its closest eluting isomer
Y = the peak height of 2,3,7,8-TCDD

NOTE: It is the responsibility of the laboratory to verify the conditions suitable for the appropriate resolution of 2,3,7,8-TCDD from all other TCDD isomers. The GC column performance check solution (Window Define) also contains the known first and last PCDD/PCDF eluters under the conditions specified in this protocol. Their retention times are used to determine the eight homolog retention time windows that are used for qualitative and quantitative purposes. All peaks (including $^{13}C_{12}$-2,3,7,8-TCDD) should be identified on the chromatograms.

Any individual selected ion current profile (SICP) (for the tetras, this would be the SICP for m/z 322 and m/z 304) or the reconstructed homolog ion current (for the tetras, this would correspond to m/z 320 + m/z 322 + m/z 304 + m/z 306) constitutes an acceptable form of data presentation. An SICP for the labeled compounds (e.g., m/z 334 for labeled TCDD) is also required.

13.1.1.3 The retention times for the switching of SIM ions characteristic of one homologous series to the next higher homologous series must be

Uncontrolled Copy
Will not be updated

indicated in the SICP. Accurate switching at the appropriate times is absolutely necessary for monitoring of these compounds. Allowable tolerance on the daily verification with the GC performance check solution should be better than 10 seconds for the absolute retention times of all the components of the mixture. Particular caution should be exercised for the switching time between the last tetrachlorinated congener (i.e., 1,2,8,9-TCDD) and the first pentachlorinated congener (i.e., 1,3,4,6,8-PeCDF), as these two compounds elute within 15 seconds of each other on the 60m DB-5 column. If the HRGC/HRMS system is not capable of detecting both congeners within one analysis, corrective action must be taken. If the recommended column is not used, then the first and last eluting isomer of each homolog must be determined experimentally on the column which is used, and the appropriate isomers must then be used for window definition and switching times.

13.1.2 Mass Spectrometer Performance

13.1.2.1 Chromatography time for PCDDs and PCDFs exceeds the long term mass stability of the mass spectrometer. Because the instrument is operated in the high-resolution mode, mass drifts of a few ppm (e.g., 5ppm in mass) can have serious adverse effects on instrument performance. Therefore, a mass drift correction is mandatory. To that effect, it is recommended to select a lock-mass ion from the reference compound (PFK is recommended) used for tuning the mass spectrometer. The selection of the lock-mass ion is dependent on the masses of the ions monitored within each descriptor. However, an acceptable lock-mass ion at any mass between the lightest and heaviest ion in each descriptor can be used to monitor and correct mass drifts. The level of the reference compound (PFK) metered into the ion chamber during HRGC/HRMS analyses should be adjusted so that the amplitude of the most intense selected lock-mass ion signal (regardless of the descriptor number) does not exceed 10% of the full scale deflection for a given set of detector parameters. Under those conditions, sensitivity changes that might occur during the analysis can be more effectively monitored.

NOTE: Excessive PFK (or any other reference substance) may cause noise problems and contamination of the ion source resulting in an increase in downtime for source cleaning.

13.1.2.1 Documentation of the instrument resolving power must then be accomplished by recording the peak profile of the high-mass reference signal (m/z 380.9760) obtained during the above peak matching experiment by using the low-mass PFK ion at m/z 304.9824 as a reference. The minimum resolving power of 10,000 must be

Uncontrolled Copy
Will not be updated

demonstrated on the high-mass ion while it is transmitted at a lower accelerating voltage than the low-mass reference ion, which is transmitted at full sensitivity. The format of the peak profile representation must allow manual determination of the resolution, i.e., the horizontal axis must be a calibrated mass scale (amu or ppm per division). The result of the peak width measurement (performed at 5 percent of the maximum, which corresponds to the 10% valley definition) must appear on the hard copy and cannot exceed 100ppm at m/z 380.9760 (or 0.038amu at that particular mass).

13.2 Quality Control Samples

13.2.1 Initial Precision and Recovery (IPR) – Prior to evaluating field samples for the first time, or following any major procedural changes, the analyst shall perform the following operations to establish the ability to generate acceptable precision and recovery:

13.2.1.1 Four identical aliquots of a reference matrix are to be spiked with the internal and matrix standards. All sample processing steps that are to be used for processing samples, including preparation, extraction and cleanup, shall be performed on these aliquots.

13.2.1.2 Using results of the set of four analyses, compute the average concentration of the extracts in ng/mL and the standard deviation of the in ng/mL for each compound.

13.2.1.3 For each native and labeled compound, the average must be within 30% of the expected value and the standard deviation must be within 20%. If the results for all compounds meet the acceptance criteria, system performance is acceptable and analysis of field samples may begin. If, however, any precision limit or accuracy limit is exceeded, system performance is unacceptable for that compound. Perform a root cause analysis, correct the problem, and repeat the test.

13.2.2 Performance Evaluation Samples – Included among the samples in all batches may be samples (blind or double blind) containing known amounts of unlabeled 2,3,7,8-substituted PCDDs/PCDFs or other PCDD/PCDF congeners.

CAS/Houston participates in performance evaluation studies through R.T. Corp (RTC). Solid, aqueous, and tissue studies are performed semiannually. All studies are performed following the guidelines of the SOP for *Proficiency Testing Sample Analysis*, ***ADM-PTS***.

13.2.3 Performance Check Solutions

13.2.3.1 At the beginning of each 12-hour period during which samples are to be analyzed, an aliquot of the GC column performance check (Window

Uncontrolled Copy
Will not be updated

Define) solution and high resolution concentration calibration solution, HRCC3, shall be analyzed to demonstrate adequate GC resolution and sensitivity, response factor reproducibility, and mass range calibration, and to establish the PCDD/PCDF retention time windows. A mass resolution check shall also be performed to demonstrate adequate mass resolution using an appropriate reference compound (PFK is recommended). If the required criteria (Section 12.2.15) are not met, corrective action must be taken before any samples are analyzed.

13.2.3.2 To validate positive sample data, the routine calibration and the mass resolution check must be performed also at the end of each 12-hour period during which samples are analyzed. A method blank must be analyzed following a calibration run and before the first sample run.

13.2.3.3 If the laboratory operates only during one period (shift) each day of 12 hours or less, the GC performance check (Window Define) solution must be analyzed once (at the beginning of the period) to validate the data acquired during the period. However, the mass resolution and continuing calibration checks must be performed at the beginning as well as at the end of the period.

13.2.3.4 If the laboratory operates during consecutive 12-hour periods (shifts), analysis of the GC performance check solution must be performed at the beginning of each 12-hour period. Acceptable mass resolution and continuing calibration checks from the previous period can be used for the beginning of the next period (thus the calibration check is allowed to occur prior to the mass resolution check).

13.2.3.5 Results of at least one analysis of the GC column performance (Window Define) solution and of two mass resolution and routine calibration checks must be reported with the sample data collected during a 12-hour period.

13.2.3.6 Deviations from criteria specified for the GC column performance check or for the mass resolution check invalidate all positive sample data collected between analyses of the performance check solution, and the extracts from those positive samples shall be reanalyzed.

13.2.3.7 If the continuing calibration check performed at the end of a 12-hour period fails by no more than 25% RPD for the 17 unlabeled compounds, and 35% RPD for the 9 labeled internal compounds, use the mean RFs from the two daily routine calibration runs to compute the analyte concentrations, instead of the RFs obtained from the initial calibration.

Uncontrolled Copy
Will not be updated

13.2.3.8 A new initial calibration (new RFs) is required immediately (within two hours) following the analysis of the samples, whenever the RPD from the end-of-shift routine calibration exceeds 25% or 35%, respectively. Failure to perform a new initial calibration immediately following the analysis of the samples will automatically require reanalysis of all positive sample extracts analyzed before the failed end-of-shift continuing calibration check.

13.2.4 Method Blank

13.2.4.1 Add 100µL of the internal standard solution at 10-50ng/mL (Table 9).

13.2.4.2 Extract and analyze according to Sections 11-12.

13.2.4.3 Evaluate the test results according to the acceptance criteria (Table 13).

NOTE: A low or high percent recovery for a blank does not require discarding the analytical data but it may indicate a potential problem with future analytical data.

13.2.5 Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS)

13.2.5.1 These quality control samples are performed in lieu of a matrix spike/matrix spike duplicate (MS/DMS).

13.2.5.2 Add 100µL of the internal standard solution at 10-50ng/mL. Add 100µL of the matrix spike at 2-10ng/mL (Table 9).

13.2.5.3 Extract and analyze according to Sections 11-12. These two measurements provide the batch's accuracy (% recovered in the LCS and DLCS) and the batch's precision (how closely the two results compare.)

13.2.5.4 Evaluate the test results according to the acceptance criteria (Table 13). Results that do not meet the acceptance criteria should be handled according to the procedures in Table 12.

13.2.6 Matrix Spike and Matrix Spike Duplicate (MS/DMS)

13.2.6.1 An MS/DMS combination is performed only at the request of the client. For Department of Defense (DoD), Texas Risk Reduction Program (TRRP), or MDH samples, an MS/DMS is required with each batch of samples.

Uncontrolled Copy
Will not be updated

13.2.6.2 Homogenize the sample and separate three identical aliquots for analysis. Often, for aqueous samples requiring MS/DMS analyses, the client will send a sufficient sample amount to use 1L for each aliquot. Add 100µL of the internal standard solution at 10-50ng/mL (Table 9). Add 100µL of the matrix spike at 2-10ng/mL (Table 9) to the two aliquots indicated for MS/DMS analysis.

13.2.6.3 Extract and analyze according to Sections 11-12. These two measurements provide the batch's accuracy (% recovered in the MS and DMS) and the batch's precision (how closely the two results compare.) The LCS acts as a second accuracy test. No DLCS is required for extraction batches containing an MS/DMS combination.

13.2.6.4 Evaluate the test results according to the acceptance criteria (Table 13).

13.2.7 Field Sample Duplicate (DUP)

13.2.7.1 A field sample duplicate is performed at the request of the client.

13.2.7.2 Homogenize the sample and separate two identical aliquots for analysis. Often, for aqueous samples requiring DUP analyses, the client will send a sufficient sample amount to use 1L for each aliquot. Add 100µL of the internal standard solution at 10-50ng/mL (Table 9). No matrix standard is added to either aliquot.

13.2.7.3 Extract and analyze according to Sections 11-12. This measurement provides the batch's precision (how closely the result compares with the field sample.) The LCS acts as an accuracy test. No DLCS is required for extraction batches containing a DUP analysis.

13.2.7.4 Evaluate the test results according to the acceptance criteria (Table 13).

13.3 Sample Preparation Batching Requirements

13.3.1 Number – The number of field samples in a preparation batch will not exceed twenty (20).

13.3.2 Matrix – The matrix to be used for the quality control samples must be consistent with the matrix of the field samples (i.e. reagent water for aqueous matrices, quartz sand or sodium sulfate for solid matrices, or blank tissue for tissue matrices).

13.3.3 Reagent Lots – A single lot of each reagent used in the analysis will be used to process the batch of samples.

Uncontrolled Copy
Will not be updated

13.3.4 Batch Time Frame – The maximum time between the start of processing of the first and last samples in the batch must be twenty-four (24) hours.

13.3.5 Batch QC Samples – Each preparation batch must contain, at a minimum, a Method Blank (Section 13.2.4) to monitor laboratory introduced contamination, an LCS (Section 13.2.5) to assess analysis performance (i.e. bias, or accuracy), and an additional sample to assess batch precision. This additional sample can be in the form of a DLCS (Section 13.2.5), an MS/DMS pair (Section 13.2.6), or a DUP (Section 13.2.7). Batch QC samples do not count towards the maximum number of sample allowed in a batch (Section 13.3.1).

13.3.6 See Figure 3 for an outline of an example sample preparation batch.

13.4 Percent Recovery of the Internal Standards

13.4.1 For each field and QC sample, calculate the percent recovery of the labeled compounds. The percent recovery must be within the acceptance criteria in Table 13. Acceptance criteria are updated periodically according to the SOP for *Control Limits*, ***ADM-CTRL_LIM***. The acceptance criteria located in Table 13 are interim control limits for when none are available.

NOTE: A low or high percent recovery for a blank does not require discarding the analytical data but it may indicate a potential problem with future analytical data.

13.5 Identification Criteria

13.5.1 If either one of the identification criteria in Sections 12.3.4.1.1 through 12.3.4.1.4 are not met for a homologous series, it is reported that the sample does not contain unlabeled 2,3,7,8-substituted PCDD/PCDF isomers for that homologous series at the calculated detection limit.

13.5.2 If the first initial identification criteria in Sections 12.3.4.1.1 through 12.3.4.1.4 are met, but the criteria appearing in Sections 12.3.4.1.5 or 12.3.4.2 are not met, that sample is presumed to contain interfering contaminants. This must be noted on the analytical report form, and the sample should be rerun or the extract reanalyzed.

13.6 Reuse of glassware is to be minimized to avoid the risk of contamination.

14.0 DATA REDUCTION AND REPORTING

All data reduction steps (integrations, and calculations, etc.) on raw data is performed using the Micromass OPUSQuan Software, Version 3.6 X.

14.1 Calculations

Uncontrolled Copy
Will not be updated

14.1.1 For gas chromatographic peaks that have met the criteria, calculate the concentration of the PCDD or PCDF compounds using the formula:

$$C_x = \frac{A_x \times Q_{is}}{A_{is} \times wv \times \overline{RF_n}}$$

Where:
C_x = amount of unlabeled PCDD/PCDF congeners (or group of coeluting isomers within a homologous series) in pg.
A_x = sum of the integrated ion abundances of the quantitation ions for unlabeled PCDDs/PCDFs.
wv = weight or volume, in g or L, of the sample (solid or liquid).
A_{is} = sum of the integrated ion abundances of the quantitation ions for the internal standards.
Q_{is} = quantity, in pg, of the internal standards added to the sample before extraction.
$\overline{RF_n}$ = calculated mean relative response factor for the analyte RF_n [n = 1 to 17]

14.1.2 For internal standards and the clean up standard, calculate the recovery based on the recovery standards. Calculate the percent recovery measured in the sample extract, using the formula (Table 9):

$$\%\text{Recovery} = \frac{A_{is} \times Q_{rs}}{Q_{is} \times A_{rs} \times \overline{RF}_m} \times 100 \qquad \%\text{Recovery} = \frac{A_{cs} \times Q_{rs}}{Q_{cs} \times A_{rs} \times \overline{RF}_m} \times 100$$

Where:
A_{is}, A_{cs}, A_{rs} = sum of the integrated ion abundances of the quantitation ions for the internal, clean up (one ion), and recovery standards.
Q_{is}, Q_{cs}, Q_{rs} = quantity, in pg, of the internal, clean up, and recovery standards added to the sample prior to extraction.
$\overline{RF_m}$ = calculated mean relative response factor for the labeled internal (or clean up) standard relative to the appropriate recovery standard.

14.1.3 If the concentration in the final extract of any of the 2,3,7,8-substituted PCDD/PCDF compounds exceeds the upper method calibration limits (MCL), the linear range of response versus amount has been exceeded. A second analysis of the sample, a dilution, should be performed. The volumes of the internal and recovery standard solutions should remain the same as described for the sample preparation. For OCDD and OCDF peaks that do not saturate the detector, however, report the measured concentration and indicate that the value exceeds the MCL. All compounds exceeding the upper calibration limit are flagged with an E flag.

Uncontrolled Copy
Will not be updated

14.1.3.1 To prepare a dilution of 1:50 or less, combine a portion of the extract equal to the dilution factor (i.e. 1/10th of the extract for a 1:10 dilution) with an amount of internal and recovery standards equal to the amount added prior to extraction and analysis, respectively. For extracts that may have partially evaporated between the analysis and the dilution, the volume must be brought back up to the extract volume following the most recent analysis prior to removing the portion to be combined with the internal and recovery standards. Additional solvent may be added to allow for the accurate retrieval of the portion removed for combination. For dilutions higher than 1:50, serial dilutions are necessary due to the limited size of the auto sampler vials and the high volume required for the accurate retrieval of the portion removed for combination. For example, to perform a 1:100 dilution, bring the extract volume up to the volume following the previous injection. Transfer 1/10th of the extract to a new auto sampler vial, and bring this volume up to a suitable amount. Transfer 1/10th of this new volume to a final vial, where 1000-5000pg of the internal and 1000pg of the recovery standards are added. The successive 1:10 dilutions result in a 1:100 dilution.

14.1.3.2 Reanalyze the diluted sample using the labeled standard recoveries calculated from the initial analysis to correct the diluted results for losses during the original extraction and clean up. Calculate the results as below:

$$C_x = \frac{A_x \times Q_{is} \times DL}{A_{is} \times \overline{RF_n} \times \%REC}$$

Where:

C_x, A_x, A_{is}, Q_{is}, and $\overline{RF_n}$ are as defined above.

DL = Dilution factor of reanalyzed extract.

%REC = Percent recovery of the labeled internal standard in the original analysis of the extract as calculated above.

14.1.4 If there is significant interference present or if internal standard recoveries are below the acceptance criteria (Section 13.4), a re-extraction with a smaller sample size may be necessary. The analyst must take precautions to ensure a representative aliquot is taken (weights <2g are not recommended).

14.1.5 The total concentration for each homologous series of PCDD and PCDF is calculated by summing up the concentrations of all positively identified isomers of each homologous series. Therefore, the total will also include the 2,3,7,8-substituted congeners.

Uncontrolled Copy
Will not be updated

14.1.6 Sample Specific Estimated Detection Limit - The sample specific estimated detection limit (EDL) is the concentration of a given analyte required to produce a signal with a peak height of at least 2.5 times the background noise level. An EDL is calculated for each 2,3,7,8-substituted congener that is not identified, regardless of whether or not other non-2,3,7,8-substituted isomers are present. Two methods of calculation can be used, as follows, depending on the type of response produced during the analysis of a particular sample.

14.1.6.1 For samples giving a response for both quantitation ions that are less than 2.5 times the background noise level, use the expression for EDL (specific 2,3,7,8-substituted PCDD/PCDF) below. The background level is determined by measuring the range of the noise (peak to peak) for the two quantitation ions of a particular 2,3,7,8-substituted isomer within an homologous series, in the window of the SICP trace corresponding to the elution of the labeled standard (if the congener possesses a labeled standard) or in the window of the SICP where the congener is expected to elute by comparison with the routine calibration data (for those congeners that do not have a C13-labeled standard), multiplying that noise height by 2.5, and relating the product to an estimated concentration that would produce that peak height. Use the formula:

$$EDL = \frac{2.5 \times H_x \times Q_{is}}{H_{is} \times \overline{RF_n}}$$

where:

EDL = estimated detection limit for homologous 2,3,7,8-substituted PCDDs/PCDFs.

H_x = sum of the height of the noise level for each quantitation ion for the unlabeled PCDDs/PCDFs.

Q_{is} = quantity, in pg, of the internal standard added to the sample

H_{is} = sum of the height of the signal level for each quantitation ion for the internal standard.

$\overline{RF_n}$ = calculated mean relative response factor for the analyte [n=1 to 17]

14.1.6.2 For compounds characterized by the response of a signal having the same retention time as a 2,3,7,8-substituted congener, having a S/N in excess of 2.5, and does not meet any of the other qualitative identification criteria, calculate the "Estimated Maximum Possible Concentration" (*EMPC*); with the exception that the variable *A* represents the sum of the area under the smaller peak and of the other peak area calculated using the theoretical chlorine isotope ratio.

Uncontrolled Copy
Will not be updated

$$\frac{A_1}{A_2} = i_c \qquad A_1 = A_2 \times i_t \qquad (i_c > i_t)$$

$$A_2 = \frac{A_1}{i_t} \qquad (i_c < i_t)$$

Where:
A_1 = Area of the first ion used for quantitation.
A_2 = Area of the second ion used for quantitation.
i_c = Calculated ion abundance ratio for the compound.
i_t = Theoretical ion abundance ratio for the compound.

If $i_c > i_t$ then use A_2 and adjust the value for A_1. If $i_c < i_t$ then use A_1 and adjust the value for A_2. Use the second and third equations for this adjustment.

14.1.7 The relative percent difference (*RPD*) of any duplicate sample results are calculated as follows:

$$RPD = \frac{|S_1 - S_2|}{\frac{(S_1 + S_2)}{2}} \times 100$$

where: S_1, S_2 = sample and duplicate sample results.

14.1.8 The 2,3,7,8-TCDD toxicity equivalents (TEQ/TEF) of PCDDs and PCDFs present in the sample are calculated according to the method recommended by the Chlorinated Dioxins Workgroup (CDWG) of the EPA and the Center for Disease Control (CDC). This method assigns a 2,3,7,8-TCDD toxicity equivalency factor (TEF) to each of the 2,3,7,8-substituted PCDDs and PCDFs. The 2,3,7,8-TCDD equivalent of the PCDDs and PCDFs present in the sample is calculated by summing the TEF times their concentration for each of the compounds or groups of compounds. The exclusion of other homologous series such as mono-, di-, and tri- chlorinated dibenzo-p-dioxins and dibenzofurans does not mean that they are non-toxic.

14.1.8.1 The concentration of the 2,3,7,8-TCDF is obtained from the analysis of the sample extract on the 30m DB-225 fused silica capillary column. However, the HRGC/HRMS conditions must be altered so that only the first three descriptors (i.e., tetra-, penta-, and hexachlorinated congeners) are used; and the switching time between descriptor 2 (pentachlorinated congeners) and descriptor 3 (hexachlorinated congeners) takes place following the elution of $^{13}C_{12}$-1,2,3,7,8-PeCDD. The chromatographic separation between the 2,3,7,8-TCDF and its close eluters (2,3,4,7-TCDF and 1,2,3,9-TCDF) must be equal or less than 25 percent valley.

Uncontrolled Copy
Will not be updated

14.2 Data review

14.2.1 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met.

14.2.2 Refer to the SOP for *HRMS Data Review and Reporting*, ***HRMS-DATAREV,*** for general instructions for data review.

15.0 METHOD PERFORMANCE

15.1 There is no need for MDL studies for this method. Method performance is monitored using a sample specific EDL calculation, as shown above. Method reporting limits (MRLs) are determined from the minimum point of linearity as calculated from the lowest calibration point (HRCC1) for each labeled and unlabeled compound. MRLs have no correlation to the EDL.

15.2 Limits of Detection (LOD) and Limits of Quantitation (LOQ) are generated and verified according to the requirements in the Department of Defense Quality Systems Manual (Reference 19.7).

15.3 Method capabilities can be found in appropriate reference method. Training documentation and demonstrations of capability are controlled by the Quality Assurance Program Manager.

16.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat from solvent and reagents used in this method can be minimized when recycled or disposed of properly. All disposable glassware should be recycled as per the laboratory procedures. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the CAS Environmental Health and Safety (EH&S) Manual. Also, see the SOP for *Waste Disposal*, ***SMO-WASTDISP***.

17.0 CORRECTIVE ACTIONS FOR OUT OF CONTROL DATA

Corrective action measures applicable to specific analysis steps are discussed in the applicable section of this SOP. Also, refer to the SOP for *Corrective Action*, ***ADM-CA***, for correct procedures for identifying and documenting such data. Procedures for applying data qualifiers are described in the SOP for *HRMS Data Review and Reporting*, ***HRMS-DATAREV***. See Table 12 for additional example corrective actions and required documentation.

Uncontrolled Copy
Will not be updated

17.1 Contamination problems, if they arise, should be investigated systematically.

17.1.1 Contaminated chemicals (including solvents) should be discarded. If one or more additional containers of the chemical with the same lot number are present in the laboratory, the additional quantity of chemical should be evaluated for contamination prior to use.

17.1.2 Contaminated glassware should be discarded.

17.2 Problems associated with low standard recoveries are usually attributed to one of the following:

17.2.1 Low recoveries of internal standard (for samples where the clean up standard recoveries are normal) indicate that extraction is inefficient. The analysis should be repeated. If the low recoveries of internal standards are still a problem, then the cause may be a matrix effect. Low recoveries of internal standard are frequently a problem if the sample is a charcoal filter or a fly ash.

17.2.2 Low recoveries of both internal standards and clean up standards indicate that losses are taking place during the clean up process. Such losses may simply be due to inefficient transfers, or losses may be taking place during carbon column clean up. Contaminants in the sample extract may interact with the carbon and alter the retention times of analytes on the carbon column.

17.2.3 If any of the standards are completely absent from the selected ion profile, the possibility should be considered that addition of that standard to the sample or extract has not taken place.

17.2.4 If the chromatographic peak area for a standard is approximately double the anticipated area, the possibility should be considered that two aliquots of that standard have been added to the sample or extract.

17.3 Low sensitivity (poor signal-to-noise ratio) may be attributed to a number of causes.

17.3.1 A leaking septum might result in losses of sample during injection. Another consequence of a leaking septum (or any leak in the inlet system of the gas chromatograph) is reduced flow of carrier gas, resulting in increased retention times.

17.3.2 Accumulation of particles of septum or ferrule material in the injection port can lead to adsorptive losses. Similar losses are encountered when the injection port or the injection port liner are contaminated by the residues of ‘dirty’ samples.

17.3.3 A degraded column can cause peak distortion, and may also lead to adsorptive losses. Excessive bleed of stationary phase from the column may result in high background levels and, consequently, elevated noise levels (thus decreasing the signal-to-noise ratio). The problem is commonly restricted to the first few centimeters of the column, and can be corrected by cutting off 10 to 20 cm of the column.

Uncontrolled Copy
Will not be updated

17.3.4 High background levels can also be attributed to bleed from an inappropriate septum. This is a particular problem with the PeCDF channels.

17.3.5 Re-tuning of the mass spectrometer might improve the sensitivity, or the problem may be due to a contaminated ion source. If, over a period of time, continual increases in the electron multiplier voltage are needed to obtain adequate sensitivity, then the photo multiplier may have to be replaced.

18.0 CONTINGENCIES FOR HANDLING OUT OF CONTROL OR UNACCEPTABLE DATA

18.1 See Section 17.0.

19.0 REFERENCES

19.1 "Method 8290: Analytical Procedures and Quality Assurance for Multimedia Analysis of Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry". Y. Tondeur and W.F. Beckert. US Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, NV.

19.2 DoD *Quality Systems Manual*, Final Version 4.1

19.3 2003 NELAC Quality Systems Standard

19.4 USEPA, 2005-09-01; USEPA AOC National Functional Guidelines for Chlorinated Dioxin/Furan Data Review (Sept 2005)

19.5 “Method 8000B: Determinative Chromatographic Separations”, USEPA

19.6 “Laboratory Procedure Manual: PCDDs, PCDFs, cPCBs, and ortho-substituted PCBs.” National Center for Environmental Health, CDC, October 2006.

20.0 TRAINING PLAN

20.1 Refer to the SOP for *Documentation of Training*, ***ADM-TRANDOC***. The SOP describes the training outline and necessary documentation (Figure 7.)

20.2 Review the SOP. Also review safety procedures, any instrument related manuals, and all related SOPs.

20.3 Following these reviews observe the procedure as performed by an experienced analyst at a minimum of three times.

20.4 Once the analyst and trainer are comfortable with the procedure, the analyst must perform the SOP with supervision for an extended period of time. During this period, the analyst is expected to transition from a role of assisting to performing the procedure with minimal oversight from an experienced analyst.

Uncontrolled Copy
Will Not Be Updated

20.5 Independently perform the SOP and complete an Initial Demonstration of Capabilities. This study can be based on either a blind Performance Evaluation sample or four consecutive LCS samples. Document these studies.

21.0 METHOD MODIFICATIONS

The following modifications have been made to the published method (referenced parenthetically). These modifications offer equivalent performance at a reduced cost.

21.1 Reused glassware is not rinsed with solvents (Ref 19.1 Sec 4.3).
21.2 Silica gel is not pre-cleaned with DCM if blanks are contaminated. Gel mixed on a tumbler not with a glass stirring rod (Ref 19.1 Sec 5.2.3).
21.3 Acid impregnated silica gel made at 33% w/w instead of 40% (Ref 19.1 Sec 5.2.5).
21.4 0.400g of Envi-Carb used instead of AX-21/Celite for carbon clean up (Ref 19.1 Secs 5.2.6, 5.2.7, 7.5.3.1).
21.5 Tridecane is used as a keeper solvent to prevent sample from going to dryness (Ref 19.1 Sec 7.2.3-4).
21.6 Oil samples are not filtered through a glass fiber filter following extraction (Ref 19.1 Sec 7.4.2).
21.7 Paper mill effluents are not routinely filtered (Ref 19.1 Sec 7.4.5.2 Note).
21.8 Disposable jars used instead of separatory funnels (Ref 19.1 Secs 7.4.5.4 and 7.4.6.4).
21.9 First aqueous extraction step performed with 100mL instead of 60mL DCM (Ref 19.1 Sec 7.4.5.4).
21.10 Aqueous extraction step repeated only once and with 50mL DCM (Ref 19.1 Sec 7.4.5.7).
21.11 Solvent evaporated with a fan under a fume hood (primarily) instead of using the KD apparatus or rotary evaporator (Ref 19.1 Sec 7.4.5.8-9).
21.12 Sample extract is not filtered through a glass fiber filter following soxhlet extraction (Ref 19.1 Sec 7.4.6.3).
21.13 Rotary evaporator water bath is set at 65°C instead of 50°C (Ref 19.1 Sec 7.4.6.3).
21.14 Volumes for back extraction are 10mL instead of 40mL (Ref 19.1 Sec 7.5.1).
21.15 Samples are shaken with sulfuric acid for 30 seconds instead of 2 minutes (Ref 19.1 Sec 7.5.1.1).
21.16 Samples are shaken with NaCl solution for 30 seconds instead of 2 minutes (Ref 19.1 Sec 7.5.1.2).
21.17 Samples are not exposed to a base clean up (Ref 19.1 Sec 7.5.1.3).
21.18 Glass disposable columns are used for column chromatography to reduce contamination. Top layer of column bed is sodium sulfate instead of neutral silica gel (Ref 19.1 Sec 7.5.2.1).
21.19 No alumina column is used for clean up (Ref 19.1 Sec 7.5.2).
21.20 Solvent rinses performed with DCM and a 1:1 mix of hexane/ethyl acetate (Ref 19.1 Sec 7.5.3.3-4).
21.21 Extracts are concentrated (primarily) using a fan under a fume hood. During final transfer the vials are not rinsed with a 1% toluene:DCM mix, but hexane instead (Ref 19.1 Sec 7.5.3.6).

Uncontrolled Copy
Will not be updated

21.22 Target compounds without respective labeled standards are verified against the CCAL (Ref 19.1 Sec 7.8.4.1.2).

21.23 100ppm peak width not measured when demonstrating instrument resolution (Ref 19.1 Sec 8.2.2.3).

21.24 Samples appearing heterogeneous are not transferred to a larger container and/or mixed with a stainless steel spoon (polypropylene is used) (Ref 19.1 Sec 6.2.1).

21.25 Aqueous volume measured to the accuracy of the graduated cylinder (which depends on the sample size) (Ref 19.1 Sec 7.4.5.11).

22.0 INSTRUMENT SPECIFIC ADDENDUM

None.

23.0 CHANGES FROM PREVIOUS REVISION

23.1	Section 1.1	Added EPA Method reference.
23.2	Sections 1.3-1.4	Deleted.
23.3	Section 5.3	New.
23.4	Section 7.1.5.1	Deleted and all following sections renumbered.
23.5	Section 7.3	Updated.
23.6	Section 8.9	New and all following sections renumbered.
23.7	Section 8.10	Updated for muffle furnace procedure.
23.8	Section 8.17	Updated.
23.9	Section 11.1.4.5	Updated to include corn oil blank matrix.
23.10	Section 11.2.2	Updated.
23.11	Section 11.3	Updated.
23.12	Section 13.2.3.1	Updated.
23.13	Section 13.2.5.4	Updated.
23.14	Section 14.1.3	Updated.

24.0 ATTACHMENTS

24.1 **Tables –** See Appendix 1.

24.2 **Figures –** See Appendix 2.

Uncontrolled Copy
Will not be updated

APPENDIX 1

TABLE 1

MATRICES, SAMPLE SIZES, AND METHOD CALIBRATION LIMITS (PARTS PER TRILLION)

	Water	Soil, Sediment, Paper Pulp[b]	Fly ash	Fish Tissue[c]	Human Adipose Tissue	Sludges Fuel Oil
Lower MCL[a]	0.01	1.0	1.0	1.0	1.0	5.0
Upper MCL[a]	2	200	200	200	200	1000
Weight/Volume (g/mL)	1000	10	10	10	2	1
IS Spiking Levels (ppt)	1	100	100	100	100	500
Final Extract Volume (µL)	20	20	20	20	20	20

[a] For other congeners, multiply the values by 1 for TCDF/TCDD, by 2.5 for PeCDD/PeCDF, HxCDD/HxCDF/HpCDD/HpCDF, and by 5 for OCDD/OCDF.
[b] Sample dewatered prior to analysis.
[c] An additional 10g sample is used for determination of lipid content.

Uncontrolled Copy
Will not be updated

TABLE 2

THE FIFTEEN 2,3,7,8-SUBSTITUTED PCDD AND PCDF CONGENERS

PCDD	PCDF
2,3,7,8-TCDD(*)	2,3,7,8-TCDF(*)
1,2,3,7,8-PeCDD(*)	1,2,3,7,8-PeCDF(*)
1,2,3,6,7,8-HxCDD(*)	2,3,4,7,8-PeCDF
1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDF
1,2,3,7,8,9-HxCDD(+)	1,2,3,7,8,9-HxCDF
1,2,3,4,6,7,8-HpCDD(*)	1,2,3,4,7,8-HxCDF(*)
	2,3,4,6,7,8-HxCDF
	1,2,3,4,6,7,8-HpCDF(*)
	1,2,3,4,7,8,9-HpCDF

* The C13-labeled analogue is used as an internal standard
+ The C13-labeled analogue is used as recovery standard

Uncontrolled Copy
Will not be updated

TABLE 3

ISOMERS OF CHLORINATED DIOXIN AND FURANS AS A FUNCTION OF THE NUMBER OF CHLORINE ATOMS

Number of Chlorine Atoms	Number of Dioxin Isomers	Number of 2378-Dioxin	Number of Furan Isomers	Number of 2378-furans
1	2	-	4	-
2	10	-	16	-
3	14	-	28	-
4	22	1	38	1
5	14	1	28	2
6	10	3	16	4
7	2	1	4	2
8	1	1	1	1
Total	75	7	135	10

Uncontrolled Copy
Will not be updated

TABLE 4

HIGH RESOLUTION CONCENTRATION CALIBRATION SOLUTIONS

Unlabeled Analytes	**Concentrations (pg/uL)** 1	2	3	4	5
2,3,7,8-TCDD	1	2.5	10	50	200
2,3,7,8-TCDF	1	2.5	10	50	200
1,2,3,7,8-PeCDD	2.5	6.25	25	125	500
1,2,3,7,8-PeCDF	2.5	6.25	25	125	500
2,3,4,7,8-PeCDF	2.5	6.25	25	125	500
1,2,3,4,7,8-HxCDD	2.5	6.25	25	125	500
1,2,3,6,7,8-HxCDD	2.5	6.25	25	125	500
1,2,3,7,8,9-HxCDD	2.5	6.25	25	125	500
1,2,3,4,7,8-HxCDF	2.5	6.25	25	125	500
1,2,3,6,7,8-HxCDF	2.5	6.25	25	125	500
1,2,3,7,8,9-HxCDF	2.5	6.25	25	125	500
2,3,4,6,7,8-HxCDF	2.5	6.25	25	125	500
1,2,3,4,6,7,8-HpCDD	2.5	6.25	25	125	500
1,2,3,4,6,7,8-HpCDF	2.5	6.25	25	125	500
1,2,3,4,7,8,9-HpCDF	2.5	6.25	25	125	500
OCDD	5	12.5	50	250	1000
OCDF	5	12.5	50	250	1000
Internal Standards					
C13-2,3,7,8-TCDD	50	50	50	50	50
C13-2,3,7,8-TCDF	50	50	50	50	50
C13-1,2,3,7,8-PeCDD	50	50	50	50	50
C13-1,2,3,7,8-PeCDF	50	50	50	50	50
C13-1,2,3,6,7,8-HxCDD	125	125	125	125	125
C13-1,2,3,4,7,8-HxCDF	125	125	125	125	125
C13-1,2,3,4,6,7,8-HpCDD	125	125	125	125	125
C13-1,2,3,4,6,7,8-HpCDF	125	125	125	125	125
C13-OCDD	250	250	250	250	250
Recovery Standards					
C13-1,2,3,4-TCDD	50	50	50	50	50
C13-1,2,3,7,8,9-HxCDD	125	125	125	125	125

Uncontrolled Copy
Will not be updated

TABLE 5

IONS MONITORED FOR HRGC/HRMS ANALYSIS OF PCDDS/PCDFS

DESCRIPTOR	EXACT M/Z	M/Z TYPE	ELEMENT COMPOSITION	COMPOUND
1	292.9825	LOCK	C_7F_{11}	PFK
	303.9016	M	$C_{12}H_4{}^{35}Cl_4O$	TCDF
	305.8987	M+2	$C_{12}H_4{}^{35}Cl{}^{37}O$	TCDF
	315.9419	M	${}^{13}C_{12}H_4{}^{35}Cl_4O$	TCDF(S)
	317.9389	M+2	${}^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF(S)
	319.8965	M	$C_{12}H_4{}^{35}ClO_2$	TCDD
	321.8936	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD
	327.8847	M	$C_{12}H_4{}^{37}Cl_4O_2$	TCDD(CS)
	330.9792	QC	C_7F_{13}	PFK
	331.9368	M	${}^{13}C_{12}H_4{}^{35}Cl_4O_2$	TCDD(S)
	333.9339	M+2	${}^{13}C_{12}H_4{}^{35}Cl{}^{37}ClO_2$	TCDD(S)
	375.8364	M+2	$C_{12}H_4{}^{35}Cl_5{}^{37}ClO$	HXCDPE
2	339.8597	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PECDF
	341.8567	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PECDF
	351.9000	M+2	${}^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PECDF(S)
	353.8970	M+4	${}^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PECDF(S)
	355.8546	M+2	$C_{12}H_3{}^{35}Cl_3{}^{37}ClO_2$	PECDD
	357.8516	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PECDD
	367.8949	M+2	${}^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PECDD(S)
	369.8919	M+4	${}^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PECDD(S)
	409.7974	M+2	$C_{12}H_3{}^{35}Cl_6{}^{37}ClO$	HPCDPE
3	373.8208	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HXCDF
	375.8178	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O$	HXCDF
	383.8639	M	${}^{13}C_{12}H_2{}^{35}Cl_6O$	HXCDF(S)
	385.8610	M+2	${}^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HXCDF(S)

Uncontrolled Copy
Will not be updated

TABLE 5 (cont.)

DESCRIPTOR	EXACT M/Z	M/Z TYPE	ELEMENT COMPOSITION	COMPOUND
3	389.8157	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HXCDD
	391.8127	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HXCDD
	392.9760	LOCK	C_9F_{15}	PFK
	401.8559	M+2	${}^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HXCDD(S)
	403.8529	M+4	${}^{13}C_{12}H_2{}^{35}Cl_4{}^{37}C_2lO$	HXCDD(S)
	430.9729	QC	C_9F_{17}	PFK
	445.7555	M+4	$C_{12}H_2{}^{35}Cl_5{}^{37}Cl_2O$	OCDPE
4	407.7818	M+2	$C_{12}H{}^{35}Cl_6{}^{37}ClO$	HPCDF
	409.7789	M+4	$C_{12}H{}^{35}Cl_5{}^{37}Cl_2O$	HPCDF
	417.8253	M	${}^{13}C_{12}H{}^{35}Cl_7{}^{37}O$	HPCDF(S)
	419.8220	M+2	${}^{13}C_{12}H{}^{35}Cl_6{}^{37}ClO$	HPCDF(S)
	423.7766	M+2	$C_{12}H{}^{35}Cl_6{}^{37}ClO_2$	HPCDD
	425.7737	M+4	$C_{12}H{}^{35}Cl_5{}^{37}Cl_2O_2$	HPCDD
	430.9729	LOCK	C_9F_{17}	PFK
	435.8169	M+2	${}^{13}C_{12}H{}^{35}Cl_6{}^{37}ClO_2$	HPCDD(S)
	437.8140	M+4	${}^{13}C_{12}H{}^{35}Cl_5{}^{37}Cl_2O_2$	HPCDD(S)
	479.7165	M+4	$C_{12}H{}^{35}Cl_7{}^{37}Cl_2O$	NCDPE
5	441.728	M+2	$C_{12}H{}^{35}Cl_7{}^{37}ClO$	OCDF
	443.7399	M+4	$C_{12}H{}^{35}Cl_6{}^{37}Cl_2O$	OCDF
	457.7377	M+2	$C_{12}H{}^{35}Cl_7{}^{37}ClO_2$	OCDD
	459.7348	M+4	$C_{12}H{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD
	469.7779	M+2	${}^{13}C_{12}H{}^{35}Cl_7{}^{37}ClO_2$	OCDD(IS)
	471.7750	M+4	${}^{13}C_{12}H{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD(IS)
	513.6775	M+4	$C_{12}H{}^{35}Cl_8{}^{37}Cl_2O_2$	DCDPE
	442.9728	QC	$C_{10}F_{17}$	PFK

Nuclidic masses used:

H= 1.007825
C= 12.000000
${}^{13}C$ = 13.003355
F= 18.9984
O= 15.994915
${}^{35}Cl$ = 34.968853
${}^{37}Cl$ = 36.965903

PFK= PERFLUROKEROSENE
SS= INTERNAL STANDARD
CS=CLEANUP STANDARD (only one m/z)

Uncontrolled Copy
Will not be updated

TABLE 6

PCDD AND PCDF CONGENERS PRESENT IN THE GC PERFORMANCE CHECK (WINDOW DEFINE) SOLUTION

	PCDD Positional Isomer		PCDF Positional Isomers	
# Chlorine Atoms	First Eluters	Last Eluters	First Eluters	Last Eluters
4 [a]	1,3,6,8	1,2,8,9	1,3,6,8	1,2,8,9
5	1,2,4,6,8/1,2,4,7,9	1,2,3,8,9	1,3,4,6,8	1,2,3,8,9
6	1,2,4,6,7,9/1,2,4,6,8,9	1,2,3,4,6,7	1,2,3,4,6,8	1,2,3,4,8,9
7	1,2,3,4,6,7,9	1,2,3,4,6,7,8	1,2,3,4,6,7,8	1,2,3,4,7,8,9
8	1,2,3,4,6,7,8,9		1,2,3,4,6,7,8,9	

[a] In addition to these two TCDD isomers, the 1,2,3,4,-, 1,2,3,7-, 1,2,3,8-, 2,3,7,8-, $^{13}C_{12}$ – 2,3,7,8-, and 1,2,3,9-TCDD isomers must be present as a check of column resolution.

Uncontrolled Copy
Will not be updated

TABLE 7

THEORICAL ION ABUNDANCE RATIOS AND THEIR CONTROL LIMITS

# Chlorine Atoms	Ion Type	Theoretical Abundance Ratio	Control Limits Lower	Control Limits Upper
4	M/M+2	0.77	0.65	0.89
5	M+2/M+4	1.55	1.32	1.78
6	M+2/M+4	1.24	1.05	1.43
6 [a]	M/M+2	0.51	0.43	0.59
7 [b]	M/M+2	0.44	0.37	0.51
7	M+2/M+4	1.04	0.88	1.20
8	M+2/M+4	0.89	0.76	1.02

[a] Used only for $^{13}C_{12}$ – HxCDF (IS)
[b] Used only for $^{13}C_{12}$ – HpCDF (IS)

Uncontrolled Copy
Will not be updated

TABLE 8

2,3,7,8-TCDD TOXICITY EQUIVALENCY FACTORS (TEFs) FOR THE POLYCHLORINATED DIBENZO-p-DIOXINS AND DIBENZOFURANS

Analyte	TEF [a]
2,3,7,8-TCDD	1
1,2,3,7,8-PeCDD	0.5
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
1,2,3,4,6,7,8,9-OCDD	0.001
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
1,2,3,4,7,8-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
1,2,3,4,6,7,8,9-OCDF	0.001

[a] Taken from "Interim Procedure for Estimating Risk Associated with Exposures to Mixtures of Chlorinated Dibenzo-*p*-Dioxin and –Dibenzofurans 1989 Update". (EPA/625/3-89/016, March 1989).

Uncontrolled Copy
Will not be updated

TABLE 9

CONCENTRATION OF STOCK AND SPIKING SOLUTIONS CONTAINING PCDDs/PCDFs

PCDDs/PCDFs	Internal Standard Stock Solution (ng/mL)	Internal Standard Spiking Solution (ng/mL)	MS Stock Fortification Solution (ng/mL)	MS Spiking Fortification Solution (ng/mL)
2,3,7,8-TCDD			100	2
2,3,7,8-TCDF			100	2
1,2,3,7,8-PeCDD			250	5
1,2,3,7,8-PeCDF			250	5
2,3,4,7,8-PeCDF			250	5
1,2,3,4,7,8-HxCDD			250	5
1,2,3,6,7,8-HxCDD			250	5
1,2,3,7,8,9-HxCDD			250	5
1,2,3,4,7,8-HxCDF			250	5
1,2,3,6,7,8-HxCDF			250	5
1,2,3,7,8,9-HxCDF			250	5
2,3,4,6,7,8-HxCDF			250	5
1,2,3,4,6,7,8-HpCDD			250	5
1,2,3,4,6,7,8-HpCDF			250	5
1,2,3,4,7,8,9-HpCDF			250	5
OCDD			500	10
OCDF			500	10
Internal Standard				
$^{13}C_{12}$ – 2,3,7,8-TCDD	100	10		
$^{13}C_{12}$ – 2,3,7,8-TCDF	100	10		
$^{13}C_{12}$ – 1,2,3,78-PeCDD	100	10		
$^{13}C_{12}$ – 1,2,3,7,8-PeCDF	100	10		
$^{13}C_{12}$ – 1,2,3,6,7,8-HxCDD	250	25		
$^{13}C_{12}$ – 1,2,3,4,7,8-HxCDF	250	25		
$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpCDD	250	25		
$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpCDF	250	25		
$^{13}C_{12}$ – OCDD	500	50		
Cleanup Standard				
$^{37}Cl_4$ – 2,3,7,8-TCDD		8		
Recovery Standard				
$^{13}C_{12}$ – 1,2,3,4-TCDD		50		
$^{13}C_{12}$ – 1,2,3,7,8,9-HxCDD		50		

Uncontrolled Copy
Cannot be updated

TABLE 10

REFERENCE COMPOUNDS FOR QUANTITATION OF NATIVE AND LABELED PCDDs AND PCDFs

Compound Number	Type	Name	Reference Compound
1	Native	2,3,7,8-TCDD	18
2	Native	1,2,3,7,8-PeCDD	19
3	Native	1,2,3,4,7,8-HxCDD	20
4	Native	1,2,3,6,7,8-HxCDD	20
5	Native	1,2,3,7,8,9-HxCDD	20
6	Native	1,2,3,4,6,7,8-HpCDD	21
7	Native	OCDD	22
8	Native	2,3,7,8-TCDF	23
9	Native	1,2,3,7,8-PeCDF	24
10	Native	2,3,4,7,8-PeCDF	24
11	Native	1,2,3,4,7,8-HxCDF	25
12	Native	1,2,3,6,7,8-HxCDF	25
13	Native	1,2,3,7,8,9-HxCDF	25
14	Native	2,3,4,6,7,8-HxCDF	25
15	Native	1,2,3,4,6,7,8-HpCDF	26
16	Native	1,2,3,4,7,8,9-HpCDF	26
17	Native	OCDF	22
18	Internal Standard	$^{13}C_{12}$ – 2,3,7,8-TCDD	27
19	Internal Standard	$^{13}C_{12}$ – 1,2,3,7,8-PeCDD	27
20	Internal Standard	$^{13}C_{12}$ – 1,2,3,6,7,8-HxCDD	28
21	Internal Standard	$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpCDD	28
22	Internal Standard	$^{13}C_{12}$ – OCDD	28
23	Internal Standard	$^{13}C_{12}$ – 2,3,7,8-TCDF	27
24	Internal Standard	$^{13}C_{12}$ – 1,2,3,7,8-PeCDF	27
25	Internal Standard	$^{13}C_{12}$ – 1,2,3,4,7,8-HxCDF	28
26	Internal Standard	$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpCDF	28
27	Recovery Standard	$^{13}C_{12}$ – 1,2,3,4-TCDD	
28	Recovery Standard	$^{13}C_{12}$ – 1,2,3,7,8,9-HxCDD	
29	Cleanup Standard	$^{37}Cl_4$ – 1,2,3,7,8-TCDD	27

Uncontrolled Copy
Will not be updated

TABLE 11

RELATIVE RESPONSE FACTOR [RF (NUMBER)] ATTRIBUTIONS

Number	Specific Congener Name
1	2,3,7,8-TCDD (and total TCDDs)
2	2,3,7,8-TCDF (and total TCDFs)
3	1,2,3,7,8-PeCDD (and total PeCDDs)
4	1,2,3,7,8-PeCDF
5	2,3,4,7,8-PeCDF
6	1,2,3,4,7,8-HxCDD
7	1,2,3,6,7,8-HxCDD
8	1,2,3,7,8,9-HxCDD
9	1,2,3,4,7,8-HxCDF
10	1,2,3,6,7,8-HxCDF
11	1,2,3,7,8,9-HxCDF
12	2,3,4,6,7,8-HxCDF
13	1,2,3,4,6,7,8-HpCDD (and totals HpCDD)
14	1,2,3,4,6,7,8-HpCDF
15	1,2,3,4,7,8,9-HpCDF
16	OCDD
17	OCDF
18	$^{13}C_{12}$ – 2,3,7,8-TCDD
19	$^{13}C_{12}$ – 2,3,7,8-TCDF
20	$^{13}C_{12}$ – 1,2,3,7,8-PeCDD
21	$^{13}C_{12}$ – 1,2,3,7,8-PeCDF
22	$^{13}C_{12}$ – 1,2,3,6,7,8-HxCDD
23	$^{13}C_{12}$ – 1,2,3,4,7,8-HxCDF
24	$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpCDD
25	$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpDF
26	$^{13}C_{12}$ – OCDD
27	Total PeCDFs
28	Total HxCDFs
29	Total HxCDDs
30	Total HpCDFs

Uncontrolled Copy
Will not be updated

TABLE 12

CORRECTIVE ACTION SUMMARY TABLE

QC Activity	Unacceptable Criteria	Recommended Corrective Action	Documentation
Method Blank	Tetra through Hepta>MRL or Octa>3xMRL	Analyze an instrument blank to demonstrate instrument is free of possible contamination. Evaluate whether entire sample batch must be re-extracted.	Compounds associated with a value in the method blank are flagged with 'B' on Form 1s.
DoD QSM Requirement - Method Blank	>½MRL and >1/10 amount in any sample	Analyze an instrument blank to demonstrate instrument is free of possible contamination. Evaluate whether affected samples must be re-extracted.	If re-extraction is not done, compounds associated with a value in the method blank are flagged with 'B' on Form 1s.
Instrument Blank	>MRL	Determine cause of contamination. Analyze an acceptable instrument blank prior to analyzing analytical sequence.	Resolve blank issue before proceeding.
Initial Calibration Standards	±20% native standards ±30% labeled standards	Reanalyze standards. If still unacceptable, remake standards and reanalyze.	Resolve ICAL standards issue before proceeding.
Continuing Calibration Verification Standard (CCV/HRCC3)	>RRF; ±20% native and ±30% labeled for beginning cal and ±25% native and ±30% labeled for ending cal	Reanalyze standard. If still unacceptable, recalibrate and reanalyze samples from last acceptable CCV/HRCC3.	Comment in case narrative.
Laboratory Control Sample (LCS) & Laboratory Control Sample Duplicate (DLCS)	Value outside acceptance criteria; >20% RSD	If LCS or DLCS out, evaluate the labeled standard(s) associated with the compound(s). If out, evaluate the associated labeled standard(s) in the sample(s). If out, re-extract the samples. If labeled standard(s) meet the acceptance criteria, release the test results.	Comment in case narrative.
DoD Requirement – LCS/DLCS	Exceedance of any control limit, marginal exceedance of any control limit by more than allowable number, exceedance of ME limits by any analyte	LCS/DLCS fails. Evaluate whether affected samples must be re-extracted.	Where samples cannot be re-extracted, note in case narrative.
MS & DMS	Value outside acceptance criteria; >20% RSD	Evaluate parent sample. If necessary, re-extract sample and MS/DMS pair.	Comment in case narrative.

Uncontrolled Copy
Will not be updated

TABLE 12

CORRECTIVE ACTION SUMMARY TABLE (cont.)

QC Activity	Unacceptable Criteria	Recommended Corrective Action	Documentation
Duplicate (DUP)	>25% RSD	Evaluate parent samples. If necessary, re-extract sample and DUP.	Comment in case narrative
Labeled Standard Recovery(ies)	Outside acceptance criteria for all labeled standards or if any labeled standard recovery is <10%	Complete an NCAR form and re-extract the sample using a smaller sample size.	Add an 'RE' suffix to the end of the Lab Sample ID, indicating 'Re-extraction'
Recovery of labeled standard for compounds	Outside acceptance criteria	Report values and flag results.	Flag associated results with 'Y' on Form 1s.
2378-TCDF result	Quantitated value on DB-5 column	Reanalyze 2378-TCDF on DB-225 column. Report value obtained from DB-225 column.	2378-TCDF result associated with a value from the DB-5 column flagged with 'C' on Form 1s.
Sample Results	Quantitated value >5x upper calibration limit. (OCDD/OCDF are exceptions to this rule)	Report values; dilute sample and report both undiluted and diluted test results. If only OCDD and/or OCDF are over-range, do not dilute extract – report OCDD and/or OCDF as over-range.	Flag associated results with 'E' on Form 1s.
Sample Results	Quantitated value <lower end of linear calibration range and >EDL.	Report values and flag results.	Flag associated results with 'J' on Form 1s.
Sample Results	Compound not detected.	Report and flag results.	Flag associated compounds with 'U' on Form 1s.
Native ions	Outside ion abundance ratio QC limit	Report as EMPC	Flag associated results with 'K' on Form 1s.
MDH Requirement - Analyze HRCC1 monthly at minimum	%Recovery falls outside ±40% acceptance criteria	Elevate MRL to lowest point meeting acceptance criteria. Reanalyze standard.	Report all samples using elevated MRL until passing HRCC1 can be analyzed.

Uncontrolled Copy
Will not be updated

TABLE 13

METHOD ACCEPTANCE CRITERIA[a]

Compounds	LCS & DLCS		MS & DMS		DUP
	Accuracy (%Rec)	Precision (%Diff)	Accuracy (%Rec)	Precision (%Diff)	Precision (%Diff)
2,3,7,8-TCDD	70-130	≤20	70-130	≤20	≤25
2,3,7,8-TCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,7,8-PeCDD	70-130	≤20	70-130	≤20	≤25
1,2,3,7,8-PeCDF	70-130	≤20	70-130	≤20	≤25
2,3,4,7,8-PeCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,4,7,8-HxCDD	70-130	≤20	70-130	≤20	≤25
1,2,3,6,7,8-HxCDD	70-130	≤20	70-130	≤20	≤25
1,2,3,7,8,9-HxCDD	70-130	≤20	70-130	≤20	≤25
1,2,3,4,7,8-HxCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,6,7,8-HxCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,7,8,9-HxCDF	70-130	≤20	70-130	≤20	≤25
2,3,4,6,7,8-HxCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,4,6,7,8-HpCDD	70-130	≤20	70-130	≤20	≤25
1,2,3,4,6,7,8-HpCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,4,7,8,9-HpCDF	70-130	≤20	70-130	≤20	≤25
OCDD	70-130	≤20	70-130	≤20	≤25
OCDF	70-130	≤20	70-130	≤20	≤25
C13-2,3,7,8-TCDD	40-135		40-135		
C13-1,2,3,7,8-PeCDD	40-135		40-135		
C13-1,2,3,6,7,8-HxCDD	40-135		40-135		
C13-1,2,3,4,6,7,8-HpCDD	40-135		40-135		
C13-OCDD	40-135		40-135		
C13-2,3,7,8-TCDF	40-135		40-135		
C13-1,2,3,7,8-PeCDF	40-135		40-135		
C13-1,2,3,4,7,8-HxCDF	40-135		40-135		
C13-1,2,3,4,6,7,8-HpCDF	40-135		40-135		
37Cl-2,3,7,8-TCDD	40-135		40-135		

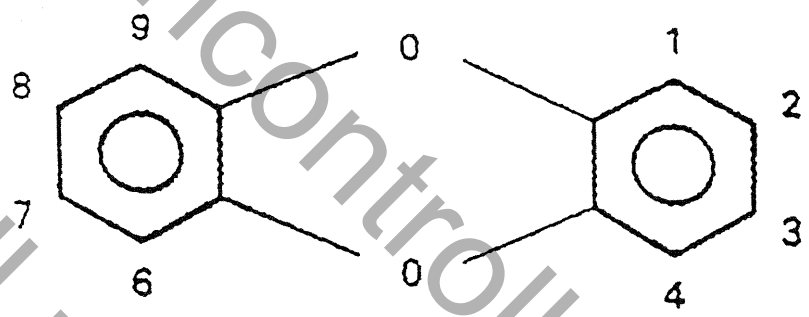
[a]Method acceptance criteria for Accuracy results interim guidelines. Actual acceptance criteria are updated annually based on the requirements of EPA SW-846 8000B and can be found in CAS LIMS.

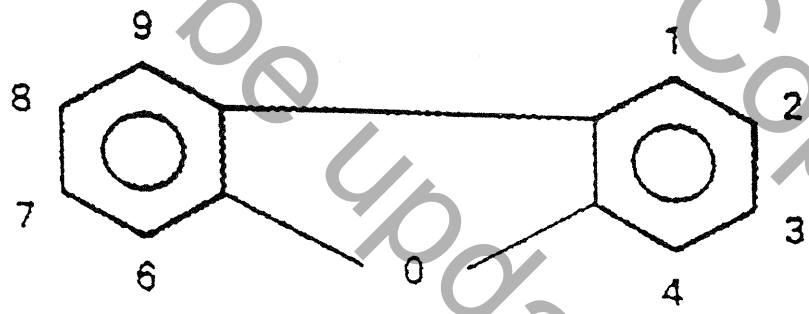
Uncontrolled Copy
Will not be updated

APPENDIX 2

FIGURE 1

GENERAL STRUCTURES OF DIBENZO-*p*-DIOXINS (TOP) AND DIBENZOFURANS (BOTTOM)



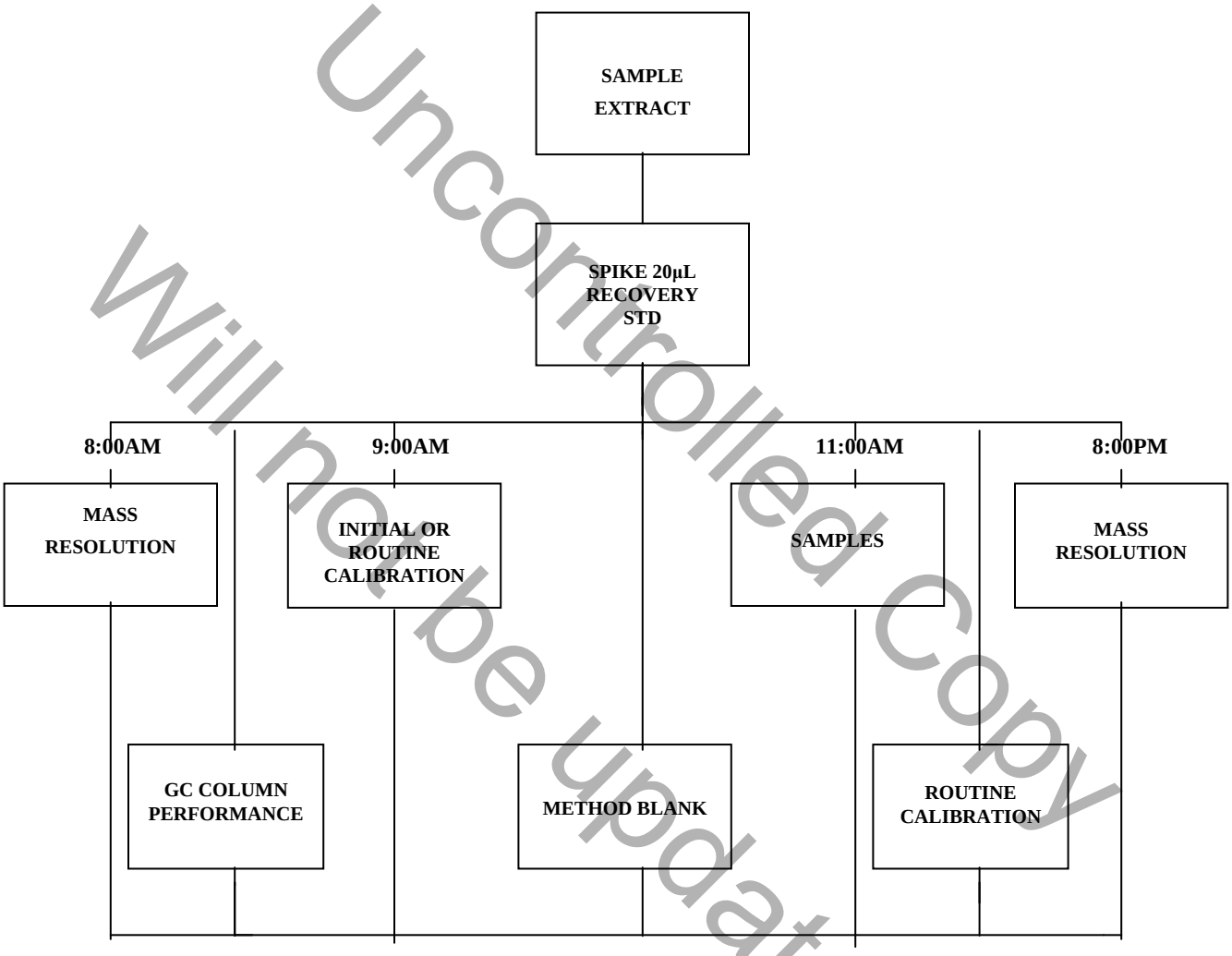


Uncontrolled Copy
Will not be updated

FIGURE 2

TYPICAL 12-HOUR ANALYSIS SEQUENCE OF EVENTS

ANALYTICAL PROCEDURE



Uncontrolled Copy
Will not be updated

FIGURE 3

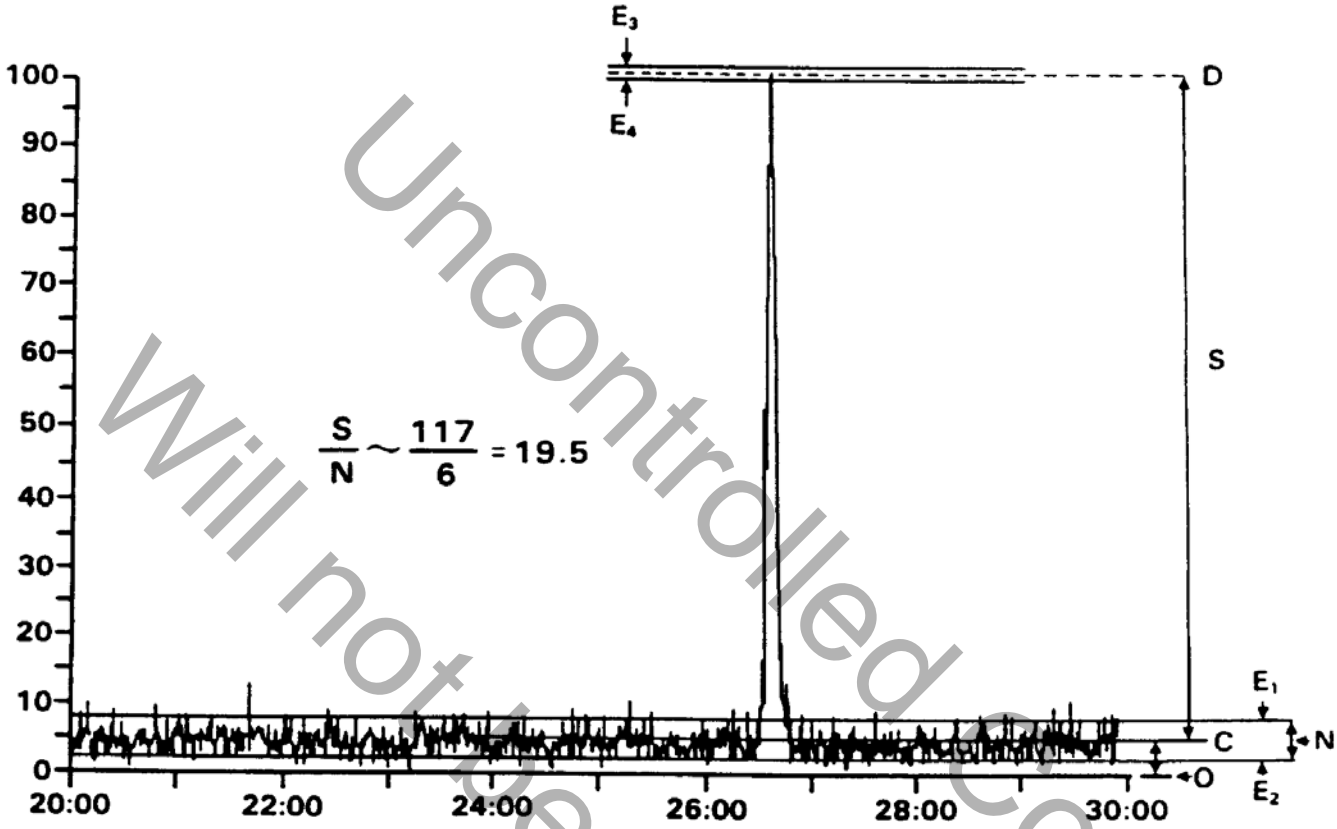
TYPICAL PREPARATION BATCH SEQUENCE

MB
LCS
DLCS (if applicable)
Field Sample 1
Field Sample 2
:
:
Field Sample n
Field Sample n MS (if applicable)
Field Sample n DMS (if applicable)
Field sample n DUP (if applicable)
:
:
Field Sample 19
Field Sample 20

Uncontrolled Copy
Will not be updated

FIGURE 4

MANUAL DETERMINATION OF S/N



The peak height (S) is measured between the mean noise (lines C and D.) These mean signal values are obtained by tracing the line between the baseline average noise extremes, E1 and E2, and between the apex average noise extremes, E3 and E4, at the apex of the signal.

NOTE: It is imperative that the instrument interface amplifier electronic zero offset be set high enough so that negative going baseline noise is recorded.

Uncontrolled Copy
Will not be updated

FIGURE 5

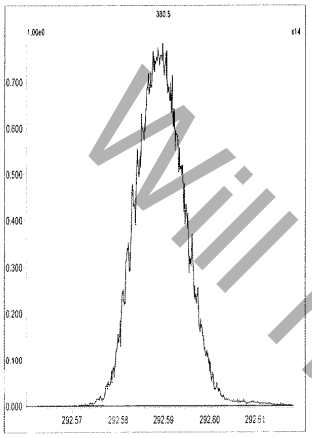
MASS RESOLUTION CHECK

Experiment Calibration Report **MassLynx 4.1** Page 1 of

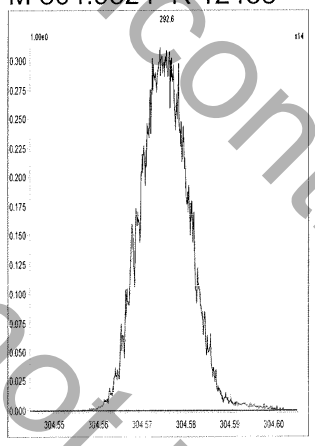
File: Experiment Reference: Pfk.ref Function: 1 @ 200 (ppm)

Printed: Friday, April 04, 2008 05:18:13 Central Standard Time

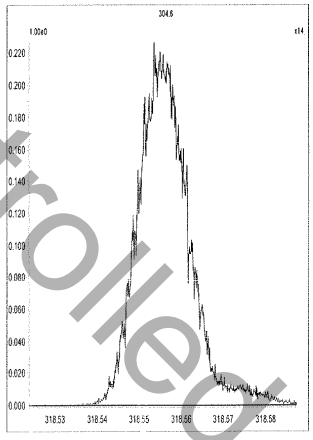
M 292.9824 R 12623



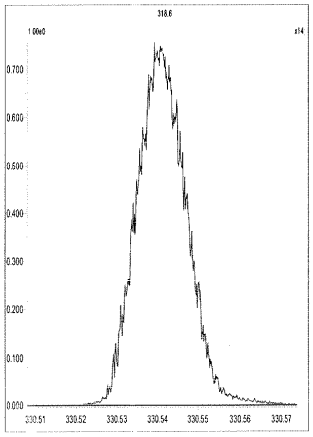
M 304.9824 R 12438



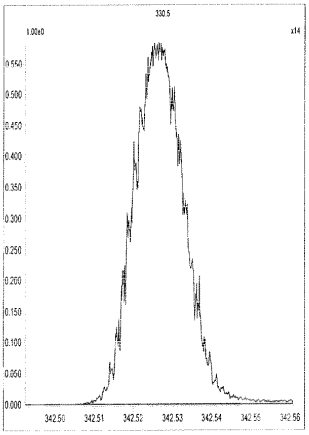
M 318.9792 R 11735



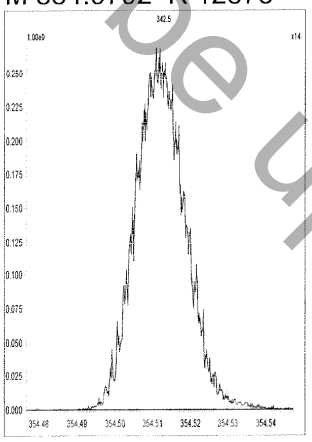
M 330.9792 R 12501



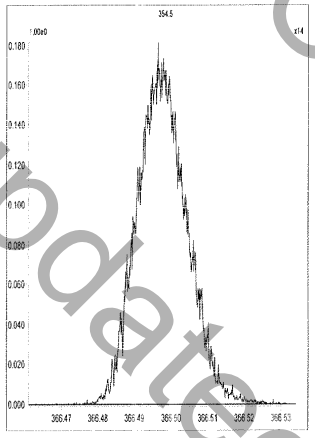
M 342.9792 R 12253



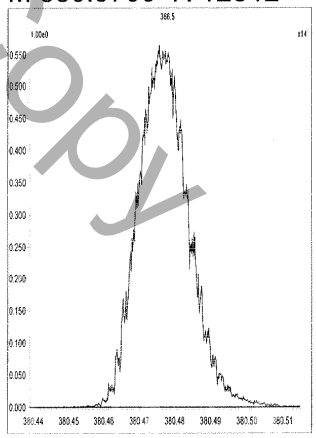
M 354.9792 R 12378



M 366.9792 R 11791



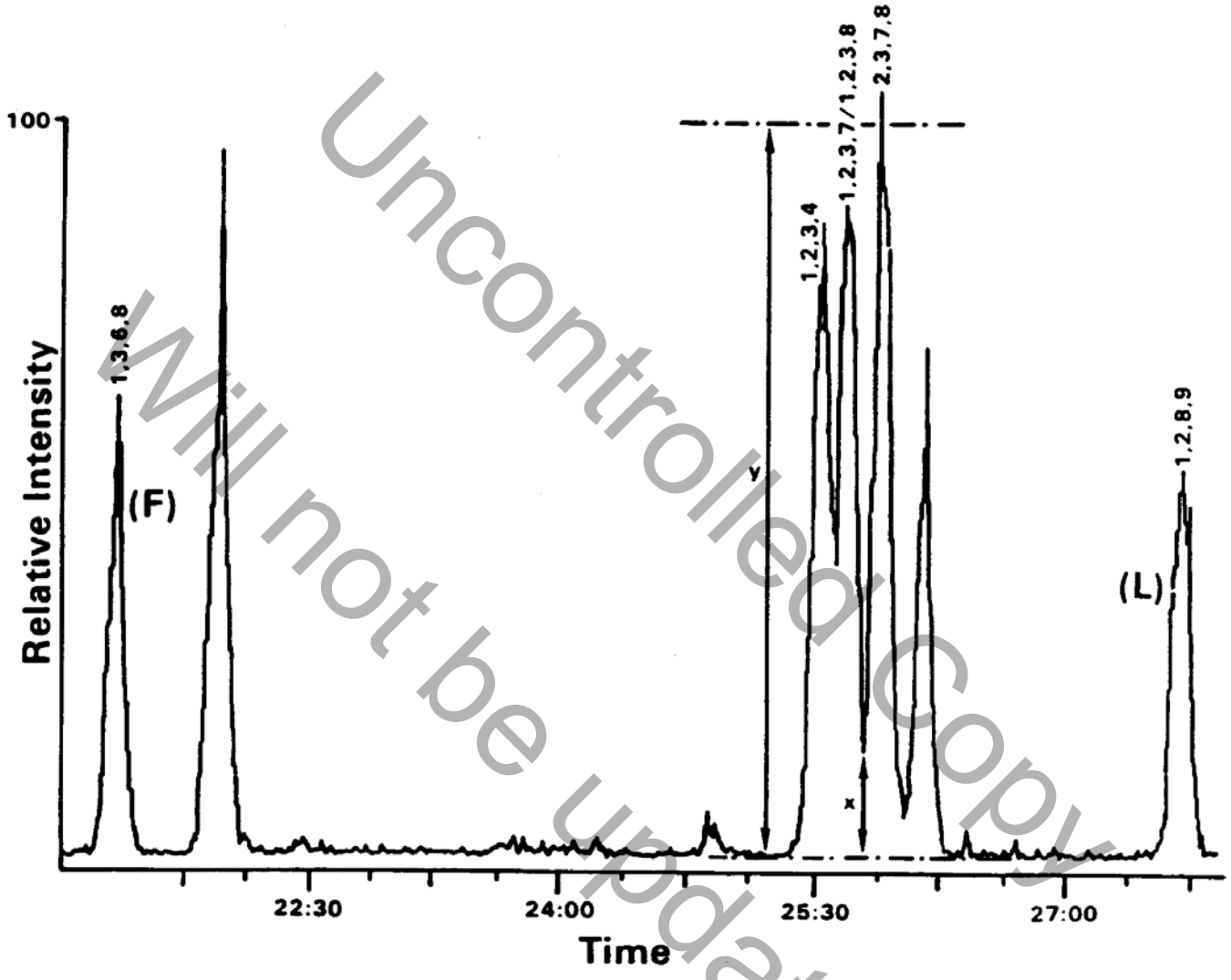
M 380.9760 R 12312



Uncontrolled Copy
Will not be updated

FIGURE 6

DB-5 GC COLUMN PERFORMANCE AND WINDOW DEFINITION



Uncontrolled Copy
Will not be updated

FIGURE 7

FORMAT FOR A TRAINING PLAN

1. Read and study SOP — Trainer: ____ Trainee: ____ Date: _____
2. Read published method.
3. Demonstrated scientific understanding of the analysis — Trainer: ____ Trainee: ____ Date: _____
   Sample preparation
   HR-Gas chromatography
   HR-Mass spectrometry
4. Demonstrated familiarity with related SOPs — Trainer: ____ Trainee: ____ Date: _____
   SOP for Analytical Batches and Analytical Sequences
   SOP for Making Entries into Logbooks and onto Bench sheets
   SOP for Manual Integration of Chromatographic Peaks
   SOP for Significant Figures
   SOP for Nonconformity and Corrective Action Documentation
   SOP for Determination of Method Detection Limits
5. Observe performance of SOP — Trainer: ____ Trainee: ____ Date: _____
   - sample preparation and sample loading
   - analytical sequence setup
   - initial calibration and continuing calibration verification
   - sample analysis
   - software introduction
   - data reduction and reporting
6. Perform SOP with supervision — Trainer: ____ Trainee: ____ Date: _____
   - sample preparation and sample loading
   - analytical sequence setup
   - initial calibration and continuing calibration verification
   - sample analysis
   - software use
   - data reduction and reporting
7. Independent performance of the SOP — Trainer: ____ Trainee: ____ Date: _____
   - sample preparation and sample loading
   - analytical sequence setup
   - initial calibration and continuing calibration verification
   - sample analysis
   -software proficiency
   - data reduction and reporting
   - initial demonstration of competency
   - IPR study
     - single blind PE sample
     - four consecutive LCSs
8. Instrument operation and maintenance — Trainer: ____ Trainee: ____ Date: _____
   - autosampler
   - gas chromatograph and capillary column installation
   - mass spectrometer
   - data system

Uncontrolled Copy
Will not be updated

THIS PAGE INTENTIONALLY BLANK

ATTACHMENT B
LABORATORY CERTIFICATIONS
(Included electronically as PDF only)

THIS PAGE INTENTIONALLY BLANK

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

COLUMBIA ANALYTICAL SERVICES, INC.

Houston, TX

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (QSM v4.1); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

Presented this 15th day of February 2010.

President & CEO
For the Accreditation Council
Certificate Number 2897.01
Valid to November 30, 2011

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

COLUMBIA ANALYTICAL SERVICES, INC.
19408 Park Row, Suite 320
Houston, Texas 77084
Andrew Biddle Phone: (713) 266 1599
abiddle@caslab.com

ENVIRONMENTAL

Valid To: November 30, 2011 Certificate Number: 2897.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1)) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

High Resolution Gas Chromatography/High Resolution Mass Spectrometry

Parameter/Analyte	**Nonpotable Water**	**Solid Hazardous Waste**	**Tissue**
PCBs			
PCB 1	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 2	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 3	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 4	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 5	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 6	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 7	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 8	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 9	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 10	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 11	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 12	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 13	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 14	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 15	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 16	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 17	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M

5301 Buckeystown Pike, Suite 350 | Frederick, Maryland 21704-8373 | Phone: 301 644 3248 | Fax: 301 662 2974 | www.A2LA.org

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
PCB 18	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 19	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 20	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 21	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 22	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 23	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 24	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 25	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 26	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 27	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 28	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 29	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 30	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 31	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 32	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 33	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 34	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 35	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 36	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 37	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 38	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 39	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 40	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 41	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 42	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 43	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 44	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 45	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 46	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 47	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 48	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 49	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 50	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 51	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 52	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 53	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 54	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 55	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 56	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 57	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 58	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 59	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
PCB 60	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 61	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 62	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 63	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 64	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 65	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 66	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 67	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 68	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 69	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 70	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 71	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 72	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 73	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 74	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 75	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 76	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 77	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 78	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 79	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 80	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 81	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 82	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 83	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 84	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 85	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 86	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 87	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 88	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 89	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 90	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 91	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 92	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 93	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 94	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 95	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 96	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 97	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 98	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 99	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 100	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 101	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 102	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
PCB 103	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 104	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 105	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 106	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 107	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 108	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 109	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 110	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 111	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 112	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 113	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 114	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 115	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 116	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 117	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 118	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 119	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 120	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 121	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 122	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 123	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 124	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 125	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 126	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 127	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 128	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 129	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 130	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 131	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 132	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 133	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 134	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 135	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 136	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 137	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 138	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 139	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 140	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 141	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 142	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 143	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 144	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 145	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
PCB 146	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 147	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 148	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 149	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 150	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 151	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 152	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 153	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 154	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 155	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 156	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 157	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 158	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 159	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 160	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 161	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 162	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 163	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 164	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 165	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 166	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 167	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 168	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 169	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 170	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 171	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 172	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 173	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 174	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 175	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 176	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 177	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 178	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 179	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 180	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 181	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 182	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 183	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 184	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 185	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 186	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 187	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 188	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
PCB 189	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 190	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 191	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 192	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 193	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 194	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 195	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 196	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 197	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 198	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 199	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 200	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 201	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 202	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 203	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 204	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 205	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 206	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 207	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 208	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 209	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
Sample Preparation	Liquid Liquid Extraction	Liquid Extraction, ASE, Soxhlet	Soxhlet
Dioxins/Furans			
2,3,7,8-TCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,7,8-PeCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,4,7,8-HxCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,6,7,8-HxCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,7,8,9-HxCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,4,6,7,8-HpCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
OCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
2,3,7,8-TCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,7,8-PeCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
2,3,4,7,8-PeCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,4,7,8-HxCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,6,7,8-HxCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,7,8,9-HxCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
2,3,4,6,7,8-HxCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,4,6,7,8-HpCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,4,7,8,9-HpCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
OCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
Sample Preparation	Liquid Liquid Extraction	Liquid Extraction, ASE, Soxhlet	Soxhlet

M = Modified Method

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below, and for the test methods applicable to NELAC Chapter 5:

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	Foods
Dioxins/Furans				
2,3,7,8-TCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8-PeCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,7,8-HxCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,6,7,8-HxCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8,9-HxCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,6,7,8-HpCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
OCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
2,3,7,8-TCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8-PeCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
2,3,4,7,8-PeCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,7,8-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,6,7,8-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8,9-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
2,3,4,6,7,8-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,6,7,8-HpCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,7,8,9-HpCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
OCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
Sample Preparation	Liquid/Liquid	Liquid/liquid	Soxhlet, ASE	Soxhlet, ASE
ASE=accelerated solvent extraction				

LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 ***Certificate Number L2278***

EMAX Laboratories, Inc

1835 W 205th Street
Torrance, CA 90501

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation Granted through: January 10, 2014

R. Douglas Leonard, Jr., Managing Director
Laboratory Accreditation Bureau
Presented the 10th of January 2011

*See the laboratory's Scope of Accreditation for details of the DoD ELAP requirements
Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

LABORATORY ACCREDITATION BUREAU

Certificate # L2278

Scope of Accreditation For EMAX Laboratories, Inc.

1835 W 205th Street
Torrance, CA 90501
Kenette Pimentel
310-618-8889

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to **EMAX Laboratories, Inc.** to perform the following tests:

Accreditation granted through: **January 10, 2014**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	AK101	GRO
GC	AK102	DRO
GC	AK103	RRO
GC	RSK175	Methane
GC	RSK175	Acetylene
GC	RSK175	Ethylene
GC	RSK175	Ethane
GC	RSK175	Propane
GC	RSK175	Carbon dioxide
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NOrgC	TKN
Spectrometric	SM4500-PE	Phosphorus
Electrode	SM9040C	pH
Electrode	SM9045D	pH
Spectrometric	SM9065	Phenols
Pensky-Martens	SW1010	Ignitability
ICP	SW6010B & 6010C	Aluminum
ICP	SW6010B & 6010C	Antimony
ICP	SW6010B & 6010C	Arsenic
ICP	SW6010B & 6010C	Barium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	SW6010B & 6010C	Beryllium
ICP	SW6010B & 6010C	Boron
ICP	SW6010B & 6010C	Cadmium
ICP	SW6010B & 6010C	Calcium
ICP	SW6010B & 6010C	Chromium
ICP	SW6010B & 6010C	Cobalt
ICP	SW6010B & 6010C	Copper
ICP	SW6010B & 6010C	Iron
ICP	SW6010B & 6010C	Lead
ICP	SW6010B & 6010C	Magnesium
ICP	SW6010B & 6010C	Manganese
ICP	SW6010B & 6010C	Molybdenum
ICP	SW6010B & 6010C	Nickel
ICP	SW6010B & 6010C	Potassium
ICP	SW6010B & 6010C	Selenium
ICP	SW6010B & 6010C	Silver
ICP	SW6010B & 6010C	Sodium
ICP	SW6010B & 6010C	Strontium
ICP	SW6010B & 6010C	Thallium
ICP	SW6010B & 6010C	Tin
ICP	SW6010B & 6010C	Titanium
ICP	SW6010B & 6010C	Vanadium
ICP	SW6010B & 6010C	Zinc
ICP-MS	SW6020A	Aluminum
ICP-MS	SW6020A	Antimony
ICP-MS	SW6020A	Arsenic
ICP-MS	SW6020A	Barium
ICP-MS	SW6020A	Beryllium
ICP-MS	SW6020A	Boron
ICP-MS	SW6020A	Cadmium
ICP-MS	SW6020A	Calcium
ICP-MS	SW6020A	Chromium
ICP-MS	SW6020A	Cobalt
ICP-MS	SW6020A	Copper
ICP-MS	SW6020A	Iron
ICP-MS	SW6020A	Lead
ICP-MS	SW6020A	Magnesium
ICP-MS	SW6020A	Manganese
ICP-MS	SW6020A	Molybdenum
ICP-MS	SW6020A	Nickel

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	SW6020A	Potassium
ICP-MS	SW6020A	Selenium
ICP-MS	SW6020A	Silver
ICP-MS	SW6020A	Sodium
ICP-MS	SW6020A	Strontium
ICP-MS	SW6020A	Thallium
ICP-MS	SW6020A	Tin
ICP-MS	SW6020A	Titanium
ICP-MS	SW6020A	Uranium
ICP-MS	SW6020A	Vanadium
ICP-MS	SW6020A	Zinc
Spectrometric	SW7196A	Hex. Chromium
IC	SW7199	Hex. Chromium
Cold-Vapor	SW7470A / 7471A	Mercury
GC	SW8015B / 8015C	Gasoline
GC	SW8015B / 8015C	Diesel
GC	SW8015B / 8015C	Motor Oil
GC	SW8015B / 8015C	JP5
GC	SW8081A / 8081B	Aldrin
GC	SW8081A / 8081B	alpha-BHC
GC	SW8081A / 8081B	beta-BHC
GC	SW8081A / 8081B	delta-BHC
GC	SW8081A / 8081B	gamma-BHC (Lindane)
GC	SW8081A / 8081B	DDD (4,4)
GC	SW8081A / 8081B	DDE (4,4)
GC	SW8081A / 8081B	DDT (4,4)
GC	SW8081A / 8081B	Dieldrin
GC	SW8081A / 8081B	Endosulfan I
GC	SW8081A / 8081B	Endosulfan II
GC	SW8081A / 8081B	Endosulfan sulfate
GC	SW8081A / 8081B	Endrin
GC	SW8081A / 8081B	Endrin Aldehyde
GC	SW8081A / 8081B	Heptachlor
GC	SW8081A / 8081B	Heptachlor epoxide
GC	SW8081A / 8081B	Methoxychlor
GC	SW8081A / 8081B	alpha-Chlordane
GC	SW8081A / 8081B	gamma-Chlordane
GC	SW8081A / 8081B	Endrin Ketone
GC	SW8081A / 8081B	Toxaphene
GC	SW8081A / 8081B	Technical Chlordane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	SW8082 / 8082A	PCB1016
GC	SW8082 & 8082A	PCB1221
GC	SW8082 & 8082A	PCB1232
GC	SW8082 & 8082A	PCB1242
GC	SW8082 & 8082A	PCB1248
GC	SW8082 & 8082A	PCB1254
GC	SW8082 & 8082A	PCB1260
GC	SW8082 & 8082A	PCB1262
GC	SW8082 & 8082A	PCB1268
GC	SW8082 & 8082A	PCB 8
GC	SW8082 & 8082A	PCB 18
GC	SW8082 & 8082A	PCB 28
GC	SW8082 & 8082A	PCB 44
GC	SW8082 & 8082A	PCB 52
GC	SW8082 & 8082A	PCB 66
GC	SW8082 & 8082A	PCB 77
GC	SW8082 & 8082A	PCB 81
GC	SW8082 & 8082A	PCB 101
GC	SW8082 & 8082A	PCB 105
GC	SW8082 & 8082A	PCB 114
GC	SW8082 & 8082A	PCB 118
GC	SW8082 & 8082A	PCB 123
GC	SW8082 & 8082A	PCB 126
GC	SW8082 & 8082A	PCB 128
GC	SW8082 & 8082A	PCB 138
GC	SW8082 & 8082A	PCB 153
GC	SW8082 & 8082A	PCB 156
GC	SW8082 & 8082A	PCB 157
GC	SW8082 & 8082A	PCB 167
GC	SW8082 & 8082A	PCB 169
GC	SW8082 & 8082A	PCB 170
GC	SW8082 & 8082A	PCB 180
GC	SW8082 & 8082A	PCB 187
GC	SW8082 & 8082A	PCB 189
GC	SW8082 & 8082A	PCB 195
GC	SW8082 & 8082A	PCB 206
GC	SW8082 & 8082A	PCB 209
GC	SW8141A	Azinphos-methyl
GC	SW8141A	Bolstar
GC	SW8141A	Chlorpyrifos

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	SW8141A	Coumaphos
GC	SW8141A	Demeton
GC	SW8141A	Diazinon
GC	SW8141A	Dichlorvos
GC	SW8141A	Disulfoton
GC	SW8141A	Ethoprop
GC	SW8141A	Fensulfothion
GC	SW8141A	Fenthion
GC	SW8141A	Merphos
GC	SW8141A	Mevinphos
GC	SW8141A	Naled
GC	SW8141A	Methyl Parathion
GC	SW8141A	Phorate
GC	SW8141A	Ronnel
GC	SW8141A	Stirophos
GC	SW8141A	Tokuthion
GC	SW8141A	Trichloronate
GC	SW8141A	Dimethoate
GC	SW8141A	EPN
GC	SW8141A	Famphur
GC	SW8141A	Malathion
GC	SW8141A	Ethyl Parathion
GC	SW8141A	O,O,O-Triethylphosphorothioate
GC	SW8141A	Sulfotepp
GC	SW8141A	Thionazin
GC	SW8141A	Tributyl Phosphate
GC-MS	SW8260B	Acetone
GC-MS	SW8260B	Acrolein
GC-MS	SW8260B	Acrylonitrile
GC-MS	SW8260B	Benzene
GC-MS	SW8260B	Bromobenzene
GC-MS	SW8260B	Bromochloromethane
GC-MS	SW8260B	Bromodichloromethane
GC-MS	SW8260B	Bromoform
GC-MS	SW8260B	Bromomethane
GC-MS	SW8260B	tert-Butyl alcohol
GC-MS	SW8260B	2-Butanone (MEK)
GC-MS	SW8260B	n-Butylbenzene
GC-MS	SW8260B	sec-Butylbenzene
GC-MS	SW8260B	tert-Butylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8260B	Carbon disulfide
GC-MS	SW8260B	Carbon tetrachloride
GC-MS	SW8260B	Chlorobenzene
GC-MS	SW8260B	2-Chloroethyl vinyl ether
GC-MS	SW8260B	Chloroethane
GC-MS	SW8260B	Chloroform
GC-MS	SW8260B	1-Chlorohexane
GC-MS	SW8260B	Chloromethane
GC-MS	SW8260B	2-Chlorotoluene
GC-MS	SW8260B	4-Chlorotoluene
GC-MS	SW8260B	Isopropyl ether (DIPE)
GC-MS	SW8260B	Dibromochloromethane
GC-MS	SW8260B	1,2-Dibromo-3-chloropropane
GC-MS	SW8260B	1,2-Dibromoethane
GC-MS	SW8260B	Dibromomethane
GC-MS	SW8260B	1,1-Dichloroethane
GC-MS	SW8260B	1,2-Dichloroethane
GC-MS	SW8260B	1,2-Dichlorobenzene
GC-MS	SW8260B	1,3-Dichlorobenzene
GC-MS	SW8260B	trans-1,4-Dichloro-2-Butene
GC-MS	SW8260B	1,4-Dichlorobenzene
GC-MS	SW8260B	Dichlorodifluoromethane
GC-MS	SW8260B	1,1-Dichloroethene
GC-MS	SW8260B	cis-1,2-Dichloroethene
GC-MS	SW8260B	trans-1,2-Dichloroethene
GC-MS	SW8260B	Dichlorofluoromethane
GC-MS	SW8260B	1,1-Dichloropropene
GC-MS	SW8260B	1,2-Dichloropropane
GC-MS	SW8260B	1,3-Dichloropropane
GC-MS	SW8260B	2,2-Dichloropropane
GC-MS	SW8260B	cis-1,3-Dichloropropene
GC-MS	SW8260B	trans-1,3-Dichloropropene
GC-MS	SW8260B	tert-Butyl ethyl ether (ETBE)
GC-MS	SW8260B	Ethyl Methacrylate
GC-MS	SW8260B	Ethylbenzene
GC-MS	SW8260B	2-Hexanone (MBK)
GC-MS	SW8260B	Hexachlorobutadiene
GC-MS	SW8260B	Iodomethane
GC-MS	SW8260B	Isopropylbenzene
GC-MS	SW8260B	p-Isopropyltoluene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8260B	Methylene Chloride
GC-MS	SW8260B	4-Methyl-2-pentanone (MIBK)
GC-MS	SW8260B	tert-Butyl methyl ether
GC-MS	SW8260B	Naphthalene
GC-MS	SW8260B	n-Propylbenzene
GC-MS	SW8260B	Styrene
GC-MS	SW8260B	tert-Amyl methyl ether (TAME)
GC-MS	SW8260B	1,1,1,2-Tetrachloroethane
GC-MS	SW8260B	1,1,2,2-Tetrachloroethane
GC-MS	SW8260B	Tetrachloroethene
GC-MS	SW8260B	Toluene
GC-MS	SW8260B	1,1,1-Trichloroethane
GC-MS	SW8260B	1,1,2-Trichloroethane
GC-MS	SW8260B	1,2,3-Trichlorobenzene
GC-MS	SW8260B	1,2,4-Trichlorobenzene
GC-MS	SW8260B	Trichloroethene
GC-MS	SW8260B	Trichlorofluoromethane
GC-MS	SW8260B	1,2,3-Trichloropropane
GC-MS	SW8260B	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	SW8260B	1,2,4-Trimethylbenzene
GC-MS	SW8260B	1,3,5-Trimethylbenzene
GC-MS	SW8260B	Vinyl Acetate
GC-MS	SW8260B	Vinyl Chloride
GC-MS	SW8260B	m-Xylene & p-xylene
GC-MS	SW8260B	o-Xylene
GC-MS	SW8260B	2-Butanol
GC-MS	SW8260B	Cyclohexane
GC-MS	SW8260B SIM	Benzene
GC-MS	SW8260B SIM	Carbon tetrachloride
GC-MS	SW8260B SIM	Chloroform
GC-MS	SW8260B SIM	Chloromethane
GC-MS	SW8260B SIM	1,2-Dibromo-3-chloropropane
GC-MS	SW8260B SIM	1,2-Dibromoethane
GC-MS	SW8260B SIM	1,2-Dichloroethane
GC-MS	SW8260B SIM	1,1-Dichloroethene
GC-MS	SW8260B SIM	cis-1,2-Dichloroethene
GC-MS	SW8260B SIM	trans-1,2-Dichloroethene
GC-MS	SW8260B SIM	1,1,2,2-Tetrachloroethane
GC-MS	SW8260B SIM	Tetrachloroethene
GC-MS	SW8260B SIM	1,1,1-Trichloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8260B SIM	1,1,2-Trichloroethane
GC-MS	SW8260B SIM	Trichloroethene
GC-MS	SW8260B SIM	1,2,3-Trichloropropane
GC-MS	SW8260B SIM	Vinyl Chloride
GC-MS	SW8270C & 8270D	Acenaphthene
GC-MS	SW8270C & 8270D	Acenaphthylene
GC-MS	SW8270C & 8270D	Aniline
GC-MS	SW8270C & 8270D	Anthracene
GC-MS	SW8270C & 8270D	Azobenzene
GC-MS	SW8270C & 8270D	Benzidine
GC-MS	SW8270C & 8270D	Benzo(a)anthracene
GC-MS	SW8270C & 8270D	benzo(a)pyrene
GC-MS	SW8270C & 8270D	Benzo(b)fluoranthene
GC-MS	SW8270C & 8270D	Benzo(e)pyrene
GC-MS	SW8270C & 8270D	Benzo(g,h,i)perylene
GC-MS	SW8270C & 8270D	Benzo(k)fluoranthene
GC-MS	SW8270C & 8270D	Benzoic Acid
GC-MS	SW8270C & 8270D	Benzyl Alcohol
GC-MS	SW8270C & 8270D	Biphenyl
GC-MS	SW8270C & 8270D	bis(2-chloroethoxy)methane
GC-MS	SW8270C & 8270D	bis(2-chloroethyl)ether
GC-MS	SW8270C & 8270D	bis(2-chloroisopropyl)ether
GC-MS	SW8270C & 8270D	bis(2-Ethylhexyl)adipate
GC-MS	SW8270C & 8270D	bis(2-Ethylhexyl)phthalate
GC-MS	SW8270C & 8270D	4-Bromophenyl-phenylether
GC-MS	SW8270C & 8270D	Butylbenzylphthalate
GC-MS	SW8270C & 8270D	Carbazole
GC-MS	SW8270C & 8270D	4-Chloro-3-methylphenol
GC-MS	SW8270C & 8270D	4-Chloroaniline
GC-MS	SW8270C & 8270D	2-Chloronaphthalene
GC-MS	SW8270C & 8270D	2-Chlorophenol
GC-MS	SW8270C & 8270D	4-Chlorophenyl-phenylether
GC-MS	SW8270C & 8270D	Chrysene
GC-MS	SW8270C & 8270D	Dibenzo(a,h)anthracene
GC-MS	SW8270C & 8270D	Dibenzofuran
GC-MS	SW8270C & 8270D	1,2-Dichlorobenzene
GC-MS	SW8270C & 8270D	1,3-Dichlorobenzene
GC-MS	SW8270C & 8270D	1,4-Dichlorobenzene
GC-MS	SW8270C & 8270D	3,3'-Dichlorobenzidine
GC-MS	SW8270C & 8270D	2,4-Dichlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8270C & 8270D	Diethylphthalate
GC-MS	SW8270C & 8270D	2,6-Dimethylnaphthalene
GC-MS	SW8270C & 8270D	2,4-Dimethylphenol
GC-MS	SW8270C & 8270D	Dimethylphthalate
GC-MS	SW8270C & 8270D	Di-n-butylphthalate
GC-MS	SW8270C & 8270D	4,6-Dinitro-2-methylphenol
GC-MS	SW8270C & 8270D	2,4-Dinitrophenol
GC-MS	SW8270C & 8270D	2,4-Dinitrotoluene
GC-MS	SW8270C & 8270D	2-6-Dinitrotoluene
GC-MS	SW8270C & 8270D	Di-n-octylphthalate
GC-MS	SW8270C & 8270D	Fluoranthene
GC-MS	SW8270C & 8270D	Fluorene
GC-MS	SW8270C & 8270D	Hexachlorobenzene
GC-MS	SW8270C & 8270D	Hexachlorobutadiene
GC-MS	SW8270C & 8270D	Hexachlorocyclopentadiene
GC-MS	SW8270C & 8270D	Hexachloroethane
GC-MS	SW8270C & 8270D	Indeno(1,2,3-cd)pyrene
GC-MS	SW8270C & 8270D	Isophorone
GC-MS	SW8270C & 8270D	1-Methylnaphthalene
GC-MS	SW8270C & 8270D	2-Methylnaphthalene
GC-MS	SW8270C & 8270D	1-Methylphenanthrene
GC-MS	SW8270C & 8270D	2-Methylphenol
GC-MS	SW8270C & 8270D	4-Methylphenol
GC-MS	SW8270C & 8270D	Naphthalene
GC-MS	SW8270C & 8270D	2-Nitroaniline
GC-MS	SW8270C & 8270D	3-Nitroaniline
GC-MS	SW8270C & 8270D	4-Nitroaniline
GC-MS	SW8270C & 8270D	Nitrobenzene
GC-MS	SW8270C & 8270D	2-Nitrophenol
GC-MS	SW8270C & 8270D	4-Nitrophenol
GC-MS	SW8270C & 8270D	n-Nitrosodimethylamine
GC-MS	SW8270C & 8270D	n-Nitroso-di-n-propylamine
GC-MS	SW8270C & 8270D	n-Nitrosodiphenylamine
GC-MS	SW8270C & 8270D	Pentachlorophenol
GC-MS	SW8270C & 8270D	Perylene
GC-MS	SW8270C & 8270D	Phenanthrene
GC-MS	SW8270C & 8270D	Phenol
GC-MS	SW8270C & 8270D	Pyrene
GC-MS	SW8270C & 8270D	Pyridine
GC-MS	SW8270C & 8270D	2,3,4,6-Tetrachlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8270C & 8270D	1,2,4-Trichlorobenzene
GC-MS	SW8270C & 8270D	2,3,4-Trichlorophenol
GC-MS	SW8270C & 8270D	2,3,5-Trichlorophenol
GC-MS	SW8270C & 8270D	2,4,5-Trichlorophenol
GC-MS	SW8270C & 8270D	2,4,6-Trichlorophenol
GC-MS	SW8270C & 8270D	2,3,5-Trimethylnaphthalene
GC-MS	SW8270C & 8270D SIM	Acenaphthene
GC-MS	SW8270C & 8270D SIM	Acenaphthylene
GC-MS	SW8270C & 8270D SIM	Anthracene
GC-MS	SW8270C & 8270D SIM	Azobenzene
GC-MS	SW8270C & 8270D SIM	Benzo(a)anthracene
GC-MS	SW8270C & 8270D SIM	benzo(a)pyrene
GC-MS	SW8270C & 8270D SIM	Benzo(b)fluoranthene
GC-MS	SW8270C & 8270D SIM	Benzo(e)pyrene
GC-MS	SW8270C & 8270D SIM	Benzo(g,h,i)perylene
GC-MS	SW8270C & 8270D SIM	Benzo(k)fluoranthene
GC-MS	SW8270C & 8270D SIM	Biphenyl
GC-MS	SW8270C & 8270D SIM	bis(2-chloroethyl)ether
GC-MS	SW8270C & 8270D SIM	bis(2-Ethylhexyl)phthalate
GC-MS	SW8270C & 8270D SIM	Carbazole
GC-MS	SW8270C & 8270D SIM	4-Chloro-3-methylphenol
GC-MS	SW8270C & 8270D SIM	2-Chlorophenol
GC-MS	SW8270C & 8270D SIM	Chrysene
GC-MS	SW8270C & 8270D SIM	Dibenzo(a,h)anthracene
GC-MS	SW8270C & 8270D SIM	2,4-Dichlorophenol
GC-MS	SW8270C & 8270D SIM	2,6-Dimethylnaphthalene
GC-MS	SW8270C & 8270D SIM	2,4-Dimethylphenol
GC-MS	SW8270C & 8270D SIM	Fluoranthene
GC-MS	SW8270C & 8270D SIM	Fluorene
GC-MS	SW8270C & 8270D SIM	Hexachlorobenzene
GC-MS	SW8270C & 8270D SIM	Indeno(1,2,3-cd)pyrene
GC-MS	SW8270C & 8270D SIM	1-Methylnaphthalene
GC-MS	SW8270C & 8270D SIM	2-Methylnaphthalene
GC-MS	SW8270C & 8270D SIM	1-Methylphenanthrene
GC-MS	SW8270C & 8270D SIM	Naphthalene
GC-MS	SW8270C & 8270D SIM	n-Nitrosodimethylamine
GC-MS	SW8270C & 8270D SIM	n-Nitroso-di-n-propylamine
GC-MS	SW8270C & 8270D SIM	Pentachlorophenol
GC-MS	SW8270C & 8270D SIM	Perylene
GC-MS	SW8270C & 8270D SIM	Phenanthrene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8270C & 8270D SIM	Phenol
GC-MS	SW8270C & 8270D SIM	Pyrene
GC-MS	SW8270C & 8270D SIM	2,4,5-Trichlorophenol
GC-MS	SW8270C & 8270D SIM	2,4,6-Trichlorophenol
GC-MS	SW8270C & 8270D SIM	2,3,5-Trimethylnaphthalene
GC-MS	SW8270C & 8270D SIM	1,4-Dioxane
HPLC	SW8310	Acenaphthene
HPLC	SW8310	Acenaphthylene
HPLC	SW8310	Anthracene
HPLC	SW8310	Benzo(a)anthracene
HPLC	SW8310	Benzo(a)pyrene
HPLC	SW8310	Benzo(b)fluoranthene
HPLC	SW8310	Benzo(g,h,i)perylene
HPLC	SW8310	Benzo(k)fluoranthene
HPLC	SW8310	Chrysene
HPLC	SW8310	Dibenzo(a,h)anthracene
HPLC	SW8310	Fluoranthene
HPLC	SW8310	Fluorene
HPLC	SW8310	Indeno(1,2,3-cd)pyrene
HPLC	SW8310	1-Methylnaphthalene
HPLC	SW8310	2-Methylnaphthalene
HPLC	SW8310	Naphthalene
HPLC	SW8310	Phenanthrene
HPLC	SW8310	Pyrene
HPLC	SW8330A	HMX
HPLC	SW8330A	RDX
HPLC	SW8330A	1,3,5-TNB
HPLC	SW8330A	1,3-DNB
HPLC	SW8330A	Tetryl
HPLC	SW8330A	Nitrobenzene
HPLC	SW8330A	2,4,6-TNT
HPLC	SW8330A	4-AM-2,6-DNT
HPLC	SW8330A	2-AM-4,6-DNT
HPLC	SW8330A	2,6-DNT
HPLC	SW8330A	2,4-DNT
HPLC	SW8330A	2-Nitrotoluene
HPLC	SW8330A	4-Nitrotoluene
HPLC	SW8330A	3-Nitrotoluene
GC	SW8151A	Acifluorfen
GC	SW8151A	Bentazon

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	SW8151A	Chloramben
GC	SW8151A	2,4-D
GC	SW8151A	2,4-DB
GC	SW8151A	Dacthal
GC	SW8151A	Dalapon
GC	SW8151A	Dicamba
GC	SW8151A	3,5 Dichlorobenzoic
GC	SW8151A	Dichlorprop
GC	SW8151A	Dinoseb
GC	SW8151A	MCPA
GC	SW8151A	MCPP
GC	SW8151A	4-Nitrophenol
GC	SW8151A	Pentachlorophenol
GC	SW8151A	Picloram
GC	SW8151A	Silvex
GC	SW8151A	2,4,5-T
Platinum Electrode	EPA 120.1	Specific Conductance
Titrimetric	EPA 130.2	Hardness
Electrode	EPA 150.1	pH
Gravimetric	EPA 160.1	TDS
Gravimetric	EPA 160.2	TSS
Gravimetric	EPA 160.3	Total Residue
Turbidimetric	EPA 180.1	Turbidity
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc
IC	EPA 218.6	Hexavalent Chromium
COLD VAPOR	EPA 245.1	Mercury
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Chloride
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Bromide
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Phosphate
IC	EPA 300.0	Sulfate
IC	EPA 300.0	Bromate
IC	EPA 300M	Lactate
IC	EPA 300M	Acetate
IC	EPA 300M	Propionate
IC	EPA 300M	Butyrate
IC	EPA 300M	Pyruvate
IC	EPA 310.1	Alkalinity
IC	EPA 314.0	Perchlorate
Titrimetric	EPA 330.3	Total Residual Chlorine
Spectrometric	EPA 352.1	Nitrate-N
Spectrometric	EPA 353.3	Nitrate-N
Spectrometric	EPA 354.1	Nitrite-N
Spectrometric	EPA 365.2	Ortho-phosphate
Spectrometric	EPA 420.1	Phenols
Spectrometric	EPA 425.1	MBAS
Spectrometric	EPA 335.2	Cyanide
Spectrometric	EPA 350.2	Ammonia
Spectrometric	EPA 351.3	TKN
Spectrometric	EPA 354.1	Nitrite-N

Non-Potable Water		
Technology	**Method**	**Analyte**
Spectrometric	EPA 365.2	Phosphorus
Spectrometric	EPA 370.1	Silica
Titrimetric	EPA 376.1	Sulfide
Spectrometric	EPA 376.2	Sulfide
Electrode	EPA 405.1	BOD
Spectrometric	EPA 410.4	COD
Combustion-IR	EPA 415.1	TOC
Turbidimetric	SM 2130B	Turbidity
Titrimetric	SM 2320B	Alkalinity
Titrimetric	SM 2340C	Hardness
Platinum Electrode	SM 2510B	Specific Conductance
Gravimetric	SM 2540C	TDS
Gravimetric	SM 2540D	TSS
Gravimetric	SM 2540B	Total Residue
Combustion-IR	SM5310	TOC
Spectrometric	SM3500-FeD	Ferrous iron
Titrimetric	SM4500-Cl B	Total Residual Chlorine
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NO2B	Nitrite-N
Spectrometric	SM4500-NO3E	Nitrate-N
Spectrometric	SM4500-NOrgC	TKN
Spectrometric	SM4500PE	Ortho-phosphate
Spectrometric	SM4500-PE(PB5)	Phosphorus
Spectrometric	SM4500-S2D	Sulfide
Titrimetric	SM4500-S2F	Sulfide
Spectrometric	SM4500-SiO2C	Silica
Electrode	SM5210B	BOD
Spectrometric	SM5220B	COD
Combustion-IR	SM 5310B	TOC
Spectrometric	SM5540C	Surfactants (MBAS)
ICP/ICP-MS	SM2340B	Hardness
GC	EPA 608	Aldrin
GC	EPA 608	alpha-BHC
GC	EPA 608	beta-BHC
GC	EPA 608	delta-BHC
GC	EPA 608	gamma-BHC (Lindane)
GC	EPA 608	DDD (4,4)
GC	EPA 608	DDE (4,4)
GC	EPA 608	DDT (4,4)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 608	Dieldrin
GC	EPA 608	Endosulfan I
GC	EPA 608	Endosulfan II
GC	EPA 608	Endosulfan sulfate
GC	EPA 608	Endrin
GC	EPA 608	Endrin Aldehyde
GC	EPA 608	Heptachlor
GC	EPA 608	Heptachlor epoxide
GC	EPA 608	Methoxychlor
GC	EPA 608	alpha-Chlordane
GC	EPA 608	gamma-Chlordane
GC	EPA 608	Endrin Ketone
GC	EPA 608	Toxaphene
GC	EPA 608	Technical Chlordane
GC	EPA 608	PCB1016
GC	EPA 608	PCB1221
GC	EPA 608	PCB1232
GC	EPA 608	PCB1242
GC	EPA 608	PCB1248
GC	EPA 608	PCB1254
GC	EPA 608	PCB1260
GC	EPA 608	PCB1262
GC	EPA 608	PCB1268
GC-MS	EPA 624	Acrolein
GC-MS	EPA 624	Acrylonitrile
GC-MS	EPA 624	Benzene
GC-MS	EPA 624	Bromodichloromethane
GC-MS	EPA 624	Bromoform
GC-MS	EPA 624	Bromomethane
GC-MS	EPA 624	Carbon tetrachloride
GC-MS	EPA 624	Chlorobenzene
GC-MS	EPA 624	2-Chloroethyl vinyl ether
GC-MS	EPA 624	Chloroethane
GC-MS	EPA 624	Chloroform
GC-MS	EPA 624	Chloromethane
GC-MS	EPA 624	Dibromochloromethane
GC-MS	EPA 624	1,1-Dichloroethane
GC-MS	EPA 624	1,2-Dichloroethane
GC-MS	EPA 624	1,2-Dichlorobenzene
GC-MS	EPA 624	1,3-Dichlorobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 624	1,4-Dichlorobenzene
GC-MS	EPA 624	Dichlorodifluoromethane
GC-MS	EPA 624	1,1-Dichloroethene
GC-MS	EPA 624	cis-1,2-Dichloroethene
GC-MS	EPA 624	trans-1,2-Dichloroethene
GC-MS	EPA 624	1,2-Dichloropropane
GC-MS	EPA 624	cis-1,3-Dichloropropene
GC-MS	EPA 624	trans-1,3-Dichloropropene
GC-MS	EPA 624	Ethylbenzene
GC-MS	EPA 624	Methylene Chloride
GC-MS	EPA 624	tert-Butyl methyl ether
GC-MS	EPA 624	Styrene
GC-MS	EPA 624	1,1,2,2-Tetrachloroethane
GC-MS	EPA 624	Tetrachloroethene
GC-MS	EPA 624	Toluene
GC-MS	EPA 624	1,1,1-Trichloroethane
GC-MS	EPA 624	1,1,2-Trichloroethane
GC-MS	EPA 624	1,2,4-Trichlorobenzene
GC-MS	EPA 624	Trichloroethene
GC-MS	EPA 624	Trichlorofluoromethane
GC-MS	EPA 624	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 624	Vinyl Chloride
GC-MS	EPA 624	m-Xylene & p-xylene
GC-MS	EPA 624	o-Xylene
GC-MS	EPA 625	Acenaphthene
GC-MS	EPA 625	Acenaphthylene
GC-MS	EPA 625	Aniline
GC-MS	EPA 625	Anthracene
GC-MS	EPA 625	Azobenzene
GC-MS	EPA 625	Benzidine
GC-MS	EPA 625	Benzo(a)anthracene
GC-MS	EPA 625	benzo(a)pyrene
GC-MS	EPA 625	Benzo(b)fluoranthene
GC-MS	EPA 625	Benzo(e)pyrene
GC-MS	EPA 625	Benzo(g,h,i)perylene
GC-MS	EPA 625	Benzo(k)fluoranthene
GC-MS	EPA 625	Benzoic Acid
GC-MS	EPA 625	Benzyl Alcohol
GC-MS	EPA 625	Biphenyl
GC-MS	EPA 625	bis(2-chloroethoxy)methane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 625	bis(2-chloroethyl)ether
GC-MS	EPA 625	bis(2-chloroisopropyl)ether
GC-MS	EPA 625	bis(2-Ethylhexyl)adipate
GC-MS	EPA 625	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 625	4-Bromophenyl-phenylether
GC-MS	EPA 625	Butylbenzylphthalate
GC-MS	EPA 625	Carbazole
GC-MS	EPA 625	4-Chloro-3-methylphenol
GC-MS	EPA 625	4-Chloroaniline
GC-MS	EPA 625	2-Chloronaphthalene
GC-MS	EPA 625	2-Chlorophenol
GC-MS	EPA 625	4-Chlorophenyl-phenylether
GC-MS	EPA 625	Chrysene
GC-MS	EPA 625	Dibenzo(a,h)anthracene
GC-MS	EPA 625	Dibenzofuran
GC-MS	EPA 625	1,2-Dichlorobenzene
GC-MS	EPA 625	1,3-Dichlorobenzene
GC-MS	EPA 625	1,4-Dichlorobenzene
GC-MS	EPA 625	3,3'-Dichlorobenzidine
GC-MS	EPA 625	2,4-Dichlorophenol
GC-MS	EPA 625	Diethylphthalate
GC-MS	EPA 625	2,6-Dimethylnaphthalene
GC-MS	EPA 625	2,4-Dimethylphenol
GC-MS	EPA 625	Dimethylphthalate
GC-MS	EPA 625	Di-n-butylphthalate
GC-MS	EPA 625	4,6-Dinitro-2-methylphenol
GC-MS	EPA 625	2,4-Dinitrophenol
GC-MS	EPA 625	2,4-Dinitrotoluene
GC-MS	EPA 625	2-6-Dinitrotoluene
GC-MS	EPA 625	Di-n-octylphthalate
GC-MS	EPA 625	1,2-Diphenylhydrazine
GC-MS	EPA 625	Fluoranthene
GC-MS	EPA 625	Fluorene
GC-MS	EPA 625	Hexachlorobenzene
GC-MS	EPA 625	Hexachlorobutadiene
GC-MS	EPA 625	Hexachlorocyclopentadiene
GC-MS	EPA 625	Hexachloroethane
GC-MS	EPA 625	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 625	Isophorone
GC-MS	EPA 625	1-Methylnaphthalene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 625	2-Methylnaphthalene
GC-MS	EPA 625	1-Methylphenanthrene
GC-MS	EPA 625	2-Methylphenol
GC-MS	EPA 625	4-Methylphenol
GC-MS	EPA 625	Naphthalene
GC-MS	EPA 625	2-Nitroaniline
GC-MS	EPA 625	3-Nitroaniline
GC-MS	EPA 625	4-Nitroaniline
GC-MS	EPA 625	Nitrobenzene
GC-MS	EPA 625	2-Nitrophenol
GC-MS	EPA 625	4-Nitrophenol
GC-MS	EPA 625	n-Nitrosodimethylamine
GC-MS	EPA 625	n-Nitroso-di-n-propylamine
GC-MS	EPA 625	n-Nitrosodiphenylamine
GC-MS	EPA 625	Pentachlorophenol
GC-MS	EPA 625	Perylene
GC-MS	EPA 625	Phenanthrene
GC-MS	EPA 625	Phenol
GC-MS	EPA 625	Pyrene
GC-MS	EPA 625	Pyridine
GC-MS	EPA 625	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 625	1,2,4-Trichlorobenzene
GC-MS	EPA 625	2,3,4-Trichlorophenol
GC-MS	EPA 625	2,3,5-Trichlorophenol
GC-MS	EPA 625	2,4,5-Trichlorophenol
GC-MS	EPA 625	2,4,6-Trichlorophenol
GC-MS	EPA 625	2,3,5-Trimethylnaphthalene
Gravimetric	EPA 1664A	Oil & Grease
GFAA	CA 939M	Organo Lead
GC-MS	EPA 524.2	Acetone
GC-MS	EPA 524.2	Benzene
GC-MS	EPA 524.2	Bromobenzene
GC-MS	EPA 524.2	Bromochloromethane
GC-MS	EPA 524.2	Bromodichloromethane
GC-MS	EPA 524.2	Bromoform
GC-MS	EPA 524.2	Bromomethane
GC-MS	EPA 524.2	tert-Butyl alcohol
GC-MS	EPA 524.2	2-Butanone (MEK)
GC-MS	EPA 524.2	n-Butylbenzene
GC-MS	EPA 524.2	sec-Butylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 524.2	tert-Butylbenzene
GC-MS	EPA 524.2	Carbon disulfide
GC-MS	EPA 524.2	Carbon tetrachloride
GC-MS	EPA 524.2	Chlorobenzene
GC-MS	EPA 524.2	Chloroethane
GC-MS	EPA 524.2	Chloroform
GC-MS	EPA 524.2	Chloromethane
GC-MS	EPA 524.2	2-Chlorotoluene
GC-MS	EPA 524.2	4-Chlorotoluene
GC-MS	EPA 524.2	Dibromochloromethane
GC-MS	EPA 524.2	1,2-Dibromo-3-chloropropane
GC-MS	EPA 524.2	1,2-Dibromoethane
GC-MS	EPA 524.2	Dibromomethane
GC-MS	EPA 524.2	1,1-Dichloroethane
GC-MS	EPA 524.2	1,2-Dichloroethane
GC-MS	EPA 524.2	1,2-Dichlorobenzene
GC-MS	EPA 524.2	1,3-Dichlorobenzene
GC-MS	EPA 524.2	1,4-Dichlorobenzene
GC-MS	EPA 524.2	Dichlorodifluoromethane
GC-MS	EPA 524.2	1,1-Dichloroethene
GC-MS	EPA 524.2	cis-1,2-Dichloroethene
GC-MS	EPA 524.2	trans-1,2-Dichloroethene
GC-MS	EPA 524.2	1,1-Dichloropropene
GC-MS	EPA 524.2	1,2-Dichloropropane
GC-MS	EPA 524.2	1,3-Dichloropropane
GC-MS	EPA 524.2	2,2-Dichloropropane
GC-MS	EPA 524.2	cis-1,3-Dichloropropene
GC-MS	EPA 524.2	trans-1,3-Dichloropropene
GC-MS	EPA 524.2	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 524.2	Ethylbenzene
GC-MS	EPA 524.2	2-Hexanone (MBK)
GC-MS	EPA 524.2	Hexachlorobutadiene
GC-MS	EPA 524.2	Isopropyl ether (DIPE)
GC-MS	EPA 524.2	Isopropylbenzene
GC-MS	EPA 524.2	p-Isopropyltoluene
GC-MS	EPA 524.2	Methylene Chloride
GC-MS	EPA 524.2	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 524.2	tert-Butyl methyl ether
GC-MS	EPA 524.2	Naphthalene
GC-MS	EPA 524.2	n-Propylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 524.2	Styrene
GC-MS	EPA 524.2	tert-Amyl methyl ether (TAME)
GC-MS	EPA 524.2	1,1,1,2-Tetrachloroethane
GC-MS	EPA 524.2	1,1,2,2-Tetrachloroethane
GC-MS	EPA 524.2	Tetrachloroethene
GC-MS	EPA 524.2	Toluene
GC-MS	EPA 524.2	1,1,1-Trichloroethane
GC-MS	EPA 524.2	1,1,2-Trichloroethane
GC-MS	EPA 524.2	1,2,3-Trichlorobenzene
GC-MS	EPA 524.2	1,2,4-Trichlorobenzene
GC-MS	EPA 524.2	Trichloroethene
GC-MS	EPA 524.2	Trichlorofluoromethane
GC-MS	EPA 524.2	1,2,3-Trichloropropane
GC-MS	EPA 524.2	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 524.2	1,2,4-Trimethylbenzene
GC-MS	EPA 524.2	1,3,5-Trimethylbenzene
GC-MS	EPA 524.2	Vinyl Chloride
GC-MS	EPA 524.2	m-Xylene & p-xylene
GC-MS	EPA 524.2	o-Xylene
HPLC-MS	EPA 6850	Perchlorate
Preparation	**Method**	**Type**
Purge & Trap	SW5030B	Volatiles Prep
Acid Digestion	SW3005A/SW3010A/ EPA200.8	Metals Prep
Continuous Liquid-Liquid	SW3520C	Organic Extraction
Separatory Funnel	SW3510B	Organic Extraction
Waste Dilution	SW3580A	Organic Extraction
TCLP	SW1311	Leaching
SPLP	SW1312	Leaching

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	AK101	GRO
GC	AK102	DRO
GC	AK103	RRO
GC	RSK175	Methane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	RSK175	Acetylene
GC	RSK175	Ethylene
GC	RSK175	Ethane
GC	RSK175	Propane
GC	RSK175	Carbon dioxide
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NOrgC	TKN
Spectrometric	SM4500-PE(PB5)	Phosphorus
Electrode	SM9040C	pH
Electrode	SM9045D	pH
Spectrometric	SM9065	Phenols
Penskey-Martens	SW1010	Ignitability
ICP	SW6010B & 6010C	Aluminum
ICP	SW6010B & 6010C	Antimony
ICP	SW6010B & 6010C	Arsenic
ICP	SW6010B & 6010C	Barium
ICP	SW6010B & 6010C	Beryllium
ICP	SW6010B & 6010C	Boron
ICP	SW6010B & 6010C	Cadmium
ICP	SW6010B & 6010C	Calcium
ICP	SW6010B & 6010C	Chromium
ICP	SW6010B & 6010C	Cobalt
ICP	SW6010B & 6010C	Copper
ICP	SW6010B & 6010C	Iron
ICP	SW6010B & 6010C	Lead
ICP	SW6010B & 6010C	Magnesium
ICP	SW6010B & 6010C	Manganese
ICP	SW6010B & 6010C	Molybdenum
ICP	SW6010B & 6010C	Nickel
ICP	SW6010B & 6010C	Potassium
ICP	SW6010B & 6010C	Selenium
ICP	SW6010B & 6010C	Silver
ICP	SW6010B & 6010C	Sodium
ICP	SW6010B & 6010C	Strontium
ICP	SW6010B & 6010C	Thallium
ICP	SW6010B & 6010C	Tin
ICP	SW6010B & 6010C	Titanium
ICP	SW6010B & 6010C	Vanadium
ICP	SW6010B & 6010C	Zinc

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
IPC-MS	SW6020A	Aluminum
IPC-MS	SW6020A	Antimony
IPC-MS	SW6020A	Arsenic
IPC-MS	SW6020A	Barium
IPC-MS	SW6020A	Beryllium
IPC-MS	SW6020A	Boron
IPC-MS	SW6020A	Cadmium
IPC-MS	SW6020A	Calcium
IPC-MS	SW6020A	Chromium
IPC-MS	SW6020A	Cobalt
IPC-MS	SW6020A	Copper
ICP-MS	SW6020A	Iron
ICP-MS	SW6020A	Lead
ICP-MS	SW6020A	Magnesium
ICP-MS	SW6020A	Manganese
ICP-MS	SW6020A	Molybdenum
ICP-MS	SW6020A	Nickel
ICP-MS	SW6020A	Potassium
ICP-MS	SW6020A	Selenium
ICP-MS	SW6020A	Silver
ICP-MS	SW6020A	Sodium
ICP-MS	SW6020A	Strontium
ICP-MS	SW6020A	Thallium
ICP-MS	SW6020A	Tin
ICP-MS	SW6020A	Titanium
ICP-MS	SW6020A	Uranium
ICP-MS	SW6020A	Vanadium
ICP-MS	SW6020A	Zinc
Spectrometric	SW7196A	Hex. Chromium
IC	SW7199	Hex. Chromium
Cold-Vapor	SW7470A / 7471A	Mercury
GC	SW8015B / 8015C	Gasoline
GC	SW8015B / 8015C	Diesel
GC	SW8015B / 8015C	Motor Oil
GC	SW8015B / 8015C	JP5
GC	SW8081A / 8081B	Aldrin
GC	SW8081A / 8081B	alpha-BHC
GC	SW8081A / 8081B	beta-BHC
GC	SW8081A / 8081B	delta-BHC
GC	SW8081A / 8081B	gamma-BHC (Lindane)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	SW8081A / 8081B	DDD (4,4)
GC	SW8081A / 8081B	DDE (4,4)
GC	SW8081A / 8081B	DDT (4,4)
GC	SW8081A / 8081B	Dieldrin
GC	SW8081A / 8081B	Endosulfan I
GC	SW8081A / 8081B	Endosulfan II
GC	SW8081A / 8081B	Endosulfan sulfate
GC	SW8081A / 8081B	Endrin
GC	SW8081A / 8081B	Endrin Aldehyde
GC	SW8081A / 8081B	Heptachlor
GC	SW8081A / 8081B	Heptachlor epoxide
GC	SW8081A / 8081B	Methoxychlor
GC	SW8081A / 8081B	alpha-Chlordane
GC	SW8081A / 8081B	gamma-Chlordane
GC	SW8081A / 8081B	Endrin Ketone
GC	SW8081A / 8081B	Toxaphene
GC	SW8081A / 8081B	Technical Chlordane
GC	SW8082 / 8082A	PCB1016
GC	SW8082 / 8082A	PCB1221
GC	SW8082 / 8082A	PCB1232
GC	SW8082 / 8082A	PCB1242
GC	SW8082 / 8082A	PCB1248
GC	SW8082 / 8082A	PCB1254
GC	SW8082 / 8082A	PCB1260
GC	SW8082 / 8082A	PCB1262
GC	SW8082 / 8082A	PCB1268
GC	SW8082 / 8082A	PCB 8
GC	SW8082 / 8082A	PCB 18
GC	SW8082 / 8082A	PCB 28
GC	SW8082 / 8082A	PCB 44
GC	SW8082 / 8082A	PCB 52
GC	SW8082 / 8082A	PCB 66
GC	SW8082 / 8082A	PCB 77
GC	SW8082 / 8082A	PCB 81
GC	SW8082 / 8082A	PCB 101
GC	SW8082 / 8082A	PCB 105
GC	SW8082 / 8082A	PCB 114
GC	SW8082 / 8082A	PCB 118
GC	SW8082 / 8082A	PCB 123
GC	SW8082 / 8082A	PCB 126

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	SW8082 / 8082A	PCB 128
GC	SW8082 / 8082A	PCB 138
GC	SW8082 / 8082A	PCB 153
GC	SW8082 / 8082A	PCB 156
GC	SW8082 / 8082A	PCB 157
GC	SW8082 / 8082A	PCB 167
GC	SW8082 / 8082A	PCB 169
GC	SW8082 / 8082A	PCB 170
GC	SW8082 / 8082A	PCB 180
GC	SW8082 / 8082A	PCB 187
GC	SW8082 / 8082A	PCB 189
GC	SW8082 / 8082A	PCB 195
GC	SW8082 / 8082A	PCB 206
GC	SW8082 / 8082A	PCB 209
GC	SW8141A	Azinphos-methyl
GC	SW8141A	Bolstar
GC	SW8141A	Chlorpyrifos
GC	SW8141A	Coumaphos
GC	SW8141A	Demeton
GC	SW8141A	Diazinon
GC	SW8141A	Dichlorvos
GC	SW8141A	Disulfoton
GC	SW8141A	Ethoprop
GC	SW8141A	Fensulfothion
GC	SW8141A	Fenthion
GC	SW8141A	Merphos
GC	SW8141A	Mevinphos
GC	SW8141A	Naled
GC	SW8141A	Methyl Parathion
GC	SW8141A	Phorate
GC	SW8141A	Ronnel
GC	SW8141A	Stirophos
GC	SW8141A	Tokuthion
GC	SW8141A	Trichloronate
GC	SW8141A	Dimethoate
GC	SW8141A	EPN
GC	SW8141A	Famphur
GC	SW8141A	Malathion
GC	SW8141A	Ethyl Parathion
GC	SW8141A	O,O,O-Triethylphosphorothioate

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	SW8141A	Sulfotepp
GC	SW8141A	Thionazin
GC	SW8141A	Tributyl Phosphate
GC-MS	SW8260B	Acetone
GC-MS	SW8260B	Acrolein
GC-MS	SW8260B	Acrylonitrile
GC-MS	SW8260B	Benzene
GC-MS	SW8260B	Bromobenzene
GC-MS	SW8260B	Bromochloromethane
GC-MS	SW8260B	Bromodichloromethane
GC-MS	SW8260B	Bromoform
GC-MS	SW8260B	Bromomethane
GC-MS	SW8260B	tert-Butyl alcohol
GC-MS	SW8260B	2-Butanone (MEK)
GC-MS	SW8260B	n-Butylbenzene
GC-MS	SW8260B	sec-Butylbenzene
GC-MS	SW8260B	tert-Butylbenzene
GC-MS	SW8260B	Carbon disulfide
GC-MS	SW8260B	Carbon tetrachloride
GC-MS	SW8260B	Chlorobenzene
GC-MS	SW8260B	2-Chloroethyl vinyl ether
GC-MS	SW8260B	Chloroethane
GC-MS	SW8260B	Chloroform
GC-MS	SW8260B	1-Chlorohexane
GC-MS	SW8260B	Chloromethane
GC-MS	SW8260B	2-Chlorotoluene
GC-MS	SW8260B	4-Chlorotoluene
GC-MS	SW8260B	Isopropyl ether (DIPE)
GC-MS	SW8260B	Dibromochloromethane
GC-MS	SW8260B	1,2-Dibromo-3-chloropropane
GC-MS	SW8260B	1,2-Dibromoethane
GC-MS	SW8260B	Dibromomethane
GC-MS	SW8260B	1,1-Dichloroethane
GC-MS	SW8260B	1,2-Dichloroethane
GC-MS	SW8260B	1,2-Dichlorobenzene
GC-MS	SW8260B	1,3-Dichlorobenzene
GC-MS	SW8260B	trans-1,4-Dichloro-2-Butene
GC-MS	SW8260B	1,4-Dichlorobenzene
GC-MS	SW8260B	Dichlorodifluoromethane
GC-MS	SW8260B	1,1-Dichloroethene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	SW8260B	cis-1,2-Dichloroethene
GC-MS	SW8260B	trans-1,2-Dichloroethene
GC-MS	SW8260B	Dichlorofluoromethane
GC-MS	SW8260B	1,1-Dichloropropene
GC-MS	SW8260B	1,2-Dichloropropane
GC-MS	SW8260B	1,3-Dichloropropane
GC-MS	SW8260B	2,2-Dichloropropane
GC-MS	SW8260B	cis-1,3-Dichloropropene
GC-MS	SW8260B	trans-1,3-Dichloropropene
GC-MS	SW8260B	tert-Butyl ethyl ether (ETBE)
GC-MS	SW8260B	Ethyl Methacrylate
GC-MS	SW8260B	Ethylbenzene
GC-MS	SW8260B	2-Hexanone (MBK)
GC-MS	SW8260B	Hexachlorobutadiene
GC-MS	SW8260B	Iodomethane
GC-MS	SW8260B	Isopropylbenzene
GC-MS	SW8260B	p-Isopropyltoluene
GC-MS	SW8260B	Methylene Chloride
GC-MS	SW8260B	4-Methyl-2-pentanone (MIBK)
GC-MS	SW8260B	tert-Butyl methyl ether
GC-MS	SW8260B	Naphthalene
GC-MS	SW8260B	n-Propylbenzene
GC-MS	SW8260B	Styrene
GC-MS	SW8260B	tert-Amyl methyl ether (TAME)
GC-MS	SW8260B	1,1,1,2-Tetrachloroethane
GC-MS	SW8260B	1,1,2,2-Tetrachloroethane
GC-MS	SW8260B	Tetrachloroethene
GC-MS	SW8260B	Toluene
GC-MS	SW8260B	1,1,1-Trichloroethane
GC-MS	SW8260B	1,1,2-Trichloroethane
GC-MS	SW8260B	1,2,3-Trichlorobenzene
GC-MS	SW8260B	1,2,4-Trichlorobenzene
GC-MS	SW8260B	Trichloroethene
GC-MS	SW8260B	Trichlorofluoromethane
GC-MS	SW8260B	1,2,3-Trichloropropane
GC-MS	SW8260B	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	SW8260B	1,2,4-Trimethylbenzene
GC-MS	SW8260B	1,3,5-Trimethylbenzene
GC-MS	SW8260B	Vinyl Acetate
GC-MS	SW8260B	Vinyl Chloride

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	SW8260B	m-Xylene & p-xylene
GC-MS	SW8260B	o-Xylene
GC-MS	SW8260B	2-Butanol
GC-MS	SW8260B	Cyclohexane
GC-MS	SW8260B SIM	Benzene
GC-MS	SW8260B SIM	Carbon tetrachloride
GC-MS	SW8260B SIM	Chloroform
GC-MS	SW8260B SIM	Chloromethane
GC-MS	SW8260B SIM	1,2-Dibromo-3-chloropropane
GC-MS	SW8260B SIM	1,2-Dibromoethane
GC-MS	SW8260B SIM	1,2-Dichloroethane
GC-MS	SW8260B SIM	1,1-Dichloroethene
GC-MS	SW8260B SIM	cis-1,2-Dichloroethene
GC-MS	SW8260B SIM	trans-1,2-Dichloroethene
GC-MS	SW8260B SIM	1,1,2,2-Tetrachloroethane
GC-MS	SW8260B SIM	Tetrachloroethene
GC-MS	SW8260B SIM	1,1,1-Trichloroethane
GC-MS	SW8260B SIM	1,1,2-Trichloroethane
GC-MS	SW8260B SIM	Trichloroethene
GC-MS	SW8260B SIM	1,2,3-Trichloropropane
GC-MS	SW8260B SIM	Vinyl Chloride
GC-MS	SW8270C / 8270D	Acenaphthene
GC-MS	SW8270C / 8270D	Acenaphthylene
GC-MS	SW8270C / 8270D	Aniline
GC-MS	SW8270C / 8270D	Anthracene
GC-MS	SW8270C / 8270D	Azobenzene
GC-MS	SW8270C / 8270D	Benzidine
GC-MS	SW8270C / 8270D	Benzo(a)anthracene
GC-MS	SW8270C / 8270D	benzo(a)pyrene
GC-MS	SW8270C / 8270D	Benzo(b)fluoranthene
GC-MS	SW8270C / 8270D	Benzo(e)pyrene
GC-MS	SW8270C / 8270D	Benzo(g,h,i)perylene
GC-MS	SW8270C / 8270D	Benzo(k)fluoranthene
GC-MS	SW8270C / 8270D	Benzoic Acid
GC-MS	SW8270C / 8270D	Benzyl Alcohol
GC-MS	SW8270C / 8270D	Biphenyl
GC-MS	SW8270C / 8270D	bis(2-chloroethoxy)methane
GC-MS	SW8270C / 8270D	bis(2-chloroethyl)ether
GC-MS	SW8270C / 8270D	bis(2-chloroisopropyl)ether
GC-MS	SW8270C / 8270D	bis(2-Ethylhexyl)adipate

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	SW8270C / 8270D	bis(2-Ethylhexyl)phthalate
GC-MS	SW8270C / 8270D	4-Bromophenyl-phenylether
GC-MS	SW8270C / 8270D	Butylbenzylphthalate
GC-MS	SW8270C / 8270D	Carbazole
GC-MS	SW8270C / 8270D	4-Chloro-3-methylphenol
GC-MS	SW8270C / 8270D	4-Chloroaniline
GC-MS	SW8270C / 8270D	2-Chloronaphthalene
GC-MS	SW8270C / 8270D	2-Chlorophenol
GC-MS	SW8270C / 8270D	4-Chlorophenyl-phenylether
GC-MS	SW8270C / 8270D	Chrysene
GC-MS	SW8270C / 8270D	Dibenzo(a,h)anthracene
GC-MS	SW8270C / 8270D	Dibenzofuran
GC-MS	SW8270C / 8270D	1,2-Dichlorobenzene
GC-MS	SW8270C / 8270D	1,3-Dichlorobenzene
GC-MS	SW8270C / 8270D	1,4-Dichlorobenzene
GC-MS	SW8270C / 8270D	3,3'-Dichlorobenzidine
GC-MS	SW8270C / 8270D	2,4-Dichlorophenol
GC-MS	SW8270C / 8270D	Diethylphthalate
GC-MS	SW8270C / 8270D	2,6-Dimethylnaphthalene
GC-MS	SW8270C / 8270D	2,4-Dimethylphenol
GC-MS	SW8270C / 8270D	Dimethylphthalate
GC-MS	SW8270C / 8270D	Di-n-butylphthalate
GC-MS	SW8270C / 8270D	4,6-Dinitro-2-methylphenol
GC-MS	SW8270C / 8270D	2,4-Dinitrophenol
GC-MS	SW8270C / 8270D	2,4-Dinitrotoluene
GC-MS	SW8270C / 8270D	2-6-Dinitrotoluene
GC-MS	SW8270C / 8270D	Di-n-octylphthalate
GC-MS	SW8270C / 8270D	Fluoranthene
GC-MS	SW8270C / 8270D	Fluorene
GC-MS	SW8270C / 8270D	Hexachlorobenzene
GC-MS	SW8270C / 8270D	Hexachlorobutadiene
GC-MS	SW8270C / 8270D	Hexachlorocyclopentadiene
GC-MS	SW8270C / 8270D	Hexachloroethane
GC-MS	SW8270C / 8270D	Indeno(1,2,3-cd)pyrene
GC-MS	SW8270C / 8270D	Isophorone
GC-MS	SW8270C / 8270D	1-Methylnaphthalene
GC-MS	SW8270C / 8270D	2-Methylnaphthalene
GC-MS	SW8270C / 8270D	1-Methylphenanthrene
GC-MS	SW8270C / 8270D	2-Methylphenol
GC-MS	SW8270C / 8270D	4-Methylphenol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	SW8270C / 8270D	Naphthalene
GC-MS	SW8270C / 8270D	2-Nitroaniline
GC-MS	SW8270C / 8270D	3-Nitroaniline
GC-MS	SW8270C / 8270D	4-Nitroaniline
GC-MS	SW8270C / 8270D	Nitrobenzene
GC-MS	SW8270C / 8270D	2-Nitrophenol
GC-MS	SW8270C / 8270D	4-Nitrophenol
GC-MS	SW8270C / 8270D	n-Nitrosodimethylamine
GC-MS	SW8270C / 8270D	n-Nitroso-di-n-propylamine
GC-MS	SW8270C / 8270D	n-Nitrosodiphenylamine
GC-MS	SW8270C / 8270D	Pentachlorophenol
GC-MS	SW8270C / 8270D	Perylene
GC-MS	SW8270C / 8270D	Phenanthrene
GC-MS	SW8270C / 8270D	Phenol
GC-MS	SW8270C / 8270D	Pyrene
GC-MS	SW8270C / 8270D	Pyridine
GC-MS	SW8270C / 8270D	2,3,4,6-Tetrachlorophenol
GC-MS	SW8270C / 8270D	1,2,4-Trichlorobenzene
GC-MS	SW8270C / 8270D	2,3,4-Trichlorophenol
GC-MS	SW8270C / 8270D	2,3,5-Trichlorophenol
GC-MS	SW8270C / 8270D	2,4,5-Trichlorophenol
GC-MS	SW8270C / 8270D	2,4,6-Trichlorophenol
GC-MS	SW8270C / 8270D	2,3,5-Trimethylnaphthalene
GC-MS	SW8270C / 8270D SIM	Acenaphthene
GC-MS	SW8270C / 8270D SIM	Acenaphthylene
GC-MS	SW8270C / 8270D SIM	Anthracene
GC-MS	SW8270C / 8270D SIM	Azobenzene
GC-MS	SW8270C / 8270D SIM	Benzo(a)anthracene
GC-MS	SW8270C / 8270D SIM	benzo(a)pyrene
GC-MS	SW8270C / 8270D SIM	Benzo(b)fluoranthene
GC-MS	SW8270C / 8270D SIM	Benzo(e)pyrene
GC-MS	SW8270C / 8270D SIM	Benzo(g,h,i)perylene
GC-MS	SW8270C / 8270D SIM	Benzo(k)fluoranthene
GC-MS	SW8270C / 8270D SIM	Biphenyl
GC-MS	SW8270C / 8270D SIM	bis(2-chloroethyl)ether
GC-MS	SW8270C / 8270D SIM	bis(2-Ethylhexyl)phthalate
GC-MS	SW8270C / 8270D SIM	Carbazole
GC-MS	SW8270C / 8270D SIM	4-Chloro-3-methylphenol
GC-MS	SW8270C / 8270D SIM	2-Chlorophenol
GC-MS	SW8270C / 8270D SIM	Chrysene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	SW8270C / 8270D SIM	Dibenzo(a,h)anthracene
GC-MS	SW8270C / 8270D SIM	2,4-Dichlorophenol
GC-MS	SW8270C / 8270D SIM	2,6-Dimethylnaphthalene
GC-MS	SW8270C / 8270D SIM	2,4-Dimethylphenol
GC-MS	SW8270C / 8270D SIM	Fluoranthene
GC-MS	SW8270C / 8270D SIM	Fluorene
GC-MS	SW8270C / 8270D SIM	Hexachlorobenzene
GC-MS	SW8270C / 8270D SIM	Indeno(1,2,3-cd)pyrene
GC-MS	SW8270C / 8270D SIM	1-Methylnaphthalene
GC-MS	SW8270C / 8270D SIM	2-Methylnaphthalene
GC-MS	SW8270C / 8270D SIM	1-Methylphenanthrene
GC-MS	SW8270C / 8270D SIM	Naphthalene
GC-MS	SW8270C / 8270D SIM	n-Nitrosodimethylamine
GC-MS	SW8270C / 8270D SIM	n-Nitroso-di-n-propylamine
GC-MS	SW8270C / 8270D SIM	Pentachlorophenol
GC-MS	SW8270C / 8270D SIM	Perylene
GC-MS	SW8270C / 8270D SIM	Phenanthrene
GC-MS	SW8270C / 8270D SIM	Phenol
GC-MS	SW8270C / 8270D SIM	Pyrene
GC-MS	SW8270C / 8270D SIM	2,4,5-Trichlorophenol
GC-MS	SW8270C / 8270D SIM	2,4,6-Trichlorophenol
GC-MS	SW8270C / 8270D SIM	2,3,5-Trimethylnaphthalene
GC-MS	SW8270C / 8270D SIM	1,4-Dioxane
HPLC	SW8310	Acenaphthene
HPLC	SW8310	Acenaphthylene
HPLC	SW8310	Anthracene
HPLC	SW8310	Benzo(a)anthracene
HPLC	SW8310	Benzo(a)pyrene
HPLC	SW8310	Benzo(b)fluoranthene
HPLC	SW8310	Benzo(g,h,i)perylene
HPLC	SW8310	Benzo(k)fluoranthene
HPLC	SW8310	Chrysene
HPLC	SW8310	Dibenzo(a,h)anthracene
HPLC	SW8310	Fluoranthene
HPLC	SW8310	Fluorene
HPLC	SW8310	Indeno(1,2,3-cd)pyrene
HPLC	SW8310	1-Methylnaphthalene
HPLC	SW8310	2-Methylnaphthalene
HPLC	SW8310	Naphthalene
HPLC	SW8310	Phenanthrene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	SW8310	Pyrene
HPLC	SW8330A	HMX
HPLC	SW8330A	RDX
HPLC	SW8330A	1,3,5-TNB
HPLC	SW8330A	1,3-DNB
HPLC	SW8330A	Tetryl
HPLC	SW8330A	Nitrobenzene
HPLC	SW8330A	2,4,6-TNT
HPLC	SW8330A	4-AM-2,6-DNT
HPLC	SW8330A	2-AM-4,6-DNT
HPLC	SW8330A	2,6-DNT
HPLC	SW8330A	2,4-DNT
HPLC	SW8330A	2-Nitrotoluene
HPLC	SW8330A	4-Nitrotoluene
HPLC	SW8330A	3-Nitrotoluene
GC	SW8151A	Acifluorfen
GC	SW8151A	Bentazon
GC	SW8151A	Chloramben
GC	SW8151A	2,4-D
GC	SW8151A	2,4-DB
GC	SW8151A	Dacthal
GC	SW8151A	Dalapon
GC	SW8151A	Dicamba
GC	SW8151A	3,5 Dichlorobenzoic
GC	SW8151A	Dichlorprop
GC	SW8151A	Dinoseb
GC	SW8151A	MCPA
GC	SW8151A	MCPP
GC	SW8151A	Pentachlorophenol
GC	SW8151A	Picloram
GC	SW8151A	Silvex
GC	SW8151A	2,4,5-T
GFAA	CA 939M	Organo Lead
Preparation	**Method**	**Type**
Purge & Trap	SW5030B/SW5035	Volatiles Prep
Acid Digestion	SW3010/SW3050B	Metals Prep
Alkaline Digestion	SW3060A	Hexavalent Chrom
Soxhlet	SW3540C	Organic Extraction
Sonication	SW3520C/SW3550C	Organic Extraction
Waste Dilution	SW3580A	Organic Extraction

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Preparation	**Method**	**Type**
TCLP	SW1311	Leaching
SPLP	SW1312	Leaching
Floricil Clean-up	SW3520B	Extract Clean-Up
GPC Clean-up	SW3640A	Extract Clean-Up
Sulfur Clean-up	SW3660B	Extract Clean-Up
Acid/Permanganate Clean-up	SW3665A	Extract Clean-Up

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	1,1,1-trichloroethane
GC-MS	TO-15	1,1,2,2-tetrachloroethane
GC-MS	TO-15	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	TO-15	1,1,2-trichloroethane
GC-MS	TO-15	1,1-dichloroethane
GC-MS	TO-15	1,1-Dichloroethene
GC-MS	TO-15	1,2,4-trichlorobenzene
GC-MS	TO-15	1,2,4-trimethylbenzene
GC-MS	TO-15	1,2-dibromoethane
GC-MS	TO-15	1,2-dichlorobenzene
GC-MS	TO-15	1,2-dichloroethane
GC-MS	TO-15	1,2-dichloroethene
GC-MS	TO-15	1,2-dichloropropane
GC-MS	TO-15	1,3,5-trimethylbenzene
GC-MS	TO-15	1,3-Butadiene
GC-MS	TO-15	1,3-Butadiene, 1,1,2,3,4,Hexachloro
GC-MS	TO-15	1,3-dichlorobenzene
GC-MS	TO-15	1,4-dichlorobenzene
GC-MS	TO-15	1,4-Dioxane
GC-MS	TO-15	2,2,4-Trimethylpentane
GC-MS	TO-15	4-Ethyltoluene
GC-MS	TO-15	Acetone
GC-MS	TO-15	Acrylonitrile
GC-MS	TO-15	Allyl Chloride
GC-MS	TO-15	Benzene
GC-MS	TO-15	Benzyl Chloride
GC-MS	TO-15	Bromodichloromethane
GC-MS	TO-15	Bromoform
GC-MS	TO-15	Bromomethane
GC-MS	TO-15	Carbon Disulfide
GC-MS	TO-15	Carbon Tetrachloride

LABORATORY ACCREDITATION BUREAU

Certificate # L2278

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	Chlorobenzene
GC-MS	TO-15	Chloroethane
GC-MS	TO-15	Chloroethene
GC-MS	TO-15	Chloroform
GC-MS	TO-15	Chloromethane
GC-MS	TO-15	cis-1,3-Dichloropropene
GC-MS	TO-15	Cyclohexane
GC-MS	TO-15	Dibromochloromethane
GC-MS	TO-15	Dichlorodifluoromethane
GC-MS	TO-15	Dichlorotetrafluoroethane
GC-MS	TO-15	Ethyl Acetate
GC-MS	TO-15	Ethylbenzene
GC-MS	TO-15	Isopropyl Alcohol
GC-MS	TO-15	m+p-Xylene
GC-MS	TO-15	Methyl butyl Ketone
GC-MS	TO-15	Methyl Ethyl Ketone
GC-MS	TO-15	Methyl Isobutyl Ketone
GC-MS	TO-15	Methyl Tert-Butyl Ether
GC-MS	TO-15	Methylene Chloride
GC-MS	TO-15	n-Heptane
GC-MS	TO-15	n-Hexane
GC-MS	TO-15	o-Xylene
GC-MS	TO-15	Styrene
GC-MS	TO-15	Tetrachloroethylene
GC-MS	TO-15	Tetrahydrofuran
GC-MS	TO-15	Toluene
GC-MS	TO-15	Trans-1,2-Dichloroethene
GC-MS	TO-15	trans-1,3-Dichloropropene
GC-MS	TO-15	Trichloroethylene
GC-MS	TO-15	Trichloromonofluoromethan
GC-MS	TO-15	Vinyl Acetate
GC-MS	TO-15	Vinyl Bromide

Notes:

1) This laboratory offers commercial testing service.

Approved By: _____ Date: January 10, 2011

R. Douglas Leonard
Chief Technical Officer

Issued: 1/10/11

The Site Safety and Health Plan has been removed from this document at the request of NMED.

The Standard Operating Procedures have been removed from this document at the request of NMED.

INCLUDED INFORMATION:

April 2011 Site Visit Notes

Photographic Log – Site Visit

Aerial Photograph (April 1991) (electronic [PDF] on CD only)

POL Yard Historical Photographic Log

1995 USGS Data Submission, Vol. 1 and 2 (electronic [PDF] on CD only)

Former Gas Station Site (ST-C502)

Base Support/Operations Generator Former UST Site (ST-C503)

Hospital Abandoned UST Site (ST-C504)

Flightline Generator USTs Site (ST-C505)

Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129)

April 2011 Site Visit Notes

Cannon AFB Site Visit (4-19/20-2011) Notes

1. Met with Anita Lafuente (575-784-1092), Karen Walker (210-553-5100), and Gene Smith (575-784-1096) in office to discuss schedule, answer questions, and review historical site documents. Gene Smith had a file on ST-C502, ST-C503, ST-C504, and ST-C505. These were four of the sites investigated by USGS in 1995. These files contained various documents including as-built drawings, UST excavation worksheets, 7-day written notification forms from Cannon AFB to NMED, UST inspection reports, photographs of site in 1995, UST closure sheets, and previous environmental investigation documents. After the meeting, a site walk was conducted at the 8 sites

    a. **Former Aerospace Ground Equipment (AGE) Dispatch Facility Spills Site (SS-C501):** Currently, the site is a new asphalt parking lot re-paved in June 2009 that formerly stored AGE. Gene mentioned and located 2-60 gallon spills where the AGE was stored on cracked asphalt. These locations were acquired by GPS. Gene mentioned focus of investigation should be down center of asphalt parking lot – look at historical aerial photo for location of AGE (including large maintenance equipment that was pulled out to the flightline to service aircraft). AGE could be fuel, oil, coolant, water, hydraulic fluid, and air. Consider petroleum, VOCs, SVOCs, PCBs, and metals analytical list.

    b. **Former Gas Station Site (ST-C502):** Currently, a credit union at Cannon AFB, the site is an asphalt parking lot with a drive-thru and a grass patch northwest of credit union. The site was formerly a gas station and vehicle service center. The current drive-thru was used as two service bays with hydraulic lifts. Gene's file was reviewed and the as-built drawings were found. As-built drawings show the exact location of pump islands and location of USTs with measurements off the building. As-built shows four USTs to the west of building 368. An NMED UST inspection report (1-23-1995) was found in Gene's file and identified three USTs (10,000 gal each). The tanks in the inspection report are identified as A, B, and C. UST A being farthest from the building and C being closest.

    c. **Base Support/Operations Generator Former UST Site (ST-C503):** Previously contained a 500 gallon diesel UST constructed of steel and the base of the tank was approximately 7 feet bgs. Currently, the site is a grassed area, has brick wall to the west, picket fence to the east and, open to the north and south. South is asphalt and concrete. Between the asphalt curb and the grassed area is a concrete trench with a metal cover containing the existing diesel lines from the AST to the east. This AST is still in use, therefore cannot be considered part of the investigation. The concrete trench along the curb is approximately 21 feet and the trench turns to the north and is approximately 17 feet long. Exposed pipes are visible at either end of the concrete trench (pipes from the AST to Bldg. 600). Just east of the AST are two dumpsters. There is a manhole

and sewer lines at this site. In Gene's file, photographs of the open excavation show that the excavation went directly up to the brick wall, the southern concrete trench, and the eastern picket fence. As-built drawings show the former fuel UST not within the boundary of the excavation shown on figures in the 1995 USGS document. Photos of the 1995 USGS sampling locations are consistent with the sampling maps in the 1995 USGS document.

d. **Hospital Abandoned UST Site (ST-C504):** The UST was a 25,000 gal diesel UST, constructed of steel, with the base of the UST at approximately 18 feet bgs, and was filled and abandoned in place (tank was approximately 12 foot in diameter – so 6 foot deep). Currently, the site is grassed with two large cooling towers, and asphalt to the west. The asphalt curb appears to be unchanged from the 1995 USGS investigation. The cooling towers are surrounded by an 8 foot chain link fence. The exact location of the abandoned tank is unknown – the map in the 1995 USGS document does not match with the available space between the curb (which has likely remained unchanged) and the cooling towers (likely new since 1995). This site may also be a candidate for a geophysical investigation (GPR). Gene's file has documentation of the tank closure report which indicated the tank was disposed in place on 10-5-94. . Gene's file has a report from Keers Environmental that presented results of a limited subsurface investigation (3 borings to 15 feet on 8-17-94 and a follow up investigation which included 4 borings to 20 feet on 9-22-94). TRPH were above NMED limits to the west of the tank and hydrocarbon odors were noted in B-1.

e. **Flightline Generator UST Site (ST-C505):** Previously contained two 500 gallon diesel USTs constructed of fiberglass and the base of the tanks were at approximately 9 feet bgs. Currently, the site has generator building and UST in a vault to the south of the building. The generator is used in case of a power loss. Fuel lines are in concrete trench with steel plate over the top. Former UST excavation is somewhat visible at the surface (stressed vegetation and red soil). Gene's folder for 505 (building 3060) did not have as-built plan, and as-built plans could not be located. Gene's folder did have photographs of 1995 USGS sampling locations that are consistent with site sampling maps in 1995 USGS document. Gene's file also had 7-day written notice of release at 3060 that indicates release from overfilling (not leaking), follow up sampling result from 12-28-1994, and excavation site worksheets indicating 48 CY of contaminated soil was removed at only UST B.

f. **Former Petroleum, Oil, and Lubricants (POL) Yard Refueling Area Site (SS-C507):** Met with William (Bill) O'Shea (575-784-2087) at southeast gate of POL yard. Former POL yard to be investigated is to west of JP-8 tanks and containment berm. New POL yard is located to the east. Historical aerial photo

will be used to define our site boundary. Bill was asked if he could provide as-built drawing – he mentioned none were available for the site. Bill mentioned they are responsible to maintain the containment berms and 2 foot beyond berms, so the rest of the site inside the fence is the area to be investigated. Bill also mentioned an area outside of the fence to the west that was a former railroad yard. Mr. O'Shea stated that the railroad yard was deactivated prior to 1992. He was not aware of POLs stored in this area, and stated that this area was used to deliver general supplies to the base. In the summer of 2009, the POL yard refueling area was closed and is inactive. MOGAS filling station was first stop just inside east gate and east of road. Small concrete area where vehicles could pull off to the side. Bill and Gene mentioned a MOGAS spill at the dispensing port/fill port (the GPS location was acquired). Bill recommended investigating the concrete area and around MOGAS pipe stick-up. MOGAS fill port stick-up is set back off the concrete by approximately 25 feet. Underground MOGAS lines went to the north to MOGAS vault (see photo and GPS coordinates) and Building 390. MOGAS line markers not visible at surface. Sewer manhole is directly adjacent to MOGAS fill port stick-up. Next stop was at JP-8 refueling islands (two islands parallel north south). There was a former OWS to the east that sat in a below ground vault. There was also a drum containment area with four 55-gallon drums (contents unknown). The two pump islands were surrounded by concrete (see aerial photo) and the area sloped to the east where a drainage swale is located, leading to a break in the curb. The dispensers have been removed but the underground JP-4/JP-8 lines are still present. The concrete surrounding the pump islands, the drainage swale leading to the break in the curb, and the area just outside the curb (in the grassed oval area) should be investigated (highest likelihood of potential contamination per Gene). Gene mentioned spills on either side of pump islands. Pipe stick-ups are still present on JP-8 pump islands. Next stop was MOGAS vault (see photo). Four pipes are sticking up out of the ground (furthest south is MOGAS). Three north pipes were JP-8 leading to Building 390. Just west of MOGAS vault was the location of former Building 390 (see aerial photo.) Gene mentioned large spill of JP-8 to the north of Building 390. Bill mentioned that the seals in piping directly north of Building 390 broke twice and there were two spills (unknown sizes and exact areas unknown – presumably around piping under former canopy). Gene said a soil excavation was complete to the north and east of 390. Red soil backfill is visible at surface. JP-8 lines lead to Building 390 from north (in from Clovis) and from west (from Building 392 and tub containment area). There is a JP-8 vault to the east (see photo and coordinates) that is the low point from Building 392 to 390. Lines also exist from Building 390 to JP-8 pump islands. Next stop was diesel fill areas (two stick-ups) on concrete. The two diesel fill areas were 398 (to the south) and 399 (to the north). The fill ports were in the concrete and set back off the curb by less than 2 feet (short – 1 foot stick-ups). These two

diesel fill pipes lead to former diesel piping that sat inside a canopy. Above ground pipes were present east of the former canopy location (see aerial photo for canopy and above ground lines). A break in the concrete curb was observed to the west of the diesel pump island (see GPS coordinates). There is an overflow valve to the south small containment berm that previously had four ASTs. This valve is still used to discharge storm water that collects inside active containment areas. Next stop was two concrete tub areas (fuel unloading areas) on the west side of the grassed oval area. 8,000 gallon tankers brought in JP-8 in the northwest gate and unloaded to fill ports inside concrete trenched covered with steel plates. Previously, train tankers brought fuel to the unloading area – RR tracks were previously present west of the fill ports. The former RR spur in visible to the north. At the former fill port locations, holes in the steel plates are still visible where the JP-8 was filled. All piping inside the concrete trenches is gone. There is a grate within each concrete tub area that has a small 4" by 4" square drain that leads to a clean out due east and then leads into a former OWS in the grassed oval area (see aerial photo and GPS coordinates). Building 392 would receive the JP-8 from the truck/tanker and transfer it to building 390. Gene and Bill mentioned a previous release occurred to the southwest of Building 392 (approximately 400 gallons of JP-8). This area was excavated – approximate excavation limits were provided by Bill and Gene. The last stop was to the south of the grassed oval area where a break in the concrete curb was photographed (GPS coordinates acquired) which is a likely area for runoff (sediment from runoff was visible on the asphalt near the break in the curb. This is one of the main low spots. There is a set of three protective posts near the break in the concrete curb – with an electrical conduit sticking out – use was unknown. According to Bill and Gene, the oval landscaped area inside the asphalt pavement was not used to store or dispose of any substances. This area was strictly aesthetical.

g. **Surface Disposal Area Site (SD-C508)** EOD does training in the area – more to the south where UXO signs are posted. Location of surface disposal was found using GPS coordinates from compliance sampling in 2009. Surface disposal is still visible at surface composed of burned metal, wood, pipes, and other debris. The localized area around the debris is void of vegetation. Other burned metal was observed throughout the field. From a distance the area is slightly mounded and the main portion of the visible debris is at the peak of the mound. The vegetation on the mounded area looked slightly different from the surrounding vegetation that is not as noticeable on the aerial photo. This mounded area may be from the disposal of debris that was removed from the adjacent FTA #3. There is another site (SWMU 107 FTA #3) located to the south and west of the surface disposal. The small tree to the south (visible on the aerial photo) is no

longer at the site. The metal storage box (visible on the aerial photo) has been moved to the north just onto the abandoned runway.

h. **Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129)** URS explained to Cannon AFB that focus of this investigation should be leach field associated with site, not the former AST area - per NMED. This site is within SWMU 129 and there are no plans to sample around former OWS or ASTs. The site is currently not in use and is mainly grass, soil, and some concrete. Gene explained this was an unmanned disposal facility with three dump pits (two north of OWS and one south of OWS). Dump pits lead to OWS and water was discharged to leach field. There were also two drains within the AST containment area between tanks 2 and 3, and 3 and 4 (tanks 1-5, 5,000 gallon each from north to south). These drains lead to OWS. Leach field is located to the southwest. As-built drawing indicated the leach field is 95' from clean out. Former site fence boundary (38'X65') was located and approximate location of clean out was found and coordinates collected with GPS. Trench for pipe leading from clean out to leach field distribution box was visible at surface (grassed linear feature, consistent with as-built). Trench line and location of distribution box was surveyed with GPS. End of leach field is inside the flightline fence (12 feet from fence).

THIS PAGE INTENTIONALLY BLANK

Photographic Log – Site Visit

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base **Cannon Air Force Base, New Mexico**	**AFCEE and Cannon AFB**	**Contract No. FA8903-08-D-8783** **Task Order No. 0169**

Photograph No. 01

Description:

SS-C501: View southwest from the northern part of the site. Approximate area of northeastern spill is visible in the foreground.

Photograph No. 02

Description:

ST-C502: View southwest from the north side of the site. Grassed area and paved area to the southwest is near the former pump island locations.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 03

Description:

ST-C502: View southeast from the northwest part of the site, showing former pump island area and current credit union.

Photograph No. 04

Description:

ST-C503: View northeast of the former UST location (left side of photo) and the currently present AST enclosure (right side of photo).

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 05

Description:

ST-C503: View south of the former UST location and the AST enclosure.

Photograph No. 06

Description:

ST-C503: View west of the brick wall enclosing the generator and the diesel line leading to the generator.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 07

Description:

ST-C504: View east from the west corner of the site. The grassed area is the location of the abandoned UST.

Photograph No. 08

Description:

ST-C504: View east from the southern part of the site showing a concrete pad, transformers, and the north corner of the hospital.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base **Cannon Air Force Base, New Mexico**	**AFCEE and Cannon AFB**	**Contract No. FA8903-08-D-8783** **Task Order No. 0169**

Photograph No. 09

Description:

ST-C504: View northeast from the south side of the site. Fenced area with cooling towers and associated piping is visible on the right side of the photo.

Photograph No. 10

Description:

ST-C504: View southwest from the north side of the site with cooling tower and piping in fenced in area.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 11

Description:

ST-C504: View southwest of the transformer and cooling towers on the northeast part of the site.

Photograph No. 12

Description:

ST-C504: View of manhole cover that appears to be located near the area above the center of the UST.

Photograph No. 13

Description:

ST-C505: View south from the north part of the site, showing the previous excavated area left of the building (note sparse vegetation).

Photograph No. 14

Description:

ST-C505: View northwest from the south part of the site, showing the currently present generator, diesel UST vault, and concrete trench containing the connecting pipe.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 15

Description:

SS-C507: View southwest from the northeastern part of the site. Elbow connector pipe ends and the location of former diesel piping and canopy are visible in the foreground, with the diesel fuel pump island to the right.

Photograph No. 16

Description:

SS-C507: View northwest from the southeastern part of the site. The former MOGAS unloading and dispensing area.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 17

Description:

SS-C507: View east from the central portion of the site. The former JP-4 and JP-8 pump islands are visible, with the ASTs and concrete berms in the background.

Photograph No. 18

Description:

SS-C507: View north from the southeast part of the site. The former JP-4 and JP-8 pump islands are visible, with the diesel fuel pump island in the background.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 19

Description:

SS-C507: View south from the north end of JP-4/JP-8 unloading area and associated grated concrete trench. Former unloading ports shown to the right.

Photograph No. 20

Description:

SS-C507: View south, showing the former location of Building 392 (concrete pad in center of photo), former location of above ground piping and canopy, and metal plate-covered concrete trenches formerly containing fuel lines visible on the right side of the photo.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 21

Description:

SS-C507: Location of former unloading ports in the JP-4/JP-8 fuel unloading area.

Photograph No. 22

Description:

SS-C507: View northeast showing the northern diesel fuel unloading port (399), with the former location of the above ground diesel fuel lines and canopy in the background.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base **Cannon Air Force Base, New Mexico**	**AFCEE and Cannon AFB**	**Contract No. FA8903-08-D-8783** **Task Order No. 0169**

Photograph No. 23

Description:

SS-C507: View east showing the southern diesel fuel unloading port (398).

Photograph No. 24

Description:

SD-C508: View of surface debris such as burned metal slag, wood, and mechanical parts within site boundary.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 25

Description:

TA/AS-C129: View northwest from southern portion of leach field site boundary. Approximate location of former ASTs directly west of fenced in storage area.

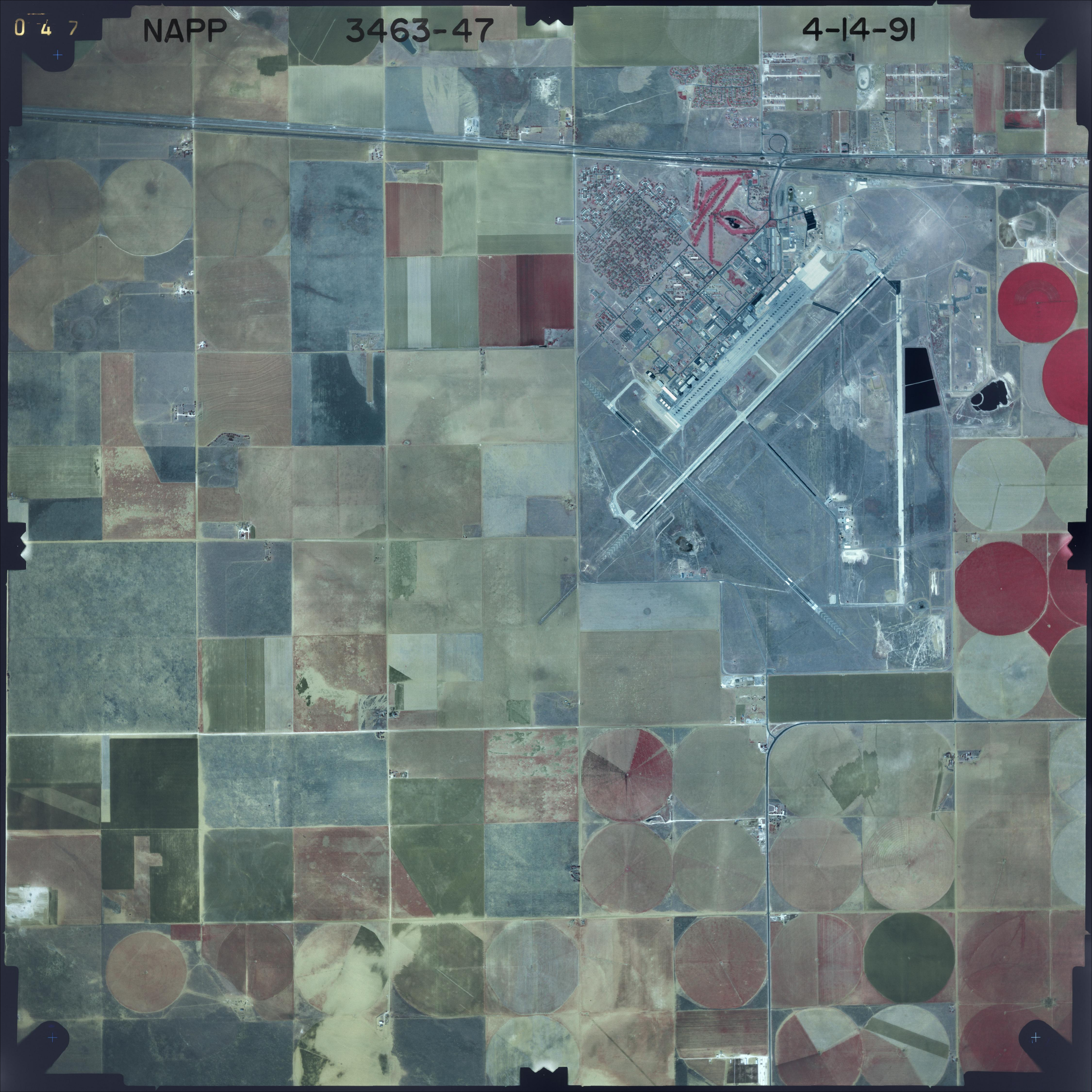
Photograph No. 26

Description:

TA/AS-C129: View southeast from northern portion of leach field site boundary. Note line of grass matching the location of the leach field drain pipe (presumably former trench for drain pipe).

Aerial Photograph (April 1991)

(electronic [PDF] on CD only)


0 4 7
NAPP
3463-47
4-14-91

POL Yard Historical Photographic Log

SITE HISTORY PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 01

Description:

SS-C507: View to the north from south end of two pump islands used to dispense JP-4/JP-8. Diesel fuel island in the background.

Photograph No. 02

Description:

SS-C507: View southwest from the northeast side of the site showing former Building 390 and above ground fuel lines under canopy.

SITE HISTORY PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 03

Description:

SS-C507: View south from the north portion of the site showing former Building 390, above ground fuel lines, fuel dispensers, and unloading ports. Above ground diesel fuel lines and canopy are visible at the bottom of photo.

Photograph No. 04

Description:

SS-C507: View northwest from the south portion of the site. Concrete drainage swale in foreground and former landscaped berm in background.

SITE HISTORY PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 05

Description:

SS-C507: View north from the middle of oval shaped non paved part of the site, showing former landscaped berm.

Photograph No. 06

Description:

SS-C507: View west from the central part of the site showing a former landscaped berm, pond, and JP-4/JP-8 unloading area in the background.

SITE HISTORY PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 07

Description:

SS-C507: View east from the northwest corner of the former pond with active ASTs in background.

Photograph No. 08

Description:

SS-C507: View north from south end of JP-4/JP-8 unloading area. Building 392 and unloading ports (right side of photo) and former train tanker storage rail yard (left side of photo).

SITE HISTORY PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 09

Description:

SS-C507: View west from the former fuel unloading port and concrete unloading area with metal grated drain.

Photograph No. 10

Description:

SS-C507: View south from north end of JP-4/JP-8 unloading area with Building 392 and canopy in background.

1995 USGS Data Submission

Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico. 1995. (Vol. 1 and 2)

(electronic [PDF] on CD only)

INVESTIGATION OF EIGHT UNDERGROUND STORAGE TANK FACILITIES ON CANNON AIR FORCE BASE AND MELROSE BOMBING RANGE, NEW MEXICO, 1995

VOLUME I

PREPARED FOR

ENVIRONMENTAL MANAGEMENT FLIGHT
CANNON AIR FORCE BASE, NEW MEXICO 88103

PREPARED BY

FREDRICK E. GEBHARDT
U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION
4501 INDIAN SCHOOL ROAD NE, SUITE 200
ALBUQUERQUE, NEW MEXICO 87110

PREFACE

The purpose of this investigation was to assess potential contamination in soils at or immediately adjacent to eight Underground Storage Tank (UST) facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico, where contaminants may have been released due to leaks or spills.

Project Chief of this investigation is Fredrick Gebhardt. Technical support was provided by employees of the U.S. Geological Survey's New Mexico District and National Water Quality Lab. Text and illustrations were prepared by the Publications Unit of the New Mexico District. Chemical analyses were performed by Quanterra Environmental Services a Division of Quanterra Incorporated in Arvada, Colorado.

Appreciation is extented to the base point of contact, Mr. Rick Chandler, Environmental Management, Cannon Air Force Base. The assistance and cooperation of personnel from Cannon AFB and Melrose Bombing Range is greatly appreciated.

Approved:

Russell K. Livingston
District Chief, New Mexico
U.S. Geological Survey

Rick Chandler
Technical Project Manager
Cannon AFB, New Mexico

NOTICE

This report has been prepared for Cannon Air Force Base by the U.S. Geological Survey, Water Resources Division, New Mexico District, for the purpose of aiding in the implementation of remedial action at eight Underground Storage Tank (UST) facilities. As the report relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest.

It should be noted that all subsurface investigations are inherently limited in the sense that conclusions are drawn and recommendations are developed from test samples which depict subsurface conditions over short periods of time. Subsurface conditions elsewhere may differ from those at the sampling locations. In addition, subsurface conditions at sampling locations may vary over longer periods of time than can be observed in a study of this type.

Acceptance of this report in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

TABLE OF CONTENTS
VOLUME I

Page

1.0 INTRODUCTION/ SCOPE OF WORK 1

2.0 PROJECT SUMMARY 3-8

2.1 FIELD INVESTIGATION 3
2.1.1 Decontamination Procedure for Geoprobe Brass Sleeves 4

2.2 LABORATORY ANAYLSIS 7
2.2.1 Sample Identification 7
2.2.2 Methods of Sampling for Petroleum Hydrocarbons 8

3.0 ENVIRONMENTAL SETTING 9-11

3.1 CLIMATE 9

3.2 GEOGRAPHY 9

3.3 GEOLOGY 10

3.4 SOILS 10
3.4.1 Soil Boring Descriptions 10

3.5 SURFACE WATER 11

3.6 GROUNDWATER 11

4.0 SITE SPECIFIC DATA 12-60

4.1 FACILITY 728 12-15
4.1.1 Site Description 12
4.1.2 U.S. Geological Investigation 12
4.1.3 Recommendations 12

4.2 FACILITY 2285 16-19
4.2.1 Site Description 16
4.2.2 USGS Investigation 16
4.2.3 Recommendations 16

4.3 FACILITY 130 20-23
4.3.1 Site Descriptions 20
4.3.2 USGS Investigation 20
4.4.3 Recommendations 20

TABLE OF CONTENTS -- Continued

Page

4.4 FACILITY 600 24-29
- 4.4.1 Site Description 24
- 4.4.2 USGS Investigation 24
- 4.4.3 Recommendations 25

4.5 FACILITY 3060 30-35
- 4.5.1 Site Description 30
- 4.5.2 USGS Investigation 30
- 4.5.3 Recommendations 31

4.6 FACILITY 1400 36-43
- 4.6.1 Site Description 36
- 4.6.2 USGS Investigation 36
- 4.6.3 Recommendations 37
- 4.6.4 Soil Boring Descriptions -- Facility 1400 37

4.7 FACILITY 368 44-52
- 4.7.1 Site Description 44
- 4.7.2 USGS Investigation 44-45
- 4.7.3 Recommendations 45
- 4.7.4 Soil Boring Descriptions -- Facility 368 45

4.8 FACILITY 3121 53-60
- 4.8.1 Site Description 53
- 4.8.2 USGS Investigation 53-54
- 4.8.3 Recommendations 54
- 4.8.4 Soil Boring Descriptions -- Facility 3121 54

TABLE OF CONTENTS -- Continued

List of Figures

		Page
Figure 1.1	Map showing location of Cannon Air Force Base and Melrose Bombing Range, New Mexico	2
Figure 2.1.1	Map showing location of Underground Storage Tanks on Cannon Air Force Base	5
Figure 4.1.1	Location of boreholes at Facility 728 (Rapcon Building)	13
Figure 4.2.1	Location of boreholes at Facility 2285 (runway)	17
Figure 4.3.1	Location of boreholes at Facility 130 (Fire Department)	21
Figure 4.4.1	Location of boreholes at Facility 600 (Base Support Center/ Operation Group)	26
Figure 4.5.1	Location of boreholes at Facility 3060 (generator shed)	32
Figure 4.6.1	Location of boreholes at Facility 1400 (Hospital)	38
Figure 4.7.1	Location of boreholes at Facility 368 (old gas station)	46
Figure 4.7.2	Location of boreholes at Facility 368 (pump island)	47
Figure 4.8.1	Location of boreholes at Facility 3121 (Melrose Bombing Range)	55

List of Tables

Table 4.1.1	Summary of analytical data results, Facility 728	14
Table 4.2.1	Summary of analytical data results, Facility 2285	18
Table 4.3.1	Summary of analytical data results, Facility 130	22
Table 4.4.1	Summary of analytical data results, Facility 600	27-28
Table 4.5.1	Summary of analytical data results, Facility 3060	33-34

TABLE OF CONTENTS -- Concluded

		Page
Table 4.6.1	Summary of analytical data results, Facility 1400	39-41
Table 4.7.1	Summary of analytical data results, Facility 368	48-50
Table 4.8.1	Summary of analytical data results, Facility 3121	56-58

List of Gas Chromatograms

Gas Chromatograms 2.1.1	Gas Chromatograph Standards	6
Gas Chromatograms 4.1.1	Facility 728, samples CAFB-FAC0728-0104, -0303	15
Gas Chromatograms 4.2.1	Facility 2285, samples CAFB-FAC2285-0202, -0502	19
Gas Chromatograms 4.3.1	Facility 130, samples CAFB-FAC0130-0102, -0402	23
Gas Chromatograms 4.4.1	Facility 600, samples CAFB-FAC0600-0104, -0302, -0702	29
Gas Chromatograms 4.5.1	Facility 3060, samples CAFB-FAC3060-0302, -0601	35
Gas Chromatograms 4.6.1	Facility 1400, samples CAFB-FAC1400-0301, -0305, -1101, -0306, -0307	42-43
Gas Chromatograms 4.7.1	Facility 368, samples CAFB-FAC0368-0102, -0102M, -1001, -1005, -1006, -1601	51-52
Gas Chromatograms 4.8.1	Facility 3121, samples CAFB-FAC3121-0101, -0301, -0601, -0801, -0107, -0108	59-60

VOLUME II

APPENDICES (Laboratory Analytical Data)

1.0 INTRODUCTION/ SCOPE OF WORK

U.S. Geological Survey, WRD, New Mexico District conducted an subsurface investigation of eight Underground Storage Tanks (UST's) facilities at Cannon Air Force Base, Curry County and Melrose Bombing Range, Roosevelt County, New Mexico (Figure 1.1). The purpose of this investigation was to determine if subsurface soils at eight UST's facilities had been contaminated with petroleum hydrocarbons, and if contamination does exist, what is the magnitude and extent of the contamination. The suspect contamination may have resulted from leaks/spills from UST's previously utilized on the sites. All UST's with the exception of one (Facility 1400, CAFB Hospital) were recently decommissioned and excavated. The UST laocated adjacent to the Base Hospital at Cannon AFB (Facility 1400) has been decommissioned and abandoned in place.

The subsurface field investigation consisted of the collection of soil borings at the eight UST facilities, which was conducted from April 5, 1995 thru December 13, 1995. The investigation was performed in accordance with New Mexico Environmental Department's Underground Storage Tank Regulations, Section 1205. The soil borings were analyzed for Diesel Range Organics (DRO; modified method 8015), or Gasoline Range Organics (GRO; modified 8015). Complete description of the analysis, laboratory results, and chain of custody forms are attached in the Appendices of this report.

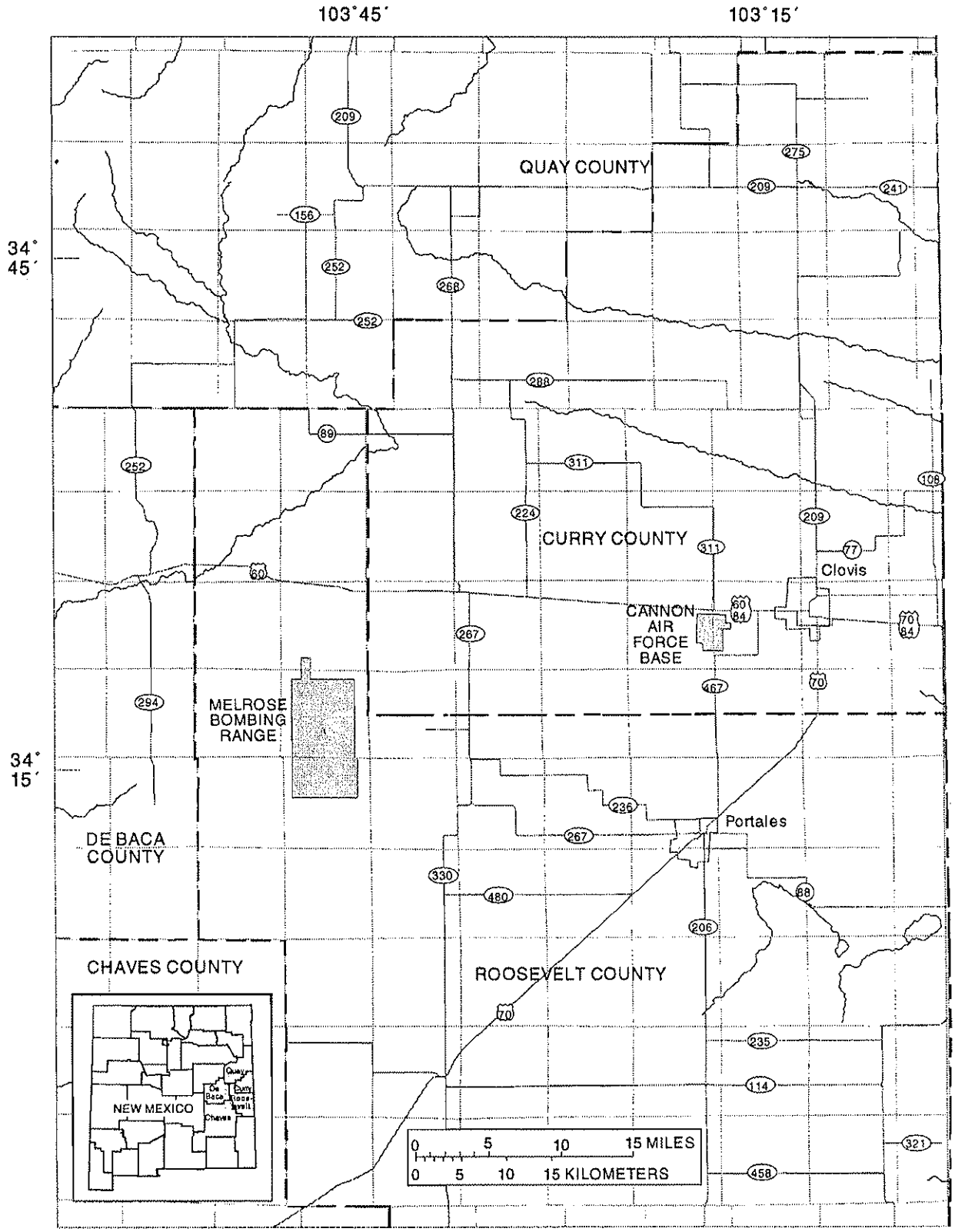


Figure 1.1--Location of Cannon Air Force Base and Melrose Bombing Range, New Mexico.

2.0 PROJECT SUMMARY

2.1 FIELD INVESTIGATION

On April 5, 1995 the U.S. Geological Survey, WRD began a subsurface investigation of eight Underground Storage Tank (UST) facilities, on Cannon Air Force Base (Fig. 2.1.1) and Melrose Bombing Range. After reviewing each individual UST site, and with the approval of Rick Chandler of the Cannon AFB Environmental Department, sampling locations and procedures were determined.

The initial investigation, consisted of the validation of original samples, collected during the excavation of the UST's (EXCEPTION: Facility 1400--CAFB Hospital, samples were collected with this tank in place). After the evaluation of these samples, if contamination levels were above reporting limits, additional soil borings and and sampling occured in an outward and downward direction from contaminated soil locations.

The procedure for evaluating samples were by utilizing field instruments and/or analyzed by an approved laboratory (Section 2.2).

FIELD INSTRUMENTS

(2) Photovac Gas Chromatograph (GC)
Model 10S50 Serial # 6180151
Model 10S50 Serial # 0471492/ 6071535
Standards for Gas Chromatograph (G.C. 2.1.1):
Benzene - Toluene - Xylene (BTX)
Diesel Fuel

Photovac - Microtip
Photoionization Detector
Model HL-2000 Serial # PA930103
Calibrated to 100 ppm Isobutylene

The initial equipment used to advance the soil borings on the UST facilities were a Model 8-MU GEOPROBE (hydraulic punch system). Brass sleeves were used for the collection of soil samples for field screening and lab analysis (Decontamination Procedure for Brass Sleeves 2.1.1).

Due to the lithology of the subsurface soil, larger drilling equipment was needed to investigate the extent of the contamination. A Mobile Drill B53 auger drilling rig and a Gardner-Denver 17W rotary drilling rig were used. A hollow stem auger retrofitted with a split-barrel sampling devise was used to collect soil for screening and sampling.

The 5-foot split-barrel sampling devise was decontaminated between sampling events to prevent cross contamination of samples.

Decontamination procedure for split-barrel:
Liquinox - Deionized Water - Methanol - Deionized Water

2.1.1 Decontamination Procedure for Geoprobe Brass Sleeves

RE: Cleaning and decontamination procedure for Geoprobe metal soil sampler liners.

The following procedures are used in the cleaning and decontamination of all brass and stainless steel liners used to retain samples in Geoprobe Systems Large Bore and Macro Core soil samplers. These procedures apply to liners with the following part numbers: AT-723, AT-666, and AT-667.

All liners are first washed in an agitated detergent bath at a temperature of approximately 180 degrees F.

After detergent wash, all liners are placed in mesh bottom trays and rinsed with hot high pressure tap water at a temperature of approximately 180 degrees F.

Following this rinse, the liners are allowed to air dry before being placed on a stainless steel arbor and clad with a heat shrinkable PVC outer wrap. Once removed from this arbor, the assembled liners are capped with vinyl end caps.

GEOPROBE SYSTEMS

Thomas M. Christy, P.E.
Vice President

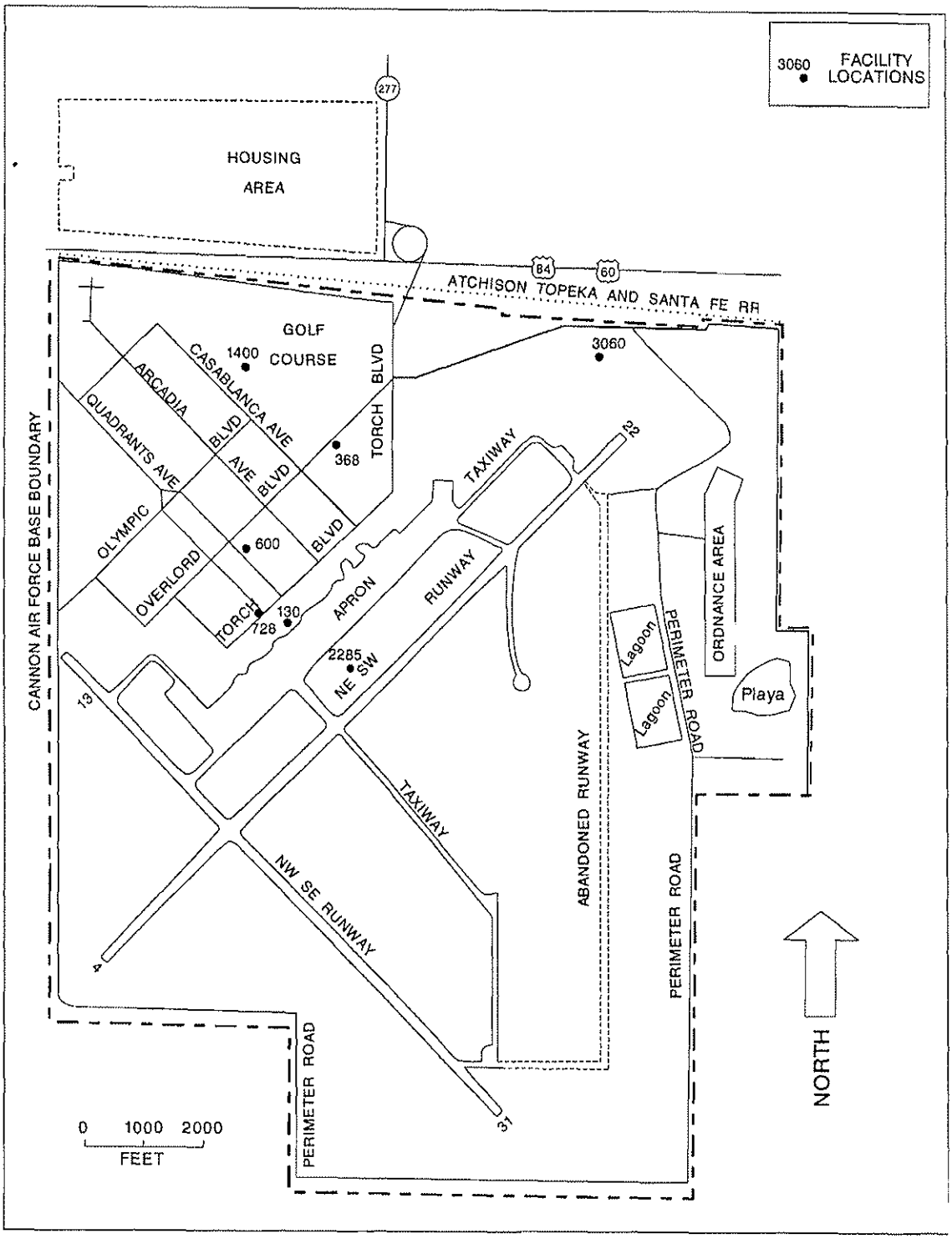
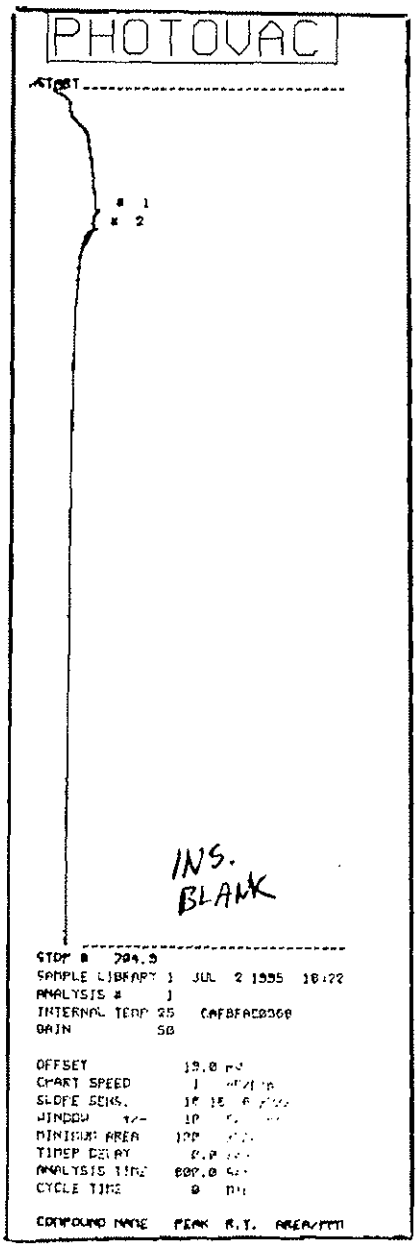
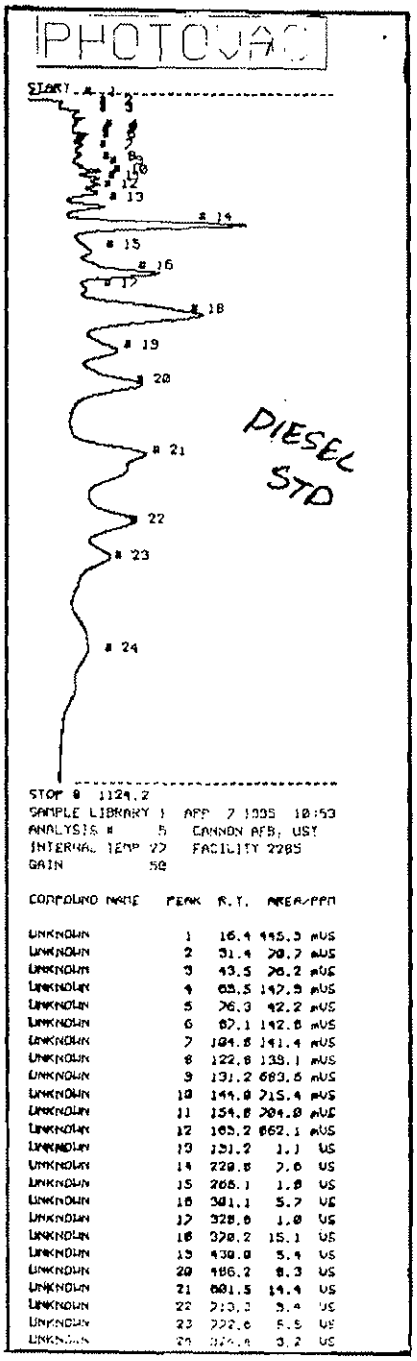


Figure 2.1.1--Location of underground storage tanks on Cannon Air Force Base.

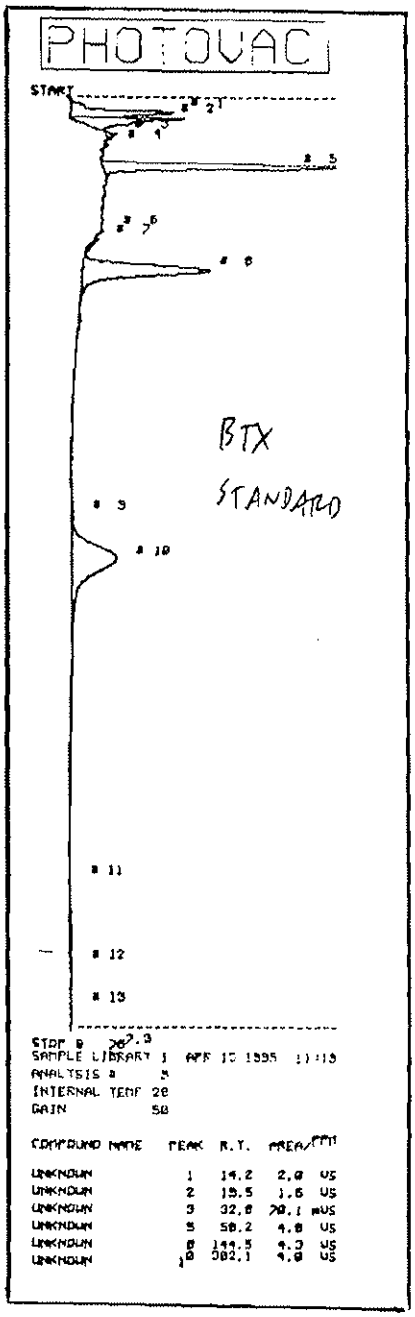
2.1.1 Gas Chromatograph Standards



Instrument Blank



Diesel Standard



BTX Standard
Benzene-Tolune-Xylene

2.2 LABORATORY ANALYSIS

At each Underground Storage Tank facility, soil samples were collected for field screening and/or lab anaylsis. Soil samples were tested for suspected contamination, specifically Petroleum Hydrocarbons. The method of anaylsis was Diesel Range Organics (DRO; modified method 8015), or Gasoline range Organics (GRO; modified method 8015). A complete description of the methods of analizing for Petroleum Hydrocarbons can be found in Section 2.2.2.

Soil samples for lab anaylsis were submitted to an accredited laboratory, Quanterra Environmental Services, Arvada, Colorado. Samples were recieved by the laboratory's Sample Control Group and were carefully checked for label identification, chain-of-custody, and any discrepencies. Each sample was then assigned a unique laboratory identification number through a computerized Laboratory Information Management System (LIMS), which stores all identifications and essential information. Access to the laboratory is restricted to prevent any unauthorized contact with samples, extracts or documentation.

Quality Assurance (QA) and Quality Control (QC) procedures were followed according to Environmental Protection Agency (EPA) and New Mexico Environmental Department (NMED).

2.2.1 SAMPLE IDENTIFICATION

Each soil sample collected was uniquely identified by both a field and a laboratory sample identification number. The field number is assigned by the Geological Survey sampling crew using a 16-character string of letters and numbers. For example, the field sample identification number CAFB-FAC1400-0102 signifies:

CAFB for Cannon Air Force Base
FAC1400 for facility number
01 for borehole number
02 for sample number

For laboratory number, Quanterra assignes a six-digit project number to each set of samples recieved in one day, and each sample was assigned a four-digit sample number in addition to the project number. For example, 043723-0002 is a unique sample number, where 043723 is the project number, 0002 is the sample number.

Quanterra
Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

Gasoline Range Organics (GRO; modified method 8015)

This is a purge and trap GC/FID method that measures the volatile hydrocarbons present in a sample. The carbon range covered is C6 to C10. Higher molecular weight hydrocarbons cannot be measured using this method because they are not sufficiently volatile to be recovered by purge and trap.

Diesel Range Organics (DRO; modified method 8015)

In this method, samples are extracted with methylene chloride and analyzed by GC/FID. Normally, the hydrocarbon range analyzed is from C10 to C28. However, this range can easily be expanded to meet specific project requirements. For example, the range can be expanded to C8 to C32 to provide data equivalent to the TCO method described below. Lower molecular weight hydrocarbons (less than C8) generally cannot be analyzed by this method since their volatility causes them to be lost during sample preparation.

Total Chromatographable Organics (TCO; modified method 8015)

The TCO method is a GC/FID method which was developed in the late 1980's and has since been replaced by other methods (e.g. GRO and DRO). This method is currently provided only by Quanterra's Denver lab and we are no longer recommending its use. The TCO method will continue to be offered when necessary for on-going projects. For new projects, and existing projects where a method change is acceptable, we recommend the use of the DRO method. Equivalent results to TCO can be obtained by adjusting the integration range for the DRO method to match the TCO range (C8 to C32). Since these methods are so similar, use of both TCO and DRO is redundant and unnecessarily increases the analytical costs.

Total Recoverable Petroleum Hydrocarbons (Method 418.1)

This is a general screening method that measures freon-extractable material. Certain non-petroleum compounds can cause "false" positive results. Low molecular weight hydrocarbons may be lost due to their volatility. High molecular weigh hydrocarbons may be incompletely recovered due to their limited solubility in freon. Furthermore, as you may know, the production of Freon is being phased out under the Clean Air Act Amendments of 1990. As a result of the phase-out, Freon costs are rising and availability is limited. At some point in the future, we will no longer be able to perform these methods for our clients. The EPA has proposed replacing these methods with a hexane extraction/ gravimetric procedure, with or without a silica gel clean-up. This method has not yet been finalized and we will continue to offer the Freon-based methods for as long as possible. We also hope to offer whatever replacement method(s) are developed by the EPA. However, when these methods are not required for regulatory reasons (e.g. NPDES), we are recommending that our clients switch to one of the GC/FID methods described above.

3.0 ENVIRONMENTAL SETTING

3.1 CLIMATE

The climate for the Underground Storage Tank (UST) subject areas are semiarid. Average annual rainfall recorded at Cannon AFB is 15.2 inches, most of which falls during the summer months as thundershowers. Monthly averages vary from 0.4 inches in the winter months to 2.5 and 2.7 inches in July and August, respectively. Maximum monthly rainfall is 11.4 inches in July and maximum daily rainfall is 4.8 inches. Annual snowfall for this region is 10 to 13 inches and the record snowfall is 19 inches.

Average monthly temperatures range from the mid-30's in January to the upper 70's in July. Occasional days of temperature more than 100 degrees occur in summer, the highest recorded temperature is 106 degrees. Minimum temperatures range from the low- 20's in January to the mid- 60's in July, the lowest recorded temperature is 11 degrees.

Winds in the area are often gusty and can average 19 miles per hour(mph) or greater. The prevailing surface wind direction is west. These west winds blow primarily from October to May. During the remainder of the year, winds tend to be from the south. Monthy wind averages range from 6 to 10 mph; the maximum recorded wind gust is 84 mph.

3.2 GEOGRAPHY

The majority of UST facilities on this project are located on Cannon Air Force Base, which is located on the U.S.G.S. Portair, New Mexico Quadrangle, 7.5 Minute Topographic Map. One facility is on Melrose Bombing Range located on U.S.G.S. Tolar S.E. New Mexico Quadrangle, 7.5 Minute Topographic Map.

Both Cannon AFB and Melrose Bombing Range are situated in the Southern High Plains Pysiographic Province. The region is essentially a plateau, bounded on the north by the Canadian River and on the east and west by prominent escarpments rising as much as 300 or more feet above the lower lands.

The surface of the plains is flat throughout much of the area and gently undulating in the remainder. An exception to the flat surface is the Portales Valley, which is the drainage for much of the area.

3.3 GEOLOGY

The UST facilities of this project, as previously stated are located in Curry and Roosevelt Counties of New Mexico. These two countiues lie within the region of the High Plains Aquifer, which is underlain by rocks of the late Tertiary or Quaternary age. The rocks of the late Tertiary age consist of the Ogallala Formation, and the Quaternary deposits consist of alluvial, dune sand, and valley-fill deposits. The Ogallala is the principal geologic unit in the majority of the subject area, however, the alluvial deposits are significant in the northern part of Roosevelt County.

The Ogallala Formation is mostly unconsolidated clay, silt, fine- to coarse- grained sand and gravel. Also, in the upper part of the Ogallala the sediments have been cemented, chiefly by calcium carbonate, forming single or multiple beds of caliche.

The unconsolidated Quaternary alluvial and valley-fill deposits, like the Ogallala Formation, consist of clay, silt, sand and gravel. These rocks primarily are derived from reworked Ogallala material.

3.4 SOILS

The soil on Cannon Air Force is characterized by the Amarillo Soils. Amarillo Soils have formed on medium texture to moderatly coarse textured calcareous materials, probably alluvium reworked by wind. These soils have well developed profiles.

The Amarillo series is represented in Curry County by three soil types. Amarillo Loam, Amarillo fine sandy loam and Amarillo loamy fine sand.

The soil at the UST facilities on Cannon AFB are generally classified as Amarillo fine sandy loam, these soils have a moderate to rapid permeability.

The soils on Melrose Bombing Range are generally of the Amarillo-Clovis loams and Amarrillo-Clovis fine sandy loams association. However, the soil at the UST Facility 3121 can further be subdivided into either Amarillo Loam and/or Olton Loam.

3.4.1 Soil Boring Desription

A general description of the subsurface soil (0-20 feet) on Cannon AFB is described as follows:

0-3 feet	moderate brown sandy silt, very fined grained (vfg) - fine grained (fg) root zone.
3-6 feet	light brown-pinkish gray caliche cemented sand, vfg.
6-12 feet	light brown sand mixed with pinkish gray cemented sand, vfg-fg.
12-20 feet	reddish-brown sandy silt, vfg-fg, with pinkish gray caliche nodules throughout the interval.

3.5 SURFACE WATER

Surface water is not located on or adjacent to any of the UST facilities, however, a man-made lake is situated within the golf course located several hundred yards to the north of Facility 368 (Old Gas Station) and northeast of Facility 1400(Hospital).

There is no natural occuring perennial surface water in the area. However, during intense periods of precipitation, water flows in the normally dry stream channels and overland. Ephemeral lakes form in playa basins after a heavy event of precipitation.

3.6 GROUNDWATER

The majority of the subject areas are located on Cannon Air Force Base. The Base is situated in the Southern High Plains Pysiographic Province. The aquifer underlying the Base is the Ogallala Formation, which is easterly dipping and thickening aquifer having its western edge and recharge area about 40 miles west of the Base. Recharge also occurs from precipitation infiltrating into the ground over the whole area. Depth to water on the Base is approximatly 280 feet below land surface, with the general direction of the ground water flow towards the southeast.

One UST facility is located on Melrose Bombing Range. Underlying the Range is Quaternary alluvium of the Portales Valley which is considered the southwestern edge of the Ogallala Formation. Groundwater in the Ogallala is unconfined and contained in the pore spaces of the uncolidated or partially consolidated sediments. The saturated thickness of Ogallala material is estimated to be less than 100 feet on the Range due to its proximity to the western edge of the aquifer.

Depth to water varies from 41 feet below land surface along the Canada del Tule on the southeast corner of the Range to 128 feet along the east-central Range boundary. Groundwater on the Range flows in a northeasterly direction toward the Portales Valley.

4.0 SITE SPECIFIC DATA

4.1 FACILITY 728

4.1.1 Site Description

The Underground Storage Tank (UST) at Facility 728 had a capacity of 1000 gallons and contained diesel fuel, required for an emergency generator at the Rapcon Building on Cannon Air Force Base (Fig. 2.1.1). The tank was constructed of steel and the base of tank was approximately nine feet below land surface.

In September and October 1994 a private contractor collected five soil samples during the excavation of the UST. The samples were taken at the center and at each of the four corners of the excavated area, and at least two feet below the base of the tank. One sample collected during the excavation had above reporting limits of "Total Petroleum Hydrocarbons (TPH)" concentrations. The sample taken at the west end of tank had a concentration of 577 ppm TPH.

4.1.2 U.S. Geological Survey Investigation

On April 6, 1995 with the use of a Geoprobe, five boreholes were advanced, collecting eleven environmental samples, ranging in depth from 4 to 21 feet (Fig. 4.1.1 and Table 4.1.1). The purpose of these samples was to validate the results from soil samples taken during the removal of the tank.

The results from field screening indicated no contamination (Gas Chromatograms 4.1.1), and lab anaylsis (DRO method) confirmed that concentrations were below reporting limits (Table 4.1.1).

4.1.3 Recommendations

No further investigation should be required for this facility.

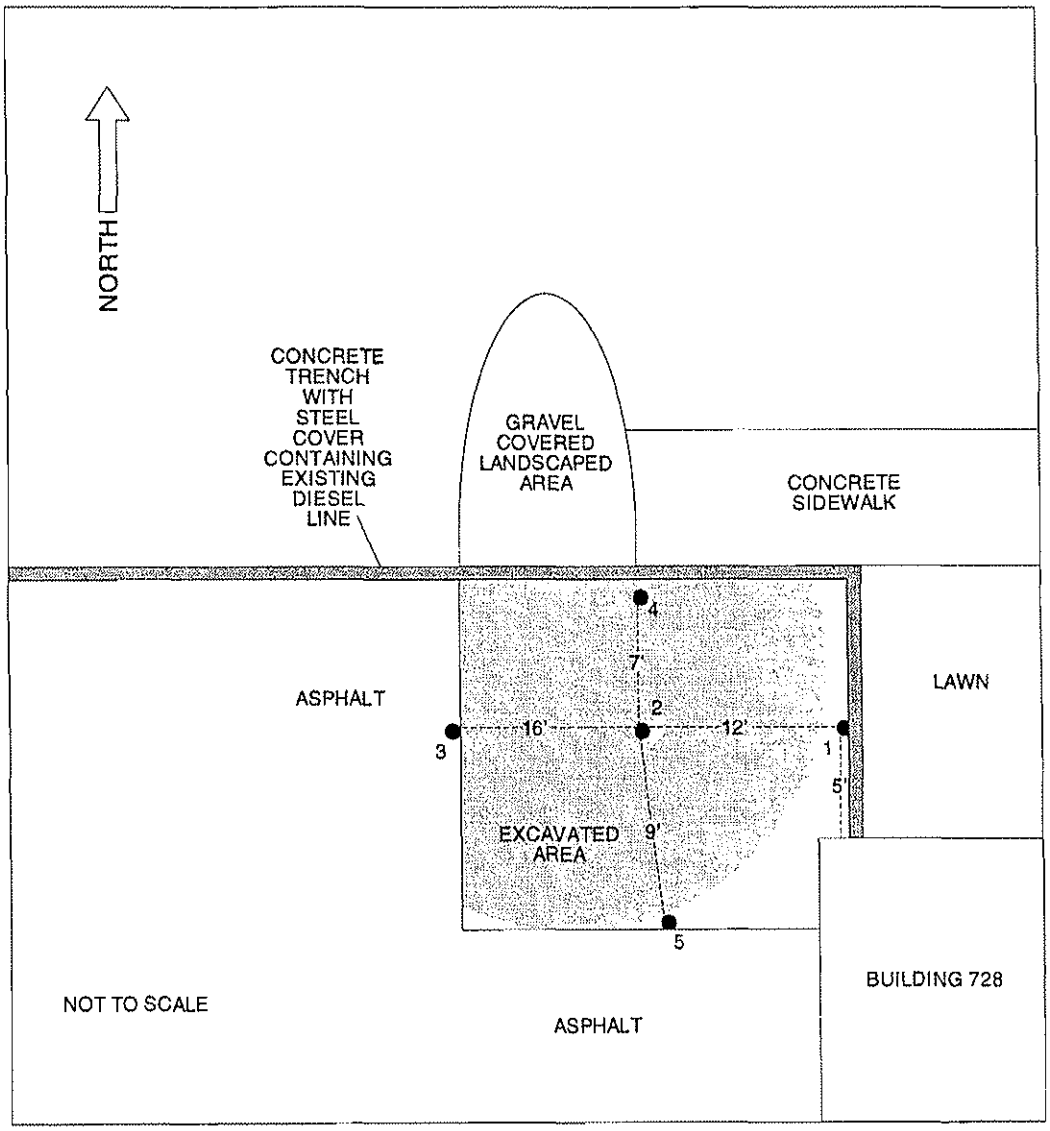


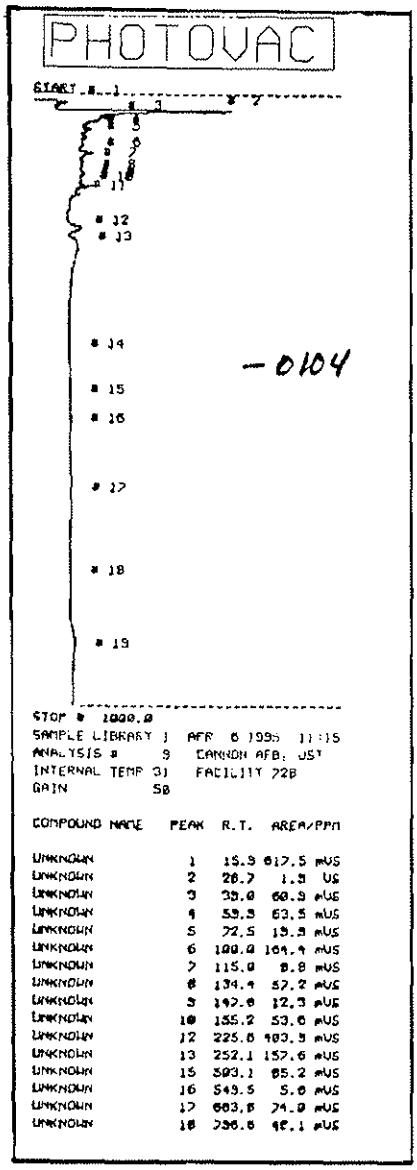
Figure 4.1.1--Location of boreholes at Facility 728 (Rapcon Building).

Facility 728 (RAPCON BUILDING)

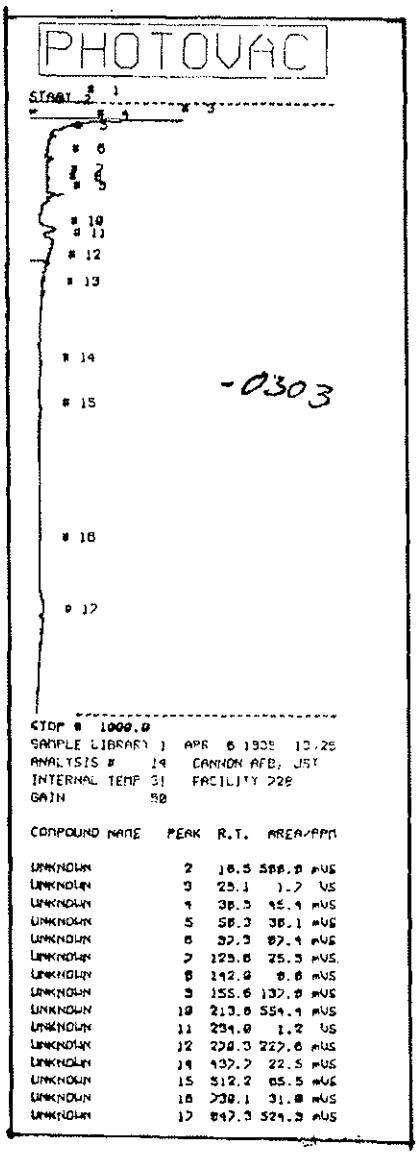
Table 1.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 728 , Cannon Air Force Base, New Mexico. [DRO,Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C12-C24 (for detail, see project 041427 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved]

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC0728-0101	4.5-6.5	06APR95	Soil	Environmental	8.3 ql	4.0
CAFB-FAC0728-0102	9.0-11.0	06APR95	Soil	Environmental	6.2 ql	4.0
CAFB-FAC0728-0103	14.0-16.0	06APR95	Soil	Environmental	5.9 ql	4.0
CAFB-FAC0728-0104	19.0-21.0	06APR95	Soil	Environmental	5.5 ql	4.0
CAFB-FAC0728-0201	13.0-15.0	06APR95	Soil	Environmental	4.9 ql	4.0
CAFB-FAC0728-0301	4.0-6.0	06APR95	Soil	Environmental	4.6 ql	4.0
CAFB-FAC0728-0302	9.0-11.0	06APR95	Soil	Environmental	ND	4.0
CAFB-FAC0728-0303	14.0-16.0	06APR95	Soil	Environmental	12.0 ql	4.0
CAFB-FAC0728-0401	13.0-15.0	06APR95	Soil	Environmental	5.7 ql	4.0
CAFB-FAC0728-0501	4.0-6.0	06APR95	Soil	Environmental	4.5 ql	4.0
CAFB-FAC0728-0502	4.0-6.0	06APR95	Soil	Duplicate	7.7 ql	4.0
CAFB-FAC0728-0503		06APR95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC0728-0504	9.0-11.0	06APR95	Soil	Environmental	3.9 j	4.0
CAFB-FAC0728-0505	14.0-16.0	06APR95	Soil	Environmental	5.8 ql	4.0

4.1.1 Gas Chromatograms -- Facility 728



CAFB-FAC0728-0104



CAFB-FAC0728-0303

4.2 FACILITY 2285

4.2.1 Site Description

The Underground Storage Tank (UST) at Facility 2285 had a capacity of 500 gallons and contained diesel fuel, required for an emergency generator located adjacent to the runway on Cannon AFB (Fig. 2.1.1). The tank was constructed of steel and the base of tank was approximately nine feet below land surface..

A private contractor in January 1995 collected four soil samples during the excavation of the UST. They were taken at each of the four corners of the excavated area, and two feet below the base of the tank. All samples collected during the excavation had above reporting limits of "Total Recoverable Petroleum Hydrocarbons (TRPH)" concentrations. The TRPH concentrations ranged from 271 to 1,040 ppm.

4.2.2 USGS Investigation

On April 7, 1995 with the use of a Geoprobe, five boreholes were advanced, collecting nine environmental samples, ranging in depth from 9 to 16 feet (Fig. 4.2.1 and Table 4.2.1). The purpose of these samples was to validate the results from soil samples taken during the removal of the tank.

The results from field screening indicated only low concentrations of contamination (G.C. 4.2.1), and the lab anaylsis (DRO method) confirmed that concentrations were below reporting limits (Table 4.2.1).

4.2.3 Recommendations

No further investigation should be required for this faciity

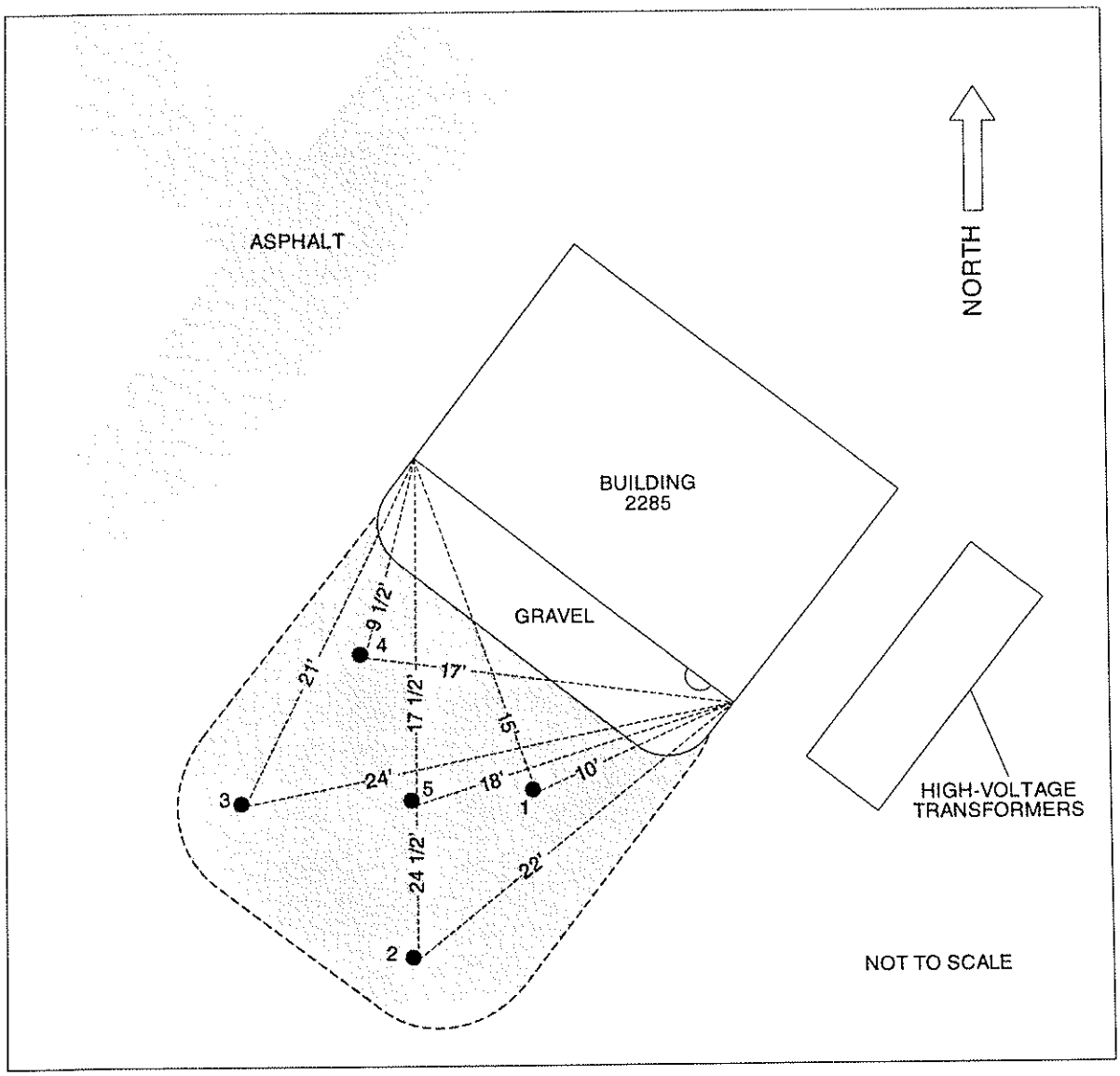


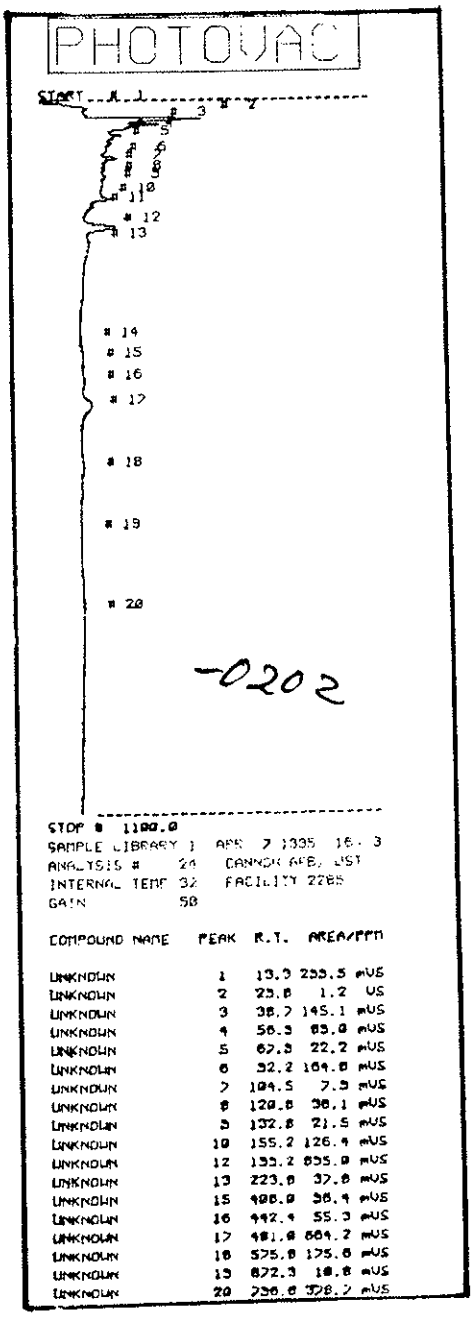
Figure 4.2.1--Location of boreholes at Facility 2285 (runway).

FACILITY 2285 (RUNWAY)

Table 2.--Summary of analytical data results in soil samples from underground tank site Facility 2285, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C26 (for detail, see project 041449 in Appendix); q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.]

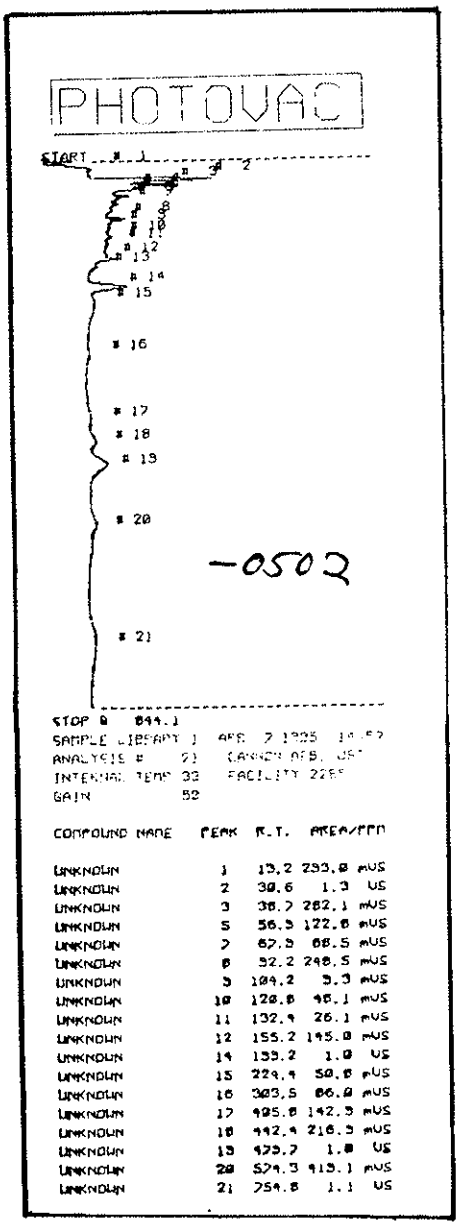
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg	Reporting Limit
CAFB-FAC2285-0101	9.0-11.0	07APR95	Soil	Environmental	20.0 ql	4.0
CAFB-FAC2285-0102	14.0-16.0	07APR95	Soil	Environmental	24.0 ql	4.0
CAFB-FAC2285-0201	9.0-11.0	07APR95	Soil	Environmental	3.2 j	4.0
CAFB-FAC2285-0202	14.0-16.0	07APR95	Soil	Environmental	3.0 j	4.0
CAFB-FAC2285-0301	9.0-11.0	07APR95	Soil	Environmental	3.2 j	4.0
CAFB-FAC2285-0401	9.0-11.0	07APR95	Soil	Environmental	5.3 ql	4.0
CAFB-FAC2285-0402	13.0-15.0	07APR95	Soil	Environmental	13.0 ql	4.0
CAFB-FAC2285-0501	9.0-11.0	07APR95	Soil	Environmental	6.6 ql	4.0
CAFB-FAC2285-0502	14.0-16.0	07APR95	Soil	Environmental	8.2 ql	4.0

4.2.1 Gas Chromatograms -- Facility 2285



COMPOUND NAME	PEAK	R.T.	AREA/FFD	
UNKNOWN	1	13.9	233.5	mVS
UNKNOWN	2	23.8	1.2	VS
UNKNOWN	3	38.7	145.1	mVS
UNKNOWN	4	56.3	83.0	mVS
UNKNOWN	5	67.3	22.2	mVS
UNKNOWN	6	92.2	164.8	mVS
UNKNOWN	7	104.5	7.3	mVS
UNKNOWN	8	120.8	38.1	mVS
UNKNOWN	9	132.8	21.5	mVS
UNKNOWN	10	155.2	126.4	mVS
UNKNOWN	12	155.2	855.0	mVS
UNKNOWN	13	223.8	37.8	mVS
UNKNOWN	15	408.0	38.4	mVS
UNKNOWN	16	442.4	55.3	mVS
UNKNOWN	17	481.8	864.2	mVS
UNKNOWN	18	575.8	175.6	mVS
UNKNOWN	19	872.3	18.8	mVS
UNKNOWN	20	756.8	328.2	mVS

CAFB-FAC2285-0202



COMPOUND NAME	PEAK	R.T.	AREA/FFD	
UNKNOWN	1	13.2	233.8	mVS
UNKNOWN	2	30.6	1.3	VS
UNKNOWN	3	38.7	282.1	mVS
UNKNOWN	5	56.3	122.6	mVS
UNKNOWN	7	67.3	68.5	mVS
UNKNOWN	8	92.2	248.5	mVS
UNKNOWN	9	104.2	9.3	mVS
UNKNOWN	10	120.8	45.1	mVS
UNKNOWN	11	132.4	26.1	mVS
UNKNOWN	12	155.2	145.8	mVS
UNKNOWN	14	155.2	1.0	VS
UNKNOWN	15	229.4	50.6	mVS
UNKNOWN	16	303.5	86.0	mVS
UNKNOWN	17	425.8	142.3	mVS
UNKNOWN	18	442.4	216.3	mVS
UNKNOWN	19	479.7	1.8	VS
UNKNOWN	20	574.3	415.1	mVS
UNKNOWN	21	754.8	1.1	VS

CAFB-FAC2285-0502

4.3 FACILITY 130

4.3.1 Site Description

The Underground Storage Tank (UST) at Facility 130 had a capacity of 500 gallons and contained diesel fuel, required for an emergency generator at the Fire Department on Cannon AFB (Fig. 2.1.1). The tank was constructed of steel and the base of tank was approximately nine feet below land surface.

A private contractor in January 1995 collected four soil samples during the excavation of the UST. They were taken at the four corners of the excavated area, and below the base of the tank. One sample collected during the excavation had above reporting limits of "Total Recoverable Petroleum Hydrocarbon (TRPHC)" concentration. The sample collected at the southwest corner of tank had a concentration of 153.5 ppm TRPHC.

4.3.2 USGS Investigation

On April 8, 1995 with the use of a Geoprobe, five boreholes were advanced, collecting twelve environmental samples, ranging in depth from 9 to 21 feet (Fig. 4.3.1 and Table 4.3.1). The purpose of these samples was to validate the results from the soil sample collected during the removal of the tank.

The results from the field screening indicated only low concentrations of contamination (G.C. 4.3.1) and the lab anaylsis (DRO method) confirmed that concentrations were below reporting limits (Table 4.3.1).

4.3.3 Recommendations

No further investigation should be required for this facility.

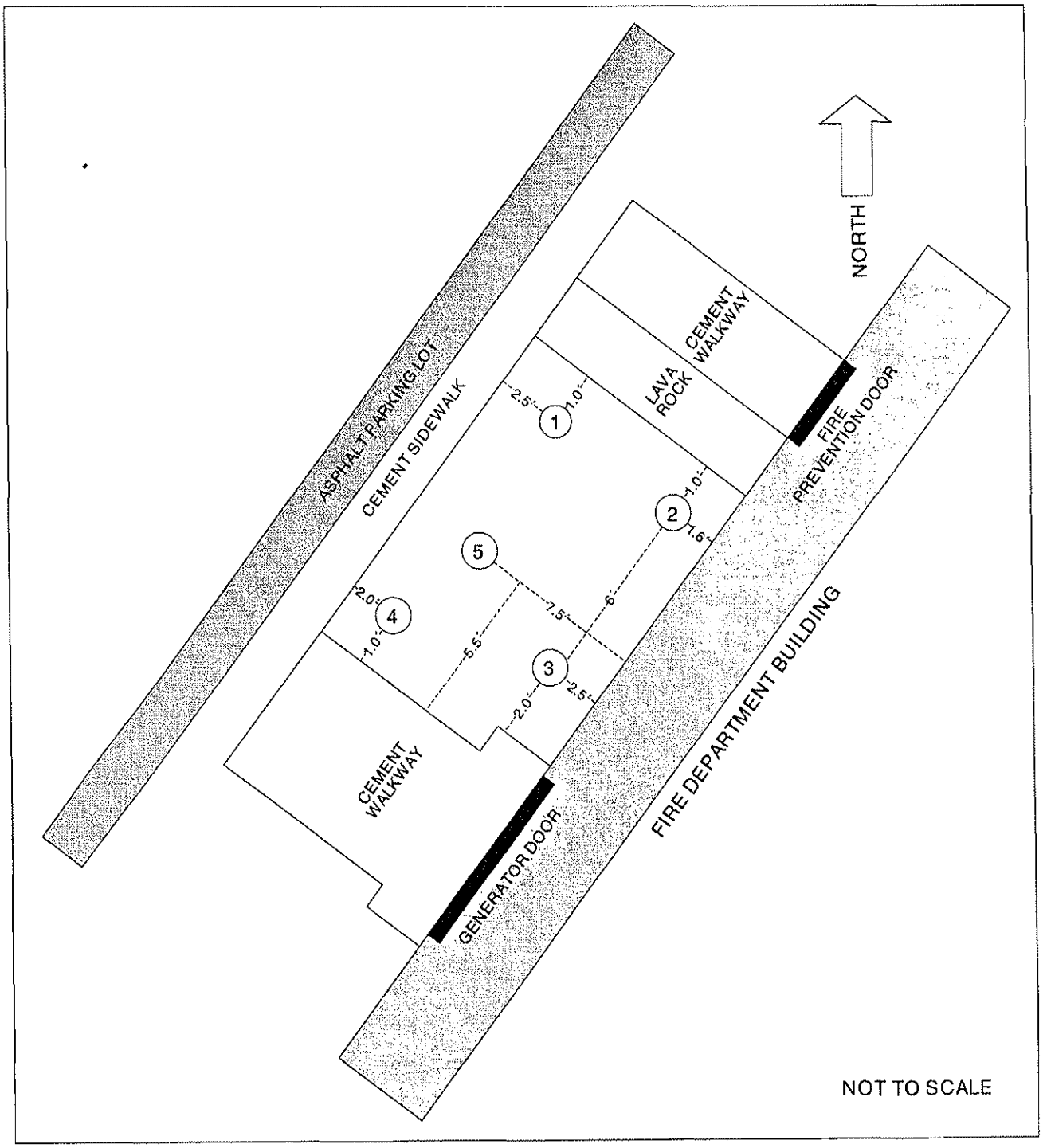


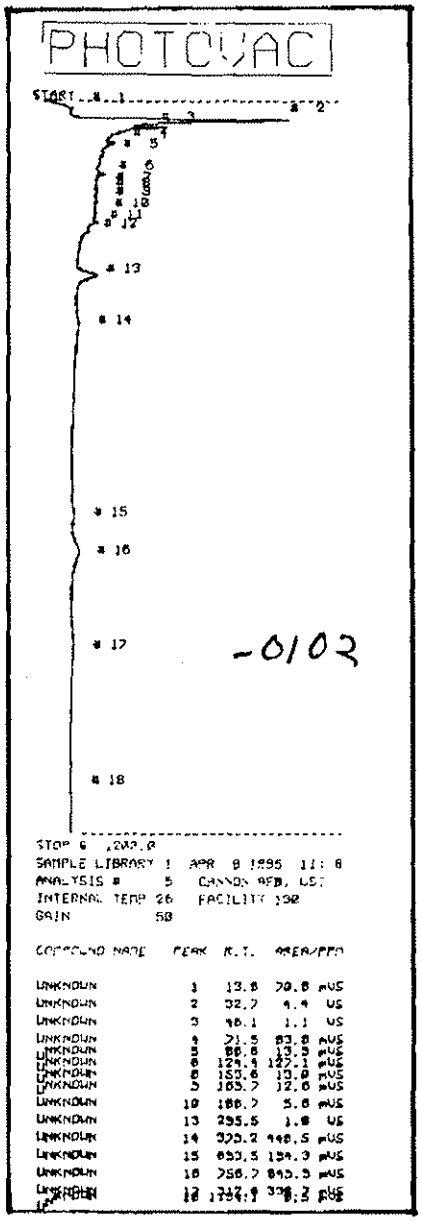
Figure 4.3.1--Location of boreholes at Facility 130 (Fire Department).

FACILITY 130 (FIRE DEPARTMENT)

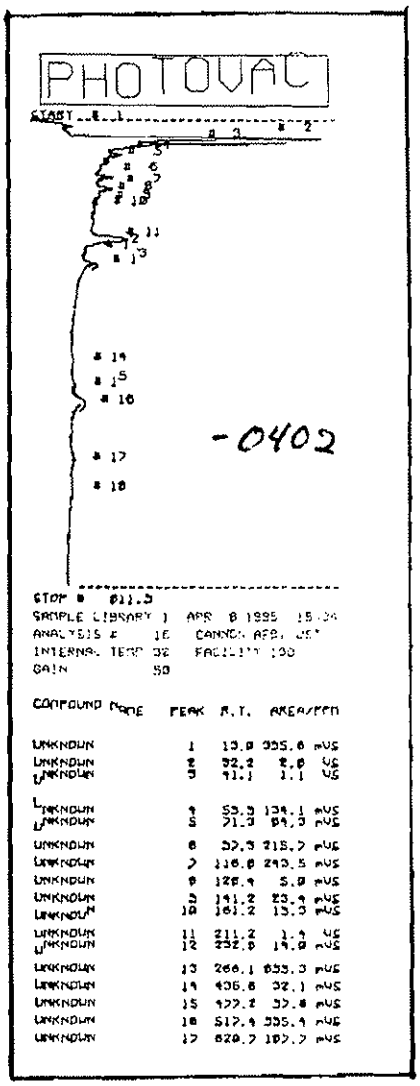
Table 3.--Summary of analytical data results in soil samples from underground tank site Facility 130, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample contains a single peak C16 or C24 (for detail, see project 041450 in Appendix) ; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; *, Field G.C. slight peak reading.]

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg	Reporting Limit
CAFB-FAC0130-0101	9.0-11.0	08APR95	Soil	Environmental	2.6 j	4.0
CAFB-FAC0130-0102	14.0-16.0	08APR95	Soil	Environmental	5.0 ql	4.0
CAFB-FAC0130-0201	9.0-11.0	08APR95	Soil	Environmental	2.2 j	4.0
CAFB-FAC0130-0202	14.0-16.0	08APR95	Soil	Environmental (Field screening only)	Positive *	
CAFB-FAC0130-0203	19.0-21.0	08APR95	Soil	Environmental	8.8 ql	4.0
CAFB-FAC0130-0301	9.0-11.0	08APR95	Soil	Environmental	4.1 ql	4.0
CAFB-FAC0130-0302	14.0-16.0	08APR95	Soil	Environmental	5.5 ql	4.0
CAFB-FAC0130-0401	9.0-11.0	08APR95	Soil	Environmental	6.0 ql	4.0
CAFB-FAC0130-0402	14.0-16.0	08APR95	Soil	Environmental	6.9 ql	4.0
CAFB-FAC0130-0501	9.0-11.0	08APR95	Soil	Environmental	3.5 j	4.0
CAFB-FAC0130-0502	14.0-16.0	08APR95	Soil	Environmental	4.4 ql	4.0
CAFB-FAC0130-0503	19.0-21.0	08APR95	Soil	Environmental	3.2 j	4.0

4.3.1 Gas Chromatograms -- Facility 130



CAFB-FAC0130-0102



CAFB-FAC0130-0402

4.4 FACILITY 600

4.4.1 Site Description

The Underground Storage Tank (UST) at Facility 600 had a capacity of 500 gallons and contained diesel fuel, required for an emergency generator at the Base Support Center/ Operation Group Building on Cannon AFB (Fig. 2.1.1). The tank was constructed of steel and the base of tank was approximately seven feet below land surface.

In October 1994 during the excavation of the UST, four soil samples were taken at a depth two feet below the tank bottom. Three soil samples, had concentrations above the reporting limits. Sample results indicated 3,940 ppm, 6,760 ppm, and 18,100 ppm "Total Petroleum Hydrocarbon (TPH)" concentrations.

Upon receipt of the original sample results, the contractor removed an additional two feet of soil and took two samples at a depth of four feet below the tank bottom. Both soil samples had high TPH concentrations. The sample collected at the north end of the excavation had a concentration of 705 ppm TPH, and on the south end had a concentration of 1,369 ppm TPH.

4.4.2 USGS Investigation

On April 9, 1995 with the use of a Geoprobe, five boreholes were advanced, collecting fifteen environmental samples, ranging in depth from 10 to 21 feet (Fig. 4.4.1 and Table 4.4.1). The purpose of these samples was to validate the results from the second set of the original soil samples collected after the tank excavation.

The results from the field screening indicated high concentrations of contamination (G.C. 4.4.1) and the lab anaylsis (DRO method) confirmed that concentrations were above reporting limits in two of the boreholes (Table 4.4.1).

The assessment of the results from this first series of samples identified the vertical extent of the contamination, however additional sampling was needed to determine the extent of the lateral migration. On July 27 the Geoprobe was used to investigate lateral migration inside the excavated area, and on August 23 a Mobile Drill B53 auger rig was utilized to determine if the contamination had migrated outside the excavation (Fig. 4.4.1 and Table 4.4.1).

A comprehensive site assessment determined that the contamination's lateral migration has been confined inside the excavated area, and the extent of it's vertical migration will not impact the groundwater.

4.4.3 Recommendations

Remedial method for this facility should be Natural Attenuation/ Assimilation. However, the New Mexico Environmental Department's Underground Storage Tank Regulations, Section 1209 -- Treatment of Highly Contaminated Soils, suggest that a Corrective Action System should be implemented, specifically soil excavation and/ or enhanced soil venting.

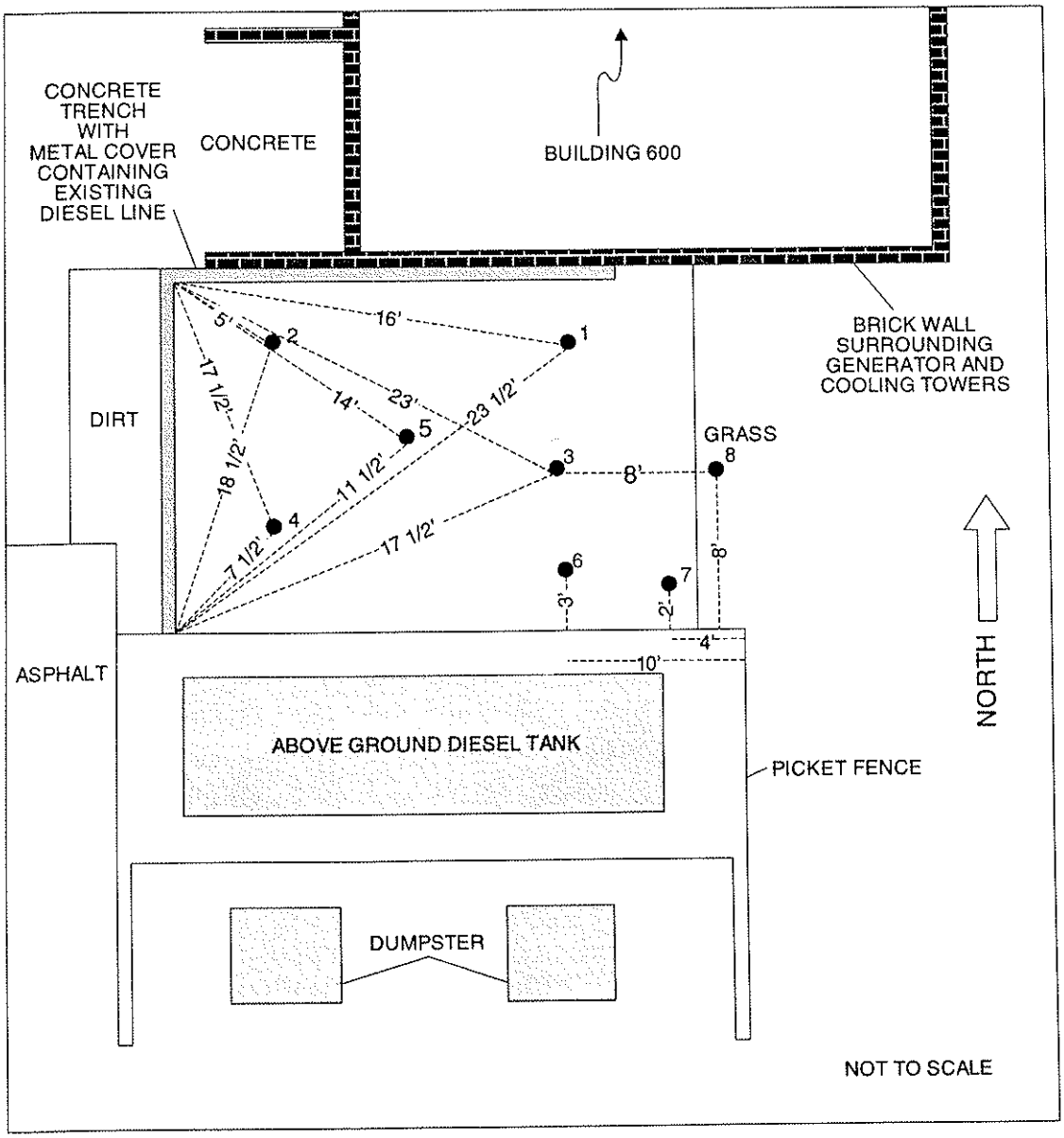


Figure 4.4.1--Location of boreholes at Facility 600 (Base Support Center/Operation Group).

FACILITY 600 (BASE SUPPORT CENTER / OPERATION GROUP)

Table 4.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 600, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28. This sample has GC/FID characteristics that are similar to Fuel Oil #2 (for detail, see projects 041450, 043171, and 044268 in Appendix); q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]

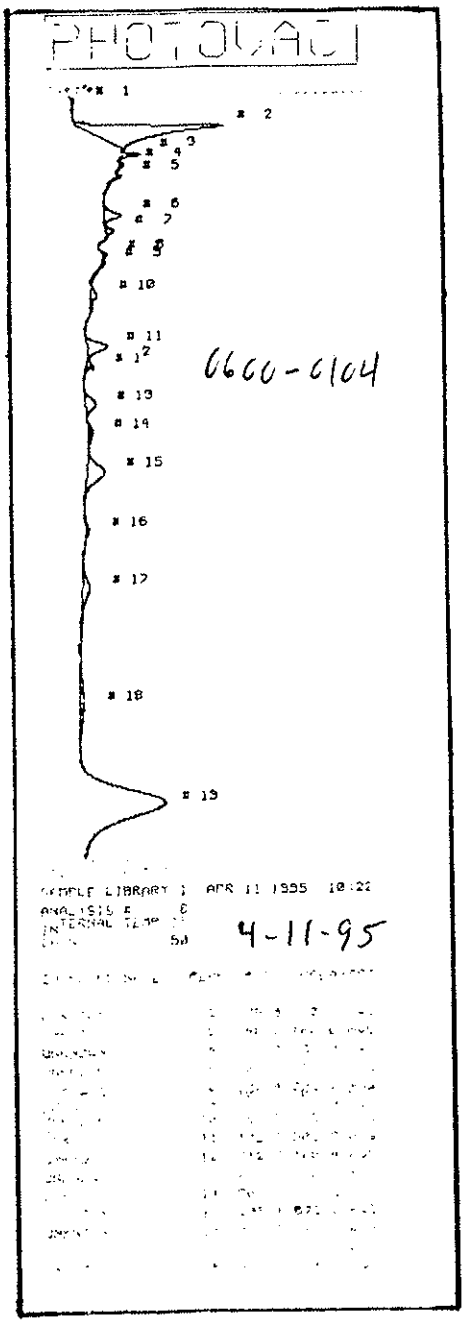
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC0600-0101	10.0-12.0	09APR95	Soil	Environmental	2.4 j	4.0
CAFB-FAC0600-0102	10.0-12.0	09APR95	Soil	Duplicate	2.5 j	4.0
CAFB-FAC0600-0103	14.0-16.0	09APR95	Soil	Environmental	ND	4.0
CAFB-FAC0600-0104	19.0-21.0	09APR95	Soil	Environmental	2.6 j	4.0
CAFB-FAC0600-0201	10.0-12.0	09APR95	Soil	Environmental	2.6 j	4.0
CAFB-FAC0600-0202	14.0-16.0	09APR95	Soil	Environmental	ND	4.0
CAFB-FAC0600-0203	19.0-21.0	09APR95	Soil	Environmental	3.1 j	4.0
CAFB-FAC0600-0301	10.0-12.0	09APR95	Soil	Environmental	2,800.0 lt	400.0
CAFB-FAC0600-0302	14.0-16.0	09APR95	Soil	Environmental	3,500.0 lt	400.0
CAFB-FAC0600-0303		09APR95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC0600-0304	19.0-21.0	09APR95	Soil	Environmental	7.8 ql	4.0
CAFB-FAC0600-0401	10.0-12.0	09APR95	Soil	Environmental	4.1 ql	4.0

FACILITY 600 (BASE SUPPORT CENTER / OPERATION GROUP)

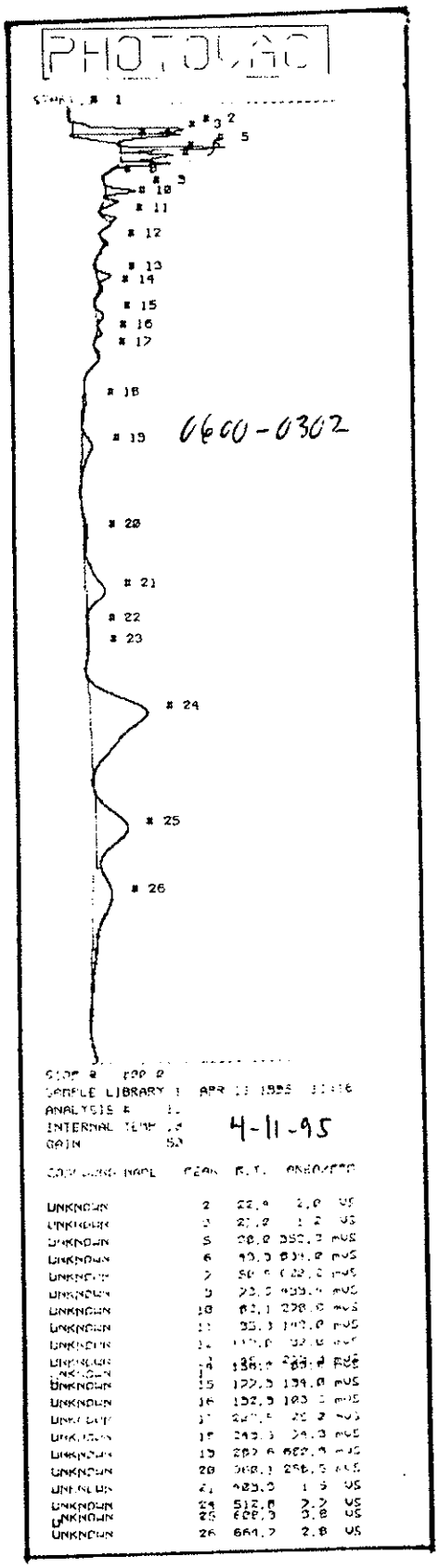
Table 4.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 600, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28. This sample has GC/FID characteristics that are similar to Fuel Oil #2 (for detail, see projects 041450, 043171, and 044268 in Appendix); q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC0600-0402	14.0-16.0	09APR95	Soil	Environmental	2.9 j	4.0
CAFB-FAC0600-0403	18.0-20.0	09APR95	Soil	Environmental	3.8 j	4.0
CAFB-FAC0600-0501	10.0-12.0	09APR95	Soil	Environmental	820.0 qlt	80.0
CAFB-FAC0600-0502	14.0-16.0	09APR95	Soil	Environmental	14.0 ql	4.0
CAFB-FAC0600-0503	19.0-21.0	09APR95	Soil	Environmental	7.6 ql	4.0
CAFB-FAC0600-0601	14.0-16.0	27JUN95	Soil	Environmental	13.0 ql	4.0
CAFB-FAC0600-0602	19.0-21.0	27JUN95	Soil	Environmental	6.5 ql	4.0
CAFB-FAC0600-0701	14.0-16.0	27JUN95	Soil	Environmental	18.0 ql	4.0
CAFB-FAC0600-0702	19.0-21.0	27JUN95	Soil	Environmental	7.4 ql	4.0
CAFB-FAC0600-0801		23AUG95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC0600-0802	15.0-16.0	23AUG95	Soil	Environmental	ND	4.0

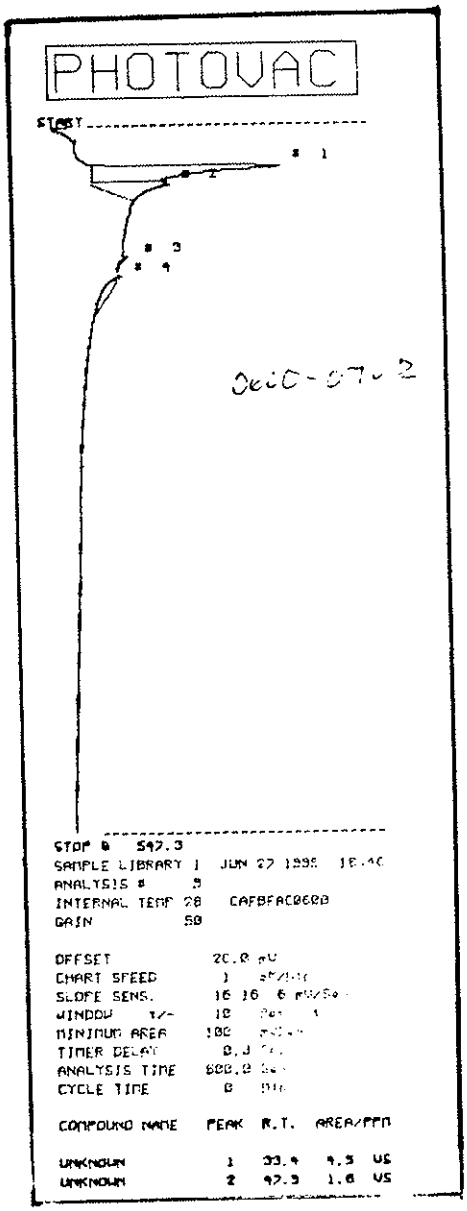
4.4.1 Gas Chromatograms -- Facility 600



CAFB-FAC0600-0104



CAFB-FAC0600-0302



CAFB-FAC0600-0702

4.5 FACILITY 3060

4.5.1 Site Description

There were two 500 gallon Underground Storage Tanks (UST's), containing diesel fuel at Facility 3060. This fuel was required for an emergency generator, which is inside a shed located southeast of the Environmental Management Building on Cannon AFB (Fig 2.1.1). The tanks were constructed of fiberglass and the base of the tanks were approximately nine feet below land suface.

In December 1994 and January 1995 a private contractor collected eight soil samples during the excavation of the two USTs. The samples were taken at the four corners of each tank, and two feet below the base of the tanks. It is assumed from information provided by Cannon AFB Environmental Management that the western tank was Tank 1(A) and eastern tank was Tank 2(B). The results from the soil samples indicates that Tank 1 samples were all below reporting limits. However, Tank 2 samples were all above reporting limits of "Total Recoverable Petroleum Hydrocarbons (TRPHC) concentrations. The TRPHC concentrations ranged from 118.9 ppm to 1,782 ppm.

4.5.2 USGS Investigation

On April 11, 1995 with the use of a Geoprobe, seven boreholes were advanced, collecting nine environmental samples, ranging in depth from 9 to 16 feet (Fig. 4.5.1 and Table 4.5.1). The purpose of these samples were to validate the results from soil samples taken during the removal of Tank 2.

The results from the field screening indicated only a low concentrations of contamination (G.C. 4.5.1), however, lab anaylsis (DRO method) confirmed that high levels of contamination existed in two of the boreholes (Table 4.5.1).

The investigation with the Geoprobe resumed on June 28, this was to determine the lateral extent of the contamination. This phase of sampling was inconclusive, and it appeared that the contamination was moving northward. A Mobile Drill B53 was used July 25 to confirm that the furthest extent of the downward migration of contamination was within exceptable concentration limits. The completion of the investigation was accomplished August 23 with the Geoprobe, when the northern extent of the lateral migration was identified (Fig. 4.5.1 and Table 4.5.1).

A comprehensive site assessment determined that the contamination's lateral migration has been confined just north of the excavated area, and the extent of it's vertical migration will not impact the groundwater.

4.5.3 Recommendations

Remedial method for this facility should be Natural Attenuation/ Assimilation. However, the New Mexico Environmental Department's Underground Storage Tank Regulations, Section 1209 -- Treatment of Highly Contaminated Soils suggest that a Corrective Action System should be implemented, specifically soil excavation and/ or enhanced soil venting.

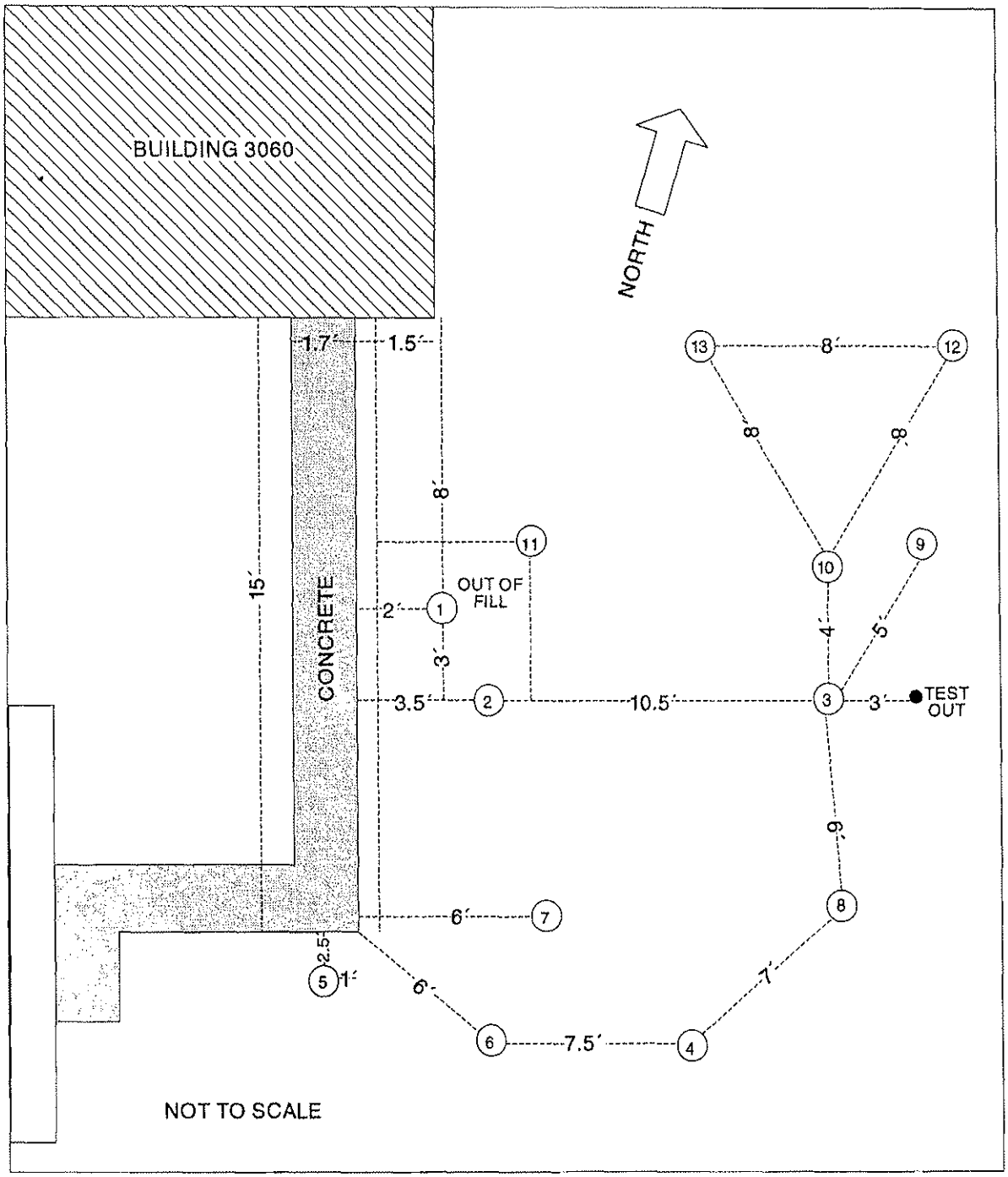


Figure 4.5.1--Location of boreholes at Facility 3060 (generator shed).

FACILITY 3060 (GENERATOR SHED)

Table 5.--Summary of analytical data results in soil samples from underground tank site Facility 3060, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28. Sample has GC/FID characteristics that are similar to fuel #2 (for detail, see projects 041519, 043171, 043723, and 044301 in Appendix); q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]

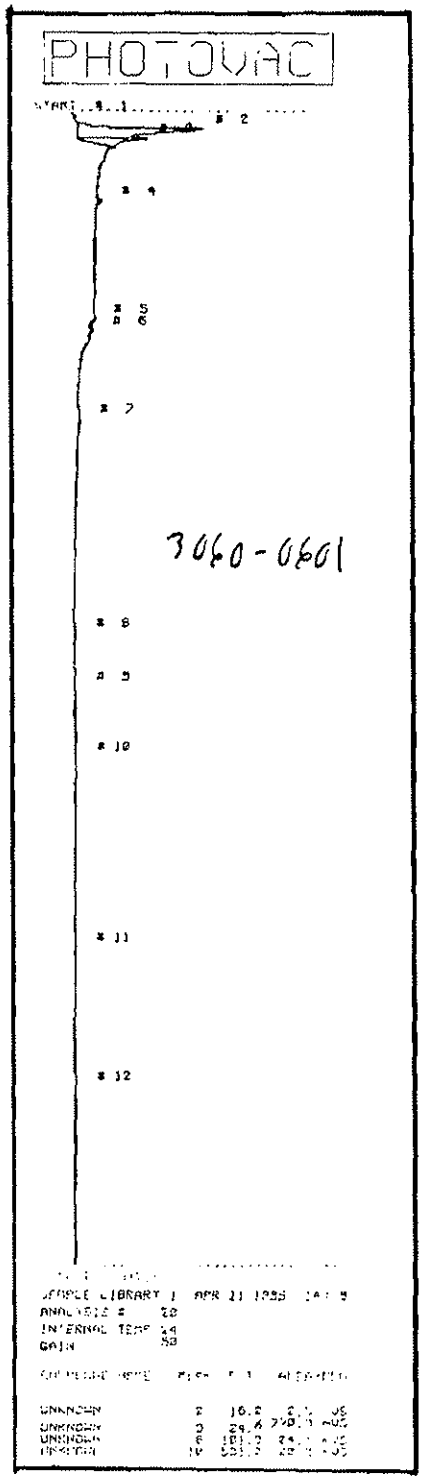
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil- mg/kg; Aqueous- Mg/L	Reporting Limit
CAFB-FAC3060-0101	9.0-11.0	11APR95	Soil	Environmental (Field screening only)	ND	
CAFB-FAC3060-0201	9.0-11.0	11APR95	Soil	Environmental	1,300.0 tl	40.0
CAFB-FAC3060-0202	14.0-16.0	11APR95	Soil	Environmental	8.7 ql	4.0
CAFB-FAC3060-0301	9.0-11.0	11APR95	Soil	Environmental	5,300.0 tl	400.0
CAFB-FAC3060-0302	14.0-16.0	11APR95	Soil	Environmental	23.0 l	4.0
CAFB-FAC3060-0303	24.0	25JUL95	Soil	Environmental	78.0 l	4.0
CAFB-FAC3060-0304EB		25JUL95	Aqueous	Equipment blank	0.47 ql	0.10
CAFB-FAC3060-0401	9.0-11.0	11APR95	Soil	Environmental	4.3 ql	4.0
CAFB-FAC3060-0501	9.0-11.0	11APR95	Soil	Environmental	3.2 j	4.0
CAFB-FAC3060-0601	9.0-11.0	11APR95	Soil	Environmental	37.0 l	4.0
CAFB-FAC3060-0701	9.0-10.0	11APR95	Soil	Environmental (Field screening only)	ND	

FACILITY 3060 (GENERATOR SHED)

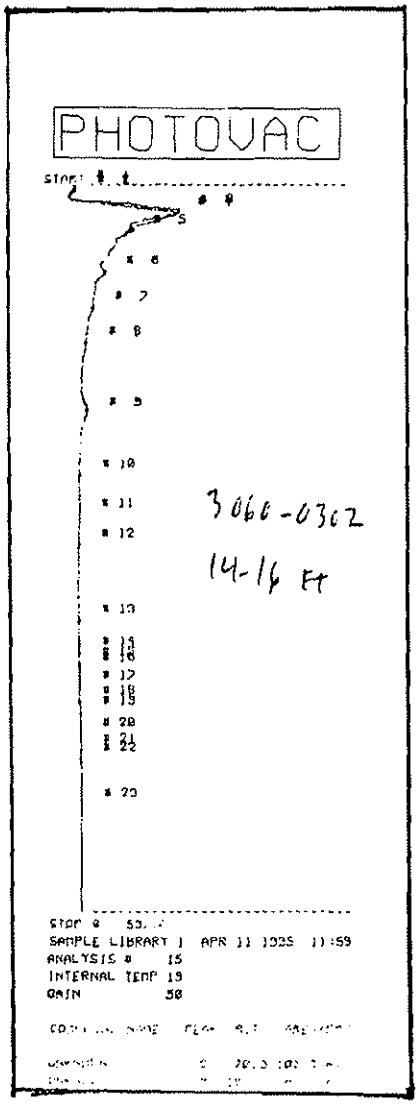
Table 5.--Summary of analytical data results in soil samples from underground tank site Facility 3060, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28. Sample has GC/FID characteristics that are similar to fuel #2 (for detail, see projects 041519, 043171, 043723, and 044301 in Appendix); q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil- mg/kg; Aqueous- Mg/L	Reporting Limit
CAFB-FAC3060-0801	10.0-12.0	28JUN95	Soil	Environmental	15.0 ql	4.0
CAFB-FAC3060-0901	9.0-11.0	28JUN95	Soil	Environmental	40.0 ql	4.0
CAFB-FAC3060-1001	11.0-13.0	28JUN95	Soil	Environmental	160.0 ql	4.0
CAFB-FAC3060-1101	10.0-12.0	28JUN95	Soil	Environmental	22.0 ql	4.0
CAFB-FAC3060-1201	12.0-14.0	23AUG95	Soil	Environmental	ND	4.0
CAFB-FAC3060-1301	11.0-13.0	23AUG95	Soil	Environmental	ND	4.0
CAFB-FAC3060-1302	11.0-13.0	23AUG95	Soil	Duplicate	ND	4.0

4.5.1 Gas Chromatograms -- Facility 3060



CAFB-FAC3060-0601



CAFB-FAC3060-0302

4.6 FACILITY 1400

4.6.1 Site Description

The Underground Storage Tank (UST) at Facility 1400 had a capacity of 25,000 gallons and contained diesel fuel, required to operate an emergency generator at the Cannon Air Force Base Hospital (Fig. 2.1.1). The UST has been decommissioned and prepared for abandonment in place. The tank is constructed of steel and the base of the tank is approximately eighteen feet below land surface.

A private contractor in September 1994 collected four soil samples around the abandoned UST, samples were taken between 18 and 20 feet. The soil sample collected on the northwest side of the UST had above reporting limit of "Total Recoverable Petroleum Hydrocarbons (TRPH)", the concentration of TRPH was 8,200 ppm.

4.6.2 USGS Investigation

On April 12 and 14, 1995, with the use of a Geoprobe, six boreholes were advanced, collecting ten environmental samples (Fig. 4.6.1 and Table 4.6.1). The pupose of these samples was to validate the existence of contamination that was discovered in the original samples collected in September 1994.

The results from field screening indicated high concentrations of contamination (G.C. 4.6.1) and the laboratory anaylsis confirmed that high concentrations of contamination existed on all sides of the abandoned UST with the exception of the southwest corner (Table 4.6.1).

Due to the location, lithology of subsurface soils, and the wide spread migration of contamination at Facility 1400, a combination of drilling equipment was used.

Geoprobe - July 2, 1995 and December 12, 1995.
Mobile Drill B53 auger drilling rig - August 26, 27, 28, 1995.
Gardner-Denver 17W rotary drilling rig - December 14, 1995.

It was also determined that one deep borehole would be significant to identify the extent of the downward migration, due to the close proximity of the other contaminated boreholes

A comprehensive site assessment determined that the lateral and downward migration of contamination has been confined. Northwest and western movement of the contamination has been confined to the middle of the hospital's paved road. North and eastern confinement area is within a few feet of the UST (Fig. 4.6.1). The downward extent of the contamination was determined in Borehole #3, soil samples collected at 83 and 92 feet had "not detected" contamination levels. This suggest that the vertical extent of the contamination will not impact the growndwater.

4.6.3 Recommendations

Remedial method for this facility should be Natural Attenuation/ Assimilation. However, the New Mexico Environmental Department's Underground Storage Tank Regulations, Section 1209 -- Treatment of Highly Contaminated Soils suggest that a Corrective Action System should be implemented, specifically soil excavation and/ or enhanced soil venting.

4.6.4 Soil Boring Description - Facility 1400

A general description of the subsurface soil (0-20 feet) on Cannon Air Force Base can be found in Section 3.3.1 of this text.

Lithology below twenty feet is described as follows:

20-21 ft. pinkish gray caliche layer.
21-26 ft. light-brown sand, vfg, slightly indurated with pinkish gray caliche nodules.
26-34 ft. light brown sandy-silt, vfg, mixed with pinkish gray caliche nodules.
34-40 ft. light-brown silty-sand, unconsolidated, vfg.
40-46 ft. light-brown sandy-silt to sandy-clay, vfg, caliche layer at 46 ft.
46-51 ft. light-brown silty-sand, vfg.
51-80 ft. light-brown sand, vfg-mg.
80-92 ft. light brown cemented silty-sand, vfg-fg.

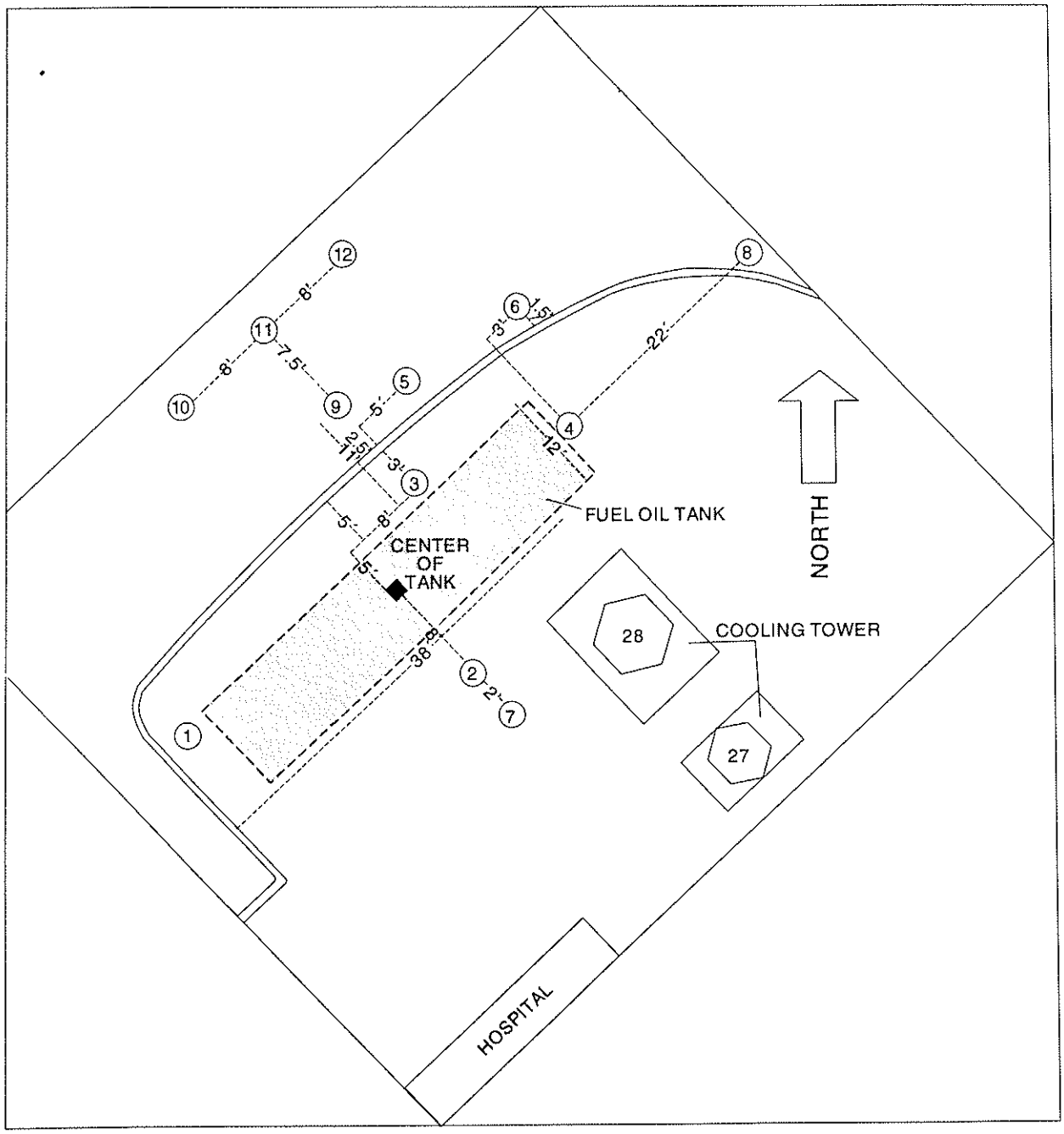


Figure 4.6.1--Location of boreholes at Facility 1400 (Hospital).

FACILITY 1400 (HOSPITAL)

Table 6.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 1400, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041519, 041554, 043197, 044320, and 046431 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC1400-0101	14.0-16.0	12APR95	Soil	Environmental (Field screening only)	ND	
CAFB-FAC1400-0102	16.0-18.0	12APR95	Soil	Environmental	51.0 tql	8.0
CAFB-FAC1400-0201	18.0-20.0	12APR95	Soil	Environmental	6,200.0 tl	400.0
CAFB-FAC1400-0301	18.0-20.0	12APR95	Soil	Environmental	9,900.0 tl	400.0
CAFB-FAC1400-0302	22.0-24.0	12APR95	Soil	Environmental	370.0 tl	8.0
CAFB-FAC1400-0302	36.0-37.0	28AUG95	Soil	Environmental	8,000.0 lt	400.0
CAFB-FAC1400-0303	36.0-37.0	28AUG95	Soil	Duplicate	8,000.0 lt	400.0
CAFB-FAC1400-0304	49.5-50.5	28AUG95	Soil	Environmental	11,000.0 lt	400.0
CAFB-FAC1400-0305	65.0-66.0	28AUG95	Soil	Environmental	5,800.0 lt	400.0
CAFB-FAC1400-0306	75.0	14DEC95	Soil	Environmental	9,300.0 tl	400.0
CAFB-FAC1400-0307	83.0	14DEC95	Soil	Environmental	ND	4.0
CAFB-FAC1400-0308	91.0-92.0	14DEC95	Soil	Environmental	ND	0.1

FACILITY 1400 (HOSPITAL)

Table 6.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 1400, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041519, 041554, 043197, 044320, and 046431 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

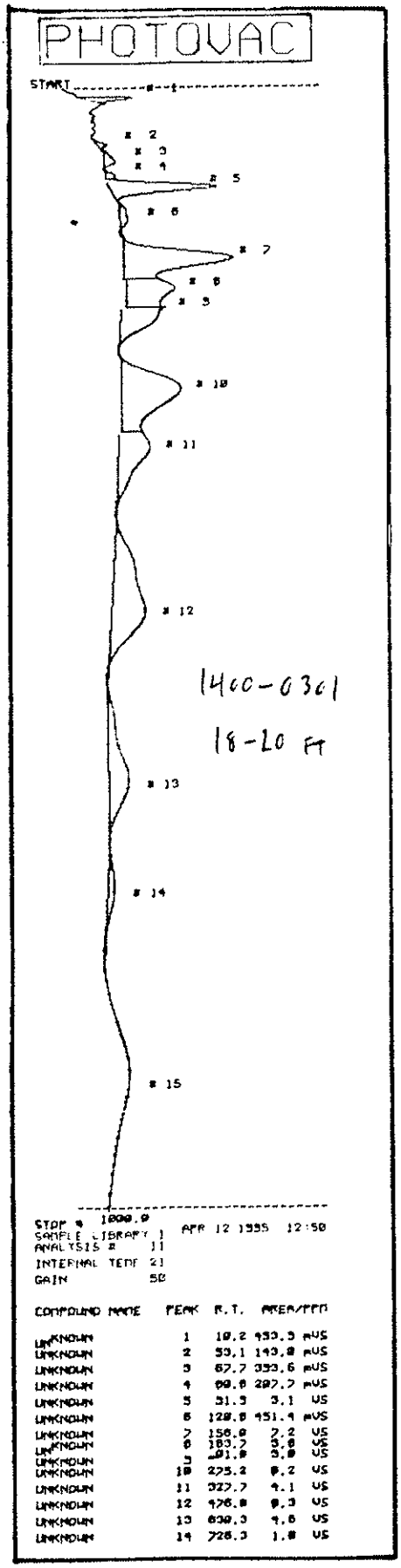
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC1400-0401	17.0-19.0	12APR95	Soil	Environmental	16.0 ql	4.0
CAFB-FAC1400-0402	20.0-22.0	12APR95	Soil	Environmental	2,500.0 tl	80.0
CAFB-FAC1400-0403		12APR95	Aqueous	Equipment blank	ND	0.10
CAFB-FAC1400-0501	10	14APR95	Soil	Environmental (Field screening only)	ND	
CAFB-FAC1400-0601	9.5-11.5	14APR95	Soil	Environmental (Field screening only)	ND	
CAFB-FAC1400-0602	20.0-22.0	14APR95	Soil	Environmental	5.2 ql	4.0
CAFB-FAC1400-0701	19.0-20.0	02JUL95	Soil	Environmental	20.0 ql	4.0
CAFB-FAC1400-0702EB		02JUL95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC1400-0801	25.0-26.0	26AUG95	Soil	Environmental	ND	4.0
CAFB-FAC1400-0901EB		27AUG95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC1400-0902	25.0-26.0	27AUG95	Soil	Environmental	890.0 qlt	16.0
CAFB-FAC1400-1001	23.0-25.0	12DEC95	Soil	Environmental	ND	4.0
CAFB-FAC1400-1101	22.0-24.0	12DEC95	Soil	Environmental	ND	4.0

FACILITY 1400 (HOSPITAL)

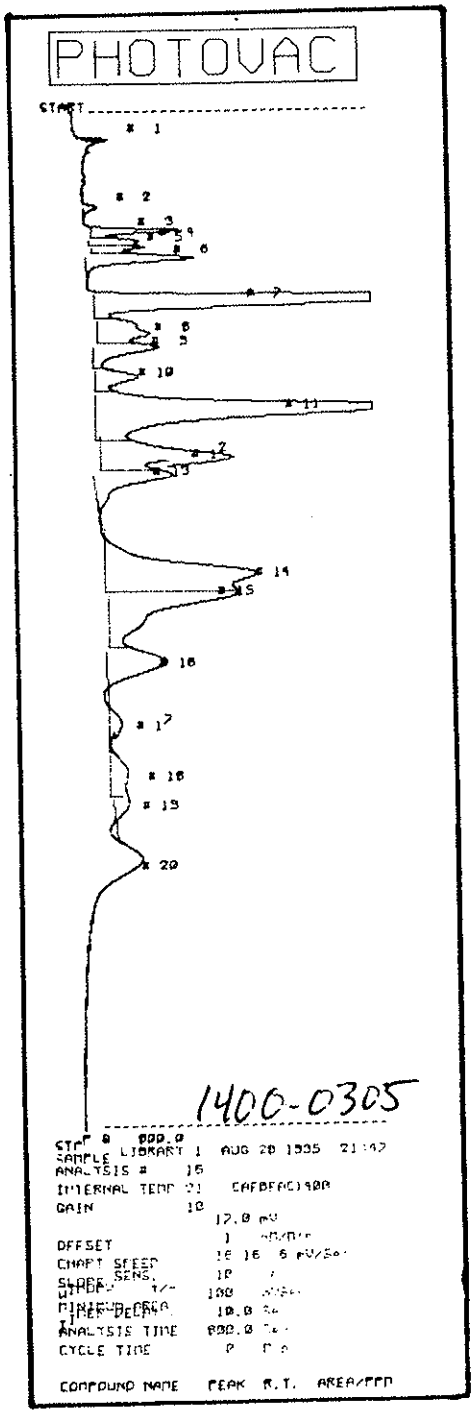
Table 6.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 1400, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041519, 041554, 043197, 044320, and 046431 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC1400-1201	24.0-26.0	12DEC95	Soil	Environmental	16.0 ql	4.0

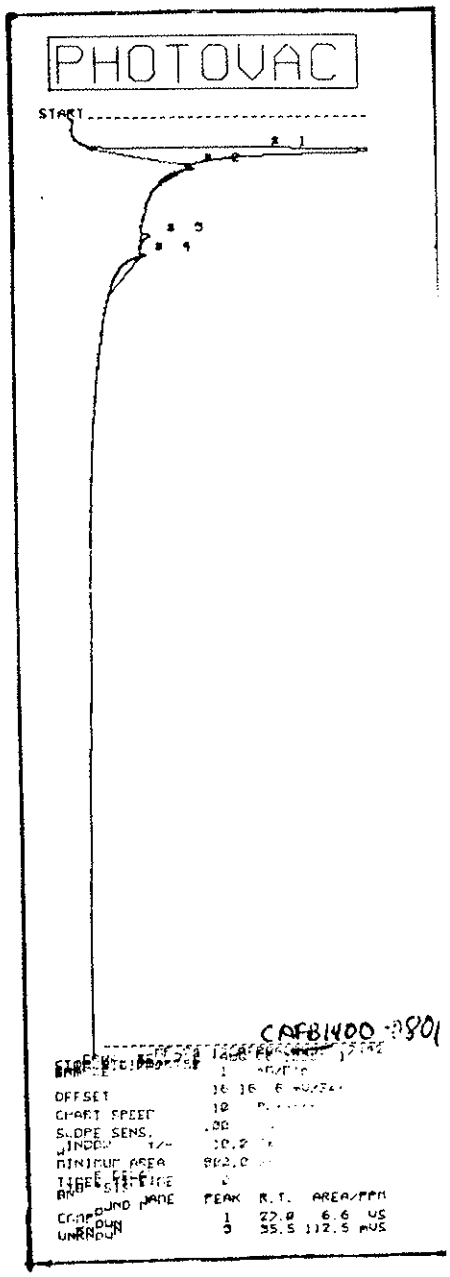
4.6.1 Gas Chromatograms -- Facility 1400



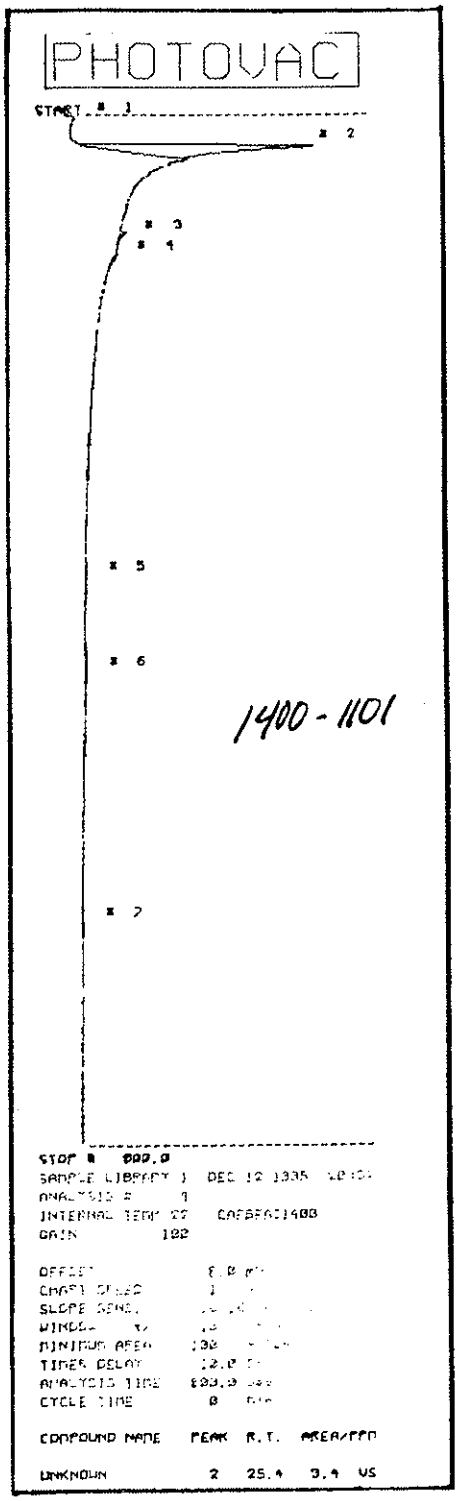
CAFB-FAC1400-0301



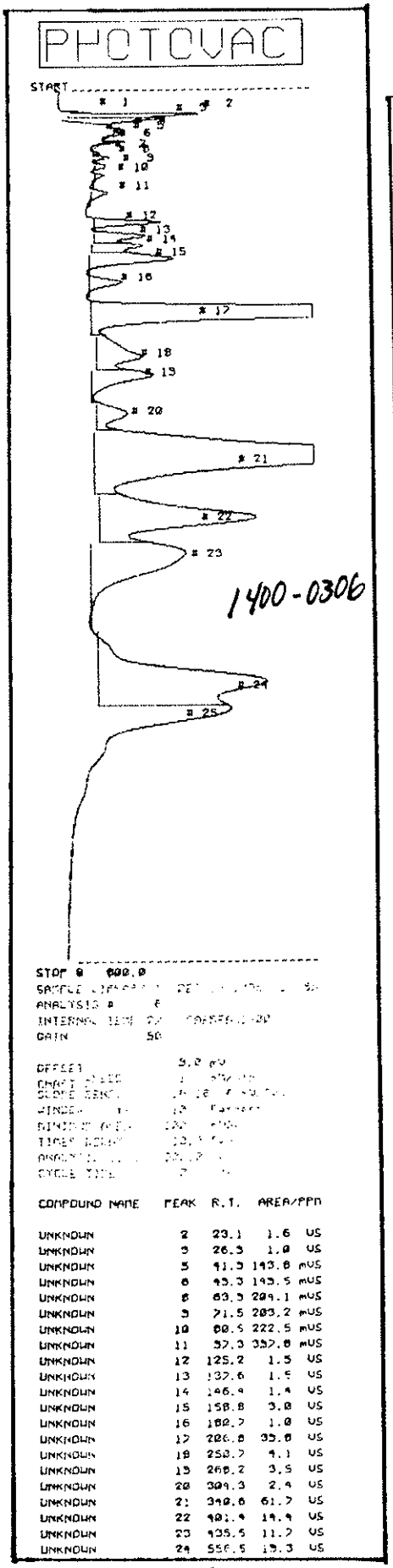
CAFB-FAC1400-0305



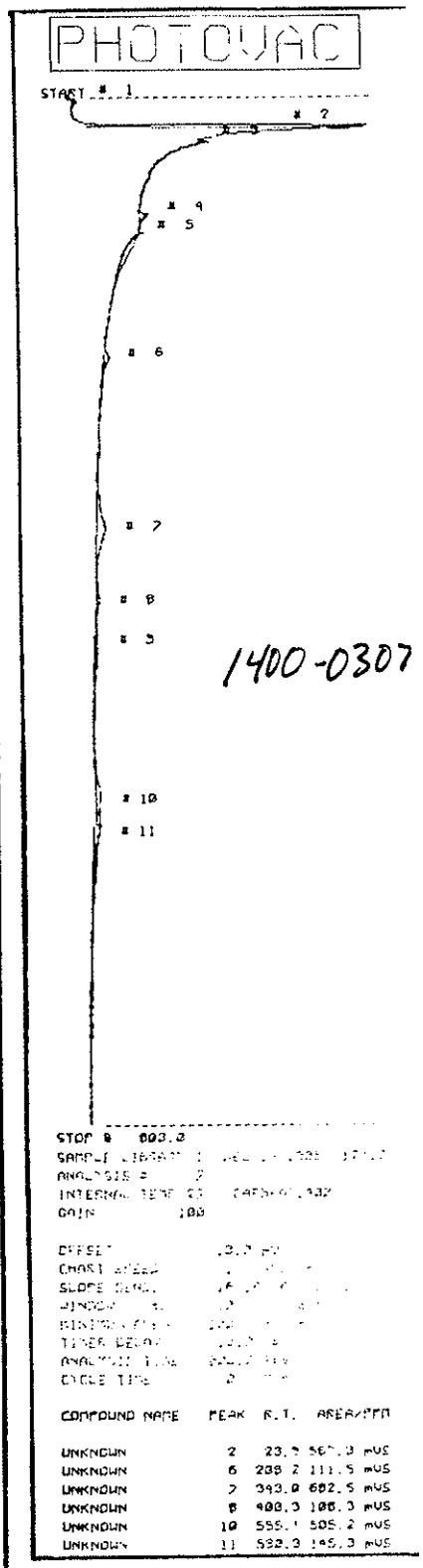
CAFB-FAC1400-0801



CAFB -FAC1400-1101



CAFB-FAC1400-0306



CAFB-FAC1400-0307

4.7 FACILITY 368

4.7.1 Site Description

Facility 368 consisted of three Underground Storage Tanks (USTs), having a capacity of 10,000 gallons each and contained gasoline, which supplied the gasoline pumps at the old gasoline station on Cannon AFB (Fig. 2.1.1). The tanks were constructed of steel and the base of the tanks were approximately twelve feet below land surface.

In July 1995, the gasoline pump islands were added to the field investigation. The gasoline pumps have been removed, leaving two islands areas approximately thirty-six feet in length and six feet wide (Fig. 4.7.2).

In January 1995, a private contractor collected six soil samples during the excavation of the three USTs. The samples were taken at the four corners, and the east and west sides of the excavated area. The samples were also taken at a level two feet below the bottom of the tanks. One sample collected during the excavation had above reporting limits of "Total Recoverable Petroleum Hydrocarbon (TRPHC)" concentrations. The sample taken at the southwest end of the excavation had a concentration of 2,447 ppm TRPHC.

4.7.2 USGS Investigation

On April 13 and 14, with the use of a Geoprobe nine boreholes were advanced, collecting eleven environmental samples, ranging in depth from 10 to 16 feet (Fig. 4.7.1 and Table 4.7.1). The pupose of these samples was to validate the results from soil samples taken during the removal of the tanks.

The results from the field screening indicated no contamination (G.C. 4.7.1), and lab anaylsis (GRO method) confirmed that concentrations were below reporting limits (Table 4.7.1).

NOTE: Initial Gasoline Range Organic (GRO) sampling April 13 & 14 were performed following NMUST Regulations Part II Section 1209(D). However, NMED revised this section in March 1995, by adopting the Methanol Extraction Method. The U.S. Geological Survey was informed of this revision April 21. Two of the borehole samples collected April 13 were resampled July 1 using the Methanol Extration Method (These samples are distinguished by the field ID being followed by an M). This allowed a comparison of the two different lab anaylize for GRO, qualifying the initial set of samples. As of July 1, 1995 all GRO sampling was collected and analyized by using the Methanol Extration Method.

On July 1 and 2, the pump island investigation, with the Geoprobe was initiated. Eight boreholes were advanced collecting nine environmental samples (Fig. 4.7.2). The purpose of these samples were to determine if the recently removed gasoline pumps had leaked.

Intially four boreholes were advanced at each end of the excavated pump islands, collecting one sample per borehole. Field screening indicated high concentrations of contamination in Borehole #10 (G.C. 4.7.1 and Table 4.7.1). To determine lateral migration an additional of four boreholes were advanced encompassing Borehole #10, one sample was collected from each borehole (Fig. 4.7.2). The results from field screening indicated no lateral migration. Lab anaylsis confirmed the high concentrations of contamination in Borehole #10, and also confirmed no to low concentrations in the encompassing boreholes (Table 4.7.1).

To determine the extent of downward migration of the contamination at Borehole #10, a Mobile Drill B53 auger drill rig was used August 25 and 26. At 52 feet the concentration of the contamination was below reporting limits.

A comprehensive site assessment determined that contamination levels at the excavation area are below reporting limits, and the extent of downward migration at the pump island (Borehole #10) will not impact the groundwater.

4.7.3 Recommendations

No further investigation should be required for the excavated area at this facility. Remedial method for the pump island (Borehole #10) should follow New Mexico Environmental Department's Underground Storage Regulation, Section 1209 -- Treatment of Highly Contaminated Soils, specifically, enhanced soil venting.

4.7.4 Soil Boring Description - Facility 368

A general description of the subsurface soil (0-20 feet) on Cannon Air Force Base can be found in Section 3.3.1 of this text.

Lithology below twenty feet is described as follows:

20-23 ft. the soil consisted of reddish-brown sandy silt, vfg-fg, with pinkish gray caliche nodules.
23-24 ft. dark brown silty-clay with a few pinkish gray caliche nodules.
24-26 ft. light-brown sand, vfg, slightly indurated with pinkish gray caliche.
26-39 ft. light-brown silty-sand, vfg.
39-41 ft. caliche cemented sand, vfg, pinkish gray.
41-49 ft. light-brown sand ,vfg, mixed with pinkish gray caliche and cemented sand.
49-52 ft. light-brown silty-sand, unconsolidated, vfg-fg.

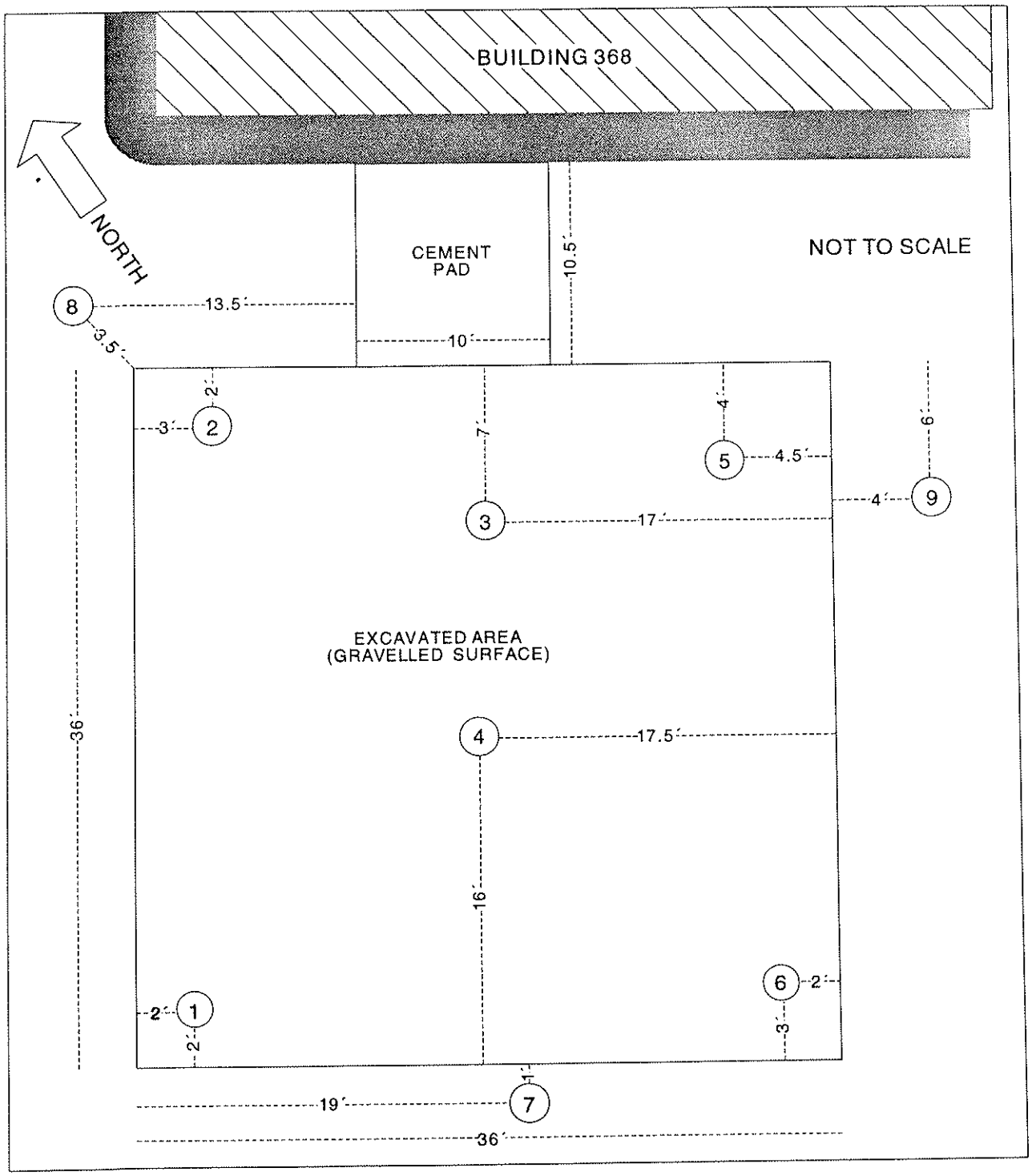


Figure 4.7.1--Location of boreholes at Facility 368 (old gas station).

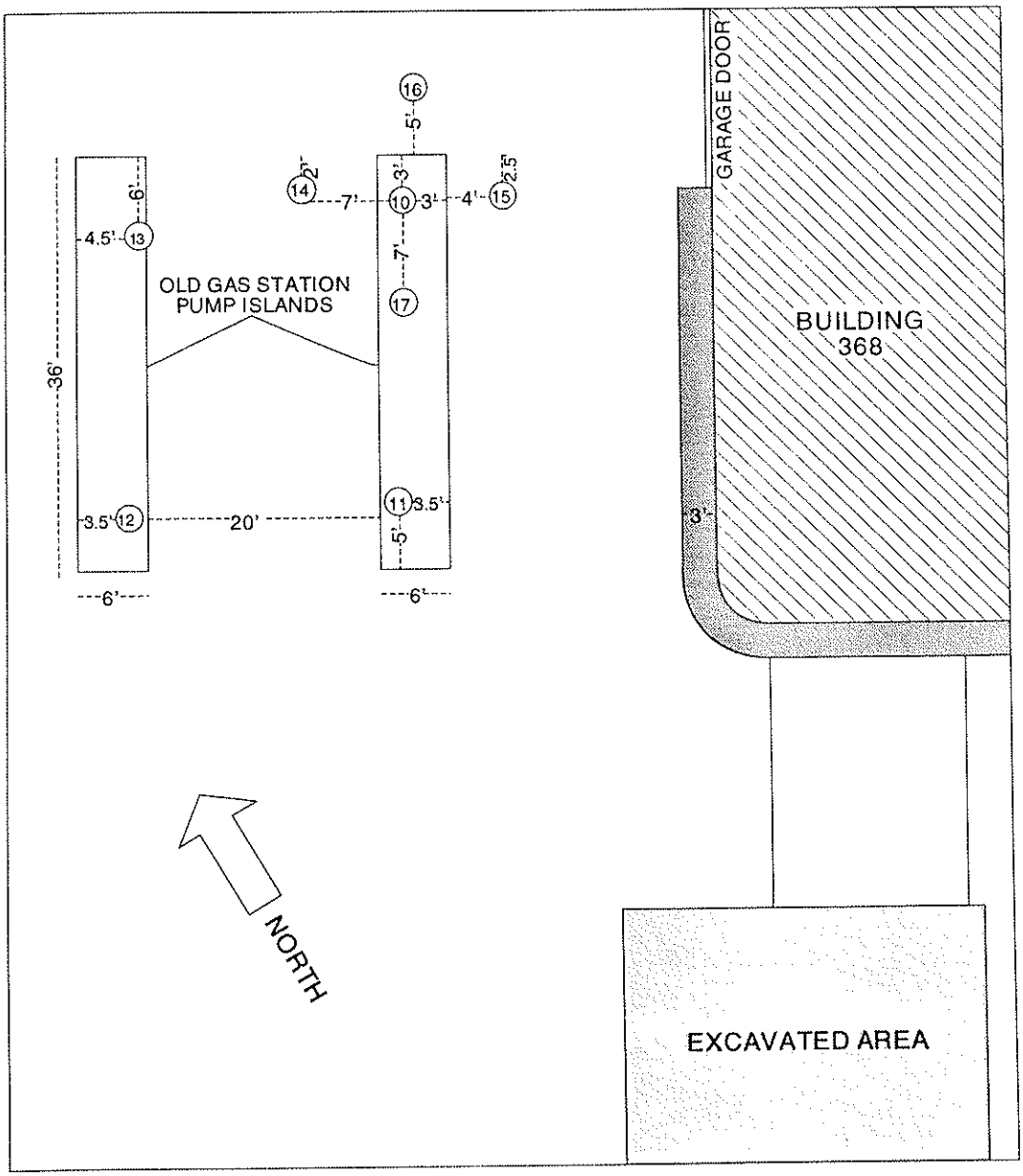


Figure 4.7.2--Location of boreholes at Facility 368 (pump island).

FACILITY 368 (OLD GAS STATION)

Table 7.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 368, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; GRO, Gasoline range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26 (for detail, see project 041554, 043197, and 044268 in Appendix); m, This sample has GC/FID characteristics that are similar to weathered gasoline; ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.]

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg, Aqueous-ug/L	SW8015 (GRO),Soil-mg/kg, Aqueous-ug/L	Reporting Limit
CAFB-FAC0368-0101	10.0-12.0	13APR95	Soil	Environmental		0.57 q	0.5
CAFB-FAC0368-0102	13.0-15.0	13APR95	Soil	Environmental		0.44 qj	0.5
CAFB-FAC0368-0102M	13.0-15.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-0201	10.0-12.0	13APR95	Soil	Environmental		0.27 qj	0.5
CAFB-FAC0368-0202	14.0-16.0	13APR95	Soil	Environmental		ND	0.5
CAFB-FAC0368-0301	12.0-14.0	13APR95	Soil	Environmental		ND	0.5
CAFB-FAC0368-0401	11.0-13.0	13APR95	Soil	Environmental		0.25 qj	0.5
CAFB-FAC0368-0501	10.0-11.0	13APR95	Soil	Environmental		0.57 q	0.5
CAFB-FAC0368-0601	12.0-14.0	13APR95	Soil	Environmental		ND	0.5
CAFB-FAC0368-0601M	12.0-14.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-0602		13APR95	Aqueous	Equipment blank		ND	10.0
CAFB-FAC0368-0701	13.0-15.0	14APR95	Soil	Environmental		ND	0.5

FACILITY 368 (OLD GAS STATION)

Table 7.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 368, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; GRO, Gasoline range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26 (for detail, see project 041554, 043197, and 044268 in Appendix); m, This sample has GC/FID characteristics that are similar to weathered gasoline; ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.]--Continued

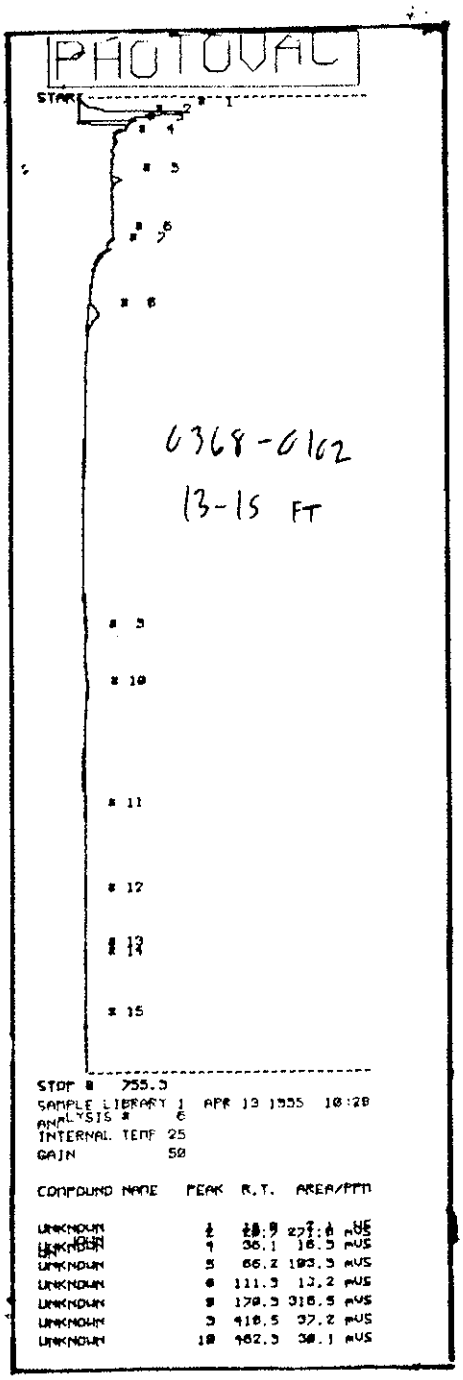
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg, Aqueous-ug/L	SW8015 (GRO),Soil-mg/kg, Aqueous-ug/L	Reporting Limit
CAFB-FAC0368-0801	10.0	14APR95	Soil	Environmental (Field Screening only)		ND	
CAFB-FAC0368-0901	10.0	14APR95	Soil	Environmental (Field screening only)		ND	
CAFB-FAC0368-1001	12.0-14.0	01JUL95	Soil	Environmental		800.0 q	100.0
CAFB-FAC0368-1001	12.0-14.0	02JUL95	Soil	Environmental	160.0 ql		4.0
CAFB-FAC0368-1002EB		25AUG95	Aqueous	Equipment blank		ND	10.0
CAFB-FAC0368-1003	24.0-25.0	25AUG95	Soil	Environmental		1,000.0 m	50.0
CAFB-FAC0368-1004	24.0-25.0	25AUG95	Soil	Duplicate		830.0 m	40.0
CAFB-FAC0368-1005	35.0-36.0	26AUG95	Soil	Environmental		37.0 q	10.0
CAFB-FAC0368-1006	50.0-52.0	26AUG95	Soil	Environmental		0.97 j	1.0
CAFB-FAC0368-1007TB		26AUG95	Aqueous	Trip blank		ND	1.0
CAFB-FAC0368-1101	10.0-11.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-1201	12.0-14.0	01JUL95	Soil	Environmental		ND	1.0

FACILITY 368 (OLD GAS STATION)

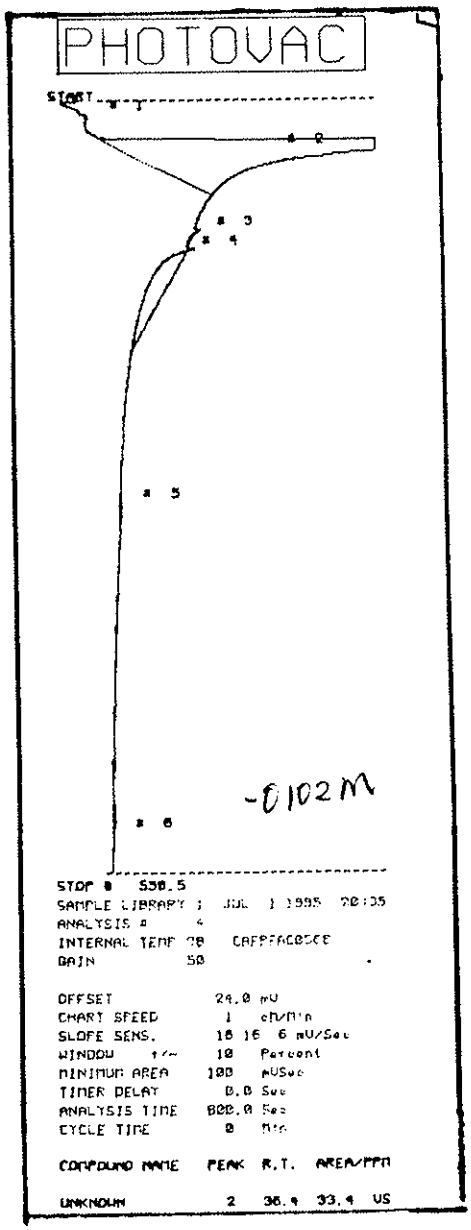
Table 7.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 368, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; GRO, Gasoline range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26 (for detail, see project 041554, 043197, and 044268 in Appendix); m, This sample has GC/FID characteristics that are similar to weathered gasoline; ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.]--Continued

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg, Aqueous-ug/L	SW8015 (GRO),Soil-mg/kg, Aqueous-ug/L	Reporting Limit
CAFB-FAC0368-1301	10.0-11.0	01JUL95	Soil	Environmental		18.0 m	1.0
CAFB-FAC0368-1401	13.0-15.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-1501	12.0-14.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-1601	13.0-15.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-1602		01JUL95	Aqueous	Equipment blank		ND	10.0
CAFB-FAC0368-1701	13.0-15.0	02JUL95	Soil	Environmental	5.1 ql		4.0

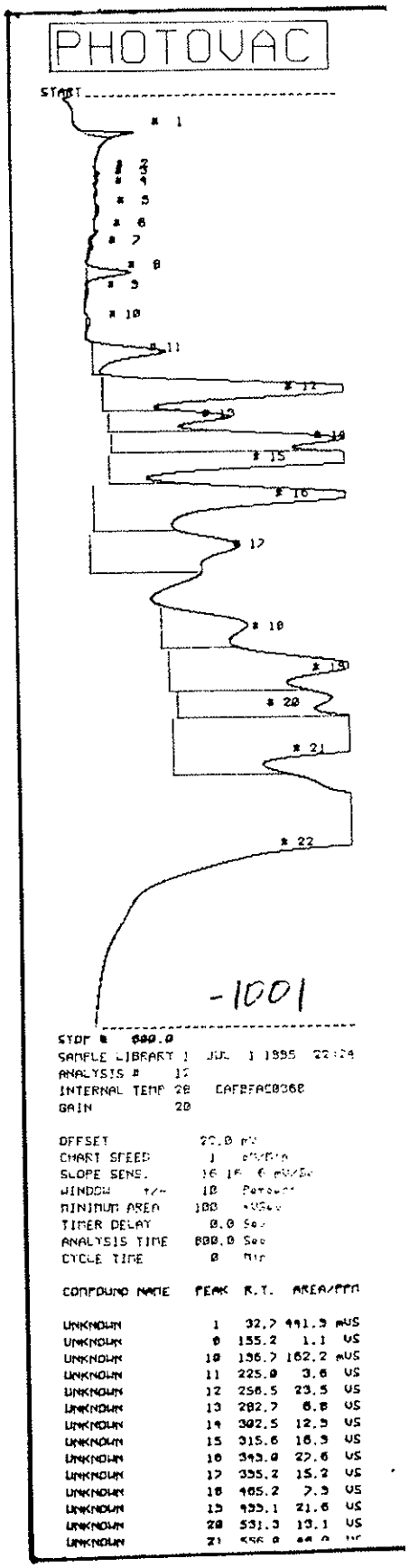
4.7.1 Gas Chromatograms -- Facility 368



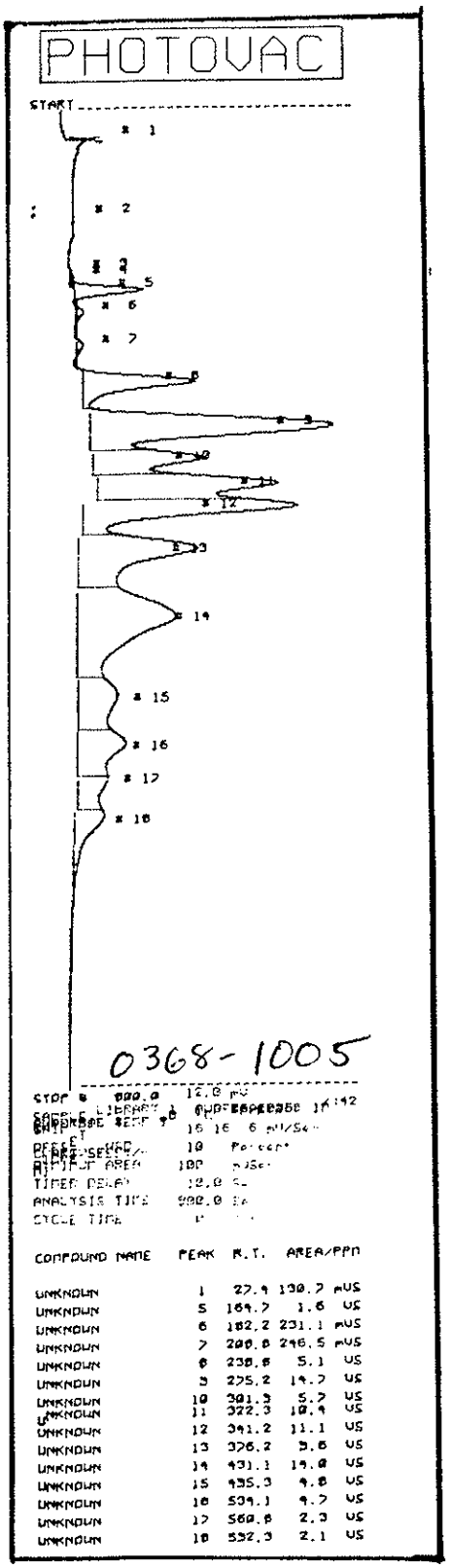
CAFB-FAC0368-0102



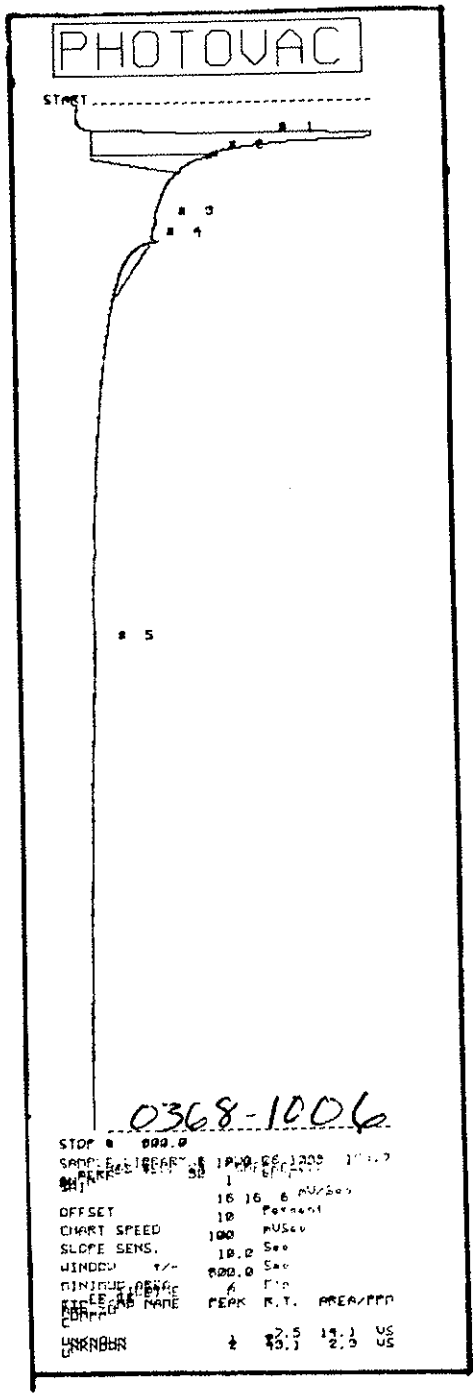
CAFB-FAC0368-0102M



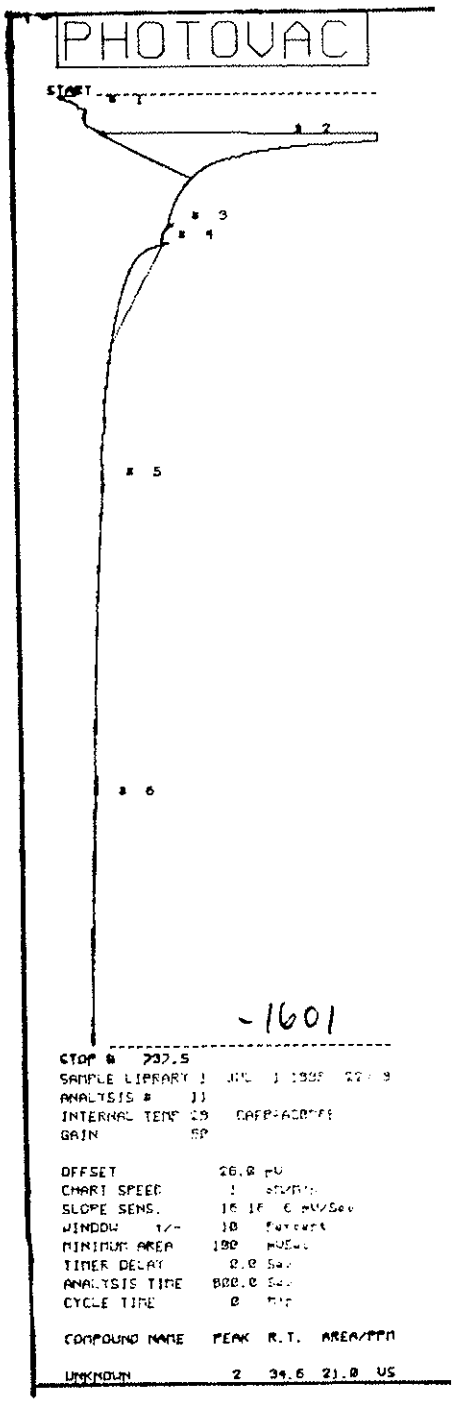
CAFB-FAC0368-1001



CAFB-FAC0368-1005



CAFB-FAC0368-1006



CAFB-FAC0368-1601

4.8 FACILITY 3121

4.8.1 Site Description

The Underground Storage Tank (UST) at Facility 3121 had a capacity of 275 gallons and contained heating oil, which was used for heating the building complex at Melrose Bombing Range. The tank was constructed of steel and the base of tank was approximetly nine feet below land surface.

In November 1994 a private contractor collected four samples during the excavation of the UST. They were taken at each of the four corners of the excavated area. Two of the samples collected during the excavation had above reporting limits of "Total Petroleum Hydrocarbon (TPH)" concentrations. The sample collected at the southeast corner of the excavation had a concentration of 1,850 ppm TPH, and on the northwest corner the concentration was 12,900 ppm TPH.

4.8.2 USGS Investigation

On April 18, 1995, with the use of a Geoprobe, seven boreholes were advanced, collecting eight environmental samples, ranging in depth from 8 to 16 feet (Fig. 4.8.1 and Table 4.8.1). The purpose of these samples were to validate the results from soil samples taken during the removal of the tank.

The results from field screening indicated high concentrations of contamination (G.C. 4.8.1) and the lab anaylses confirmed that high concentrations of contamination existed in all boreholes except for the northern most borehole, Borehole #7 (Table 4.8.1).

A second series of soil samples were collected with the Geoprobe on June 29. These samples were collected to determine the extent of lateral migration. Four boreholes were advanced collecting four environmental samples (Fig. 4.8.1 and Table 4.8.1). The results from Borehole #8 was to determine if the contamination had migrated east, under the Melrose Bombing Range Building Complex. A 30 degree angled borehole was advanced underneath the building, this allowed a sample to be collected at a fifteen foot vertical depth and nine foot horizontal distance. The results from the second series of samples showed only low concentration of contamination, identifing the extent of the lateral migration (Table 4.8.1).

On July 26-27 a Mobile Drill B53 auger rig was used to find the downward extent of the contamination. However, due to mechanical difficulties with the auger rig the results were inconclusive. August 24-25 the auger rig was again used reaching a total depth of 60.5 feet. At this depth the concentrations of contamination were below reporting limits (Table 4.8.1). It was also determined that one deep borehole would be significant to identify the extent of the downward migration, due to the close proximity of the other contaminated boreholes (Fig. 4.8.1).

NOTE: The lab samples collected at 40-41 feet, indicated "no detection" of contamination. At this depth was a large reddish brown clay layer. It is speculated that the contamination found a fracture in the clay allowing it to migrate into the sand below. The next two sample intervals had the same sand composition, indicating the furthest extent of the contamination's downward migration was between 51-60 feet.

After evaluating the data collected, it is difficult to make a complete assessment of the problems that may occur at this facility due to the release of this contamination. Groundwater levels in this area are not well defined. So it must be assumed that there is the possibility that the contamination may impact the groundwater.

4.8.3 Recommendations

Remedial methods for this facility should follow New Mexico Environmental Department's Underground Storage Tank Regulation, Section 1209 -- Treatment of Highly Contaminated Soils should be implemented immediately, specifically enhanced soil venting. However, Section 1210 -- Hydrogeologic Investigation must be addressed.

4.8.4 Soil Description -- Facility 3121

0-3 ft. Moderate-brown silt, lightly compacted with some fine sand and traces of small pepples.
3-7 ft. Light-brown silty sand with caliche and minor pepples, sand vfg-fg.
7-9 ft. Moderate-brown sandy silt, with small amount of clay, sand vfg-fg.
9-11ft. Moderate-reddish brown silty sand with some clay, sand vfg-fg.
11-18 ft. Light-reddish brown clayey silt with sand, slightly compacted due to calcification, sand vfg-fg-mg.
18-24 ft. Silty clay, similar to previous interval.
24-31 ft. Light-brown sandy silt with clay, sand vfg-fg in lower part of this interval, upper part has vfg-mg sand moderately compacted, weakly cemented by calcification.
31-38 ft. Moderate-brown sandy silt mixed equally with silty clay, and few pepples, slightly compacted, sand fg-mg.
38-44 ft. Dark-reddish brown clay, few pinkish gray caliche nodules throughout this interval.
44-47 ft. Dark-brown silty clay, small amount of pepples mixed with vfg-fg sand, few large caliche nodules.
47-50 ft. Yellowish-gray sand vfg-fg, strongly cemented by calcification.
50-60 ft. Light-dark gray sand fg-mg, slightly to moderately cemented by calcification.

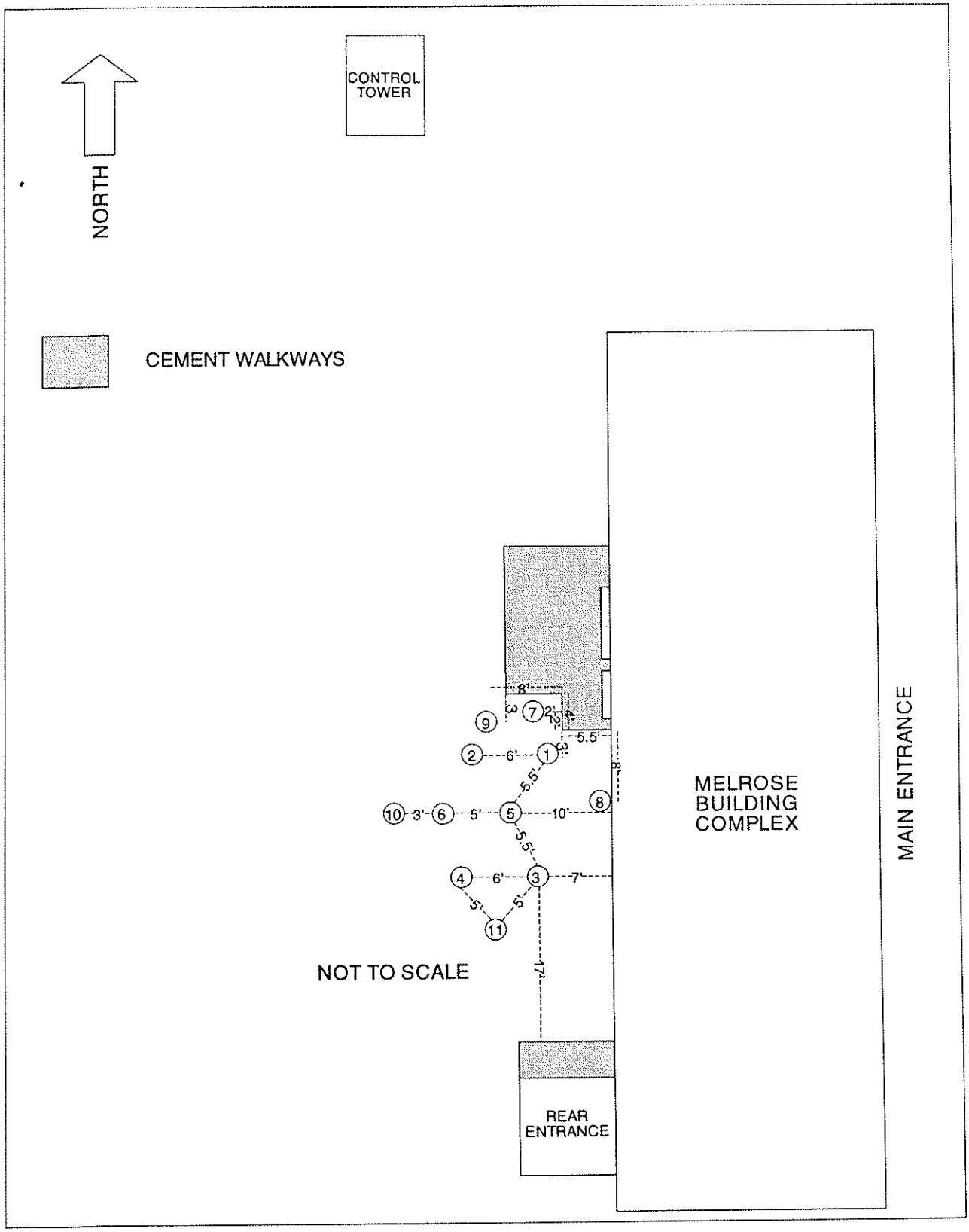


Figure 4.8.1--Location of boreholes at Facility 3121 (Melrose Bombing Range).

FACILITY 3121 (MELROSE BOMBING RANGE)

Table 8.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 3121, Melrose Air Force Range, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041621, 043171, 043723, and 044268 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC3121-0101	8.0-10.0	18APR95	Soil	Environmental	17,000.0 qlt	400.0
CAFB-FAC3121-0102	14.0-16.0	18APR95	Soil	Environmental	5,000.0 lt	400.0
CAFB-FAC3121-0103EB		26JUL95	Aqueous	Equipment blank	0.12 ql	0.1
CAFB-FAC3121-0104	24.0-26.0	26JUL95	Soil	Environmental	13,000.0 tl	400.0
CAFB-FAC3121-0105	29.0-31.0	26JUL95	Soil	Environmental	11,000.0 tl	400.0
CAFB-FAC3121-0106	40.0-41.0	24AUG95	Soil	Environmental	ND	4.0
CAFB-FAC3121-0107	49.5-50.5	24AUG95	Soil	Environmental	9,500.0 lt	400.0
CAFB-FAC3121-0108	59.5-60.5	25AUG95	Soil	Environmental	ND	4.0
CAFB-FAC3121-0201	10.5-12.5	18APR95	Soil	Environmental	3,500.0 qlt	400.0
CAFB-FAC3121-0301	10.0-12.0	18APR95	Soil	Environmental	12,000.0 lt	400.0
CAFB-FAC3121-0302	10.0-12.0	18APR95	Soil	Duplicate	8,800.0 lt	400.0

FACILITY 3121 (MELROSE BOMBING RANGE)

Table 8.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 3121, Melrose Air Force Range, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041621, 043171, 043723, and 044268 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

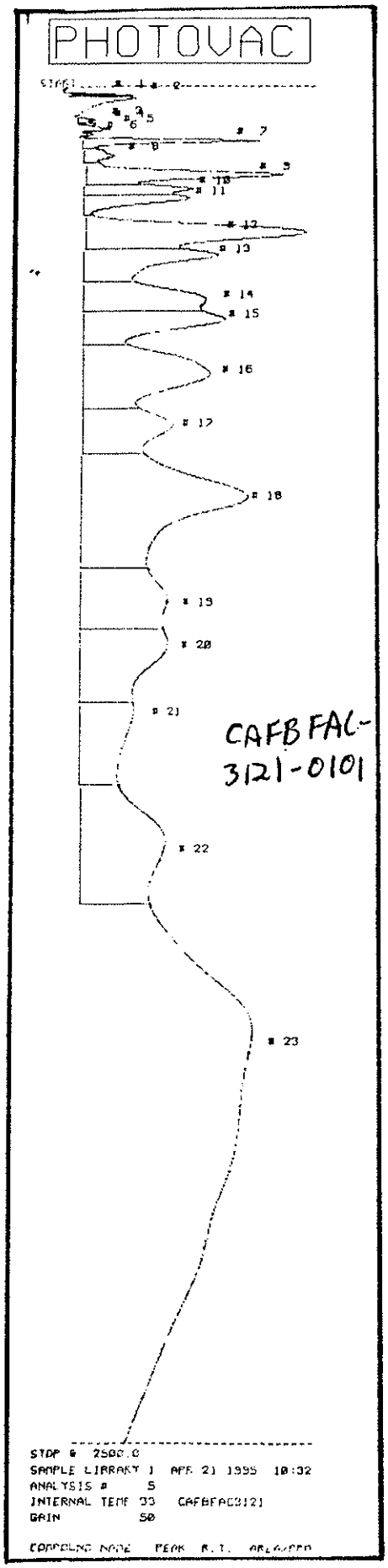
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC3121-0303		27JUL95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC3121-0303	19.0-21.0	27JUL95	Soil	Environmental	25,000.0 tl	400.0
CAFB-FAC3121-0304	29.0-29.5	27JUL95	Soil	Environmental	17,000.0 tl	400.0
CAFB-FAC3121-0401	11.0-13.0	18APR95	Soil	Environmental	10,000.0 lt	400.0
CAFB-FAC3121-0501	11.0-13.0	18APR95	Soil	Environmental	5,900.0 lt	400.0
CAFB-FAC3121-0601	11.0-13.0	18APR95	Soil	Environmental	3,700.0 lt	400.0
CAFB-FAC3121-0701	12.0-14.0	18APR95	Soil	Environmental	3.2 j	4.0
CAFB-FAC3121-0702		18APR95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC3121-0801	15.0	29JUN95	Soil	Environmental	3.7 j	4.0
CAFB-FAC3121-0901	11.0-13.0	29JUN95	Soil	Environmental	7.2 ql	4.0
CAFB-FAC3121-0902	11.0-13.0	29JUN95	Soil	Duplicate	4.2 ql	4.0
CAFB-FAC3121-1001	14.0-16.0	29JUN95	Soil	Environmental	2.5 j	4.0
CAFB-FAC3121-1101	13.0-15.0	29JUN95	Soil	Environmental	8.6 ql	4.0

FACILITY 3121 (MELROSE BOMBING RANGE)

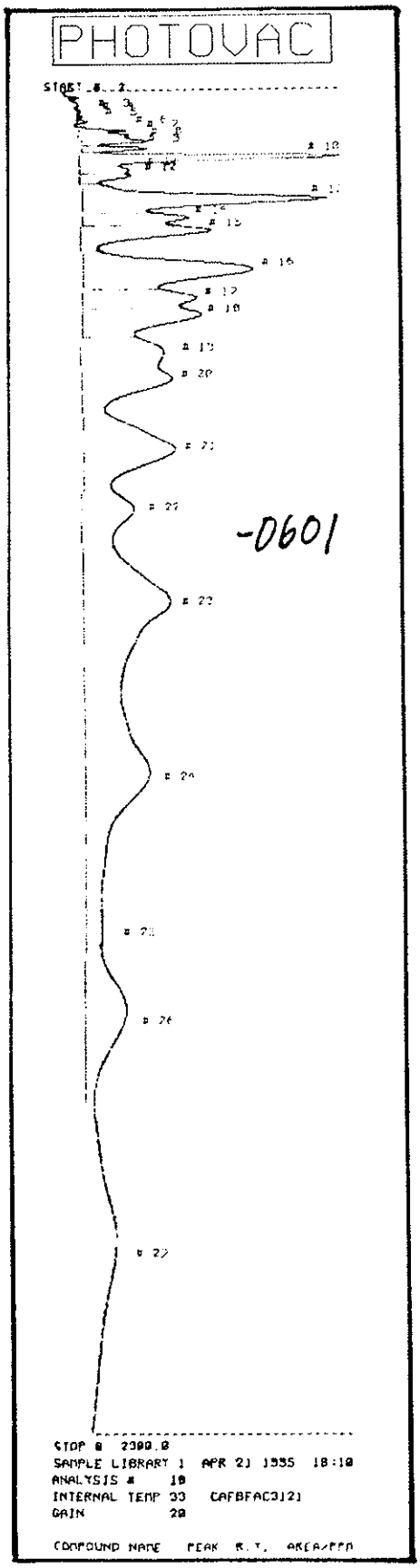
Table 8.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 3121, Melrose Air Force Range, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041621, 043171, 043723, and 044268 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC3121-1102		29JUN95	Aqueous	Equipment blank	ND	0.1

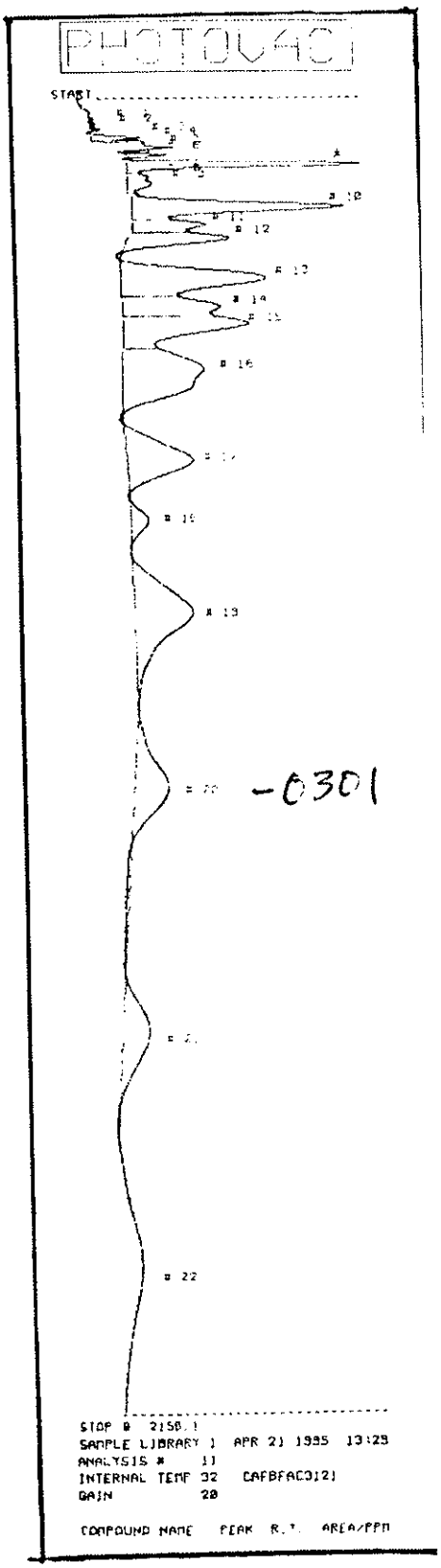
4.8.1 Gas Chromatograms -- Facility 3121



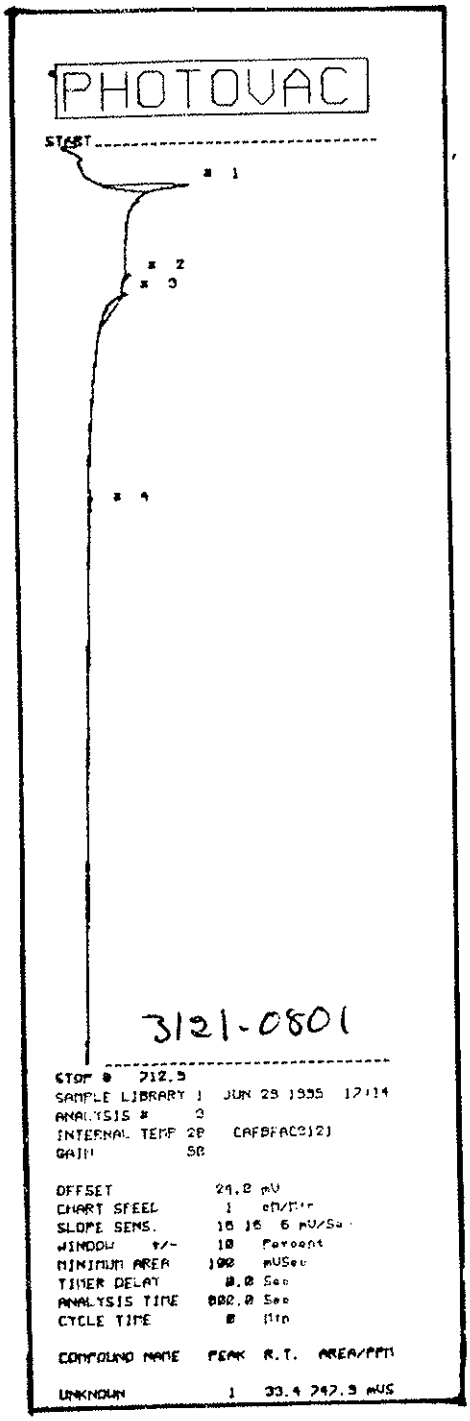
CAFB-FAC3121-0101



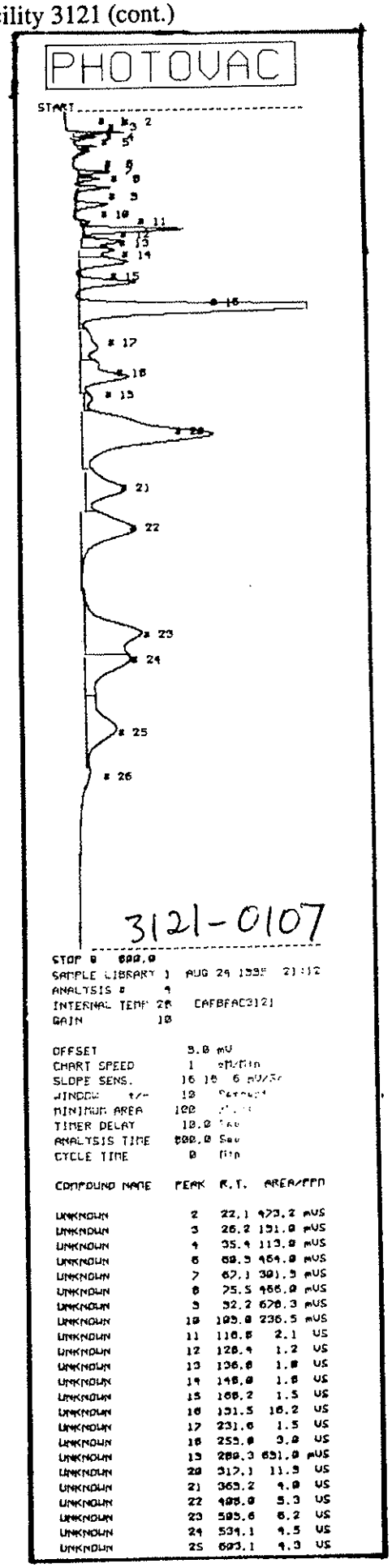
CAFB-FAC3121-0601



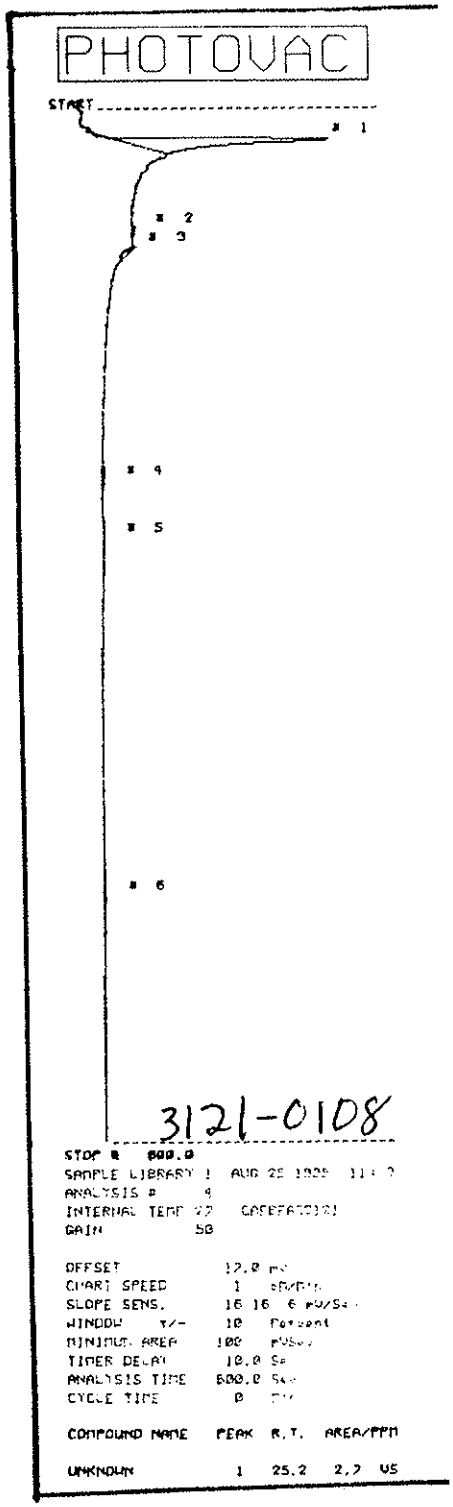
CAFB-FAC3121-0301



CAFB-FAC3121-0801



CAFB-FAC3121-0107



CAFB-FAC3121-0108

THIS PAGE INTENTIONALLY BLANK

CANNON AFB
NEW MEXICO

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 1328

INVESTIGATION OF EIGHT UNDERGROUND STORAGE TANK FACILITIES ON CANNON AIR FORCE BASE AND MELROSE BOMBING RANGE, NEW MEXICO, 1995

VOLUME II

PREPARED FOR

ENVIRONMENTAL MANAGEMENT FLIGHT
CANNON AIR FORCE BASE, NEW MEXICO 88103

PREPARED BY

FREDRICK E. GEBHARDT
U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION
4501 INDIAN SCHOOL ROAD NE, SUITE 200
ALBUQUERQUE, NEW MEXICO 87110

Quanterra Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

FIC 728

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041427

APRIL 26, 1995

Reviewed by: Grant Wilton

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 8, 1995, Quanterra Environmental Services, Denver received one aqueous and thirteen soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical
IV. Quality Control Report

Standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041427-0001-SA	CAFB-FAC0728-0101	SOIL	06 APR 95	08:45	08 APR 95
041427-0002-SA	CAFB-FAC0728-0102	SOIL	06 APR 95	09:45	08 APR 95
041427-0003-SA	CAFB-FAC0728-0103	SOIL	06 APR 95	10:10	08 APR 95
041427-0004-SA	CAFB-FAC0728-0104	SOIL	06 APR 95	10:50	08 APR 95
041427-0005-SA	CAFB-FAC0728-0201	SOIL	06 APR 95	11:20	08 APR 95
041427-0006-SA	CAFB-FAC0728-0301	SOIL	06 APR 95	12:00	08 APR 95
041427-0007-SA	CAFB-FAC0728-0302	SOIL	06 APR 95	12:20	08 APR 95
041427-0008-SA	CAFB-FAC0728-0303	SOIL	06 APR 95	12:50	08 APR 95
041427-0009-SA	CAFB-FAC0728-0401	SOIL	06 APR 95	13:30	08 APR 95
041427-0010-SA	CAFB-FAC0728-0501	SOIL	06 APR 95	14:00	08 APR 95
041427-0011-SA	CAFB-FAC0728-0502	SOIL	06 APR 95	14:20	08 APR 95
041427-0012-SA	CAFB-FAC0728-0504	SOIL	06 APR 95	14:35	08 APR 95
041427-0013-SA	CAFB-FAC0728-0505	SOIL	06 APR 95	14:50	08 APR 95
041427-0014-EB	CAFB-FAC0728-0503	AQUEOUS	06 APR 95	14:30	08 APR 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041427	Group Code	Analysis Description	Custom Test?
0001 - 0013	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0014	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method.

The analytical data reported are subject to the following limitations of the analytical methodology:

Quanterra
Environmental Services

Volatile Organics

a) Due to the chemical nature of ethanol, this component cannot be consistently recovered using EPA Method 624 or 8240. This component is reported with a NR (Not Recoverable) in place of a reporting limit.

b) Methylene chloride and acetone are common laboratory contaminants in GC/MS analysis. We have programs in place to minimize contamination, occasionally these compounds will be found at low levels in samples.

Semivolatile Organics

a) Benzo(b) and benzo(k) fluoranthene cannot be differentiated based on their mass spectra; retention times are almost identical. The isomer which is the closest in retention time to the sample is reported.

b) 1,2-diphenylhydrazine is measured as azobenzene.

c) Diphenylamine cannot be distinguished from N-nitrosodiphenylamine.

d) 3-Methyl phenol and 4-methyl phenol cannot be differentiated because their mass spectra and retention times are almost identical. Results are reported as 3/4-methyl phenol (or m&p-cresols).

e) Several Appendix IX and Refinery List compounds are not consistently recovered using Method 8270, and reporting limits cannot be established. These compounds include: dimethoate, famphur, hexachlorophene, 4-nitroquinoline-1-oxide, 4-phenylenediamine, and benzenethiol.

f) Two Refinery List compounds, pyridine and quinoline, are not recovered after alumina column cleanup.

g) Bis-2-(ethylhexyl)phthalate is a common laboratory contaminant in GC/MS analysis. We have programs in place to minimize this contamination, occasionally these compounds will be found at low levels in samples.

Tentatively Identified Compounds

This report presents results for the "identification" of unknown compounds that were detected in the GC/MS analysis. The results from this work are presented as "tentatively identified compounds" (TIC). The approach used for reporting TICs was based on the protocol established for this purpose in the EPA Superfund methods and on guidelines established by the American Chemical Society (ACS).

In summary, the mass spectrum of chromatographic peaks in concentrations in excess of 10% of the internal standard were obtained. Normally, the number of unknown compounds identified is limited to 10 compounds in the volatile fraction and 20 compounds in the semivolatile fraction. Each mass spectrum was then compared to a library of over 30,000 reference spectra in a computerized "library search." The three "best" matches obtained by the computer were hardcopied along with the mass spectrum of the unknown peak. This information was then reviewed by an analyst who "identified" the compound based on the available information.

All identifications were based on the "Guidelines for GC/MS Identification" developed by the American Chemical Society (Environmental Science and Technology, 1982, 16 143A). As recommended in these guidelines, identifications of unknown substances were reported with a level of confidence. The three levels of confidence cited in the ACS guidelines and used in this report are as follows:

Level 3: Confirmed Identification

The identification is based on the analysis of an authentic standard.

Level 2: Confident Identification

- Good agreement was observed between the unknown compound and a specific library spectrum.

Level 1: Tentative Identification

The unknown compound is only indicative of a specific library spectrum.

Class Identification

The unknown compound was not similar to a specific library spectrum, but it did contain ions characteristic of a class of compounds (saturated hydrocarbon, chlorinated hydrocarbon, etc.).

If there were no library spectra similar to the unknown, and it could not be assigned to a particular class of compounds, the compound is reported as "unknown."

Quantitation of TICs is based on the total ionization peak area relative to an internal standard, assuming a response factor of one. Accordingly, the reported concentration is an estimate.

In general, mass spectrometry cannot distinguish isomers (compounds with the same molecular formula). Therefore, an identified compound may be any one of several different isomers.

The tentatively identified compounds in this report include some compounds reported as "siloxanes". Siloxanes are common laboratory and field artifacts or contaminants. Potential sources include silicon-based grease in the field or laboratory plus the liquid phase coating on gas chromatography columns, as well as other equipment in the laboratory. However, siloxanes may be present in environmental samples from spills of silicone oils or lubricating oils with siloxane additives.

Metals

All nominal reporting limits for metals have been established from instrument detection limit (IDL) evaluations and represent the level above which reliable data can be routinely obtained. Low level standards are analyzed seven times on three non-consecutive days on each instrument. The standard deviations of the three runs are summed to yield the IDL. Nominal reporting limits are generally 2-5 times the IDL (consistent with the American Chemical Society definition for the Limit of Quantification). The ability to achieve these quoted reporting limits is verified each quarter. Reporting limits above the nominal levels are often submitted due to matrix interferences or elevated analyte levels.

Reporting limits for metals analyzed by Inductively Coupled Plasma (ICP) are typically raised only for dilution due to an analyte exceeding the instrument linear range. Background and interelement interferences are corrected automatically and do not require dilution.

Metals analyzed by Graphite Furnace Atomic Absorption (GFAA) are subject to matrix interferences. Consequently, Quanterra Environmental Services, Denver laboratory's protocol is to analyze a spiked aliquot with every sample. The severity of the interference, based upon analyte level and spike recovery, is assessed against specific criteria and the need for an elevated reporting limit or dilution is determined.

The analysis of mercury by Cold Vapor Atomic Absorption (CVAA) is generally free from matrix interferences. As with ICP, reporting limits are raised only for dilution due to a sample concentration exceeding the linear range of the instrument.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analysts judgement) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as in the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatile Organics, 1/10 of the reporting limit for GC/MS Semivolatile Organics, 1/2 the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

Quanterra
Environmental Services

T Preferred value unless footnoted on the secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with the footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multi-analyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0101
Lab ID: 041427-0001-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.3	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	96	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0102
Lab ID: 041427-0002-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.2	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	102	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C20.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0103
Lab ID: 041427-0003-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.9	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	96	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C16.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0104
Lab ID: 041427-0004-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.5	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	90	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0201
Lab ID: 041427-0005-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.9	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	91	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0301
Lab ID: 041427-0006-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.6	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	91	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C20.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0302
Lab ID: 041427-0007-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	94	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0303
Lab ID: 041427-0008-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	12	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	99	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C22.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0401
Lab ID: 041427-0009-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.7	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	105	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0501
Lab ID: 041427-0010-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.5	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	94	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0502
Lab ID: 041427-0011-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.7	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	100	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0504
Lab ID: 041427-0012-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.9	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	89	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0505
Lab ID: 041427-0013-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.8	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	90	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0503
Lab ID: 041427-0014-EB
Matrix: AQUEOUS Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 12 APR 95 Analyzed: 14 APR 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	95	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0101
Lab ID: 041427-0001-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.7	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0102
Lab ID: 041427-0002-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0103
Lab ID: 041427-0003-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0104
Lab ID: 041427-0004-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0201
Lab ID: 041427-0005-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0301
Lab ID: 041427-0006-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0302
Lab ID: 041427-0007-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0303
Lab ID: 041427-0008-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0401
Lab ID: 041427-0009-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0501
Lab ID: 041427-0010-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0502
Lab ID: 041427-0011-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0504
Lab ID: 041427-0012-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0505
Lab ID: 041427-0013-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a rigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results)

to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery:

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD):

$$\text{RPD} = \frac{\left| \text{Measured Concentration DCS1} - \text{Measured Concentration DCS2} \right|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041427-0001-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0002-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0003-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0004-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0005-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0006-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0007-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0008-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0009-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0010-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0011-SA	SOIL	8015M-D-S	14 APR 95-N22	14 APR 95-N22
041427-0012-SA	SOIL	8015M-D-S	14 APR 95-N22	14 APR 95-N22
041427-0013-SA	SOIL	8015M-D-S	14 APR 95-N22	14 APR 95-N22
041427-0014-EB	AQUEOUS	8015M-D-A	12 APR 95-N11	12 APR 95-N11

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 14 APR 95-N21 Concentration Units: mg/kg								
Diesel Range Organics	20.0	20.6	19.5	20.0	100	48-138	5.5	32
Category: 8015M-D-S Matrix: SOIL QC Lot: 14 APR 95-N22 Concentration Units: mg/kg								
Diesel Range Organics	20.0	21.3	19.1	20.2	101	48-138	11	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 12 APR 95-N11 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.347	0.320	0.334	67	26-121	8.1	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 14 APR 95-N21 QC Run: 14 APR 95-N21				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.816	102	64-136
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 14 APR 95-N22 QC Run: 14 APR 95-N22				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.741	93	64-136
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 12 APR 95-N11 QC Run: 12 APR 95-N11				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0197	98	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit	
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 14 APR 95-N21 QC Run: 14 APR 95-N21				
Diesel Range Organics	3.8	mg/kg	4.0	J
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 14 APR 95-N22 QC Run: 14 APR 95-N22				
Diesel Range Organics	3.8	mg/kg	4.0	J
Test: 8015M-DRO-FID-A Matrix: AQUEOUS QC Lot: 12 APR 95-N11 QC Run: 12 APR 95-N11				
Diesel Range Organics	ND	mg/L	0.10	

J = Result is detected below the reporting limit or is an estimated concentration.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number	PACKING AND SHIPPING DETAILS	
Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	Packed and Sealed for Shipping by: Ralph Wilcox	Seal Number: 001
Sampling Location: Facility 728	Delivered to Shipper by: Ralph Wilcox	Airbill Number: 3436569673
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing	

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
04/06/95	0845	CAFB-FAC0728-0101	SOIL	1	SW8015 (DRO)	Environmental Sample	-01
"	0945	" -0102	"	"	"	"	-02
"	1010	" -0103	"	"	"	"	-03
"	1050	" -0104	"	"	"	"	-04
"	1120	" -0201	"	"	"	"	-05
"	1200	" -0301	"	"	"	"	-06
"	1220	" -0302	"	"	"	"	-07
"	1250	" -0303	"	"	"	"	-08
"	1330	" -0401	"	"	"	"	-09
"	1400	" -0501	"	"	"	"	-10
"	1420	" -0502	"	"	"	"	-11
"	1435	" -0504	"	"	"	"	-12
"	1450	" -0505	"	"	"	"	-13
"	1430	" -0503	WATER	"	"	Equipment Blank	-14

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt ☒ Yes ☐ No
Ralph Wilcox III	to Federal Express	04/07/95	1400	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: Good
	[illegible] QDL	4/8/95	0900	ph: (303) 421-6611	Contents Temperature: 4.1°C
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41427

QDL# 41427

Quanterra Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

FIDC
130
2285

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041449

APRIL 30, 1995

Reviewed by:

Grant Wilton

FOR

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 11, 1995, Quanterra Environmental Services, Denver received nineteen soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical
IV. Quality Control Report

Standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041449-0001-SA	CAFB-FAC2285-0101	SOIL	07 APR 95	09:50	11 APR 95
041449-0002-SA	CAFB-FAC2285-0201	SOIL	07 APR 95	10:20	11 APR 95
041449-0003-SA	CAFB-FAC2285-0301	SOIL	07 APR 95	10:50	11 APR 95
041449-0004-SA	CAFB-FAC2285-0401	SOIL	07 APR 95	11:30	11 APR 95
041449-0005-SA	CAFB-FAC2285-0402	SOIL	07 APR 95	12:00	11 APR 95
041449-0006-SA	CAFB-FAC2285-0501	SOIL	07 APR 95	13:50	11 APR 95
041449-0007-SA	CAFB-FAC2285-0502	SOIL	07 APR 95	14:30	11 APR 95
041449-0008-SA	CAFB-FAC2285-0102	SOIL	07 APR 95	15:00	11 APR 95
041449-0009-SA	CAFB-FAC2285-0202	SOIL	07 APR 95	15:40	11 APR 95
041449-0010-SA	CAFB-FAC0130-0101	SOIL	08 APR 95	09:50	11 APR 95
041449-0010-MS	CAFB-FAC0130-0101	SOIL	08 APR 95	09:50	11 APR 95
041449-0010-SD	CAFB-FAC0130-0101	SOIL	08 APR 95	09:50	11 APR 95
041449-0011-SA	CAFB-FAC0130-0102	SOIL	08 APR 95	10:45	11 APR 95
041449-0012-SA	CAFB-FAC0130-0201	SOIL	08 APR 95	11:20	11 APR 95
041449-0013-SA	CAFB-FAC0130-0203	SOIL	08 APR 95	12:20	11 APR 95
041449-0014-SA	CAFB-FAC0130-0301	SOIL	08 APR 95	12:55	11 APR 95
041449-0015-SA	CAFB-FAC0130-0302	SOIL	08 APR 95	13:20	11 APR 95
041449-0016-SA	CAFB-FAC0130-0401	SOIL	08 APR 95	13:55	11 APR 95
041449-0017-SA	CAFB-FAC0130-0402	SOIL	08 APR 95	14:20	11 APR 95
041449-0018-SA	CAFB-FAC0130-0501	SOIL	08 APR 95	15:20	11 APR 95
041449-0019-SA	CAFB-FAC0130-0502	SOIL	08 APR 95	15:45	11 APR 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041449	Group Code	Analysis Description	Custom Test?
0001 - 0019	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N

Quanterra
Environmental Services

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analysts judgement) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as in the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatile Organics, 1/10 of the reporting limit for GC/MS Semivolatile Organics, 1/2 the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

T Preferred value unless footnoted on the secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with the footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multi-analyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0101
Lab ID: 041449-0001-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	20	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	107	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0201
Lab ID: 041449-0002-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	91	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0301
Lab ID: 041449-0003-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	95	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0401
Lab ID: 041449-0004-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.3	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	101	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0402
Lab ID: 041449-0005-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	13	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	110	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C16-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0501
Lab ID: 041449-0006-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.6	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	96	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C16-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0502
Lab ID: 041449-0007-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.2	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	104	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0102
Lab ID: 041449-0008-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 24 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	24	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	104	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0202
Lab ID: 041449-0009-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 24 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.0	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	98	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0101
Lab ID: 041449-0010-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 24 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.6	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	98	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0102
Lab ID: 041449-0011-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.0	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	102	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0201
Lab ID: 041449-0012-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	97	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0203
Lab ID: 041449-0013-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.8	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	97	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0301
Lab ID: 041449-0014-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.1	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	101	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0302
Lab ID: 041449-0015-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.5	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	108	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0401
Lab ID: 041449-0016-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.0	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	101	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0402
Lab ID: 041449-0017-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.9	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	95	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0501
Lab ID: 041449-0018-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.5	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	99	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0502
Lab ID: 041449-0019-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.4	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	98	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0101
Lab ID: 041449-0001-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0201
Lab ID: 041449-0002-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0301
Lab ID: 041449-0003-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.8	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0401
Lab ID: 041449-0004-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0402
Lab ID: 041449-0005-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0501
Lab ID: 041449-0006-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0502
Lab ID: 041449-0007-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0102
Lab ID: 041449-0008-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0202
Lab ID: 041449-0009-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0101
Lab ID: 041449-0010-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	7.5	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0102
Lab ID: 041449-0011-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.8	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0201
Lab ID: 041449-0012-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0203
Lab ID: 041449-0013-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0301
Lab ID: 041449-0014-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0302
Lab ID: 041449-0015-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0401
Lab ID: 041449-0016-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.2	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0402
Lab ID: 041449-0017-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.9	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0501
Lab ID: 041449-0018-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0502
Lab ID: 041449-0019-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorjzed: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results)

to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery:

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD):

$$\text{RPD} = \frac{\left| \text{Measured Concentration DCS1} - \text{Measured Concentration DCS2} \right|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041449-0001-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0002-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0003-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0004-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0005-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0006-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0007-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0008-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0009-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0010-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0010-MS	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0010-SD	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0011-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0012-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0013-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0014-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0015-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0016-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0017-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0018-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0019-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 17 APR 95-N12 Concentration Units: mg/kg								
Diesel Range Organics	20.0	21.6	20.2	20.9	105	48-138	6.7	32
Category: 8015M-D-S Matrix: SOIL QC Lot: 17 APR 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	22.0	20.5	21.2	106	48-138	7.1	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 17 APR 95-N12 QC Run: 17 APR 95-N12				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.789	99	64-136
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 17 APR 95-N1 QC Run: 17 APR 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.835	104	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 17 APR 95-N12 QC Run: 17 APR 95-N12			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 17 APR 95-N12 QC Run: 17 APR 95-N12			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 17 APR 95-N1 QC Run: 17 APR 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

Quanterra
Environmental Services

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Organics by Chromatography

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE DUPLICATE	8015M-DRO-FID-S	041449-0010-SD	17 APR 95-N12
MATRIX SPIKE	8015M-DRO-FID-S	041449-0010-MS	17 APR 95-N12

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
ganics by Chromatography
Project: 041449

Category: 8015M-D-S Diesel Range Organics in Solid Samples
Matrix: SOIL
Sample: 041449-0010
MS Run: 17 APR 95-N12
Units mg/kg Units Qualifier: Wet wt.

Analyte	Concentration Sample Result		MS Result	MSD Result	Amount Spiked MS	Amount Spiked MSD	% Recovery MS	% Recovery MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Diesel Range Organics (C8-C32)	2.6	J	19	24	20	20	84	107	48-138	24	32

J = Result is detected below the reporting limit or is an estimated concentration.

Calculations are performed before rounding to avoid round-off errors in calculated results.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITIES 2285, 130, and 600	Packed and Sealed for Shipping by: Fred Gebhardt — Seal Number: 001
Team Leader: Fred Gebhardt	Delivered to Shipper by: Fred Gebhardt — Airbill Number: 3436570701
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
04/07/95	0950	CAFB-FAC2285-0101	SOIL	1	SW8015 (DRO)	Environmental Sample
"	1020	" -0201	"	"	"	"
"	1050	" -0301	"	"	"	"
"	1130	" -0401	"	"	"	"
"	1200	" -0402	"	"	"	"
"	1350	" -0501	"	"	"	"
"	1430	" -0502	"	"	"	"
"	1500	" -0102	"	"	"	"
"	1540	" -0202	"	"	"	"
04/08/95	0950	CAFB-FAC0130-0101	"	2	"	Environmental Sample plus MS and MSD

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick E. Gebhardt		4/10/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	[illegible]	4/11/95	915	ph: (303) 421-6611	Contents Temperature: 2.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41449

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITIES 2285, 130, and 600	Packed and Sealed for Shipping by: Fred Gebhardt — Seal Number: 001
Team Leader: Fred Gebhardt	Delivered to Shipper by: Fred Gebhardt — Airbill Number: 3436570701
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
04/08/95	1045	CAFB-FAC0130-0102	SOIL	1	SW8015 (DRO)	Environmental Sample	-11
"	1120	" -0201	"	"	"	"	-12
~~" 1150~~		~~" -0202~~	~~"~~	~~"~~	~~"~~	~~"~~	
"	1220	" -0203	"	"	"	"	-13
"	1255	" -0301	"	"	"	"	-14
"	1320	" -0302	"	"	"	"	-15
"	1355	" -0401	"	"	"	"	-16
"	1420	" -0402	"	"	"	"	-17
"	1520	" -0501	"	"	"	"	-18
"	1545	" -0502	"	"	"	"	-19

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick E. Gebhardt		4/10/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: Good
	J. McChas	4/11/95	915	ph: (303) 421-6611	Contents Temperature: 2.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41449

Quanterra
Environmental Services

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041450

MAY 5, 1995

FMC
130
600

Reviewed by: _____ FOR
Grant Wilton

_____
Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 11, 1995, Quanterra Environmental Services, Denver laboratory received 1 aqueous and 17 soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

DEISEL RANGE ORGANICS

All analyses at Quanterra's Denver laboratory are performed so that the maximum concentration of sample consistent with the method is analyzed. Dilutions are at times required to achieve linearity of the specific parameter or to reduce matrix interferences. In this event, reporting limits are adjusted proportionately. Surrogates may not be reportable in samples that have been diluted. The surrogates for samples 041450-0009-SA, -0010-SA, -0016-SA, -0016-MS and -0016-SD were diluted out.

With the exceptions as noted above, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041450-0001-SA	CAFB-FAC0130-0503	SOIL	08 APR 95	16:15	11 APR 95
041450-0002-SA	CAFB-FAC0600-0101	SOIL	09 APR 95	08:30	11 APR 95
041450-0003-SA	CAFB-FAC0600-0102	SOIL	09 APR 95	08:30	11 APR 95
041450-0004-SA	CAFB-FAC0600-0103	SOIL	09 APR 95	09:00	11 APR 95
041450-0005-SA	CAFB-FAC0600-0104	SOIL	09 APR 95	09:20	11 APR 95
041450-0006-SA	CAFB-FAC0600-0201	SOIL	09 APR 95	10:10	11 APR 95
041450-0007-SA	CAFB-FAC0600-0202	SOIL	09 APR 95	10:40	11 APR 95
041450-0008-SA	CAFB-FAC0600-0203	SOIL	09 APR 95	11:00	11 APR 95
041450-0009-SA	CAFB-FAC0600-0301	SOIL	09 APR 95	11:30	11 APR 95
041450-0010-SA	CAFB-FAC0600-0302	SOIL	09 APR 95	11:45	11 APR 95
041450-0011-EB	CAFB-FAC0600-0303	AQUEOUS	09 APR 95	12:00	11 APR 95
041450-0012-SA	CAFB-FAC0600-0304	SOIL	09 APR 95	12:05	11 APR 95
041450-0013-SA	CAFB-FAC0600-0401	SOIL	09 APR 95	12:30	11 APR 95
041450-0014-SA	CAFB-FAC0600-0402	SOIL	09 APR 95	12:50	11 APR 95
041450-0015-SA	CAFB-FAC0600-0403	SOIL	09 APR 95	13:20	11 APR 95
041450-0016-SA	CAFB-FAC0600-0501	SOIL	09 APR 95	13:50	11 APR 95
041450-0016-MS	CAFB-FAC0600-0501	SOIL	09 APR 95	13:50	11 APR 95
041450-0016-SD	CAFB-FAC0600-0501	SOIL	09 APR 95	13:50	11 APR 95
041450-0017-SA	CAFB-FAC0600-0502	SOIL	09 APR 95	14:20	11 APR 95
041450-0018-SA	CAFB-FAC0600-0503	SOIL	09 APR 95	14:40	11 APR 95

– diluted

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041450	Group Code	Analysis Description	Custom Test?
0001 - 0010, 0012 - 0018	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0011	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Custom footnotes may be used for example, with GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgement) the product that appears to be present. The general qualifiers that serve to identify problems and pertinent observations made during sample analysis and review that are not discussed in the Overview section of this report are described below:

B Compound is also detected in the method blank.

This footnote indicates that the compound was detected in the sample as well as in the method blank. Please note that the "B" flag is not used when the sample result is ND (not detected).

G Reporting limit raised due to matrix interference.

This footnote indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all compounds determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the compound was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit (MDL) study, "J" values are generally reported to 1/5 of the reporting limit for GC/MS volatile organics, 1/10 of the reporting limit for GC/MS semivolatile organics, 1/2 of the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

T Preferred value unless footnoted on the secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footenote will be listed only for the first compound but pertains to all the compounds determined by the method. It is used in conjunction with the "V" footnote.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the "T" footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates the reporting limits were raised due to the presence of target compounds outside the calibration range of the method. For multi-compound methods, the footnote will appear only for the first compound but pertains to all compounds determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0503
Lab ID: 041450-0001-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	89	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0101
Lab ID: 041450-0002-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.4	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	98	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0102
Lab ID: 041450-0003-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.5	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	95	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0103
Lab ID: 041450-0004-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	93	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0104
Lab ID: 041450-0005-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.6	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	98	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0201
Lab ID: 041450-0006-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.6	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	100	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0202
Lab ID: 041450-0007-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	86	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0203
Lab ID: 041450-0008-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.1	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	94	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0301
Lab ID: 041450-0009-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2800	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0302
Lab ID: 041450-0010-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3500	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0303
Lab ID: 041450-0011-EB
Matrix: AQUEOUS Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 15 APR 95 Analyzed: 21 APR 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	113	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0304
Lab ID: 041450-0012-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.8	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	98	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0401
Lab ID: 041450-0013-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.1	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	97	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : This sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0402
Lab ID: 041450-0014-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.9	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	92	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0403
Lab ID: 041450-0015-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.8	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	80	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0501
Lab ID: 041450-0016-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	820	mg/kg	80	qlt
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0502
Lab ID: 041450-0017-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	14	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	97	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0503
Lab ID: 041450-0018-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.6	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	94	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0503
Lab ID: 041450-0001-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0101
Lab ID: 041450-0002-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0102
Lab ID: 041450-0003-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0103
Lab ID: 041450-0004-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0104
Lab ID: 041450-0005-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0201
Lab ID: 041450-0006-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	4.2	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0202
Lab ID: 041450-0007-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0203
Lab ID: 041450-0008-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0301
Lab ID: 041450-0009-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.6	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0302
Lab ID: 041450-0010-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0304
Lab ID: 041450-0012-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	6.3	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0401
Lab ID: 041450-0013-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0402
Lab ID: 041450-0014-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.7	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0403
Lab ID: 041450-0015-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0501
Lab ID: 041450-0016-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.9	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0502
Lab ID: 041450-0017-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0503
Lab ID: 041450-0018-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{Measured Concentration DCS1} - \text{Measured Concentration DCS2}|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041450-0001-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0002-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0003-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0004-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0005-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0006-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0007-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0008-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0009-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0010-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0011-EB	AQUEOUS	8015M-D-A	15 APR 95-N1	15 APR 95-N1
041450-0012-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0013-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0014-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0015-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0016-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0016-MS	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0016-SD	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0017-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0018-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Limits	Precision (RPD) DCS	Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 18 APR 95-N2 Concentration Units: mg/kg								
Diesel Range Organics	20.0	17.8	17.4	17.6	88	48-138	2.3	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 15 APR 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.473	0.310	0.391	78	26-121	42	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 18 APR 95-N2 QC Run: 18 APR 95-N2				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.751	94	64-136
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 15 APR 95-N1 QC Run: 15 APR 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0218	109	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 18 APR 95-N2 QC Run: 18 APR 95-N2			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 15 APR 95-N1 QC Run: 15 APR 95-N1			
Diesel Range Organics	ND	mg/L	0.10
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 18 APR 95-N2 QC Run: 18 APR 95-N2			
Diesel Range Organics	ND	mg/kg	4.0

Quanterra
Environmental Services

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Organics by Chromatography

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE DUPLICATE	8015M-DRO-FID-S	041450-0016-SD	18 APR 95-N2
MATRIX SPIKE	8015M-DRO-FID-S	041450-0016-MS	18 APR 95-N2

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
ganics by Chromatography
Project: 041450

Category: 8015M-D-S Diesel Range Organics in Solid Samples
Matrix: SOIL
Sample: 041450-0016
MS Run: 18 APR 95-N2
Units mg/kg Units Qualifier: Wet wt.

Analyte	Concentration Sample Result	MS Result	MSD Result	Amount Spiked MS	MSD	% Recovery MS	MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Diesel Range Organics (C8-C32)	820	800	810	20	20	NC	NC	48-138	NC	32

NC = Not Calculated, calculation not applicable.

Calculations are performed before rounding to avoid round-off errors in calculated results.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	PACKING AND SHIPPING DETAILS: Packed and Sealed for Shipping by: FRED GEBHARDT; Seal Number: 001
Sampling Location: FACILITIES 2285, 130, and 600	Delivered to Shipper by: FRED GEBHARDT; Airbill Number: 3436570701
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
04/08/95	1615	CAFB-FAC0130-0503	SOIL	1	SW8015 (DRO)	Environmental Sample	-01
04/09/95	0830	CAFB-FAC0600-0101	"	"	"	"	-02
"	0830	" -0102	"	"	"	"	-03
"	0900	" -0103	"	"	"	"	-04
"	0920	" -0104	"	"	"	"	-05
"	1010	" -0201	"	"	"	"	-06
"	1040	" -0202	"	"	"	"	-07
"	1100	" -0203	"	"	"	"	-08
"	1130	" -0301	"	"	"	"	-09
"	1145	" -0302	"	"	"	"	-10

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick E. Gebhardt		4/10/95	1200	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[illegible]	4/11/95	915	ph: (303) 421-6611	Contents Temperature: 2.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41450

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITIES 2285, 130, and 600	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 001
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436570701
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
04/09/95	1200	CAFB-FAC0600-0303	WATER	1	SW8015 (DRO)	Equipment Blank	-11
"	1205	" -0304	SOIL	"	"	Environmental Sample	-12
"	1230	" -0401	"	"	"	"	-13
"	1250	" -0402	"	"	"	"	-14
"	1320	" -0403	"	"	"	"	-15
"	1350	" -0501	"	2	"	Environmental Sample plus MS and MSD	-16 MS SD
"	1420	" -0502	"	1	"	Environmental Sample	-17
"	1440	" -0503	"	"	"	"	-18

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick E. Gebhardt		4/10/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	[illegible]	4/11/95	915	ph: (303) 421-6611	Contents Temperature: 2.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 7450

Quanterra Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

1060
1400

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041519

MAY 11, 1995

Reviewed by: Grant Wilton

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 14, 1995, Quanterra Environmental Services, Denver received one aqueous and thirteen soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical
IV. Quality Control Report

DIESEL RANGE ORGANIC ANALYSIS

Due to the dilutions required to bring the samples within the calibration range of the instrument, surrogate recoveries could not be determined for Quanterra sample numbers 041519-0003-SA, -0009-SA, -0010-SA and -0013-SA.

Except where indicated above, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041519-0001-SA	CAFB-FAC3060-0201	SOIL	11 APR 95	11:00	14 APR 95
041519-0002-SA	CAFB-FAC3060-0202	SOIL	11 APR 95	11:15	14 APR 95
041519-0003-SA	CAFB-FAC3060-0301	SOIL	11 APR 95	11:30	14 APR 95
041519-0004-SA	CAFB-FAC3060-0302	SOIL	11 APR 95	12:15	14 APR 95
041519-0005-SA	CAFB-FAC3060-0401	SOIL	11 APR 95	12:45	14 APR 95
041519-0006-SA	CAFB-FAC3060-0501	SOIL	11 APR 95	13:15	14 APR 95
041519-0007-SA	CAFB-FAC3060-0601	SOIL	11 APR 95	13:45	14 APR 95
041519-0008-SA	CAFB-FAC1400-0102	SOIL	12 APR 95	10:00	14 APR 95
041519-0009-SA	CAFB-FAC1400-0201	SOIL	12 APR 95	11:00	14 APR 95
041519-0010-SA	CAFB-FAC1400-0301	SOIL	12 APR 95	12:30	14 APR 95
041519-0011-SA	CAFB-FAC1400-0302	SOIL	12 APR 95	14:00	14 APR 95
041519-0012-SA	CAFB-FAC1400-0401	SOIL	12 APR 95	15:00	14 APR 95
041519-0013-SA	CAFB-FAC1400-0402	SOIL	12 APR 95	16:20	14 APR 95
041519-0014-EB	CAFB-FAC1400-0403	AQUEOUS	12 APR 95	17:30	14 APR 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041519	Group Code	Analysis Description	Custom Test?
0001 - 0013	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0014	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041519	Group Code	Analysis Description	Custom Test?
0001 - 0013	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0014	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analysts judgement) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as in the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatile Organics, 1/10 of the reporting limit for GC/MS Semivolatile Organics, 1/2 the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

T Preferred value unless footnoted on the secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with the footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multi-analyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0201
Lab ID: 041519-0001-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	1300	mg/kg	40	t1
Surrogate	Recovery			
o-Terphenyl	194	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0202
Lab ID: 041519-0002-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.7	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	104	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0301
Lab ID: 041519-0003-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5300	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0302
Lab ID: 041519-0004-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	23	mg/kg	4.0	1
Surrogate	Recovery			
o-Terphenyl	122	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0401
Lab ID: 041519-0005-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.3	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	111	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0501
Lab ID: 041519-0006-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	104	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0601
Lab ID: 041519-0007-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	37	mg/kg	4.0	1
Surrogate	Recovery			
o-Terphenyl	118	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0102
Lab ID: 041519-0008-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	51	mg/kg	8.0	tql
Surrogate	Recovery			
o-Terphenyl	124	%		

Note t : Sample diluted due to the concentration of target compounds.

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0201
Lab ID: 041519-0009-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 02 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6200	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0301
Lab ID: 041519-0010-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	9900	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0302
Lab ID: 041519-0011-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 02 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	370	mg/kg	8.0	t1
Surrogate	Recovery			
o-Terphenyl	127	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0401
Lab ID: 041519-0012-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 02 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	16	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	128	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0402
Lab ID: 041519-0013-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 02 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2500	mg/kg	80	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0403
Lab ID: 041519-0014-EB
Matrix: AQUEOUS Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 15 APR 95 Analyzed: 21 APR 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	97	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0201
Lab ID: 041519-0001-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0202
Lab ID: 041519-0002-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0301
Lab ID: 041519-0003-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0302
Lab ID: 041519-0004-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.1	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0401
Lab ID: 041519-0005-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	6.9	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0501
Lab ID: 041519-0006-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0601
Lab ID: 041519-0007-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.8	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0102
Lab ID: 041519-0008-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	3.5	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0201
Lab ID: 041519-0009-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0301
Lab ID: 041519-0010-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.9	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0302
Lab ID: 041519-0011-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.6	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0401
Lab ID: 041519-0012-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0402
Lab ID: 041519-0013-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	19	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results)

to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery:

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD):

$$\text{RPD} = \frac{\left| \text{Measured Concentration DCS1} - \text{Measured Concentration DCS2} \right|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041519-0001-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0002-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0003-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0004-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0005-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0006-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0007-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0008-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0009-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0010-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0011-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0012-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0013-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0014-EB	AQUEOUS	8015M-D-A	15 APR 95-N1	15 APR 95-N1

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 22 APR 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	22.8	21.9	22.4	112	48-138	4.0	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 15 APR 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.473	0.310	0.391	78	26-121	42	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 22 APR 95-N1 QC Run: 22 APR 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.938	117	64-136
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 15 APR 95-N1 QC Run: 15 APR 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0218	109	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 22 APR 95-N1 QC Run: 22 APR 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 15 APR 95-N1 QC Run: 15 APR 95-N1			
Diesel Range Organics	ND	mg/L	0.10

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number	PACKING AND SHIPPING DETAILS.	
Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	Packed and Sealed for Shipping by: FRED GEBHARDT	Seal Number: 001
Sampling Location: FACILITY 3060 & 1400	Delivered to Shipper by: FRED GEBHARDT	Airbill Number: 3436570690
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing	

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
4/11/95	1100	CAFB-FAC3060-0201	SOIL	1	SW8015 (DRO)	ENVIRONMENTAL SAMPLE	-01
"	1115	" -0202	"	1	"	"	-02
"	1130	" -0301	"	1	"	"	-03
"	1215	" -0302	"	1	"	"	-04
"	1245	" -0401	"	1	"	"	-05
"	1315	" -0501	"	1	"	"	-06
"	1345	" -0601	"	1	"	"	-07
4/12/95	1000	CAFB-FAC1400-0102	SOIL	1	"	"	-08
	1100	" -0201	"	1	"	"	-09
	1230	" -0301	"	1	"	"	-10

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick E. Gebhardt	TO FEDERAL EXPRESS	4/13/95	1400	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: Good
	[illegible]	4/14/95	845	ph: (303) 421-6611	Contents Temperature: 2.1
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 4159

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number	PACKING AND SHIPPING DETAILS	
Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	Packed and Sealed for Shipping by: FRED GEBHARDT	Seal Number: 001
Sampling Location: FACILITY 1400	Delivered to Shipper by: FRED GEBHARDT	Airbill Number: 3436570690
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☐ Continuing	

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
4/12/95	1400	CAFB FAC 1400-0302	SOIL	1	SW8015 (DRO)	ENVIRONMENTAL SAMPLE	-11
"	1500	" -0401	"	1	"	"	-12
"	1620	" -0402	"	1	"	"	-13
"	1730	" -0403	WATER	1	"	EQUIPMENT BLANK	-14

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick G. Gebhardt	TO FEDERAL EXPRESS	4/13/95	1400	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: Good
	[illegible]	4/14/95	845	ph: (303) 421-6611	Contents Temperature: 2.1
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 415/9

Quanterra
Environmental Services

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041554

MAY 4, 1995

Reviewed by: _____ FOR
Grant Wilton

_____
Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 18, 1995, Quanterra Environmental Services, Denver laboratory received 1 aqueous and 10 soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

Standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041554-0001-SA	CAFB-FAC0368-0101	SOIL	13 APR 95	09:15	18 APR 95
041554-0002-SA	CAFB-FAC0368-0102	SOIL	13 APR 95	10:15	18 APR 95
041554-0003-SA	CAFB-FAC0368-0201	SOIL	13 APR 95	10:45	18 APR 95
041554-0004-SA	CAFB-FAC0368-0202	SOIL	13 APR 95	11:15	18 APR 95
041554-0005-SA	CAFB-FAC0368-0301	SOIL	13 APR 95	11:45	18 APR 95
041554-0006-SA	CAFB-FAC0368-0401	SOIL	13 APR 95	12:30	18 APR 95
041554-0007-SA	CAFB-FAC0368-0501	SOIL	13 APR 95	14:00	18 APR 95
041554-0008-SA	CAFB-FAC0368-0601	SOIL	13 APR 95	14:30	18 APR 95
041554-0009-EB	CAFB-FAC0368-0602	AQUEOUS	13 APR 95	15:00	18 APR 95
041554-0010-SA	CAFB-FAC0368-0701	SOIL	14 APR 95	12:30	18 APR 95
041554-0011-SA	CAFB-FAC1400-0602	SOIL	14 APR 95	10:45	18 APR 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041554	Group Code	Analysis Description	Custom Test?
0001 - 0008,	A	Percent Water: ASTM D2216	N
0010		Gasoline Range Organics	N
0009	B	Gasoline Range Organics	N
0011	C	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Custom footnotes may be used for example, with GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgement) the product that appears to be present. The general qualifiers that serve to identify problems and pertinent observations made during sample analysis and review that are not discussed in the Overview section of this report are described below:

B Compound is also detected in the method blank.

This footnote indicates that the compound was detected in the sample as well as in the method blank. Please note that the "B" flag is not used when the sample result is ND (not detected).

G Reporting limit raised due to matrix interference.

This footnote indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all compounds determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the compound was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit (MDL) study, "J" values are generally reported to 1/5 of the reporting limit for GC/MS volatile organics, 1/10 of the reporting limit for GC/MS semivolatile organics, 1/2 of the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

T Preferred value unless footnoted on the secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footenote will be listed only for the first compound but pertains to all the compounds determined by the method. It is used in conjunction with the "V" footnote.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the "T" footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates the reporting limits were raised due to the presence of target compounds outside the calibration range of the method. For multi-compound methods, the footnote will appear only for the first compound but pertains to all compounds determined by the method.

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0101
Lab ID: 041554-0001-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Gasoline Range Organics	0.57	mg/kg	0.50	q
Surrogate	Recovery			
a,a,a-Trifluorotoluene	94	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0102
Lab ID: 041554-0002-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Gasoline Range Organics	0.44	mg/kg	0.50	qJ
Surrogate	Recovery			
a,a,a-Trifluorotoluene	96	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0201
Lab ID: 041554-0003-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Gasoline Range Organics	0.27	mg/kg	0.50	qJ
Surrogate	Recovery			
a,a,a-Trifluorotoluene	90	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0202
Lab ID: 041554-0004-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit
Gasoline Range Organics	ND	mg/kg	0.50
Surrogate	Recovery		
a,a,a-Trifluorotoluene	91	%	

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0301
Lab ID: 041554-0005-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit
Gasoline Range Organics	ND	mg/kg	0.50
Surrogate	Recovery		
a,a,a-Trifluorotoluene	94	%	

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0401
Lab ID: 041554-0006-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Gasoline Range Organics	0.25	mg/kg	0.50	qJ
Surrogate	Recovery			
a,a,a-Trifluorotoluene	94	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0501
Lab ID: 041554-0007-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Gasoline Range Organics	0.57	mg/kg	0.50	q
Surrogate	Recovery			
a,a,a-Trifluorotoluene	92	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0601
Lab ID: 041554-0008-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit
Gasoline Range Organics	ND	mg/kg	0.50
Surrogate	Recovery		
a,a,a-Trifluorotoluene	93	%	

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0602
Lab ID: 041554-0009-EB
Matrix: AQUEOUS Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 20 APR 95

Parameter	Result	Units	Reporting Limit
Gasoline Range Organics	ND	ug/L	10
Surrogate	Recovery		
a,a,a-Trifluorotoluene	95	%	

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0701
Lab ID: 041554-0010-SA
Matrix: SOIL Sampled: 14 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit
Gasoline Range Organics	ND	mg/kg	0.50
Surrogate	Recovery		
a,a,a-Trifluorotoluene	94	%	

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0602
Lab ID: 041554-0011-SA
Matrix: SOIL Sampled: 14 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: 22 APR 95 Analyzed: 02 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.2	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	120	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0101
Lab ID: 041554-0001-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	7.6	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0102
Lab ID: 041554-0002-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	4.3	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0201
Lab ID: 041554-0003-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.0	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0202
Lab ID: 041554-0004-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0301
Lab ID: 041554-0005-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.7	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0401
Lab ID: 041554-0006-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.0	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall

Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0501
Lab ID: 041554-0007-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.1	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0601
Lab ID: 041554-0008-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0701
Lab ID: 041554-0010-SA
Matrix: SOIL Sampled: 14 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.8	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0602
Lab ID: 041554-0011-SA
Matrix: SOIL Sampled: 14 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall

Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{Measured Concentration DCS1} - \text{Measured Concentration DCS2}|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041554-0001-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0002-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0003-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0004-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0005-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0006-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0007-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0008-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0009-EB	AQUEOUS	8015M-G-A	20 APR 95-A	20 APR 95-A
041554-0010-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0011-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Category: 8015M-G-S Matrix: SOIL QC Lot: 19 APR 95-A Concentration Units: mg/kg								
Gasoline Range Organics	25.0	21.6	21.8	21.7	87	75-125	0.9	20
Category: 8015M-G-A Matrix: AQUEOUS QC Lot: 20 APR 95-A Concentration Units: ug/L								
Gasoline Range Organics	500	417	419	418	84	75-125	0.5	20
Category: 8015M-D-S Matrix: SOIL QC Lot: 22 APR 95-NI Concentration Units: mg/kg								
Diesel Range Organics	20.0	22.8	21.9	22.4	112	48-138	4.0	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-G-S				
Matrix: SOIL				
QC Lot: 19 APR 95-A QC Run: 19 APR 95-A				
Concentration Units: mg/kg				
a,a,a-Trifluorotoluene	1.50	1.41	94	89-117
Category: 8015M-G-A				
Matrix: AQUEOUS				
QC Lot: 20 APR 95-A QC Run: 20 APR 95-A				
Concentration Units: ug/L				
a,a,a-Trifluorotoluene	30.0	27.6	92	81-120
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 22 APR 95-N1 QC Run: 22 APR 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.938	117	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8015M-GRO-S			
Matrix: SOIL			
QC Lot: 19 APR 95-A QC Run: 19 APR 95-A			
Gasoline Range Organics	ND	mg/kg	0.50
Test: 8015M-GRO-AP			
Matrix: AQUEOUS			
QC Lot: 20 APR 95-A QC Run: 20 APR 95-A			
Gasoline Range Organics	ND	ug/L	10
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 22 APR 95-N1 QC Run: 22 APR 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number	PACKING AND SHIPPING DETAILS	
Cannon Air Force Base, Underground Storage Tank Sampling (463536004) 2	Packed and Sealed for Shipping by: FRED GEBHARDT	Seal Number: 001
Sampling Location: FACILITY 0368	Delivered to Shipper by: FRED GEBHARDT	Airbill Number: 3436570712
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing	

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
4/13/95	0915	CAFB-FAC0368-0101	SOIL	1	SW8015 (GRO) (-01)	ENVIRONMENTAL SAMPLE
"	1015	" -0102	"	1	" (-02)	"
"	1045	" -0201	"	1	" (-03)	"
"	1115	" -0202	"	1	" (-04)	"
"	1145	" -0301	"	1	" (-05)	"
"	1230	" -0401	"	1	" (-06)	"
"	1400	" -0501	"	1	" (-07)	"
"	1430 ~~1500~~	" -0601	"	1	" (-08)	"
"	1500	" -0602	WATER	3	" (-09)	EQUIPMENT BLANK
4/14/95	1230	CAFB-FAC0368-0701	SOIL	1	" (-10)	ENVIRONMENTAL SAMPLE

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick E Gebhardt	TO FEDERAL EXPRESS	4/17/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	Anthony Jerry (DOL)	4/18/95	0890	ph: (303) 421-6611	Contents Temperature: 3.0°C
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41554

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004) 2	PACKING AND SHIPPING DETAILS: Packed and Sealed for Shipping by: FRED GEBHARDT; Seal Number: 001
Sampling Location: FACILITY 1400	Delivered to Shipper by: FRED GEBHARDT; Airbill Number: 3436570712
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
4/14/95	1045	CAFB-FAC1400-D602	SOIL	1	SW8015 (DRO) (-11)	ENVIRONMENTAL SAMPLE

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick S. Gebhardt	TO FEDERAL EXPRESS	4/17/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	Anthony Turner (QPQ)	4/18/95	0840	ph: (303) 421-6611	Contents Temperature: 3.0 °C
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41554

Quanterra Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041621

MAY 11, 1995

FNC 3121

Reviewed by: Grant Wilton

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 20, 1995, Quanterra Environmental Services, Denver received one aqueous and nine soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical
IV. Quality Control Report

DIESEL RANGE ORGANIC ANALYSIS

Due to the dilutions required to bring the samples within the calibration range of the instrument, surrogate recoveries could not be determined for Quanterra sample numbers 041621-0001-SA through -0008-SA,-MS and -SD. In addition, the matrix spike compounds were also diluted out.

Except where indicated above, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041621-0001-SA	CAFB-FAC3121-0101	SOIL	18 APR 95	09:15	20 APR 95
041621-0002-SA	CAFB-FAC3121-0102	SOIL	18 APR 95	10:10	20 APR 95
041621-0003-SA	CAFB-FAC3121-0201	SOIL	18 APR 95	11:10	20 APR 95
041621-0004-SA	CAFB-FAC3121-0301	SOIL	18 APR 95	12:00	20 APR 95
041621-0005-SA	CAFB-FAC3121-0302	SOIL	18 APR 95	12:00	20 APR 95
041621-0006-SA	CAFB-FAC3121-0401	SOIL	18 APR 95	12:50	20 APR 95
041621-0007-SA	CAFB-FAC3121-0501	SOIL	18 APR 95	13:30	20 APR 95
041621-0008-SA	CAFB-FAC3121-0601	SOIL	18 APR 95	14:10	20 APR 95
041621-0008-MS	CAFB-FAC3121-0601	SOIL	18 APR 95	14:10	20 APR 95
041621-0008-SD	CAFB-FAC3121-0601	SOIL	18 APR 95	14:10	20 APR 95
041621-0009-SA	CAFB-FAC3121-0701	SOIL	18 APR 95	14:50	20 APR 95
041621-0010-EB	CAFB-FAC3121-0702	AQUEOUS	18 APR 95	17:00	20 APR 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041621	Group Code	Analysis Description	Custom Test?
0001 - 0009	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0010	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analysts judgement) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as in the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatile Organics, 1/10 of the reporting limit for GC/MS Semivolatile Organics, 1/2 the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

Quanterra
Environmental Services

T Preferred value unless footnoted on the secondary column test.

. This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with the footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multi-analyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0101
Lab ID: 041621-0001-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	17000	mg/kg	400	qlt
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0102
Lab ID: 041621-0002-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0201
Lab ID: 041621-0003-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3500	mg/kg	400	q1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0301
Lab ID: 041621-0004-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	12000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0302
Lab ID: 041621-0005-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8800	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0401
Lab ID: 041621-0006-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	10000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0501
Lab ID: 041621-0007-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5900	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0601
Lab ID: 041621-0008-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3700	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0701
Lab ID: 041621-0009-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	104	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0702
Lab ID: 041621-0010-EB
Matrix: AQUEOUS Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 25 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	107	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0101
Lab ID: 041621-0001-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0102
Lab ID: 041621-0002-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0201
Lab ID: 041621-0003-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0301
Lab ID: 041621-0004-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0302
Lab ID: 041621-0005-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0401
Lab ID: 041621-0006-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0501
Lab ID: 041621-0007-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0601
Lab ID: 041621-0008-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0701
Lab ID: 041621-0009-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results)

to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery:

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD):

$$\text{RPD} = \frac{\left| \text{Measured Concentration DCS1} - \text{Measured Concentration DCS2} \right|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041621-0001-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0002-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0003-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0004-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0005-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0006-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0007-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0008-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0008-MS	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0008-SD	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0009-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0010-EB	AQUEOUS	8015M-D-A	25 APR 95-N1	25 APR 95-N1

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 27 APR 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	20.2	20.6	20.4	102	48-138	2.0	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 25 APR 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.372	0.357	0.364	73	26-121	4.1	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 27 APR 95-N1 QC Run: 27 APR 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.908	114	64-136
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 25 APR 95-N1 QC Run: 25 APR 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0224	112	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit	
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 27 APR 95-N1 QC Run: 27 APR 95-N1				
Diesel Range Organics	2.0	mg/kg	4.0	J
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 27 APR 95-N1 QC Run: 27 APR 95-N1				
Diesel Range Organics	2.0	mg/kg	4.0	J
Test: 8015M-DRO-FID-A Matrix: AQUEOUS QC Lot: 25 APR 95-N1 QC Run: 25 APR 95-N1				
Diesel Range Organics	ND	mg/L	0.10	

J = Result is detected below the reporting limit or is an estimated concentration.

Quanterra
Environmental Services

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Organics by Chromatography

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE DUPLICATE	8015M-DRO-FID-S	041621-0008-SD	27 APR 95-N1
MATRIX SPIKE	8015M-DRO-FID-S	041621-0008-MS	27 APR 95-N1

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Organics by Chromatography
Project: 041621

Category: 8015M-D-S Diesel Range Organics in Solid Samples
Matrix: SOIL
Sample: 041621-0008
MS Run: 27 APR 95-N1
Units mg/kg Units Qualifier: Wet wt.

Analyte	Concentration Sample Result	MS Result	MSD Result	Amount Spiked MS	MSD	% Recovery MS	MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accep Limit
Diesel Range Organics (C8-C32)	3700	3900	4000	20	20	NC	NC	48-138	NC	32

NC = Not Calculated, calculation not applicable.

Calculations are performed before rounding to avoid round-off errors in calculated results.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number	PACKING AND SHIPPING DETAILS	
Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	Packed and Sealed for Shipping by: FRED GEBHARDT	Seal Number: 001
Sampling Location: FACILITY 3121	Delivered to Shipper by: FRED GEBHARDT	Airbill Number: 3436569684
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing HOWEVER, TEMPORARY ON HOLD	

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
4/18/95	0915	CAFB-FAC 3121-0101	SOIL	1	SW8015 (DRO)	ENVIRONMENTAL SAMPLE -01
"	1010	" -0102	"	1	"	" -02
"	1110	" -0201	"	1	"	" -03
"	1200	" -0301	"	1	"	" -0
"	1200	" -0302	"	1	"	" -0
"	1250	" -0401	"	1	"	" -06
"	1330	" -0501	"	1	"	" -07
"	1410	CAFB-FAC 3121-0601	SOIL	2	SW8015 (DRO)	ENVIRONMENTAL SAMPLE, MATRIX SPIKE & MSD -08
"	1450	" -0701	"	1	"	ENVIRONMENTAL SAMPLE -0
"	1700	CAFB-FAC 3121-0702	WATER	1	SW8015 (DRO)	EQUIPMENT BLANK -10

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick G. Gebhardt	TO FEDERAL EXPRESS	4/19/95		Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
		4/20/95	1500	ph: (303) 421-6611	Contents Temperature: 3.1
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41621

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 043171
JULY 25, 1995

IAS
600
2060

Reviewed by:

Grant Wilton

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On July 1, 1995 Quanterra Environmental Services, received one aqueous and thirteen soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
043171-0001-SA	CAFBFAC0600-0601	SOIL	27 JUN 95	10:20	01 JUL 95
043171-0002-SA	CAFBFAC0600-0602	SOIL	27 JUN 95	11:00	01 JUL 95
043171-0003-SA	CAFBFAC0600-0701	SOIL	27 JUN 95	14:45	01 JUL 95
043171-0004-SA	CAFBFAC0600-0702	SOIL	27 JUN 95	15:35	01 JUL 95
043171-0005-SA	CAFBFAC3060-0801	SOIL	28 JUN 95	11:20	01 JUL 95
043171-0006-SA	CAFBFAC3060-0901	SOIL	28 JUN 95	12:00	01 JUL 95
043171-0007-SA	CAFBFAC3060-1001	SOIL	28 JUN 95	12:50	01 JUL 95
043171-0008-SA	CAFBFAC3060-1101	SOIL	28 JUN 95	13:15	01 JUL 95
043171-0009-SA	CAFBFAC3121-0801	SOIL	29 JUN 95	10:00	01 JUL 95
043171-0010-SA	CAFBFAC3121-0901	SOIL	29 JUN 95	11:15	01 JUL 95
043171-0011-SA	CAFBFAC3121-0902	SOIL	29 JUN 95	11:30	01 JUL 95
043171-0012-SA	CAFBFAC3121-1001	SOIL	29 JUN 95	12:00	01 JUL 95
043171-0013-SA	CAFBFAC3121-1101	SOIL	29 JUN 95	12:45	01 JUL 95
043171-0014-EB	CAFBFAC3121-1102	AQUEOUS	29 JUN 95	17:30	01 JUL 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 043171	Group Code	Analysis Description	Custom Test?
0001 - 0013	A	Percent Water: ASTM D2216	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
0014	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0601
Lab ID: 043171-0001-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	13	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	87	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0602
Lab ID: 043171-0002-SA
Matrix: SOIL
Authorized: 01 JUL 95

Sampled: 27 JUN 95
Prepared: 10 JUL 95

Received: 01 JUL 95
Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.5	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	81	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux

Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0701
Lab ID: 043171-0003-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	18	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	95	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0702
Lab ID: 043171-0004-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.4	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	90	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC306C-0801
Lab ID: 043171-0005-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	15	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	94	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-0901
Lab ID: 043171-0006-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	40	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	96	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-1001
Lab ID: 043171-0007-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 24 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	160	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	119	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-1101
Lab ID: 043171-0008-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	22	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	92	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0801
Lab ID: 043171-0009-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.7	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	89	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0901
Lab ID: 043171-0010-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 24 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.2	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	90	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0902
Lab ID: 043171-0011-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.2	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	66	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-1001
Lab ID: 043171-0012-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.5	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	85	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-1101
Lab ID: 043171-0013-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.6	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	102	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method GC/FID

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-1102
Lab ID: 043171-0014-EB
Matrix: AQUEOUS Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: NA Analyzed: 05 JUL 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	94	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0601
Lab ID: 043171-0001-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall

Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0602
Lab ID: 043171-0002-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0701
Lab ID: 043171-0003-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0702
Lab ID: 043171-0004-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-0801
Lab ID: 043171-0005-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.5	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-0901
Lab ID: 043171-0006-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-1001
Lab ID: 043171-0007-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	1C	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-1101
Lab ID: 043171-0008-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.1	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0801
Lab ID: 043171-0009-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0901
Lab ID: 043171-0010-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0902
Lab ID: 043171-0011-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-1001
Lab ID: 043171-0012-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-1101
Lab ID: 043171-0013-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
043171-0001-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0002-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0003-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0004-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0005-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0006-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0007-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0008-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0009-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0010-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0011-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0012-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0013-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0014-EB	AQUEOUS	DRO-A	05 JUL 95-N1	05 JUL 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 10 JUL 95-N2 Concentration Units: mg/kg								
Diesel Range Organics	20.0	20.2	22.6	21.4	107	48-138	11	32
Category: DRO-A Matrix: AQUEOUS QC Lot: 05 JUL 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.342	0.352	0.347	69	26-121	2.9	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 10 JUL 95-N2 QC Run: 10 JUL 95-N2				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.719	90	64-136
Category: DRO-A				
Matrix: AQUEOUS				
QC Lot: 05 JUL 95-N1 QC Run: 05 JUL 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0187	94	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 10 JUL 95-N2 QC Run: 10 JUL 95-N2			
Diesel Range Organics	ND	mg/kg	4.0
Test: DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 05 JUL 95-N1 QC Run: 05 JUL 95-N1			
Diesel Range Organics	ND	mg/L	0.10

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number Cannon Air Force Base, Underground Storage Tank Sampling 463536002 ~~(463536004)~~	PACKING AND SHIPPING DETAILS
Sampling Location FACILITIES 600 + 3060	Packed and Sealed for Shipping by: FRED GEBHARDT Seal Number: 001
Team Leader Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT Airbill Number: 3436570756
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
6/27/95	1020	CAFBFAC0600-0601	SOIL	1	SW8015 -1	ENVIRONMENTAL SAMPLE
6/27/95	1100	CAFBFAC0600-0602	"	1	" -2	"
6/27/95	1445	CAFBFAC0600-0701	"	1	" -3	"
6/27/95	1535	CAFBFAC0600-0702	"	1	" -4	"
6/28/95	1120	CAFBFAC3060-0801	SOIL	1	SW8015 -5	ENVIRONMENTAL SAMPLE
6/28/95	1200	CAFBFAC3060-0901	"	1	" -6	"
6/28/95	1250	CAFBFAC3060-1001	"	1	" -7	"
6/28/95	1315	CAFBFAC3060-1101	"	1	" -8	"

Additional Comments: PAGE 1 OF 2

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick S. Gebhardt	TO FEDERAL EXPRESS	6/30/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	[illegible]	7/1/95	900	ph: (303) 421-6611	Contents Temperature: 5.2
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 4371

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number Cannon Air Force Base, Underground Storage Tank Sampling 463536002 ~~(463536004)~~	PACKING AND SHIPPING DETAILS.
Sampling Location FACILITY 3121	Packed and Sealed for Shipping by: FRED GEBHARDT Seal Number: 001
Team Leader Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT Airbill Number: 3436570756
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
6/29/95	1000	CAFBFAC3121-0801	SOIL	1	SW8015 -9	ENVIRONMENTAL SAMPLE
6/29/95	1115	CAFBFAC3121-0901	"	1	" -10	"
6/29/95	1130	CAFBFAC3121-0902	"	1	" -11	"
6/29/95	1200	CAFBFAC3121-1001	"	1	" -12	"
6/29/95	1245	CAFBFAC3121-1101	"	1	" -13	"
6/29/95	1730	CAFBFAC3121-1102	WATER	1	" -14	EQUIPMENT BLANK

Additional Comments: PAGE 2 OF 2

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick S. Gebhardt	TO FEDERAL EXPRESS	6/30/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: Good
	[illegible]	7/1/95	1100	ph: (303) 421-6611	Contents Temperature: 5.2
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 43171

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 043197
AUGUST 3, 1995

FMCs
2 of
3 of
[illegible]

Reviewed by:

FOR
Grant Wilton

Lindsay Breyer

I. OVERVIEW

On July 6, 1995 Quanterra Environmental Services, Denver received two aqueous and seventeen soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

Gasoline Range Organics

The soil samples were analyzed using the field methanol extraction method. Pre-weighed vials were supplied for sampling, and the vials were weighed again after sample collection. Labels placed on the vials at the time of sampling contributed to the measured sample weight, and the results may therefore have a negative bias.

Examination of the raw data will reveal an apparent discrepancy in the sample weights and extract volumes used in the calculations. The vials were supplied with 20 mL of solvent and the sample weights were between 12 and 20 grams. Due to software limitations, calculations had to be performed on the basis of 10 mL solvent. In order to obtain the correct results, the sample weights were therefore divided by two for entry into the data system.

The reporting limits were not adjusted based on sample weight. The reporting limit used is above the low point on the calibration curve, so the same reporting limit can be supported for all of the samples despite variations in the sample weights analyzed.

Diesel Range Organics

The samples were received between four and six days after collection. The laboratory was able to meet the applicable holding times except for sample 043197-0019-SA, which was extracted one day after the extraction holding time had expired.

Low surrogate recovery was obtained for sample 043197-0001-SA. The sample was re-extracted and analyzed with improved surrogate recovery. The re-extracted sample is reported as 043197-0001-RE. The second extraction took place after the extraction holding time had expired. The DCS associated with the re-extracted sample was mistakenly spiked at four times the normal spiking level. This was taken into account in calculating the recoveries.

General Inorganics

The only container received for sample 043197-0008-SA was for field extraction of GRO. The moisture content could not be measured.

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
043197-0001-SA	CAFBFAC0244-0101	SOIL	30 JUN 95	09:00	06 JUL 95
043197-0001-RE	CAFBFAC0244-0101	SOIL	30 JUN 95	09:00	06 JUL 95
043197-0002-SA	CAFBFAC0244-0201	SOIL	30 JUN 95	09:40	06 JUL 95
043197-0003-SA	CAFBFAC0244-0301	SOIL	30 JUN 95	10:15	06 JUL 95
043197-0004-SA	CAFBFAC0244-0401	SOIL	30 JUN 95	10:45	06 JUL 95
043197-0005-SA	CAFBFAC0244-0501	SOIL	30 JUN 95	11:10	06 JUL 95
043197-0006-SA	CAFBFAC0368-0102M	SOIL	01 JUL 95	08:20	06 JUL 95
043197-0007-SA	CAFBFAC0368-0601M	SOIL	01 JUL 95	09:15	06 JUL 95
043197-0008-SA	CAFBFAC0368-1001	SOIL	01 JUL 95	09:45	06 JUL 95
043197-0009-SA	CAFBFAC0368-1101	SOIL	01 JUL 95	11:00	06 JUL 95
043197-0010-SA	CAFBFAC0368-1201	SOIL	01 JUL 95	11:35	06 JUL 95
043197-0011-SA	CAFBFAC0368-1301	SOIL	01 JUL 95	12:25	06 JUL 95
043197-0012-SA	CAFBFAC0368-1401	SOIL	01 JUL 95	13:00	06 JUL 95
043197-0013-SA	CAFBFAC0368-1501	SOIL	01 JUL 95	13:45	06 JUL 95
043197-0014-SA	CAFBFAC0368-1601	SOIL	01 JUL 95	14:20	06 JUL 95
043197-0015-EB	CAFBFAC0368-1602	AQUEOUS	01 JUL 95	15:00	06 JUL 95
043197-0016-SA	CAFBFAC0368-1001	SOIL	02 JUL 95	07:55	06 JUL 95
043197-0017-SA	CAFBFAC0368-1701	SOIL	02 JUL 95	08:35	06 JUL 95
043197-0018-SA	CAFBFAC1400-0701	SOIL	02 JUL 95	09:40	06 JUL 95
043197-0019-EB	CAFBFAC1400-0702	AQUEOUS	02 JUL 95	12:00	06 JUL 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 043197	Group Code	Analysis Description	Custom Test?
0006 - 0014	A	Percent Water: ASTM D2216	N
		Gasoline Range Organics and Selected Components	N
		Gasoline Range Organics and Selected Components	N
0015	B	Gasoline Range Organics and Selected Components	N
0016 - 0018	C	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0001 - 0005	D	Percent Water: ASTM D2216	N
		Gasoline Range Organics and Selected Components	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Gasoline Range Organics and Selected Components	N
0019	E	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0101
Lab ID: 043197-0001-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	78	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0201
Lab ID: 043197-0002-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	71	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0301
Lab ID: 043197-0003-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	81	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0401
Lab ID: 043197-0004-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	88	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0501
Lab ID: 043197-0005-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	90	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-0102M
Lab ID: 043197-0006-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	78	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-0601M
Lab ID: 043197-0007-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	80	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1001
Lab ID: 043197-0008-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	5.0	t
Toluene	ND	mg/kg	5.0	
Ethylbenzene	ND	mg/kg	5.0	
Xylenes (total)	42	mg/kg	5.0	
Gasoline Range Organics	800	mg/kg	100	q

Surrogate	Recovery	
a,a,a-Trifluorotoluene	105	%

Note t : Sample diluted due to the concentration of target compounds.

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1101
Lab ID: 043197-0009-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	99	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1201
Lab ID: 043197-0010-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	93	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1301
Lab ID: 043197-0011-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	0.050	
Toluene	ND	mg/kg	0.050	
Ethylbenzene	0.038	mg/kg	0.050	J
Xylenes (total)	0.25	mg/kg	0.050	
Gasoline Range Organics	18	mg/kg	1.0	m

Surrogate	Recovery	
a,a,a-Trifluorotoluene	105	%

Note J : Result is detected below the reporting limit or is an estimated concentration.

Note m : This sample has GC/FID characteristics that are similar to weathered gasoline.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1401
Lab ID: 043197-0012-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	94	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1501
Lab ID: 043197-0013-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	99	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1601
Lab ID: 043197-0014-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	101	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1602
Lab ID: 043197-0015-EB
Matrix: AQUEOUS Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Units	Reporting Limit
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	0.50
Gasoline Range Organics	ND	ug/L	10

Surrogate	Recovery	
a,a,a-Trifluorotoluene	99	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0101
Lab ID: 043197-0001-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.7	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	30	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0101
Lab ID: 043197-0001-RE
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 25 JUL 95 Analyzed: 26 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.7	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	106	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C20.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0201
Lab ID: 043197-0002-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.7	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	91	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0301
Lab ID: 043197-0003-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	11	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	98	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0401
Lab ID: 043197-0004-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	10	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	97	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0501
Lab ID: 043197-0005-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.3	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	95	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1001
Lab ID: 043197-0016-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	160	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	107	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product cccurring within the n-alkane range of C10-C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1701
Lab ID: 043197-0017-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.1	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	100	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0701
Lab ID: 043197-0018-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	20	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	95	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0702
Lab ID: 043197-0019-EB
Matrix: AQUEOUS Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	106	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0101
Lab ID: 043197-0001-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0201
Lab ID: 043197-0002-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0301
Lab ID: 043197-0003-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0401
Lab ID: 043197-0004-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.6	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0501
Lab ID: 043197-0005-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.7	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-0102M
Lab ID: 043197-0006-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-0601M
Lab ID: 043197-0007-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.9	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1101
Lab ID: 043197-0009-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	18	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1201
Lab ID: 043197-0010-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.2	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1301
Lab ID: 043197-0011-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.9	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1401
Lab ID: 043197-0012-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1501
Lab ID: 043197-0013-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	6.9	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1601
Lab ID: 043197-0014-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1001
Lab ID: 043197-0016-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1701
Lab ID: 043197-0017-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0701
Lab ID: 043197-0018-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is
charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
043197-0001-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0002-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0003-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0004-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0005-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0006-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0007-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0008-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0009-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0010-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0011-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0012-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0013-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0014-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0015-EB	AQUEOUS	8020-G-A	11 JUL 95-B	11 JUL 95-B

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Category: 8020-F-S Matrix: SOIL QC Lot: 11 JUL 95-K Concentration Units: mg/kg								
Benzene	0.525	0.598	0.565	0.582	111	69-124	5.7	10
Toluene	1.12	1.31	1.33	1.32	118	65-139	1.5	11
Ethylbenzene	0.535	0.558	0.500	0.529	99	73-120	11	11
Xylenes (total)	2.60	2.76	2.65	2.70	104	50-128	4.1	10
Gasoline Range Organics	25.0	18.3	18.5	18.4	74	51- 99	1.1	10
Category: 8020-G-A Matrix: AQUEOUS QC Lot: 11 JUL 95-B Concentration Units: ug/L								
Benzene	10.5	10.8	10.7	10.8	102	70-120	0.9	10
Toluene	22.4	18.6	18.6	18.6	83	71-126	0.0	10
Ethylbenzene	10.7	11.5	11.6	11.6	108	74-119	0.9	10
Xylenes (total)	52.1	48.0	47.4	47.7	92	72-122	1.3	10
Gasoline Range Organics	500	351	346	348	70	50-100	1.4	10

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8020-F-S				
Matrix: SOIL				
QC Lot: 11 JUL 95-K QC Run: 11 JUL 95-K				
Concentration Units: mg/kg				
a,a,a-Trifluorotoluene	1.50	1.51	101	89-117
Category: 8020-G-A				
Matrix: AQUEOUS				
QC Lot: 11 JUL 95-B QC Run: 11 JUL 95-B				
Concentration Units: ug/L				
a,a,a-Trifluorotoluene	30.0	29.4	98	81-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8020-GRO-FIELD-S			
Matrix: SOIL			
QC Lot: 11 JUL 95-K QC Run: 11 JUL 95-K			
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0
Test: 8020-GRO-FIELD-S			
Matrix: SOIL			
QC Lot: 11 JUL 95-K QC Run: 11 JUL 95-K			
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0
Test: 8020-GRO-AP			
Matrix: AQUEOUS			
QC Lot: 11 JUL 95-B QC Run: 11 JUL 95-B			
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	0.50
Gasoline Range Organics	ND	ug/L	10

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
043197-0001-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0001-RE	SOIL	8015M-D-S	25 JUL 95-N1	25 JUL 95-N1
043197-0002-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0003-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0004-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0005-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0016-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0017-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0018-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0019-EB	AQUEOUS	8015M-D-A	10 JUL 95-N1	10 JUL 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 13 JUL 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	19.0	17.9	18.4	92	48-138	6.0	32
Category: 8015M-D-S Matrix: SOIL QC Lot: 25 JUL 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	80.0	76.6	77.9	77.2	97	48-138	1.7	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 10 JUL 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.426	0.420	0.423	85	26-121	1.4	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S Matrix: SOIL QC Lot: 13 JUL 95-N1 QC Run: 13 JUL 95-N1 Concentration Units: mg/kg				
o-Terphenyl	0.800	0.872	109	64-136
Category: 8015M-D-S Matrix: SOIL QC Lot: 25 JUL 95-N1 QC Run: 25 JUL 95-N1 Concentration Units: mg/kg				
o-Terphenyl	0.800	0.595	74	64-136
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 10 JUL 95-N1 QC Run: 10 JUL 95-N1 Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0230	115	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 13 JUL 95-N1 QC Run: 13 JUL 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 25 JUL 95-N1 QC Run: 25 JUL 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 13 JUL 95-N1 QC Run: 13 JUL 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-A Matrix: AQUEOUS QC Lot: 10 JUL 95-N1 QC Run: 10 JUL 95-N1			
Diesel Range Organics	ND	mg/L	0.10

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling 463536002 ~~(463536004)~~	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITIES 244 & 368	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 001
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436570734
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
6/30/95	0900	CAFBFAC0244-0101	SOIL	2	GRO SW8015M, DRO SW815, D2216	ENVIRONMENTAL SAMPLES	-1
6/30/95	0940	CAFBFAC0244-0201	"	2	" " "	"	-2
6/30/95	1015	CAFBFAC0244-0301	"	2	" " "	"	-3
6/30/95	1045	CAFBFAC0244-0401	"	2	" " "	"	-4
6/30/95	1110	CAFBFAC0244-0501	"	2	" " "	"	-5
7/1/95	0820	CAFBFAC0368-0102M	"	2	GRO SW8015M, D2216	"	-6
7/1/95	0915	CAFBFAC0368-0601M	"	2	" "	"	-7
7/1/95	0945	CAFBFAC0368-1001	"	2	" "	"	-8
7/1/95	1100	CAFBFAC0368-1101	"	2	" "	"	-9
7/1/95	1135	CAFBFAC0368-1201	"	2	" "	"	-10

Additional Comments: SAMPLE CAFBFAC0368-1001 HAD VERY HIGH HITS ON FIELD INSTRUMENTS.

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick G. Gebhardt	TO FEDERAL EXPRESS	7/5/95	1400	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[illegible]	7/6/95	830	ph: (303) 421-6611	Contents Temperature: 4.3
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 43197

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling ~~(463536004)~~ 463536002	PACKING AND SHIPPING DETAILS..
	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 001
Sampling Location: FACILITY 368 & 1400	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436570734
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing HOWEVER, TEMPORARY DELAYED.

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
7/1/95	1225	CAFBFAC0368-1301	SOIL	2	GRO SW8015M, D2216	ENVIRONMENTAL SAMPLES	-11
7/1/95	1300	CAFBFAC0368-1401	"	2	" "	"	-12
7/1/95	1345	CAFBFAC0368-1501	"	2	" "	"	-13
7/1/95	1420	CAFBFAC0368-1601	"	2	" "	"	-14
7/1/95	1500	CAFBFAC0368-1602	WATER	3	GRO SW8015M	EQUIPMENT BLANK	-15
7/2/95	0755	CAFBFAC0368-1001	SOIL	1	DRO SW8015, D2216	ENVIRONMENTAL SAMPLES	-16
7/2/95	0835	CAFBFAC0368-1701	"	1	DRO SW8015, D2216	"	-17
7/2/95	0940	CAFBFAC1400-0701	"	1	DRO SW8015, D2216	"	-18
7/2/95	1200	CAFBFAC1400-0702	WATER	1	DRO SW8015	EQUIPMENT BLANK	-19

Additional Comments: SAMPLE CAFBFAC0368-1001 WAS COLLECTED BOTH 7/1 & 7/2, I WANT THESE SAMPLES TO BE ANALYSISED FOR BOTH GRO & DRO.

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick E. Gebhardt	TO FEDERAL EXPRESS	7/5/95	1400	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[signature]	7/6/95	830	ph: (303) 421-6611	Contents Temperature: 4.3
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 43197

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 043723
AUGUST 23, 1995

FACS
3060

Reviewed by:

Mark D. Stella

Lindsay Breyer

I. OVERVIEW

On July 29, 1995 Quanterra Environmental Services, Denver received three aqueous and five soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

Diesel Range Organics

Samples 043723-0004-SA, -0005-SA, -0007-SA, and -0008-SA required dilution due to the concentration of target analytes present. As a result of the required dilutions, the concentrations of the surrogates in the samples were reduced to nondetectable levels.

The concentration of DRQ in the matrix spike duplicate (043723-0002-SD) was lower than the unspiked sample. As a result, the recovery and RPD could not be calculated. The sample was re-analyzed and the original result was confirmed. It is suspected that this problem was caused by sample inhomogeneity.

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
043723-0001-EB	CAFB-FAC-3060-0304EB	AQUEOUS	25 JUL 95	12:30	29 JUL 95
043723-0002-SA	CAFB-FAC-3060-0303	SOIL	25 JUL 95	14:49	29 JUL 95
043723-0002-MS	CAFB-FAC-3060-0303MSMSD	SOIL	25 JUL 95	14:49	29 JUL 95
043723-0002-SD	CAFB-FAC-3060-0303MSMSD	SOIL	25 JUL 95	14:49	29 JUL 95
043723-0003-EB	CAFB-FAC-3121-0103EB	AQUEOUS	26 JUL 95	11:20	29 JUL 95
043723-0004-SA	CAFB-FAC-3121-0104	SOIL	26 JUL 95	13:30	29 JUL 95
043723-0005-SA	CAFB-FAC-3121-0105	SOIL	26 JUL 95	15:20	29 JUL 95
043723-0006-EB	CAFB-FAC-3121-0303	AQUEOUS	27 JUL 95	09:20	29 JUL 95
043723-0007-SA	CAFB-FAC-3121-0303	SOIL	27 JUL 95	10:20	29 JUL 95
043723-0008-SA	CAFB-FAC-3121-0304	SOIL	27 JUL 95	15:15	29 JUL 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 043723	Group Code	Analysis Description	Custom Test?
0002 , 0004,	A	Percent Water: ASTM D2216	N
0005 , 0007,		Extractable Petroleum Hydrocarbons	N
0008		Prep - Hydrocarbons by GC	N
0001 , 0003,	B	Extractable Petroleum Hydrocarbons	N
0006		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3060-0304EB
Lab ID: 043723-0001-EB
Matrix: AQUEOUS Sampled: 25 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 01 AUG 95 Analyzed: 02 AUG 95

Parameter	Result	Units	Reporting Limit	
Diesel Range Organics	0.47	mg/L	0.10	q1
Surrogate	Recovery			
o-Terphenyl	85	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3060-0303
Lab ID: 043723-0002-SA
Matrix: SOIL Sampled: 25 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 18 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	78	mg/kg	4.0	1
Surrogate	Recovery			
o-Terphenyl	118	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C28.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0103EB
Lab ID: 043723-0003-EB
Matrix: AQUEOUS Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 01 AUG 95 Analyzed: 02 AUG 95

Parameter	Result	Units	Reporting Limit	
Diesel Range Organics	0.12	mg/L	0.10	q1
Surrogate	Recovery			
o-Terphenyl	83	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0303
Lab ID: 043723-0006-EB
Matrix: AQUEOUS Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 01 AUG 95 Analyzed: 02 AUG 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	102	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0105
Lab ID: 043723-0005-SA
Matrix: SOIL Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 21 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	11000	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0104
Lab ID: 043723-0004-SA
Matrix: SOIL Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 21 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	13000	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0105
Lab ID: 043723-0005-SA
Matrix: SOIL Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 21 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	11000	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0303
Lab ID: 043723-0006-EB
Matrix: AQUEOUS Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 01 AUG 95 Analyzed: 02 AUG 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	102	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0303
Lab ID: 043723-0007-SA
Matrix: SOIL Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 21 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	25000	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0304
Lab ID: 043723-0008-SA
Matrix: SOIL Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 21 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	17000	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3060-0303
Lab ID: 043723-0002-SA
Matrix: SOIL Sampled: 25 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	03 AUG 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0104
Lab ID: 043723-0004-SA
Matrix: SOIL Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.9	%	0.10	D2216	NA	03 AUG 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0105
Lab ID: 043723-0005-SA
Matrix: SOIL Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.3	%	0.10	D2216	NA	03 AUG 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0303
Lab ID: 043723-0007-SA
Matrix: SOIL Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.8	%	0.10	D2216	NA	03 AUG 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0304
Lab ID: 043723-0008-SA
Matrix: SOIL Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.1	%	0.10	D2216	NA	03 AUG 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is
charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \text{ X } 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \text{ X } 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
043723-0001-EB	AQUEOUS	8015M-D-A	01 AUG 95-N1	01 AUG 95-N1
043723-0002-SA	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0002-MS	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0002-SD	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0003-EB	AQUEOUS	8015M-D-A	01 AUG 95-N1	01 AUG 95-N1
043723-0004-SA	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0005-SA	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0006-EB	AQUEOUS	8015M-D-A	01 AUG 95-N1	01 AUG 95-N1
043723-0007-SA	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0008-SA	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 01 AUG 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.314	0.348	0.331	66	26-121	10	44
Category: 8015M-D-S Matrix: SOIL QC Lot: 08 AUG 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	23.6	21.1	22.4	112	48-138	11	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 01 AUG 95-N1 QC Run: 01 AUG 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0192	96	47-137
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 08 AUG 95-N1 QC Run: 08 AUG 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.829	104	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 01 AUG 95-N1 QC Run: 01 AUG 95-N1			
Diesel Range Organics	ND	mg/L	0.10
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 08 AUG 95-N1 QC Run: 08 AUG 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 08 AUG 95-N1 QC Run: 08 AUG 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

Quanterra
Environmental Services

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Semivolatile Organics by GC

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE DUPLICATE	8015M-DRO-FID-S	043723-0002-SD	08 AUG 95-N1
MATRIX SPIKE	8015M-DRO-FID-S	043723-0002-MS	08 AUG 95-N1

Quanterra
Environmental Services

TRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Semivolatile Organics by GC
Project: 043723

Category: 8015M-D-S Diesel Range Organics in Solid Samples
Matrix: SOIL
Sample: 043723-0002
MS Run: 08 AUG 95-N1
Units mg/kg Units Qualifier: Wet wt.

Analyte	Concentration Sample Result	MS Result	MSD Result	Amount Spiked MS	MSD	% Recovery MS	MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Diesel Range Organics (C8-C32)	78	98	74	20	20	100	NC	48-138	NC	32

NC = Not Calculated, calculation not applicable.

Calculations are performed before rounding to avoid round-off errors in calculated results.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	PACKING AND SHIPPING DETAILS
Sampling Location: FAC 3060 & Melrose 3121	Packed and Sealed for Shipping by: Jerry Larson — Seal Number: 001
Team Leader: ~~Fred Gebhardt~~ Jerry Larson	Delivered to Shipper by: Jerry Larson — Airbill Number: 3436968461
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
7-25-95	1230	CAFBFAC-3060-0304 EB	water	1	SW8015 – DRO	Equipment Blank	-01
7-25-95	1445	CAFBFAC-3060-0303	soil	1	SW8015 – DRO	Enviro Sample	-02
7-25-95	1445	CAFBFAC-3060-0303 MS/MSD	Soil	1	" "	MS – MSD	-02 MS/SD
7-26-95	1120	CAFBFAC-3121-0103 EB	water	1	" "	Equip Blank	-03
7-26-95	1330	CAFBFAC-3121-0104	soil	1	" "	Enviro 24-26 ft	-04
7-26-95	1520	CAFBFAC-3121-0105	Soil	1	" "	Enviro 29-31 ft	-05
7-27-95	0920	CAFBFAC-3121-0303	water	1	" "	Equip Blank	-06
7-27-95	1020	CAFBFAC-3121-0303	Soil	1	" "	Enviro 19-21 ft	-07
7-27-95	1515	CAFBFAC-3121-0304	Soil	1	" "	Enviro 29-29.5	-08

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Jerry D Larson	Fed. Express	7/28/95	1400	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	[illegible]	7/29/95	930	ph: (303) 421-6611	Contents Temperature: 3.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 43723

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 044268
SEPTEMBER 21, 1995

Reviewed by:

Mark D. Stella

Lindsay Breyer

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

I. OVERVIEW

On August 29, 1995 Quanterra Environmental Services, Denver received ten soil and two aqueous samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

At the request of Mr. Fred Gebhardt, all client sample identifications beginning with CAFBFA0358 were changed in our data system to CAFBFA0368 on September 1, 1995.

Samples 044268-0008-SA through -0011-SA could not be analyzed for moisture content. The only container submitted for these samples was the vial for GRO using the field methanol extraction method.

Gasoline Range Organics

Pre-weighed vials containing methanol spiked with the surrogate were supplied by Quanterra for sampling this parameter. The vial were re-weighed upon receipt in order to obtain the amount of sample actually collected and extracted. Labels placed on the containers at the time of sampling contributed to the measured sample weight, and may have caused a low bias in the results.

The surrogate recoveries for samples 044268-0008-SA and -0009-SA were outside QC limits. Review of the data indicated the presence of matrix interferences, and the data were accepted.

Sample 044268-0012-TB was a trip blank for GRO using the field methanol extraction method. It consisted of a vial containing methanol and was logged in as a soil sample. The results for this sample were calculated using a nominal sample weight of 10 grams.

Diesel Range Organics

The surrogate recovery for sample 044268-0005-SA was outside QC limits. Review of the data indicated the presence of matrix interferences, and the data were accepted.

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
044268-0001-EB	CAFBFAC0600-0801EB	AQUEOUS	23 AUG 95	16:20	29 AUG 95
044268-0002-SA	CAFBFAC0600-0802	SOIL	23 AUG 95	18:05	29 AUG 95
044268-0003-SA	CAFBFAC0600-0803	SOIL	23 AUG 95	19:05	29 AUG 95
044268-0003-MS	CAFBFAC0600-0803	SOIL	23 AUG 95	19:05	29 AUG 95
044268-0003-SD	CAFBFAC0600-0803	SOIL	23 AUG 95	19:05	29 AUG 95
044268-0004-SA	CAFBFAC3121-0106	SOIL	24 AUG 95	12:45	29 AUG 95
044268-0005-SA	CAFBFAC3121-0107	SOIL	24 AUG 95	15:20	29 AUG 95
044268-0006-SA	CAFBFAC3121-0108	SOIL	25 AUG 95	11:00	29 AUG 95
044268-0007-EB	CAFBFAC0368-1002EB	AQUEOUS	25 AUG 95	16:10	29 AUG 95
044268-0008-SA	CAFBFAC0368-1003	SOIL	25 AUG 95	18:10	29 AUG 95
044268-0009-SA	CAFBFAC0368-1004	SOIL	25 AUG 95	18:30	29 AUG 95
044268-0010-SA	CAFBFAC0368-1005	SOIL	26 AUG 95	09:55	29 AUG 95
044268-0011-SA	CAFBFAC0368-1006	SOIL	26 AUG 95	13:00	29 AUG 95
044268-0012-TB	CAFBFAC0368-1007TB	SOIL	26 AUG 95	13:30	29 AUG 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 044268	Group Code	Analysis Description	Custom Test?
0008 - 0012	A	Percent Water: ASTM D2216	N
		Gasoline Range Organics and Selected Components	N
0007	B	Gasoline Range Organics and Selected Components	N
0002 - 0006	C	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0001	D	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1002EB
Lab ID: 044268-0007-EB
Matrix: AQUEOUS Sampled: 25 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 31 AUG 95

Parameter	Result	Units	Reporting Limit
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	0.50
Gasoline Range Organics	ND	ug/L	10

Surrogate	Recovery	
a,a,a-Trifluorotoluene	96	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1003
Lab ID: 044268-0008-SA
Matrix: SOIL Sampled: 25 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 05 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	2.5	t
Toluene	ND	mg/kg	2.5	
Ethylbenzene	7.4	mg/kg	2.5	
Xylenes (total)	270	mg/kg	2.5	
Gasoline Range Organics	1000	mg/kg	50	m

Surrogate	Recovery	
a,a,a-Trifluorotoluene	ND	%

Note t : Sample diluted due to the concentration of target compounds.

Note m : This sample has GC/FID characteristics that are similar to weathered gasoline.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1004
Lab ID: 044268-0009-SA
Matrix: SOIL Sampled: 25 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 05 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	2.0	t
Toluene	3.6	mg/kg	2.0	
Ethylbenzene	6.7	mg/kg	2.0	
Xylenes (total)	210	mg/kg	2.0	
Gasoline Range Organics	830	mg/kg	40	m

Surrogate	Recovery	
a,a,a-Trifluorotoluene	ND	%

Note t : Sample diluted due to the concentration of target compounds.

Note m : This sample has GC/FID characteristics that are similar to weathered gasoline.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1005
Lab ID: 044268-0010-SA
Matrix: SOIL Sampled: 26 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 31 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	0.50	t
Toluene	ND	mg/kg	0.50	
Ethylbenzene	ND	mg/kg	0.50	
Xylenes (total)	2.9	mg/kg	0.50	
Gasoline Range Organics	37	mg/kg	10	q

Surrogate	Recovery	
a,a,a-Trifluorotoluene	97	%

Note t : Sample diluted due to the concentration of target compounds.

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1006
Lab ID: 044268-0011-SA
Matrix: SOIL Sampled: 26 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 05 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	0.050	
Toluene	ND	mg/kg	0.050	
Ethylbenzene	0.10	mg/kg	0.050	
Xylenes (total)	0.055	mg/kg	0.050	
Gasoline Range Organics	0.97	mg/kg	1.0	J

Surrogate	Recovery	
a,a,a-Trifluorotoluene	110	%

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1007TB
Lab ID: 044268-0012-TB
Matrix: SOIL Sampled: 26 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 31 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	100	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0801EB
Lab ID: 044268-0001-EB
Matrix: AQUEOUS Sampled: 23 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 30 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	94	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Karen Kuiken

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0802
Lab ID: 044268-0002-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	96	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Karen Kuiken

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0803
Lab ID: 044268-0003-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.9	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	91	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C18-C28.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Karen Kuiken

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0106
Lab ID: 044268-0004-SA
Matrix: SOIL Sampled: 24 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	97	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0107
Lab ID: 044268-0005-SA
Matrix: SOIL Sampled: 24 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 31 AUG 95 Analyzed: 06 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	9500	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Karen Kuiken

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0108
Lab ID: 044268-0006-SA
Matrix: SOIL Sampled: 25 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	89	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Karen Kuiken

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0802
Lab ID: 044268-0002-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0803
Lab ID: 044268-0003-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	16	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0106
Lab ID: 044268-0004-SA
Matrix: SOIL Sampled: 24 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	17	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0107
Lab ID: 044268-0005-SA
Matrix: SOIL Sampled: 24 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0108
Lab ID: 044268-0006-SA
Matrix: SOIL Sampled: 25 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	7.3	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is
charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
044268-0007-EB	AQUEOUS	8020-G-A	31 AUG 95-A	31 AUG 95-A
044268-0008-SA	SOIL	8020-F-S	05 SEP 95-L	05 SEP 95-L
044268-0009-SA	SOIL	8020-F-S	05 SEP 95-L	05 SEP 95-L
044268-0010-SA	SOIL	8020-F-S	31 AUG 95-A	31 AUG 95-A
044268-0011-SA	SOIL	8020-F-S	05 SEP 95-L	05 SEP 95-L
044268-0012-TB	SOIL	8020-F-S	31 AUG 95-A	31 AUG 95-A

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Category: 8020-G-A Matrix: AQUEOUS QC Lot: 31 AUG 95-A Concentration Units: ug/L								
Benzene	10.5	10.5	10.6	10.6	100	70-120	0.9	10
Toluene	22.4	21.0	21.2	21.1	94	71-126	0.9	10
Ethylbenzene	10.7	9.17	9.20	9.18	86	74-119	0.3	10
Xylenes (total)	52.1	48.8	48.2	48.5	93	72-122	1.2	10
Gasoline Range Organics	500	331	337	334	67	50-100	1.8	10
Category: 8020-F-S Matrix: SOIL QC Lot: 05 SEP 95-L Concentration Units: mg/kg								
Benzene	0.525	0.443	0.440	0.442	84	69-124	0.7	10
Toluene	1.12	1.19	1.17	1.18	105	65-139	1.7	11
Ethylbenzene	0.535	0.455	0.448	0.452	84	73-120	1.6	11
Xylenes (total)	2.605	2.24	2.21	2.22	85	50-128	1.3	10
Gasoline Range Organics	25.0	14.0	14.2	14.1	56	51- 99	1.4	10
Category: 8020-F-S Matrix: SOIL QC Lot: 31 AUG 95-A Concentration Units: mg/kg								
Benzene	0.525	0.525	0.530	0.528	100	69-124	0.9	10
Toluene	1.12	1.05	1.06	1.06	94	65-139	0.9	11
Ethylbenzene	0.535	0.458	0.460	0.459	86	73-120	0.4	11
Xylenes (total)	2.60	2.44	2.41	2.42	93	50-128	1.2	10
Gasoline Range Organics	25.0	16.5	16.8	16.6	67	51- 99	1.8	10

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8020-G-A				
Matrix: AQUEOUS				
QC Lot: 31 AUG 95-A QC Run: 31 AUG 95-A				
Concentration Units: ug/L				
a,a,a-Trifluorotoluene	30.0	28.3	94	81-120
Category: 8020-F-S				
Matrix: SOIL				
QC Lot: 05 SEP 95-L QC Run: 05 SEP 95-L				
Concentration Units: mg/kg				
a,a,a-Trifluorotoluene	1.50	1.48	99	89-117
Category: 8020-F-S				
Matrix: SOIL				
QC Lot: 31 AUG 95-A QC Run: 31 AUG 95-A				
Concentration Units: mg/kg				
a,a,a-Trifluorotoluene	1.50	1.42	95	89-117

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8020-GRO-AP			
Matrix: AQUEOUS			
QC Lot: 31 AUG 95-A QC Run: 31 AUG 95-A			
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	0.50
Gasoline Range Organics	ND	ug/L	10
Test: 8020-GRO-FIELD-S			
Matrix: SOIL			
QC Lot: 05 SEP 95-L QC Run: 05 SEP 95-L			
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0
Test: 8020-GRO-FIELD-S			
Matrix: SOIL			
QC Lot: 31 AUG 95-A QC Run: 31 AUG 95-A			
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
044268-0001-EB	AQUEOUS	8015M-D-A	30 AUG 95-N1	30 AUG 95-N1
044268-0002-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0003-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0003-MS	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0003-SD	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0004-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0005-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0006-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 30 AUG 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.307	0.334	0.320	64	26-121	8.4	44
Category: 8015M-D-S Matrix: SOIL QC Lot: 31 AUG 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	17.6	18.1	17.8	89	48-138	2.8	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 30 AUG 95-N1 QC Run: 30 AUG 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0185	92	47-137
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 31 AUG 95-N1 QC Run: 31 AUG 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.794	99	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 30 AUG 95-N1 QC Run: 30 AUG 95-N1			
Diesel Range Organics	ND	mg/L	0.10
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 31 AUG 95-N1 QC Run: 31 AUG 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 31 AUG 95-N1 QC Run: 31 AUG 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

Quanterra
Environmental Services

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Semivolatile Organics by GC

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE DUPLICATE	8015M-DRO-FID-S	044268-0003-SD	31 AUG 95-N1
MATRIX SPIKE	8015M-DRO-FID-S	044268-0003-MS	31 AUG 95-N1

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Semivolatile Organics by GC
Project: 044268

Category: 8015M-D-S Diesel Range Organics in Solid Samples
Matrix: SOIL
Sample: 044268-0003
MS Run: 31 AUG 95-N1
Units mg/kg Units Qualifier: Wet wt.

Analyte	Sample Result	Concentration MS Result	Concentration MSD Result	Amount Spiked MS	Amount Spiked MSD	% Recovery MS	% Recovery MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Diesel Range Organics (C8-C32)	7.9	24	26	20	20	81	91	48-138	12	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (46353600 2)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITIES 600, 3121, 358,	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 033647
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436569975
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
8/23/95	1620	CAFBFAC0600-0801EB	WATER	1	SW8015 DRO -01	EQUIPMENT BLANK
8/23/95	1805	CAFBFAC0600-0802	SOIL	1	" -02	ENVIRONMENTAL SAMPLE
8/23/95	1905	CAFBFAC0600-0803	"	2	" -03 MSD	ENVIRONMENTAL SAMPLE AND MATRIX SPIKE + MSD
8/24/95	1245	CAFBFAC3121-0106	"	1	" -04	ENVIRONMENTAL SAMPLE
8/24/95	1520	CAFBFAC3121-0107	"	1	" -05	"
8/25/95	1100	CAFBFAC3121-0108	"	1	" -06	"
8/25/95	1610	CAFBFAC0358-1002EB	WATER	3	SW8015 GRO -07	EQUIPMENT BLANK
8/25/95	1810	CAFBFAC0358-1003	SOIL/METHANOL	1	" -08	ENVIRONMENTAL SAMPLE
8/25/95	1830	CAFBFAC0358-1004	"	1	" -09	"
8/26/95	0955	CAFBFAC0358-1005	"	1	" -10	"

Additional Comments: MAJORITY OF THESE SAMPLES HAD VERY HIGH READINGS ON FIELD G.C.

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick E. Gebhardt	TO FEDERAL EXPRESS	8/28/95	1530	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[illegible]	8/29/95	930	ph: (303) 421-6611	Contents Temperature: 2-6
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 44261

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536002)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITY 358	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 033647
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436569975
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
8/26/95	1300	CAFBFAC0358-1006	SOIL / METHANOL	1	SW8015 GRO -11	ENVIRONMENTAL SAMPLE
8/26/95	1330	CAFBFAC0358-1007TB	METHANOL	1	" -12	TRIP BLANK

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick G. Gebhardt	TO FEDERAL EXPRESS	8/28/95	1530	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[illegible]	8/29/95	930	ph: (303) 421-6611	Contents Temperature: 26
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 4262

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 044301
SEPTEMBER 15, 1995

Reviewed by:

Mark D. Stella

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On August 24, 1995 Quanterra Environmental Services, Denver received three soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

The samples in this project were originally logged in under Quanterra project 044197. In accordance with instructions from Mr. Bob Brock on August 30, 1995, they were re-logged under this project.

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
044301-0001-SA	CAFBFAC30601201	SOIL	23 AUG 95	10:30	24 AUG 95
044301-0002-SA	CAFBFAC30601301	SOIL	23 AUG 95	11:30	24 AUG 95
044301-0003-SA	CAFBFAC30601302	SOIL	23 AUG 95	11:45	24 AUG 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 044301	Group Code	Analysis Description	Custom Test?
0001 - 0003	A	Percent Water: ASTM D2216	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601201
Lab ID: 044301-0001-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	110	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601301
Lab ID: 044301-0002-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	94	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601302
Lab ID: 044301-0003-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	94	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Roxanne Sullivan

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601201
Lab ID: 044301-0001-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.7	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601301
Lab ID: 044301-0002-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601302
Lab ID: 044301-0003-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.1	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is
charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \text{ X } 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \text{ X } 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
044301-0001-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044301-0002-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044301-0003-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S								
Matrix: SOIL								
QC Lot: 31 AUG 95-N1								
Concentration Units: mg/kg								
Diesel Range Organics	20.0	17.6	18.1	17.8	89	48-138	2.8	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 31 AUG 95-N1 QC Run: 31 AUG 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.794	99	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 31 AUG 95-N1 QC Run: 31 AUG 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (46353600~~X~~ 2)	PACKING AND SHIPPING DETAILS:
Sampling Location: FACILITY 3060	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 034021
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436570870
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
8/23/95	1030	CAFBFAC 3060 1201	SOIL	1	SW8015 DRO	ENVIRONMENTAL SAMPLE	-01
8/23/95	1130	CAFBFAC 3060 1301	"	1	"	"	-02
8/23/95	1145	CAFBFAC 3060 1302	"	1	"	"	-03

Additional Comments:

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick E. Gebhardt	TO FEDERAL EXPRESS	8/23/95	1200	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: ~~4.0~~ good
	[illegible]	8/24/95	930	ph: (303) 421-6611	Contents Temperature: 4.0
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: ~~44197~~ 44301

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 044320
SEPTEMBER 22,1995

FYC
1400

Reviewed by:

Mark D. Stella

Lindsay Breyer

I. OVERVIEW

On August 31, 1995 Quanterra Environmental Services, Denver received one aqueous and six soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

Diesel Range Organics

Samples 044320-0004-SA through -0007-SA required dilution due to the concentrations of target analytes present. As a result of these dilutions, the surrogate concentrations were too low to be measured and were reported as ND (Not Detected).

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
044320-0001-SA	CAFBFAC1400-0801	SOIL	26 AUG 95	17:25	31 AUG 95
044320-0002-EB	CAFBFAC1400-0901EB	AQUEOUS	27 AUG 95	08:15	31 AUG 95
044320-0003-SA	CAFBFAC1400-0902	SOIL	27 AUG 95	11:05	31 AUG 95
044320-0004-SA	CAFBFAC1400-0302	SOIL	28 AUG 95	12:35	31 AUG 95
044320-0005-SA	CAFBFAC1400-0303	SOIL	28 AUG 95	13:00	31 AUG 95
044320-0006-SA	CAFBFAC1400-0304	SOIL	28 AUG 95	15:30	31 AUG 95
044320-0007-SA	CAFBFAC1400-0305	SOIL	28 AUG 95	19:10	31 AUG 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 044320	Group Code	Analysis Description	Custom Test?
0001 , 0003, 0004 - 0007	A	Percent Water: ASTM D2216	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
0002	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0801
Lab ID: 044320-0001-SA
Matrix: SOIL Sampled: 26 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 11 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	108	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0901EB
Lab ID: 044320-0002-EB
Matrix: AQUEOUS Sampled: 27 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 01 SEP 95 Analyzed: 07 SEP 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	92	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0902
Lab ID: 044320-0003-SA
Matrix: SOIL Sampled: 27 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 12 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	890	mg/kg	16	qlt
Surrogate	Recovery			
o-Terphenyl	126	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0302
Lab ID: 044320-0004-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 12 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0303
Lab ID: 044320-0005-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 12 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0304
Lab ID: 044320-0006-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 12 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	11000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0305
Lab ID: 044320-0007-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 12 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5800	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0801
Lab ID: 044320-0001-SA
Matrix: SOIL Sampled: 26 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.6	%	0.10	D2216	NA	06 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0902
Lab ID: 044320-0003-SA
Matrix: SOIL Sampled: 27 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	6.6	%	0.10	D2216	NA	06 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0302
Lab ID: 044320-0004-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	06 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0303
Lab ID: 044320-0005-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	06 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0304
Lab ID: 044320-0006-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	06 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is
charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \text{ X } 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \text{ X } 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
044320-0001-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11
044320-0002-EB	AQUEOUS	8015M-D-A	01 SEP 95-N1	01 SEP 95-N1
044320-0003-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11
044320-0004-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11
044320-0005-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11
044320-0006-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11
044320-0007-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 08 SEP 95-N11 Concentration Units: mg/kg								
Diesel Range Organics	20.0	23.1	21.0	22.0	110	48-138	9.3	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 01 SEP 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.214	0.250	0.232	46	26-121	15	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 08 SEP 95-N11 QC Run: 08 SEP 95-N11				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.905	113	64-136
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 01 SEP 95-N1 QC Run: 01 SEP 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0166	83	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 08 SEP 95-N11 QC Run: 08 SEP 95-N11			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 01 SEP 95-N1 QC Run: 01 SEP 95-N1			
Diesel Range Organics	ND	mg/L	0.10

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (46353600~~X~~ 2)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITY 1400	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 001
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436569706
	Sampling Status: ☒ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
8/26/95	1725	CAFBFAC1400-0801	SOIL	1	SW8015 DRO -1	ENVIRONMENTAL SAMPLE
8/27/95	0815	CAFBFAC1400-0901EB	WATER	1	" -2	EQUIPMENT BLANK
8/27/95	1105	CAFBFAC1400-0902	SOIL	1	" -3	ENVIRONMENTAL SAMPLE
8/28/95	1235	CAFBFAC1400-0302	"	1	" -4	"
8/28/95	1300	CAFBFAC1400-0303	"	1	" -5	"
8/28/95	1530	CAFBFAC1400-0304	"	1	" -6	"
* 8/28/95	1910	CAFBFAC1400-0305	"	1	" -7	"

Additional Comments: ALL SAMPLES EXCEPT -0901EB HAD HIGH READINGS ON FIELD G.C.
* DO NOT RUN SOIL MOISTURE ON THIS SAMPLE, MOISTURE DUE TO ~~SURFACE~~ ADDED SURFACE WATER.

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick E. Gebhardt	TO FEDERAL EXPRESS	~~1440~~ 8-30-95	1440	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[illegible]	8-31-95	930	ph: (303) 421-6611	Contents Temperature: 2.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 4320

Quanterra Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA NO. 046431

JANUARY 11, 1996

Prepared by: Mark D. Stella

Reviewed by: Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On December 16, 1995, Quanterra Environmental Services, Denver received six soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

With the exceptions noted on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information:

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra's Denver laboratory is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests:

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
046431-0001-SA	CAFBFAC14001001	SOIL	12 DEC 95	10:45	16 DEC 95
046431-0002-SA	CAFBFAC14001101	SOIL	12 DEC 95	11:20	16 DEC 95
046431-0003-SA	CAFBFAC14001201	SOIL	12 DEC 95	12:00	16 DEC 95
046431-0004-SA	CAFBFAC14000306	SOIL	14 DEC 95	11:10	16 DEC 95
046431-0005-SA	CAFBFAC14000307	SOIL	14 DEC 95	11:40	16 DEC 95
046431-0006-SA	CAFBFAC14000308	SOIL	14 DEC 95	13:20	16 DEC 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 046431	Group Code	Analysis Description	Custom Test?
0001 - 0006	A	Percent Water: ASTM D2216	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization date is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

Quanterra does not routinely blank-correct analytical data. Uncorrected analytical results are reported, along with associated blank results, for all organic and metals analyses. Analytical results and blank results are reported for conventional inorganic parameters as specified in the method.

In addition, surrogate recovery data is presented for all GC analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method.

Footnotes and Data Qualifiers

The data sheets contained in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tenatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analysts judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction the footnote V.

V Secondary column is the preferred value.

•This footnote is used for GC tests in conjunction the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multi-analyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001001
Lab ID: 046431-0001-SA
Matrix: SOIL Sampled: 12 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 27 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	90	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001101
Lab ID: 046431-0002-SA
Matrix: SOIL Sampled: 12 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 27 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	91	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001201
Lab ID: 046431-0003-SA
Matrix: SOIL Sampled: 12 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 27 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	16	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	91	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C16-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000306
Lab ID: 046431-0004-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 30 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	9300	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000307
Lab ID: 046431-0005-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 27 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	98	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000308
Lab ID: 046431-0006-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 27 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	99	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001001
Lab ID: 046431-0001-SA
Matrix: SOIL Sampled: 12 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.6	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham Approved By: Jeff Malecha

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001101
Lab ID: 046431-0002-SA
Matrix: SOIL
Sampled: 12 DEC 95
Received: 16 DEC 95
Authorized: 16 DEC 95
Prepared: See Below
Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	6.2	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham

Approved By: Jeff Malecha

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001201
Lab ID: 046431-0003-SA
Matrix: SOIL Sampled: 12 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	7.6	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham Approved By: Jeff Malecha

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000306
Lab ID: 046431-0004-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.6	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham Approved By: Jeff Malecha

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000307
Lab ID: 046431-0005-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.6	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham Approved By: Jeff Malecha

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000308
Lab ID: 046431-0006-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham Approved By: Jeff Malecha

IV. QUALITY CONTROL REPORT

The Quanterra laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

The Quanterra QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{Measured Concentration DCS1} - \text{Measured Concentration DCS2}|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
046431-0001-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1
046431-0002-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1
046431-0003-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1
046431-0004-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1
046431-0005-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1
046431-0006-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S								
Matrix: SOIL								
QC Lot: 21 DEC 95-N1								
Concentration Units: mg/kg								
Diesel Range Organics	20.0	21.5	21.1	21.3	107	48-138	1.9	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 21 DEC 95-N1 QC Run: 21 DEC 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.764	96	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 21 DEC 95-N1 QC Run: 21 DEC 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

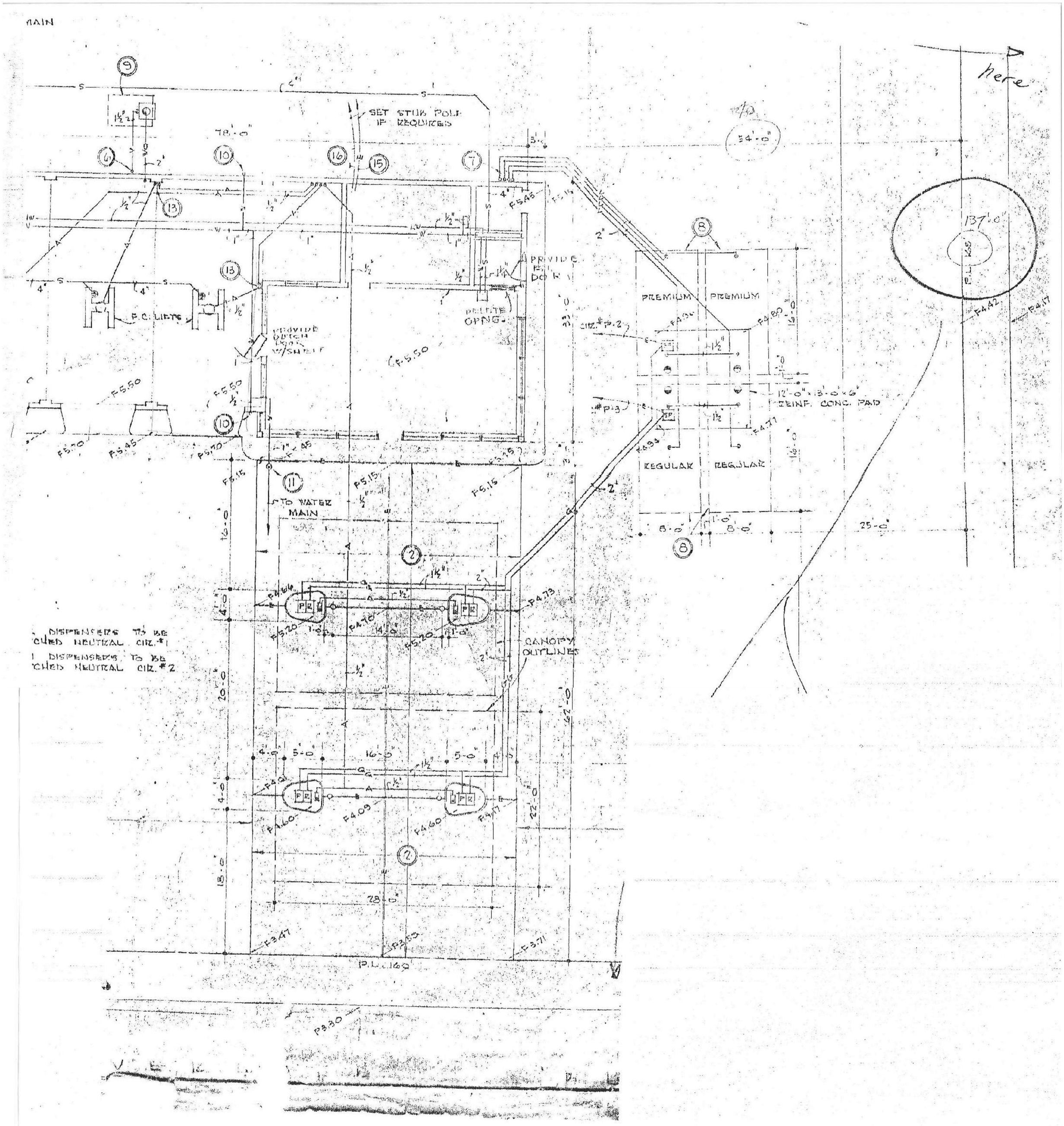
FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE

Former Gas Station Site (ST-C502)

As-built Drawing
Inspection Report


MAIN
here
SET STUB POLE IF REQUIRED
78'-0"
54'-0"
137'-0"
P.L. 135
PREMIUM
PREMIUM
REGULAR
REGULAR
12'-0" x 13'-0" x 6" REINF. CONC. PAD
F.C. LIGHTS
PROVIDE DUTCH DOOR W/SHELF
PROVIDE DOOR
DELETE OPNG.
TO WATER MAIN
CANOPY OUTLINES
DISPENSERS TO BE CHED NEUTRAL CIR. #1
DISPENSERS TO BE CHED NEUTRAL CIR. #2
P.L. 169

NM Environment Department
Underground Storage Tank Bureau
Prevention/Inspection Section
P.O. Box 26110
Santa Fe, New Mexico 87502-6110
(505) 827-0216

INSPECTION REPORT

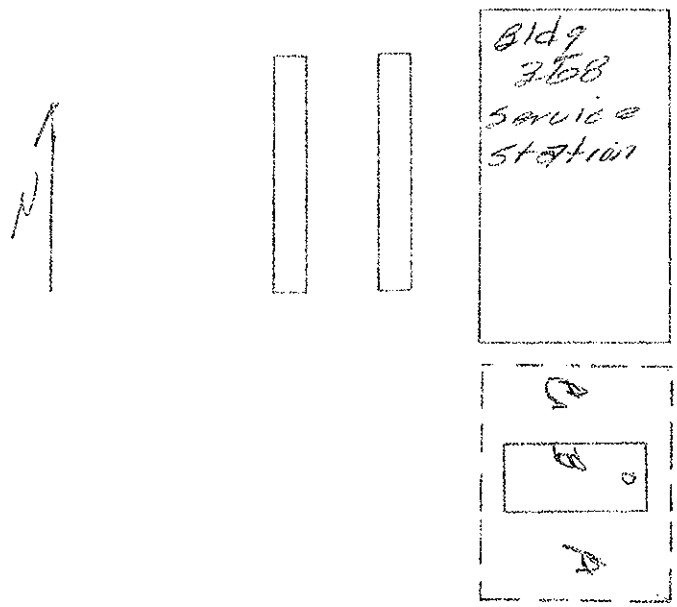
DATE	CASE NUMBER	OPENING CONFERENCE TIME
Jan 23 1995	0453	

INSPECTION TYPE: ☐ COMPLIANCE ☒ TANK CLOSURE ☐ REPAIR ☐ MODIFICATION ☐ REINSPECTION ☐ INSTALLATION ☐ COMPLAINT

Facility Name	Facility No.	Phone No.
1. BLDG 3688 Cannon AFB	6759015	
Address: 27 CES/CEV 111 Engineers Way Cannon AFB		ZIP Code: 88103-5136
Owner Name	Owner No.	Phone No.
2. U.S. Air Force FQ4855	6759	784-6022
Address: 27 CES/CEV 111 Engineers Way Cannon AFB		ZIP Code: 88103 5136
Facility Operator		Phone No.
3.		
Address		ZIP Code
Contractor Name	Installer No.	Phone No.
4. L.C.I. 2		763-1410
Address: P.O Box 1704 Clovis NM		ZIP Code: 88102-1704

TANK NO.	SIZE	CONTENTS	INSTALLATION DATE	TANK CONSTRUCTION	PIPING CONSTRUCTION	TANK RELEASE DETECTION	PIPING RELEASE DETECTION	TANK STATUS
(1) B	10,000	gasoline		steel	steel	yes	yes	Out of Service

SITE MAP



DISTRIBUTION: **WHITE** - Owner USTB **CANARY** - Operator **PINK** - ~~USTB~~ owner **GOLDENROD** - Compliance Officer

3683

		Yes	No	Unk.	N/A
1. All applicable tanks on site are registered.	1.	X			
2. Proper notification was made for the following:	2.				
a. Closure	a.	X			
b. Installation	b.				X
c. Modification	c.				X
d. Repair	d.				X
3. Tanks closed properly.	3.	X			
4. Tanks installed properly.	4.			X	
5. Tanks repaired/modified properly.	5.				X
6. Release detection — tanks.	6.	X			
7. Release detection — piping.	7.	X			
8. Record keeping:	8.				
a. Cathodic protection monitoring.	a.				X
b. Impressed current monitoring.	b.				X
c. Tank tightness test.	c.	X			
d. Line tightness test.	d.	X			
e. Line leak detector test.	e.	X			
f. Release detection performance claims, tests.	f.	X			
g. Release detection sampling/testing results.	g.	X			
h. Inventory records.	h.	X			
i. Permanent closure records.	i.	X			
j. Proof of financial responsibility.	j.	X			
9. Evidence of release/spill.	9.			X	

COMMENTS:

This 10,000 tank had no holes or holidays.
Backfilled with clean blow sand
Soil samples were taken and sent to a lab
for analysis

CLOSING CONFERENCE:	DATE	TIME
	Jan 26 1995	

Compliance Officer's Signature: [signature] Date: 1-26-95

On-site Representative's Signature: Robert L Chandler Date: 26 Jan 95

DISTRIBUTION: **WHITE** - Owner **CANARY** - Operator **PINK** - USTB **GOLDENROD**

Base Support/Operations Generator Former UST Site (ST-C503)

Photos of USGS Sample Locations

Hospital Abandoned UST Site (ST-C504)

Tank Closure Worksheet for 1400A
Tank Closure Worksheet for 1400B
Keers UST Report (August 1994)
Keers UST Report (October 1994)
Partial Utility Plan with USGS Sample Locations

TANK CLOSURE WORKSHEET
For UST at Building Number 1400 A

Tank Owner Cannon AFB Phone CEV office 505 784 4639
Address 27th Support Group, Cannon Air Force Base, 88103

Contractor Name LCI 2, INC. Phone 763-1410
Address P.O. BOX 1704 CLOVIS, NM 88102-1704

Contractor Name CHEYENNE BLDG. CONTRACTORS, INC Phone 763-1410
Address P.O. BOX 1704 ~~CLOVIS, NEW MEXICO 88101~~

Tank Closure Date 10-5-94

****

I. Tank Closure Initial Procedures (Check Measures Complied With):

- ✓ Obtain recommended safety equipment for all personnel.
- ✓ Contact Fire Marshall or other fire officials
- ✓ Bond or ground Equipment
- ✓ Drain product from piping and tank.
- ___ Disconnect, then cap or remove piping.
- ✓ Remove all residual product from tank.
- ✓ Excavate to tank top.
- ✓ Remove all tank fixtures.
- ___ Properly purge or inert tank of all flammable vapors using approved method.
- ✓ Continually monitor for explosive vapors while tank is being removed.

II. Tank Removal

- ___ Create vent hole.
- ___ Excavate tank using all safety precautions.
- ✓ Clean and inspect tank.
- ___ Check excavation for evidence of leaks and notify EID and other proper authorities if leak is found.
- ___ Check vapor levels in tank before transporting.
- ✓ Dispose of tank in approved manner.

Tank disposal location disposal in-place
How did you assess site for leakage Visual inspection and two soil tests.
Closure report kept at The base Environmental Management Office Bldg 250.
NOTE: Immediately report any evidence of leakage to EID at 827-0188

I hereby state that the above information is correct.

Signature of owner or contractor performing work.

****

FOR EID USE ONLY
Notification Received _____ Approved By _____
Inspection Date _____ Inspector _____

CHEYENNE
BUILDING CONTRACTORS INC.
P.O. BOX 1704
CLOVIS, NEW MEXICO 88102-1704
505-763-1410 FAX 505-769-0780

GB98
LIC. 30759

CERTIFICATE OF VAPOR TESTING

DATE 11-17-94

TANK OWNER Cannon AFB PHONE 784-4639

ADDRESS 27th Support Group Cannon AFB 88103

CONTRACTOR REMOVING TANK CCI, 2-INC

ADDRESS P.O.Box 1704 Clovis NM 88101 PHONE 763-1410

CHEYENNE BUILDERS IS CERTIFIED CONTRACTOR IN VAPOR TESTING.

I Troy Morales HEREBY CERTIFY THAT TANK _____ AT Bldg 1400, B _____, IS FREE FROM COMBUSTIBLE MATERIAL.

TROY MORALEZ

MIKE LANDGRAF

EXCAVATION SITE WORKSHEET
EXCAVATED SOIL VOLUME

Building/Tank Number 1400 B Date 11-17-94

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after TANK SOIL VOLUME removal.	L1 = 10 ft	W1 = 13 ft	D1 = 9 ft

TANK SOIL VOLUME YD^3 = (L1 10)x(W1 13)x(D1 9) = 43.5 YD^3

27 FT^3/YD^3

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after CONTAMINATED SOIL VOLUME removal.	L2 = 10 ft	W2 = 13 ft	D2 = 9 ft

TOTAL SOIL VOLUME YD^3 = (L2 10)x(W2 13)x(D2 9) = 43.5 YD^3

27 Ft^3/YD^3

TOTAL SOIL VOLUME YD^3 43.5 YD^3

minus TANK SOIL VOLUME YD^3 43.5 YD^3

= CONTAMINATED SOIL VOL. 0 YD^3 removed from site.

Verified by John J Barnett Contracting Officer's Representative.
(Signature)

EXCAVATION SITE WORKSHEET
SUMMARY OF ALL WORK COMPLETED AT A SITE

Building/Tank Number 1400 B Date 11-17-94

CONTRACT BID ITEM	AMOUNT OF UNIT ITEM COMPLETED	CONTRACT BID ITEM AMOUNT	TOTAL DOLLAR AMOUNT
Amount of asphalt pavement removed.	65 YD^2	$	$
Amount of asphalt pavement replaced.	0 YD^2	$	$
Amount of concrete sidewalk removed.	0 YD^2	$	$
Amount of concrete sidewalk replaced.	0 YD^2	$	$
Total Fluids purged.	0 gal	$	$
Total soil volume removed.	43.5 YD^3	$ /YD^3	$
Tank removal and disposal.	1000 GAL	$ EA	$
Soil samples and Lab results.	4 EA	$ EA	$
Jack Hammer two holes through concrete slab for soil sampling.	Lump 0 Sum	$ LS	$
Remove concrete slab.	0 YD^2	$ /YD^2	$

Type of back fill used; COMPACTED/UNCOMPACTED

Backfill as required by Appendix 1. 51.5 YD^3 $ /YD^3 $

Compact backfill in 8 inch lifts or install a loose backfill.

Verified by John J Barnett Contracting Officer's Representative.
(Signature)

TANK CLOSURE WORKSHEET
For UST at Building Number _____

Tank Owner Cannon AFB CLOVIS NM Phone CEV office 505 784 4639
Address 27th Support Group, Cannon Air Force Base, 88103

Contractor Name CHEYENNE BLDG. CONTRACTORS, INC. Phone 763-1410
Address P.O. BOX 1704 CLOVIS, NEW MEXICO 88101

Contractor Name _____ Phone _____
Address _____

Tank Closure Date 11-17-94

****

I. Tank Closure Initial Procedures (Check Measures Complied With):

- X Obtain recommended safety equipment for all personnel.
- X Contact Fire Marshall or other fire officials
- X Bond or ground Equipment
- X Drain product from piping and tank.
- X Disconnect, then cap or remove piping.
- X Remove all residual product from tank.
- X Excavate to tank top.
- X Remove all tank fixtures.
- X Properly purge or inert tank of all flammable vapors using approved method.
- X Continually monitor for explosive vapors while tank is being removed.

II. Tank Removal

- X Create vent hole.
- X Excavate tank using all safety precautions.
- X Clean and inspect tank.
- X Check excavation for evidence of leaks and notify EID and other proper authorities if leak is found.
- X Check vapor levels in tank before transporting.
- X Dispose of tank in approved manner.

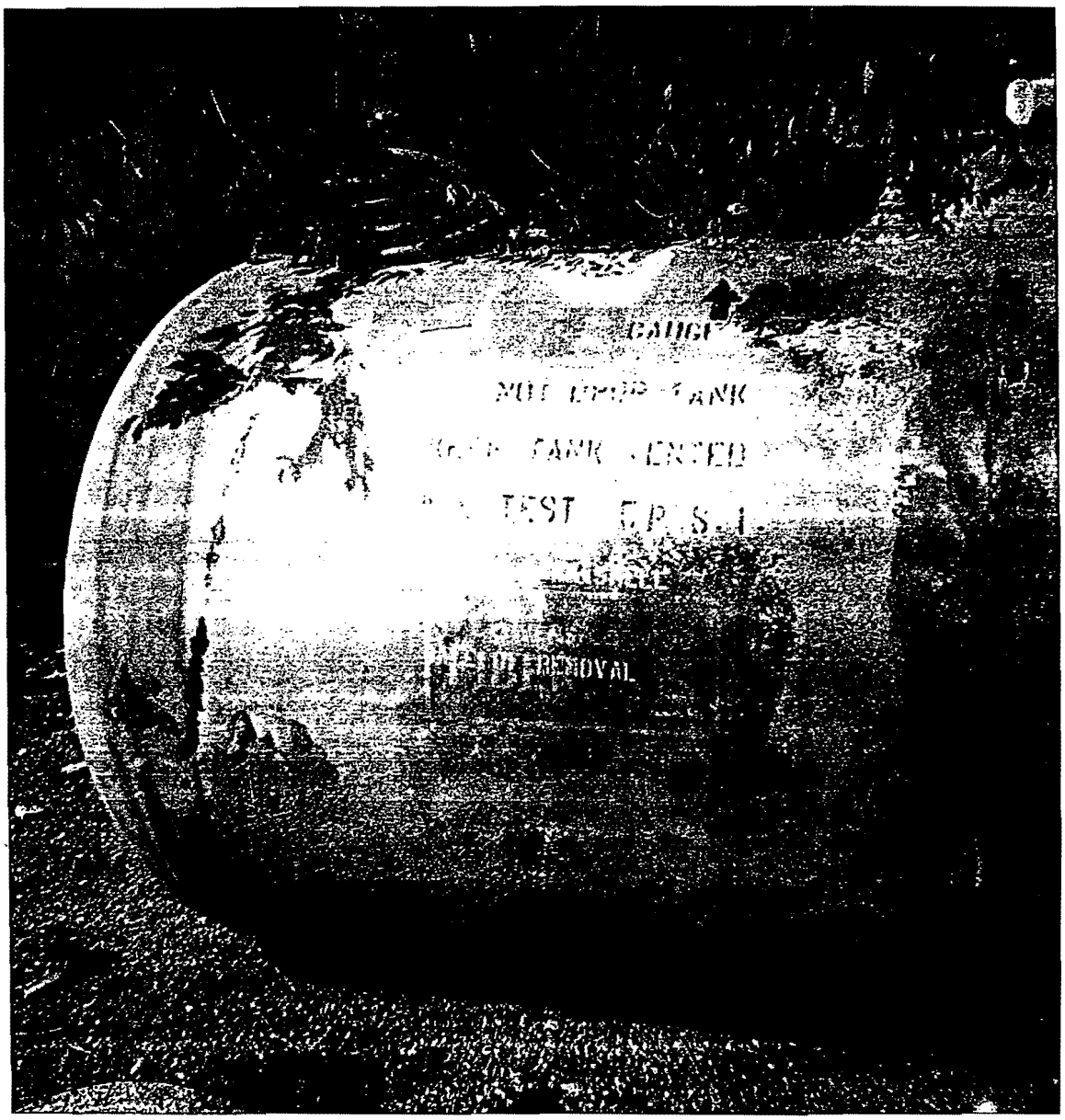
Tank disposal location 172 S Prince St CLOVIS NM 88101
How did you assess site for leakage Visual inspection and two soil tests.
Closure report kept at The base Environmental Management Office Bldg 250.
NOTE: Immediately report any evidence of leakage to EID at 827-0188

I hereby state that the above information is correct.

Signature of owner or contractor performing work.

****

FOR EID USE ONLY
Notification Received _____ Approved By _____
Inspection Date _____ Inspector _____



bldg 400 B

FACSIMILE ELECTRO MAIL TRANSMITTAL

(This information collection is not subject to OMB review under PL-96, The Paperwork Reduction Act.)

SECTION I - TO BE COMPLETED BY ORIGINATOR

CLASSIFICATION	TRANSMISSION	PAGE ONE OF 1 PAGES 7
☐ FOR OFFICIAL USE ONLY	☒ IMMEDIATE ☐ ROUTINE	

TO (Organization and Functional Address Symbol)	FAX NO. DSN	FAX NO. COMMERCIAL
27 CES		

ATTENTION	VOICE NO. DSN	VOICE NO. COMMERCIAL
John Barnett Pat Burns/Rick Chandler		

SUBJECT: UST Soil Contamination

FROM (Organization and Functional Address Symbol)	FAX NO. DSN	FAX NO. COMMERCIAL	VOICE NO. DSN	VOICE NO. COMMERCIAL
27 CONS		2959		2890

REMARKS

Please review and provide comments ASAP. Bid NLT 25 Aug 94.

RELEASER'S SIGNATURE	DATE	TIME
Brian C. Long	23 Aug	1539

SECTION II - TO BE COMPLETED BY ELECTRO MAIL OPERATOR

DATE TRANSMITTED	TIME TRANSMITTED	TRANSMITTER'S SIGNATURE

DATE ADDRESSEE CONTACTED	TIME ADDRESSEE CONTACTED	CONTACTOR'S SIGNATURE

AF Form 3535, SEP 91

Cheyenne
Building Contractors, Inc.

23 August 1994

27th Contracting Squadron CCC
100 N. Torch Blvd.
Cannon AFB, NM 88103-5131

RE: Upgrade Underground Storage Tanks, CAFB
Contract No. F29605-94-C0005

Dear Mrs. Pierce:

Please review the enclosed letter and test results from our subcontractor Keers Environmental, concerning the soil contamination around the 23,000 gallon tank located at the hospital.

This should be reviewed by both Pat Burns and Dick Chandler on what course needs to be taken.

Respectfully Submitted,

Mike Landgraf

ML:kc

enclosure:

23 AUG 1994 15 06

P.O. Box 1413 Ruidoso, New Mexico 88345 (505) 257-4212 FAX (505) 257-4243

CORPORATE OFFICE
[illegible] ALVARADO PLAZA NORTHEAST
ALBUQUERQUE, NEW MEXICO 87110
TELEPHONE: 505/ 883-9005
FACSIMILE: 505/ 883-9755

KEERS ENVIRONMENTAL

FACSIMILE

TO: Mike Lodge

COMPANY: Cheyenne Billing Contractors, Inc.

FROM: Don Keers

REGARDING: 25,000 gal UST - Cimarron

DATE: 8/23/94

TOTAL PAGES (INCLUDING COVER SHEET): 1 2 3 4 5 6

YOUR FAX NUMBER: 769-0760 OUR FAX NUMBER: 505/ 883-9755

YOUR PHONE NUMBER:

MESSAGE: See attached report & bill regarding. Please contact me if you have any questions or need to be informed of progress regarding this matter.

Thanks!

Don

IF YOU HAVE ANY PROBLEMS WITH THIS TRANSMISSION, PLEASE CALL OR FAX US.

Corporate Office
5904 Eubank Avenue Northeast
Albuquerque, New Mexico 87113
Telephone: 505/823-9006
Facsimile: 505/823-2766

August 23, 1994

Mr. Mike Landgraf
Cheyenne Building Contractors, Inc.
PO Box 1413
Ruidoso, NM 88345
(505) 763-1410

RE: Subsurface Investigation
25,000 Gallon UST
Cannon AFB

Dear Mr. Landgraf:

Keers Technical Services has completed a limited subsurface investigation at the above referenced site. This investigation was performed by Don Fernald with Keers on August 17, 1994. The following describes the events relating to this investigation.

KEERS
Technical Services

Upon arrival at the referenced site, Don Fernald met the Mr. Harry Gunn with the NMED - UST Bureau, Cheyenne Construction Personnel and Cannon AFB representatives to discuss sampling strategies and the approximate position/location of the 25,000 gallon UST.

Samples were obtained utilizing a hand driven auger that was fitted with extensions to advance soil samples to an appropriate depth below the UST (into native soils). After several failed attempts (due to encounters with the UST and/or caliche) to obtain soil samples on the north end of the UST, Cheyenne Building Contractors, Inc., utilized a back-hoe to remove several feet of soil from the north end of the UST to reveal the accurate position of the UST. A boring was advanced within the shallow excavation to a depth of 14 feet below ground surface. Hydrocarbon odors were noticeable. Prior to collecting a soil sample, the auger sampling device was decontaminated. The soil sample (sample #94600-081794-01) was collected and placed in a four (4) ounce sampling jar, labeled and stored in a cooler with ice for delivery to an analytical laboratory.

Soil samples were attempted to be collected from the south end of the UST, however, the auger was unsuccessful penetrating beyond three (3) feet in depth. Therefore, the back-hoe was utilized to remove several feet of soil from this end of the UST to reveal the end of the UST. During excavations, the back-hoe encountered UST piping and pulled it from the UST. Excavations were then terminated in this area.

A subsurface boring was then advanced on the west central portion of the UST. The hand auger was advanced to a depth of 14 feet and a soil sample (sample #94600-081794-02) was collected for analysis.

A final subsurface boring was advanced on the southwest portion of the UST. The hand auger was advanced to a depth of 14.5 feet and a soil sample (sample #94600-081794-03) was collected for analysis. All soil samples were collected utilizing standard quality assurance procedures.

Soils encountered during this subsurface investigation consisted of red fine silty clays and caliche. Caliche was encountered at approximately 14 feet at all of the boring locations.

All soil samples were sealed in jars, properly labeled and then placed into a cooler for overnight delivery to an accredited analytical laboratory (Analytical Technologies, Inc.). Since the final sample was obtained after 5:00 P.M. the samples were not sent to the laboratory until August 18, 1994. The laboratory received the samples on August 19, 1994. Soil samples were analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH) utilizing EPA Method 418.1. The following table depicts analytical results from the soil samples obtained for analysis:

Sample Number	Sample Location/Depth	Analytical Results
94600-081794-01	North side of UST/14'	2,800 *ppm
94600-081794-02	West-central side of UST/14'	640 ppm
94600-081794-03	Southwestern side of UST/14'	<20 ppm

*ppm - parts per million.

A draft of the laboratory results are attached to this report. A final draft of the results will be forwarded upon receipt by Keers Technical Services.

The NMED UST Bureau generally requires additional investigations and/or remediation for TRPH concentrations in excess of 100 ppm.

23 AUG 1994 15 07

Mr. Harry Gunn, with the NMED UST Bureau was notified of the analytical results on August 22, 1994. Mr. Gunn was questioned as to what sort of action would be required by the NMED, USTB. Mr. Gunn stated that additional investigations would be required including determining the vertical extent of contamination. Mr. Gunn was questioned as to whether the UST would be required to be removed. Mr. Gunn indicated that the UST may not necessarily be required to be removed and may possibly still be abandoned in-place.

Based on field investigations and analytical results, Keers Technical Services recommends that a 7 - day notification of spill or release be submitted to the NMED USTB as per Section 204 of the NMED UST Regulations. Additionally, Keers recommends that a subsurface investigation be initiated to determine the extent of contamination in relation to the 25,000 gallon UST present at this location. These activities should be conducted in accordance to applicable regulations and coordinated with approval from the NMED UST Bureau.

Keers Technical Services appreciates the opportunity to work with you on this project and we would be pleased to provide additional support. We look forward to providing our professional services to Cheyenne Building Contractors, Inc., on future projects. Please contact this office if you have any questions or additional requirements at (505) 823-9005 ext. 121 .

Sincerely,

Keers Environmental, Inc.

Don Fernald
Project Coordinator

Attachments: Draft Laboratory Results

Analytical Technologies, Inc., Albuquerque

Preliminary Results for Non-Aqueous Fluids Analysis

To: Dr. Ronald Company: Hess FAX #: 723-2726

From: Cecilia Rodewald, Project Manager

Comments:

Please contact your Project Manager regarding any questions or comments about this form.

Page ____ of ____ NCS Accession #: _____ Performed by: _____

Client Sample ID	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl-Benzene (mg/kg)	Total Xylenes (mg/kg)	Other (mg/kg)	TPHC (418.1) (mg/kg)
[illegible]						2700
[illegible]						640
[illegible]						< 20

Analytical Technologies, Inc. • 3708-A Pan American Freeway NE • Albuquerque, NM 87107 (505) 344-4413 Fax

Corporate Office
3904 Florence Avenue Northeast
Albuquerque, New Mexico 87109
Telephone: 505/824-9026
Facsimile: 505/824-2766

KEERS
Technical Services

Limited Subsurface Investigation for the Evaluation of Suspected Subsurface Contamination

at

Cannon AFB
Curry County, New Mexico

October 5, 1994

Prepared for:

Cheyenne Building Contractors, Inc.

Prepared by:

Keers Environmental, Inc.
Technical Services Group

Project Number 94-600

CORPORATE OFFICE
5904 FLORENCE AVENUE NORTHEAST
ALBUQUERQUE, NEW MEXICO 87113
TELEPHONE: 505/823.9006
FACSIMILE: 505/823.1766

October 5, 1994

Mr. Mike Landgraf
Cheyenne Building Contractors, Inc.
PO Box 1413
Ruidoso, New Mexico 88345

RE: Limited Subsurface Investigation
25,000 Gallon UST
Cannon AFB
Curry County, NM

Dear Mr. Landgraf:

Keers Technical Services Group has completed a limited subsurface soil investigation on the above referenced property. The findings of our work, together with conclusions and recommendations are presented in the attached report.

KEERS
TECHNICAL SERVICES

Thank you for the opportunity to serve you. We look forward to providing our professional services to Cheyenne Building Contractors on future projects. Please contact this office if you have any questions or additional requirements at (505)823-9006, ext. 121.

Sincerely,

Keers Environmental, Inc.

Don Fernald
Project Coordinator

Ronald K. Rhoades, CES, CEI
Technical Services & QA/QC Manager

Table of Contents

Limited Subsurface Investigation for the Evaluation of Suspected Subsurface Contamination

25,000 Gallon UST
Cannon AFB
Curry County, New Mexico

Project Number 94-800

Section I

PAGE NO.

1.0 Introduction/Scope of Work....1

2.0 Project Background....2

3.0 Field Investigation....2
Soil Sampling and Boring Descriptions

4.0 Laboratory Analysis....4

5.0 Geologic Information....4

6.0 Conclusions and Recommendations....5

7.0 Limitations....6

Section II

Analytical Reports

Section III

Site Plan of Boring Locations

Site Photographs

SECTION I

Limited Subsurface Investigation

at

Cannon AFB
Curry County, New Mexico

Keers Job # 94-600

1.0 : Introduction / Scope of Work

Keers Environmental, Inc., has completed a limited subsurface investigation of an area near the 25,000 gallon UST (diesel) located adjacent to the Base Hospital at Cannon AFB, Curry County, New Mexico. The drilling activities for this investigation were conducted on September 22, 1994. The purpose of this investigation was to determine the presence or absence of contaminants in subsurface soils on the subject site. The suspect contamination may have resulted from leak/spills from the 25,000 gallon underground storage tank (UST) previously utilized on the subject site. This UST was recently decommissioned and has been prepared for abandonment in place.

The subsurface investigation included the advancement four (4) soil borings to a depth of 20 feet. A total of four (4) subsurface soil samples were obtained from the borings at depths of 18 to 20 feet and analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH) utilizing EPA Method 418.1.

2.0 Project Background

The area of the subsurface investigation is located adjacent to the Cannon AFB Hospital. Mr. Don Fernald, with Keers Environmental, Inc. performed a subsurface investigation on August 17, 1994 in the area near a 25,000 gallon UST formerly utilized to store diesel fuel. This previous investigation included the advancement of three (3) subsurface samples from depths of 14 to 14.5 feet in areas surrounding the UST. Two (2) of the three (3) samples obtained for analysis indicated concentrations of Total Recoverable Petroleum Hydrocarbons (TRPH) of 2,800 and 640 parts per million (ppm). The New Mexico Environment Department, Underground Storage Tank Regulatory limits for TRPH are less than 100 ppm TRPH.

3.0 Field Investigations

On September 22, 1994, Mr. Don Fernald with Keers Environmental, Inc., performed a subsurface investigation of soils on the subject site. A total of four (4) samples were obtained from four (4) borings that were drilled in and around areas of the former tank location.

A CME 55 rotary drilling rig was used to advance the soil borings on the subject site. A hollow stem auger retrofitted with a split-spoon sampling device was used to advance soils to the surface for inspection and sampling. The two (2) foot split spoon sampling device was decontaminated between sampling events to prevent cross contamination of samples.

Soil Sampling and Boring Descriptions

The soil borings for each location were very similar in stratigraphy and composition and are described as follows: From a depth of zero (0) to approximately ten (10) feet the soils consisted of a reddish-brown colored, loose, fine, silty sandy soil. Some buff colored caliche material was encountered in some of these borings at depths of eight (8) to nine (9) feet. From a depth of approximately ten (10) to 13 feet the soil consisted of a buff colored caliche material. From 13 to 18.5 feet, the soil consisted of a reddish-brown fine, sandy silt. From 18.5 to 20 feet a tightly consolidated caliche was encountered.

Boring B-1, advanced adjacent to the northwest side of the UST was the only boring in which hydrocarbon odors were noted in during the subsurface investigation.

Soil samples were collected from each boring from a depth of 18 to 20 feet for analysis. All soil samples were placed in clean, four (4) ounce glass jars with Teflon-lined lids and placed in a cooler under ice for delivery to an accredited analytical laboratory.

4.0. Laboratory Analysis

A total of four (4) samples were submitted to an accredited laboratory for analysis. However, four (4) of the samples were not analyzed and were obtained for possible future analysis, pending the laboratory results of samples analyzed. Soil samples were tested for suspected contaminates in the soils. The soil samples were submitted to an accredited laboratory, for analysis of Total Recoverable Petroleum Hydrocarbons (TRPH) utilizing EPA Method 418.1.

The following Tables I summerizes the results from the analytical testing of the soils.

Table I

Analytical parameters of soil samples

Sample Number	Boring Number/ Depth of Sample	TRPH (PPM)
94600-092294-02	Boring B-1/18-20'	8,200
94600-092294-04	Boring B-2/18-20'	<20
94600-092294-06	Boring B-3/18-20'	<20
94600-092294-08	Boring B-4/18-20'	<20

<20 - Less than the Laboratory detectable limit.

Sample number 94600-092294-02 revealed elevated levels of TRPH.

Complete laboratory results and chain of custody forms are attached in Section II of this report.

5.0 Geologic Information

The Geology of the area is described briefly as follows:

The subject site lies within the High Plains Region above the Ogallala Formation. The Ogallala Formation was deposited during the Tertiary Period by deposition from sediment-laden streams. Near the end of the Pliocene Epoch (approximately one (1) million years ago), the climatic regime became more arid and stream capacity was greatly reduced. An extensive caliche (a calcareous deposit typical of arid climates) deposit probably formed on the Ogallala surface during this time. Cyclic caliche formation continued through the more humid transitional Pleistocene Epoch. Sand, silt, and clay were deposited on top of the caliche in some areas.

Today, the silts, sands, and gravel of the Ogallala Formation serve as an important aquifer which supplies water in Curry County and surrounding regions.

Surface Water

The subject site is located on the USGS Portair, New Mexico Quadrangle, 7.5 Minute Topographic Map. The topography of the subject site has a zero to one percent (0-2%) downward slope trending to the Northeast. Most surface water on the subject site is anticipated to flow to the Northeast.

Surface water is not located on or adjacent to UST, however, a man-made lake is situated within the golf course located several hundred yards to the north of the UST.

Ground Water

Ground water in the subject site area generally flows to the East southeast, according to information acquired from Mr. William Anderson with the New Mexico Environment Department (NMED) field office in Clovis. Depth to ground water in the subject area is approximately 285 feet according to the "Ground water Levels: Clovis Area, New Mexico" produced by the U. S. Geological Survey.

Soil Information

The soil on the subject site is characterized by the Amarillo Soils. Amarillo Soils have formed on medium texture to moderately coarse textured calcareous materials, probably alluvium reworked by wind. These soils have well-developed profiles. They resemble the Clovis soils but are deeper over lime and in may places their B horizon has a slightly stronger structure.

The Amarillo series is represented in Curry County by three soil types, Amarillo Loam, Amarillo fine sandy loam and Amarillo loamy fine sand. The Amarillo loams resemble the Pullman loams with which they merge, but the structure of their B horizon is not so strongly developed, and their profile is sandier throughout. Except that they are less sandy and their surface layers are thinner, the Amarillo loamy fine sands are like the Brownfield fine sands with which they merge. The Amarillo loamy fine sands are less sandy and are better developed structurally than the Springer loamy fine sands.

The soil on the subject site is classified as Amarillo fine sandy loam, 0 to 32 percent slopes. These soils generally have a moderate to rapid permeability.

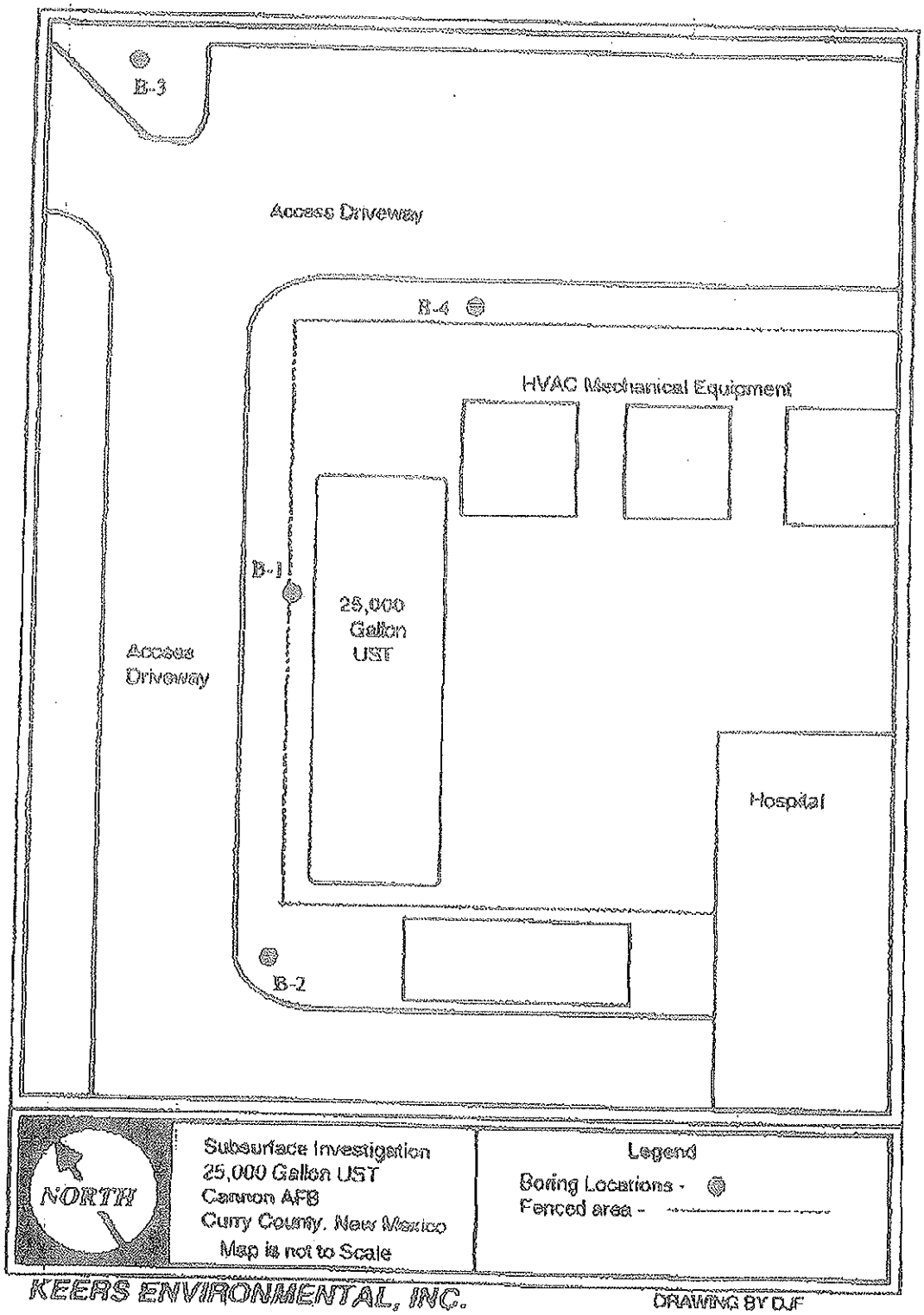
6.0 Conclusions and Recommendations

According to information gathered during field investigations, sample acquisition and laboratory reports, it appears that soils in the area of the UST has been adversely impacted by petroleum hydrocarbons. The laboratory analysis and field observations indicate that these contaminants are above current NMED UST Bureau regulations. Thus, Keers Environmental, Inc., recommends the following actions.

1. All NMED UST Bureau regulatory requirements should be followed. This includes all verbal and written notifications pertaining to the release of hydrocarbon products emanating from this 25,000 gallon UST.

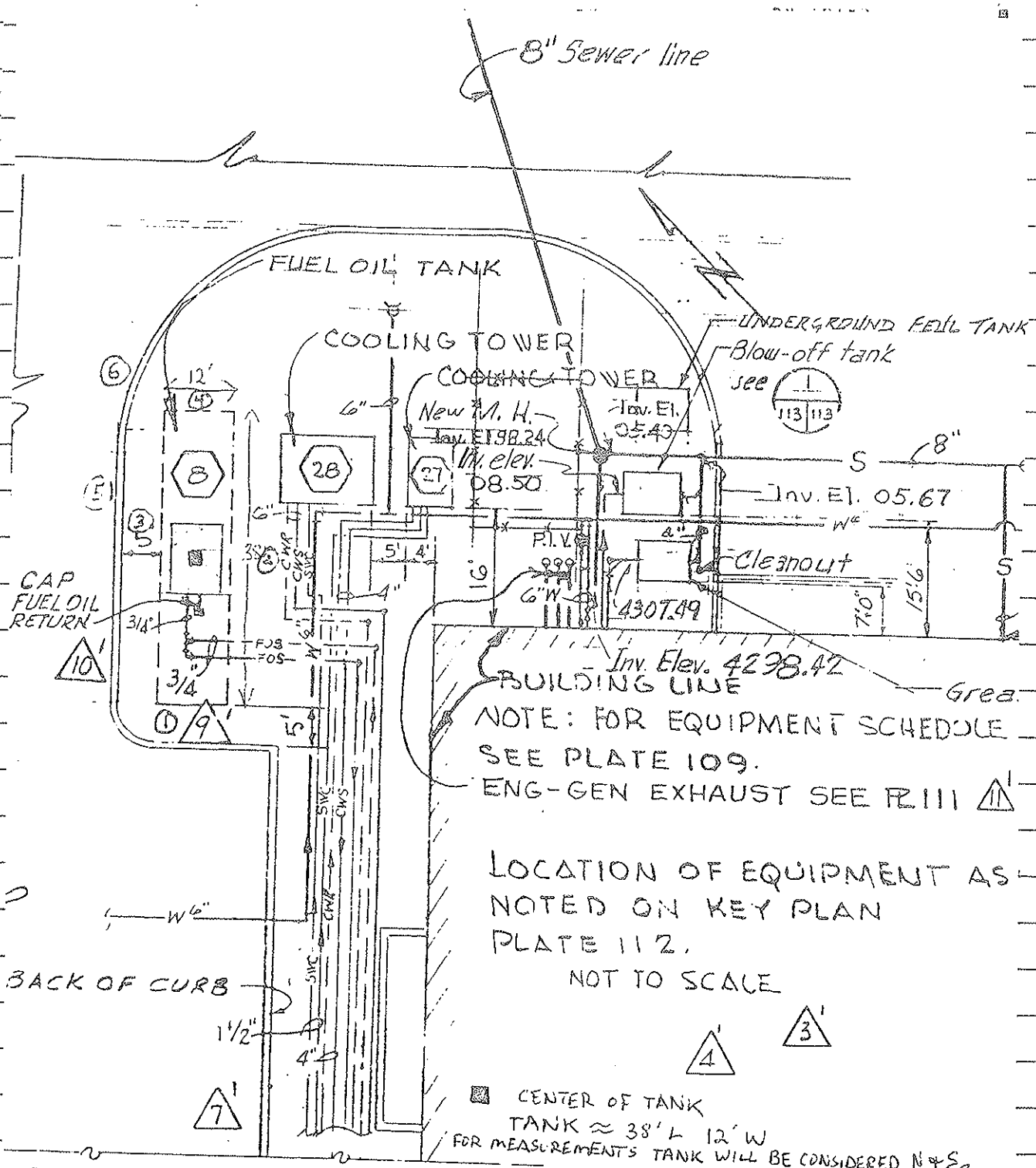
2. Keers Environmental recommends that a On-Site Investigation be performed in accordance to the NMED UST Regulations, Section 1205 and that the report to be submitted to the NMED UST Bureau in accordance to Section 1206 of the NMED UST Regulations.

In general, the On-Site Investigation includes the advancement of five (5) subsurface borings to a depth of 50 beyond contamination. Monitoring wells are required if ground water is encountered to determine any hydrocarbon impacts. This work is required to be completed within 30 days and report submittal within 45 days after the release has been reported. Time extensions may be granted by the NMED UST Bureau.


B-3
Access Driveway
B-4
HVAC Mechanical Equipment
B-1
25,000
Gallon
UST
Access
Driveway
Hospital
B-2
NORTH
Subsurface Investigation
25,000 Gallon UST
Cannon AFB
Curry County, New Mexico
Map is not to Scale
Legend
Boring Locations -
Fenced area -
KEERS ENVIRONMENTAL, INC.
DRAWING BY DJF

20

FACILITY 1400
PARTIAL UTILITY PLAN



① 2.5' N OF SOUTHERN CURB, 5.5' E OF WEST CURB
③ 3' E OF CURB 8' N OF CENTER OF TANK & 5' W OF CENTER
② 8' DUE E OF CENTER
④ 25' DUE N OF CENTER OF TANK
⑤ 5' N OF #1, 2.5' W OF CURB (ASPHALT)
⑥ 1.5' W OF CURB, 3' N OF #4 (ASPHALT)

~~6' DUE WEST OF #2~~
8' DUE N. OF #4

SAMPLE #	DATE TAKEN	DEPTH	RESULT mg/kg		
1400-0102	12-Apr-95	16' - 18'	51		
1400-0201	12-Apr-95	18' - 20'	6200		
1400-0301	12-Apr-95	18' - 20'	9900		
1400-0302	12-Apr-95	22' - 24'	370		
1400-0401	12-Apr-95	17' - 19'	16		
1400-0402	12-Apr-95	20' - 22'	2500		
1400-0403	12-Apr-95		N.D.		
1400-0602	12-Apr-95	20' - 22'	5.2		
	SAMPLE # IS LISTED AS SITE (1400), BORING (06), AND SAMPLE (02)				

Flightline Generator USTs Site (ST-C505)

Excavation Worksheet – UST A
Excavation Worksheet – UST B
7-day Notification with Sampling Results (December 1994)
Follow-up Sampling Results (January 1995)
Photos of USGS Sample Locations

EXCAVATION SITE WORKSHEET
EXCAVATED SOIL VOLUME

Building/Tank Number 3060 Tank A Date 12-15-94

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after TANK SOIL VOLUME removal.	L1 = 14 ft	W1 = 12 ft	D1 = 9 ft

TANK SOIL VOLUME YD^3 = (L1 14)x(W1 12)x(D1 9) = 56 YD^3

27 FT^3/YD^3

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after CONTAMINATED SOIL VOLUME removal.	L2 = 14 ft	W2 = 12 ft	D2 = 9 ft

TOTAL SOIL VOLUME YD^3 = (L2 14)x(W2 12)x(D2 9) = 56 YD^3

27 Ft^3/YD^3

TOTAL SOIL VOLUME YD^3 56 YD^3

minus TANK SOIL VOLUME YD^3 56 YD^3

= CONTAMINATED SOIL VOL. 0 YD^3 removed from site.

Verified by John O Barnett Contracting Officer's Representative.
(Signature)

EXCAVATION SITE WORKSHEET
EXCAVATED SOIL VOLUME

Building/Tank Number 306 OB Date 12-15-94

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after TANK SOIL VOLUME removal.	L1 = 11 ft	W1 = 10 ft	D1 = 9 ft

TANK SOIL VOLUME YD^3 = (L1 11)x(W1 10)x(D1 9) = 32 YD^3

27 FT^3/YD^3

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after CONTAMINATED SOIL VOLUME removal.	L2 = 14 ft	W2 = 12 ft	D2 = 9 ft

TOTAL SOIL VOLUME YD^3 = (L2 14)x(W2 12)x(D2 9) = 56 YD^3

27 Ft^3/YD^3

TOTAL SOIL VOLUME YD^3 37 YD^3

minus TANK SOIL VOLUME YD^3 56 YD^3

= CONTAMINATED SOIL VOL. 48 YD^3 removed from site.

Verified by John J Barnett Contracting Officer's Representative.
(Signature)

STAFF SUMMARY SHEET

	TO	ACTION	SIGNATURE (Surname), GRADE AND DATE		TO	ACTION	SIGNATURE (Surname), GRADE AND DATE
1	27 FW/ JA	Coord		6			
2	27 SPTG/ CC	Sign		7			
3	27 CE/ CEV	Sign		8			
4				9			
5				10			

SURNAME OF ACTION OFFICER AND GRADE	SYMBOL	PHONE	TYPIST'S INITIALS	SUSPENSE DATE
Chandler GS-11	CEV	4-6022		

SUBJECT

7-Day Written Notification for a Petroleum Release at Facility 3060

DATE

SUMMARY

1. This SSS request the SPTG/CC sign the letter at Tab 1 to the New Mexico Environment Department Underground Storage Tank Bureau. This is the required 7-Day release notification for a petroleum release at Facility 3060 (building has no address). This release was discovered during the underground storage tank removal project.

2. NMED is aware of the release and requires written notification.

RECOMMENDATION

3. 27 SPTG/CC sign the notification letter.

1 Tab
1. Letter

Christopher S. Long
Commander, 27th Support Group
100 S DL Ingram Blvd.
Cannon AFB NM 88103-5217

Mr. Bill Skinner
New Mexico Environment Department
Underground Storage Tank Bureau
1190 St. Francis Drive
Santa Fe NM 87503

Dear Mr. Skinner

On 21 Dec 94, Susan Holmes, of the Underground Storage Tank Bureau, was notified of a petroleum release at facility 3060. The release was discovered while removing the underground tank. The release appeared to be from overflow of the tank. The site was excavated to remove any discolored soil. After the soil was removed, 4 soil samples were taken and sent to the laboratory for analysis. Mr. Harry Gunn , from the Clovis office of the UST Bureau, was on site during the tank removal. Upon the receipt of the laboratory samples (Attachment 1), a contaminated site was indicated. The contractor has returned to the site and removed additional soil. Soil samples were taken below the additional excavation. Analysis results are not available at this time.

Additional information regarding this site is as follows:

a. The tank had a capacity of 500 gallons and contained diesel.

b. The tank was constructed of fiberglass.

c. Two water wells are located within a mile radius of the contaminated site. Both wells are approximately 3/4 of a mile from the site. Recent water sampling did not indicate contamination.

d. No surface water is in the area.

e. The soil is of sandy clay content.

f. There was no visible free product in the excavation.

g. The time of the release is unknown.

If you have any questions or more information is needed, please contact Mr. Rick Chandler at (505) 784-6022. Please consider this written notification for this site. Thank you for your assistance.

Sincerely,

Christopher S. Long, Colonel, USAF
Commander, 27th Support Group

2 Attachment:
1. Laboratory results
2. Base map

CARDINAL LABORATORIES

PHONE (915) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240
PHONE (505) 326-4669 • 118 S. COMMERCIAL AVE. • FARMINGTON, NM 87401

TPH/BTEX ANALYSIS REPORT

Company: LCI-2, Inc.
Address: P.O. Box 1704
City, State: Clovis, NM 88102-1704

Date: 12/19/94
Lab #: H1899

Project Name: UST Removal
Location: Cannon AFB, Clovis, NM
Sampled by: not given — Date: 12/15/94 — Time: 9:15 and 11:30
Analyzed by: MF — Date: 12/16;12/19/94 — Time: various
Sample Type: Soil — Sample Condition: Cool, Intact

Units: mg/kg

Samp #	Field Code	TRPHC	BENZENE	TOLUENE	ETHYL BENZENE	PARA-XYLENE	META-XYLENE	ORTHO-XYLENE	MTBE
1	3060A NE Corner	15.9	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2	3060A SE Corner	10.8	<0.001	<0.001	<0.001	<0.001	<0.001	0.009	<0.001
3	3060A SW Corner	19.6	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
4	3060A NW Corner	6.3	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
5	3060B NE Corner	307.5	<0.001	0.034	0.040	<0.001	0.017	0.026	<0.001
6	3060B NW Corner	1,782	<0.001	0.011	0.074	<0.001	0.022	0.052	<0.001
7	3060B SE Corner	230.8	<0.001	<0.001	0.011	<0.001	0.005	0.018	<0.001
8	3060B SW Corner	118.9	<0.001	<0.001	<0.001	<0.001	0.003	0.011	<0.001
QC Recovery		428.1%	0.919	0.797	0.909	0.878	0.899	0.928	0.731
QC Spike		405.9	0.881	0.865	0.869	0.866	0.860	0.886	0.764
Accuracy		105.5%	104.3%	92.1%	104.6%	101.4%	104.5%	104.7%	95.7%
Air Blank		***	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Methods - GAS CHROMOTOGRAPHY; INFRARED SPECTROSCOPY
- EPA SW-846; 8020, 418.1, 3540 OR 3510

Michael R. Fowler

12/19/94
Date

R

PRIMARY DISTRIBUTION
39 - EN PRIMARY (1997 & 10,000) 4 ACT B
K 167 E (2000 & 2001) XLNOR AS - 4AT
BASE
NORTH

CARDINAL LABORATORIES

PHONE (915) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240
PHONE (505) 326-4669 • 118 S. COMMERCIAL AVE. • FARMINGTON, NM 87401

TPH/BTEX ANALYSIS REPORT

Company: LCI-2, Inc.
Address: P.O. Box 1704
City, State: Clovis, NM 88102

Date: 1/4/95
Lab #: H1911

Project Name: Cannon AFB
Location: Clovis, NM
Sampled by: TM
Analyzed by: MF
Sample Type: Soil

Date: 12/28/94 Time: 12:00
Date: 1/3-4/94 Time: various
Sample Condition: Intact

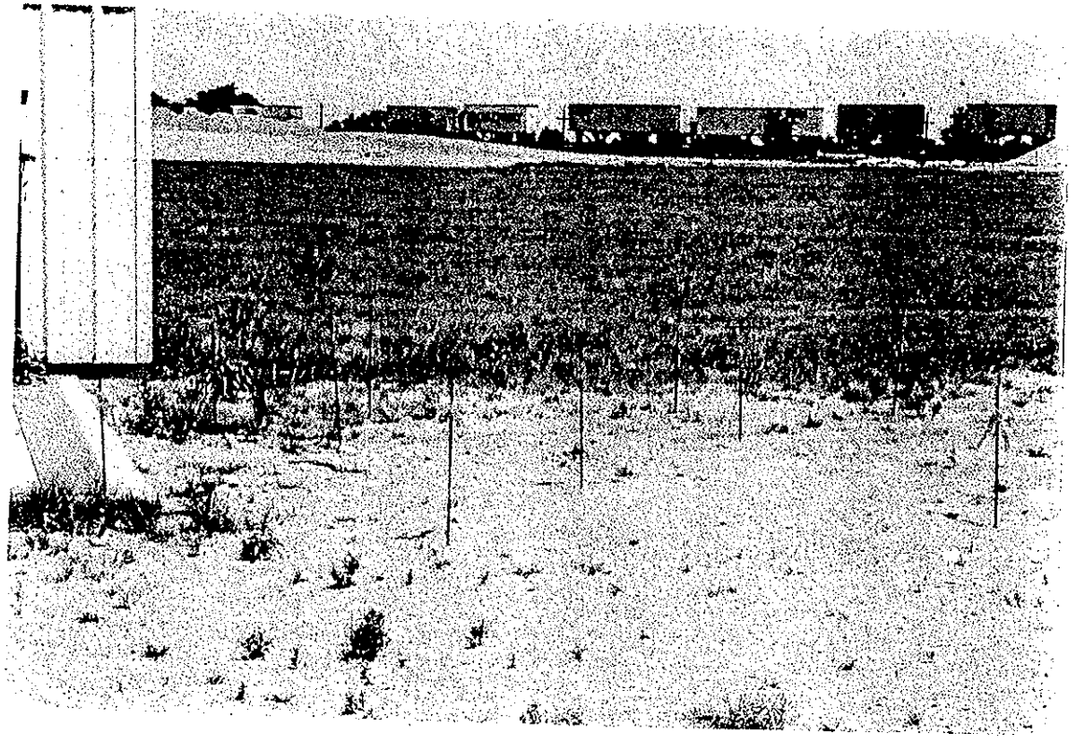
Units: mg/kg

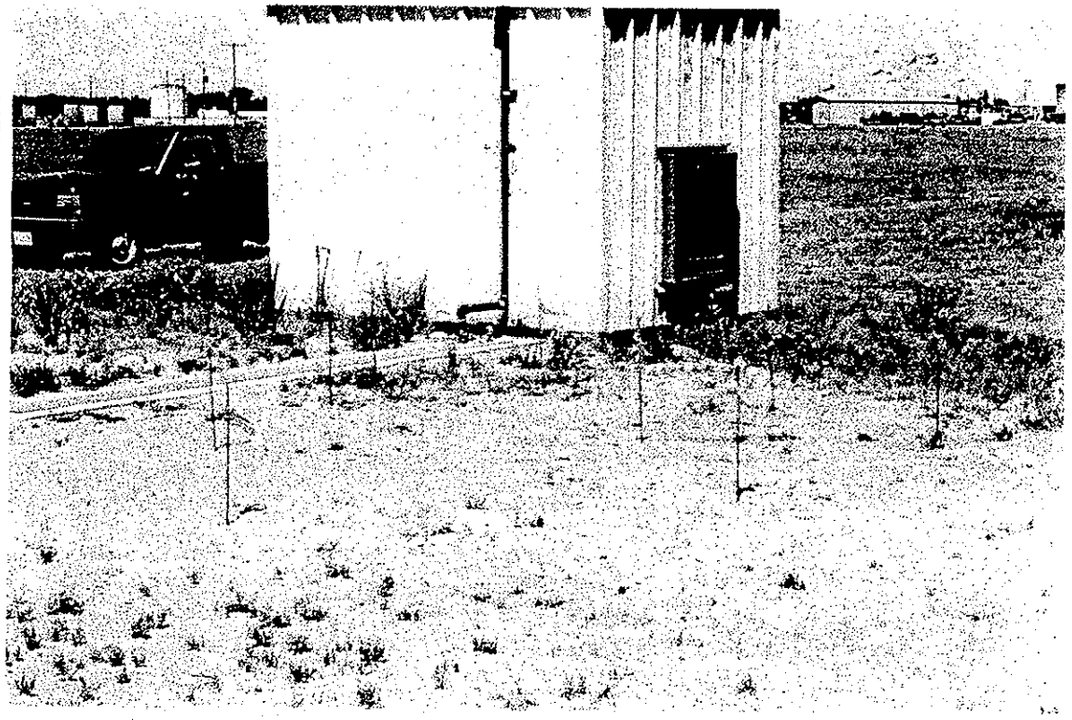
Samp #	Field Code	TRPHC	BENZENE	TOLUENE	ETHYL BENZENE	PARA-XYLENE	META-XYLENE	ORTHO-XYLENE	MTBE
1	Blg 3060 B East	106.9	<0.001	<0.001	<0.001	<0.001	<0.001	0.028	<0.001
2	Blg 3060 B West	1027.5	<0.001	0.029	0.045	0.017	0.031	0.042	<0.001
	QC Recovery	462.9	0.962	0.833	0.936	0.909	0.917	0.956	0.702
	QC Spike	405.9	0.881	0.865	0.869	0.866	0.860	0.886	0.764
	Accuracy	114.0%	109.2%	96.3%	107.7%	105.0%	106.6%	107.9%	91.9%
	Air Blank	***	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

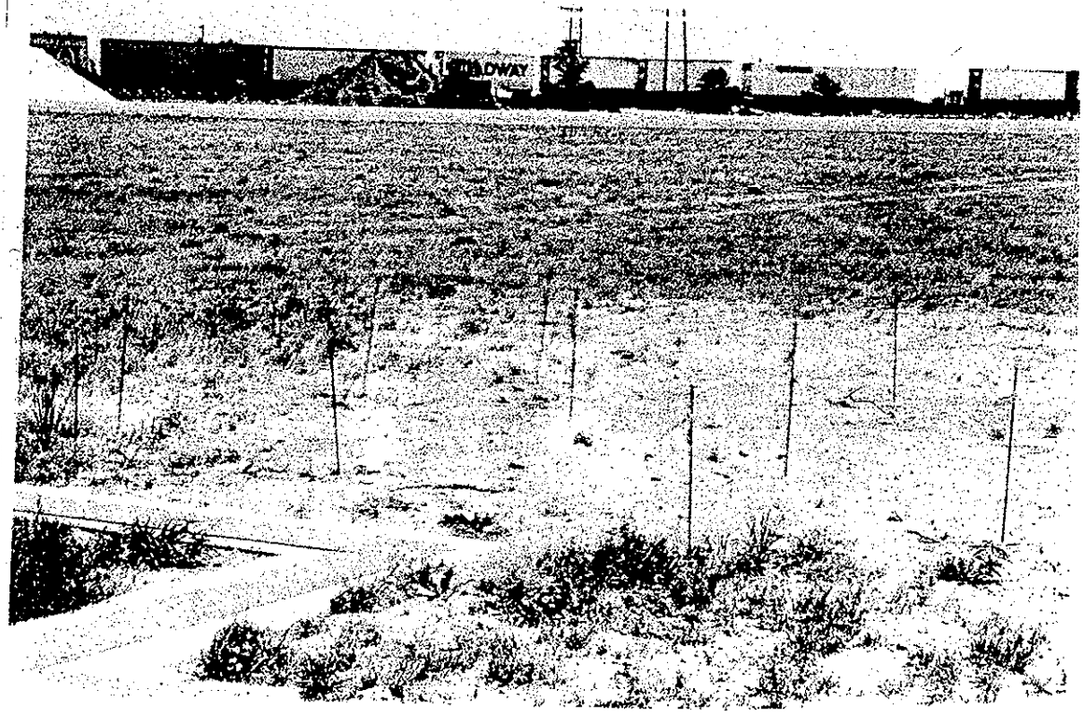
Methods - GAS CHROMOTOGRAPHY; INFRARED SPECTROSCOPY
- EPA SW-846; 8020, 418.1, 3540 OR 3510

Michael R. Fowler

1/4/95
Date






BROADWAY

THIS PAGE INTENTIONALLY BLANK

Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129)

Parallax SWMU 129 Closeout Report (July 2000) (electronic [PDF] on CD only)
As-built Drawing (Sheet 7) (March 1986)
As-built Drawing (Sheet 8) (August 1986)
Letter from NMED dated September 14, 2009

FINAL

CLOSEOUT REPORT / CONTAMINATION ASSESSMENT
SWMU 129 - FACILITY 244
ABOVEGROUND TANK STORAGE AREA
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

July 19, 2000

Submitted to:
U. S. Army Corps of Engineers
Omaha District

Submitted by:
Parallax, Inc.
20201 Century Blvd
Germantown, MD 20874

Contract No.
DACW45-99-D-Q015
Delivery Order No. 0001

Parallax
INC.

Parallax
INC.

U.S. Army Corps of Engineers
Omaha District
Attn: CENWO-PM-HA (Tom Zink)
215 North 17th Street
Omaha, NE 68102-4978

ATL-00-157

July 21, 2000

Reference: Contract No. DACA45-99-D-0015
Delivery Order No. 0001

Subject: Revised Final Closeout Report/Contamination Assessment for SWMU 129 (Facility 244) at Cannon Air Force Base, Clovis, New Mexico

Dear Mr. Zink,

Enclosed is the subject report distributed as indicated below. This revision incorporates the comments provided by Mr. Sanford Hutsell of Cannon Air Force Base. Original copies under this cover will be submitted to yourself and Cannon Air Force base per your instructions. At your convenience, I would like to discuss final completion of the submittal register for this delivery order to facilitate closeout.

Parallax appreciates the opportunity to support the U.S. Army Corps of Engineers, Omaha District, and Cannon Air Force Base on this project. Please do not hesitate to contact me at 770/955-2008 if you have any questions or comments.

Sincerely,
Parallax, Inc.

William D. Keefer

W. David Keefer
Program Manager (Acting)

cc: Cannon Air Force Base (Mr. John Pike) – 8 copies
Debbie Molinary – Parallax w/o attachment
Project File

An Engineering and Environmental Management Company
320 Interstate North Parkway, Suite 230 • Atlanta, GA 30339 • Phone: (770) 955–2008 • FAX: (770) 955–2331

TABLE OF CONTENTS

LIST OF FIGURES 4

LIST OF PHOTOGRAPHS 4

LIST OF TABLES 5

ACRONYMS AND ABBREVIATIONS 6

EXECUTIVE SUMMARY 8

1.0 INTRODUCTION 10

1.1 Project Objective 10

1.2 Technical Scope of Work 10

1.3 Project Purpose 11

2.0 FACILITY DESCRIPTION 12

2.1 Cannon Air Force Base Location/History 12

2.2 SWMU 129, Facility 244 12

3.0 FACILITY DEMOLITION AND REMOVAL ACTIONS 13

3.1 Removal of Aboveground Storage Tanks and Associated Piping 13

3.2 Demolition of Concrete Saddles and Containment Pad 14

3.3 Removal of O/W Separator 14

3.4 Disposal of Construction Debris and Waste Water 15

4.0 PRELIMINARY SITE ASSESSMENT 16

4.1 Investigation Overview 16

4.2 Field Observations 16

4.3 Sampling and Analysis 16

4.4 Data Quality Assessment 18

4.4.1 Quality Assessment Summary 18

5.0 SUMMARY AND CONCLUSIONS.....20

APPENDIX A SOIL SAMPLE ANALYTICAL DATA A-1

APPE NDIX B SOIL SAMPLE VALIDATION QUALIFERS SUMMARY.....B-1

LIST OF FIGURES
(Attached at End of Text)

Figure 2-1 Location Map of Facility 244 and Adjacent Structures 21

Figure 2-2 Map of Cannon AFB and Surrounding Area 22

Figure 2-3 Diagram of Tank Locations and Associated Features 23

Figure 3-1 Map of Haul Route to Abandoned Airstrip/Rubble Storage Area 24

Figure 3-2 Copy of Receipt from Ed's Recycling Center for Scrap Metal 25

Figure 3-3 Weight Tally Sheet, Ed's Recycling Center, Showing 6070 Pounds . . . 26

Figure 3-4 Reproduction of Check # 3156 Received for Scrap Metal 27

Figure 4-1 Copy of Chain of Custody for Soil Samples Collected 12-14-99 28

Figure 4-2 Plan View of Facility 244 Showing Soil Sampling Locations 29

LIST OF PHOTOGRAPHS
(Attached at End of Text)

Photograph 1 View of Facility 244 Prior to Start of Dismantling Operations Showing Tank Locations and Fencing 30

Photograph 2 Alternate View of the Facility with Fence Fabric Removed and Orange Safety Webbing Stretched 30

Photograph 3 Associated Distribution Piping and Manual Valves 31

Photograph 4 Omegasys Personnel Pressure Washing Interior Surfaces of Tank and Using Drain Valve to Remove Sludges and Rinse Waters 31

Photograph 5 Removal of Tank Support Saddle with Trackhoe Bucket 32

Photograph 6 Stockpiling Concrete Support Saddles at the Designated Staging Area 32

Photograph 7 Removal of Remaining Portions of the Concrete Containment Pad and Retaining Curb 33

Photograph 8 View of Soil Surface after Removal of the Containment Pad 33

Photograph 9 Sheet Metal Cover, with Accessways, for the O/W Separator and Concrete Vault 34

Photograph 10 Omegasys Personnel Removing Top Plate of O/W Separator and Disconnecting Supply/Distribution Pipes 34
Photograph 11 View of O/W Separator Interior Structure Showing Thick Deposits of Sludge and Oil-Coated Baffles 35
Photograph 12 The Trackhoe Bucket Is Used to Lift the O/W Separator from the Concrete Vault 35
Photograph 13 Field Personnel Use Shovels and Scoops to Remove Sludge Prior to Pressure Washing Interior Surfaces 36
Photograph 14 The Concrete O/W Separator Vault and Associated Dump Pits Are Demolished after Removal of Piping 36
Photograph 15 View of Construction Rubble Stockpiled at the Designated Abandoned Airstrip 37
Photograph 16 Scrap Metal Loaded on Flatbed Truck Ready for Transport to the Scrap Metal Recycler 37
Photograph 17 Delivery of Scrap Metal to Ed's Recycle Center, Clovis, New Mexico 38
Photograph 18 Omegasys Personnel Unloading Drums of Decontamination And Rinse Waters, and Residual Sludges at the On-Base RCRA 90-Day Storage Facility 38
Photograph 19 View of Facility 244 Location upon Completion of Removal Activities; Light Tan Area in Foreground Is Backfilled Area . . 39
Photograph 20 View of Tanks Removed from Facility 244, Temporarily Staged Prior to Sale as Surplus Material 39

LIST OF TABLES

Table A-1 RCRA Metals - Analytical Data A-1
Table A-2 PCBs - Analytical Data A-2
Table A-3 Pesticides - Analytical Data A-3
Table A-4 Total Petroleum Hydrocarbons - Analytical Data. A-4

Table B-1 Data Validation Qualifers Summary B-1

ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
Base	Cannon Air Force Base
AOC	Area of Concern
CA	Corrective Action
COC	Contaminant of Concern
DMRO	Defense Reutilization and Marketing Office
Facility	Facility 244
ID	Identification
mg/Kg	Milligrams per Kilogram
MS/MSD	Matrix Spike/Matrix Spike Duplicate
N/A	Not Available
NMED	New Mexico Environment Department
OSHA	Office of Safety and Health Administration
O/W	Oil/Water
Parallax	Parallax, Inc.
PCB	Polychlorinated Biphenyl
PCS	Petroleum Contaminated Soil
PID	Photoionization Detector
PM	Project Manager
PSA	Preliminary Site Assessment
QAPjP	Quality Assurance Project Plan

QC	Quality Control
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RDL	Reported Detection Limit
SHSO	Site Health and Safety Officer
SOW	Statement of Work
TPH	Total Petroleum Hydrocarbon
TSD	Treatment, Storage, and Disposal
ug/Kg	Micrograms per Kilogram
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency

EXECUTIVE SUMMARY

Parallax, Inc. (Parallax) performed a voluntary corrective action (CA) at SWMU 129, Facility 244 (Facility), Cannon Air Force Base (AFB)(Base), Clovis, New Mexico, for the U.S. Army Corps of Engineers (USACE), Omaha District. Facility 244 contained five aboveground tanks dedicated to storage of used lubricating oils and other petroleum-based products (excluding fuels).

Implementation of the CA consisted of dismantling the storage tanks, disassembly and disposal of associated distribution piping, valves, an oil/water (O/W) separator, and demolition of concrete vaults, dump pits, and the concrete containment pad and retaining curb. The interior of the storage tanks were pressure-washed prior to being removed from their supports and set aside for disposal as surplus by the U.S. Air Force (USAF), Defense Reutilization and Marketing Office (DMRO). The piping, valves, O/W separator, and miscellaneous scrap metal were decontaminated and sold to a local (Clovis) recycled metal dealer. Any sludges remaining in the tanks and the O/W separator, pressure wash waters, and decontamination water were containerized in 55gallon drums. The drums were transported to the on-Base Resource Conservation and Recovery Act (RCRA) 90-day accumulation area. The USAF assumed responsibility for characterizing, manifesting, and shipping the wastes to an appropriate treatment, storage, and disposal (TSD) facility. The concrete rubble was stockpiled on a designated abandoned airstrip for subsequent crushing and use as backfill for other construction projects.

After the overlying containment pad and appurtenances were removed, Parallax performed a Preliminary Site Assessment (PSA) of the underlying soils to determine if petroleum hydrocarbon contamination was present. The site geologist visually inspected the soils for signs of petroleum staining or characteristic odors. No discoloration or odor was detected. The ambient atmospheres directly above the ground surfaces in areas most likely to exhibit contamination (e.g., soils under the O/W separator, dump pits, and areas surrounding the outside of the retaining curbs) were monitored with a photoionization detector (PID) and Draeger® contaminant-specific colormetric tubes. These instrumentation surveys did not indicate the presence of hydrocarbon contamination.

A total of ten soil samples, including eight representative grab and two quality control (QC) [i.e., field duplicate and matrix spike/matrix spike duplicate (MS/MSD)] samples, were collected and shipped to Accura Analytical Laboratory, Norcross, Georgia, for analyses. The analytical results of these samples indicated that there were no contaminants of concern (COCs) present in the soils underlying Facility 244. The laboratory results were validated by Parallax technical personnel to ensure QC reliability and proper instrumentation methodology. Based upon the field observations and laboratory analyses, the CA at Facility 244 resulted in a clean closure and therefore should require no further action.

The excavated areas were backfilled using crushed caliche, a local "hardpan" material formed in arid/semi-arid regions as a result of leaching calcium-rich salts from surface soils by percolating rainwater and other surface water and then precipitation of an impervious, coherent chalky layer at a shallow depth below grade. The caliche is used extensively in the region as a road sub-base material because of its reaction with water to form an extremely hard backfilled surface.

1.0 INTRODUCTION

Between December 10 and 15, 1999, Parallax performed a voluntary CA at SWMU 129, Facility 244, Cannon AFB, Clovis, New Mexico, for the USACE, Omaha District. The Facility was constructed in 1991, but due to design and operational problems (i.e., there were difficulties associated with the construction of the O/W separator and liquid transfer into the various tanks), it was infrequently used. The CA consisted of removal of the storage tanks from their support saddles; disassembly and disposal of associated distribution piping, valves, and an O/W separator; and demolition of concrete vaults, dump pits, and the surrounding concrete containment pad and retaining curb. The concrete rubble was stockpiled at a designated storage area on an abandoned aircraft runway, while the scrap metal was decontaminated and sold to a local scrap-metal dealer.

After demolition of the concrete containment pad, Parallax performed a PSA on the exposed soils to determine whether hydrocarbon contaminants had leaked through the pad or spilled onto the ground surface adjacent to the retaining curbs. The soils were visually inspected for discoloration and surveyed for the release of ambient volatile organic compounds using appropriate instrumentation (i.e., PID and Draeger® colormetric tubes). Representative grab soil samples were collected and submitted to Accura Analytical Laboratory, Norcross, Georgia, for analyses. The soils appeared to be contaminant-free. These observations were later substantiated by analytical results; therefore, the excavated areas were backfilled using caliche, a locally-available road base material.

1.1 Project Objective

The current CA/PSA project was designed to achieve closure of SWMU 129, Facility 244, in such a manner that any threat to human health and the environment was minimized and the site would require no further maintenance or monitoring.

1.2 Technical Scope of Work

The technical SOW provided to Parallax included two primary tasks: 1) removal of the aboveground oil storage tanks and other appurtenances, and demolition of all concrete structures; and 2) perform a PSA of the soils underlying the concrete containment pad to determine whether petroleum hydrocarbon contamination was present. In addition, after the exposed substrate was either determined to be contaminant-free or contaminated soils were removed, the SOW required the excavated area to be backfilled. The removal actions and PSA for Closure of Facility 244 were accomplished according to the following steps:

- Ensure that all utilities in close proximity to Facility 244 were properly identified, and that all electrical power servicing the Facility was disconnected at the nearest supply transformer and all fuses/circuit breakers were removed;

- Remove the perimeter chain-link fence and gates surrounding the Facility on three sides but leave the "back" or east segment which was common to the adjoining storage area;

- Pressure wash the five 5,000-gallon aboveground storage tanks, containerize sludges and rinse waters;

- Disassemble associated piping, hoist tanks from their support saddles, and set aside for subsequent disposal by the USAF DRMO;

- Demolish concrete saddles, containment pad, and retaining curb;

- Remove O/W separator from its vault, clean out sludge, and pressure wash;

- Demolish remaining concrete vaults and dump pits;

- Haul concrete construction rubble to the designated abandoned airstrip for stockpiling;

- Dispose of piping and scrap metal through a local scrap metal recycler;

- Perform a PSA on the exposed soil surfaces underlying the containment pad to determine the presence of petroleum hydrocarbon contamination, including: visual observations, instrumentation monitoring for volatile organic vapors, and soil sampling for laboratory analyses; and

- Backfill of excavated areas using locally-available caliche sub-base material.

1.3 Project Purpose

The removal action/PSA for Facility 244 was performed to achieve closure of the site as stipulated in the Base RCRA permit issued by the New Mexico Environment Department (NMED) on behalf of the U.S. Environmental Protection Agency (USEPA).

2.0 FACILITY DESCRIPTION

SWMU 129, Facility 244, was located at the Contractor Storage Facility/laydown yard, south of Perimeter Road, and northeast of Building 208, a maintenance hanger, at Cannon AFB, Clovis, New Mexico. Facility 244 was originally built in 1991 to store waste petroleum products generated during routine maintenance of aircraft and service vehicles. The Facility

was used infrequently due to design and operational problems. Historically, lubricating oils, hydraulic fluids, and solvents were reportedly stored in the tanks, at various times. Fuels were never present at Facility 244. Figure 2- 1 shows the location of Facility 244 relative to surrounding Base features.

2.1 Cannon AFB Location/History

Cannon AFB is located in Curry County, southeastern New Mexico, south of U.S. Highway 60/84, near the New Mexico/Texas border (Figure 2-2). The Base occupies approximately 4,000 acres, six miles west of Clovis, New Mexico. The adjacent land is used primarily for farming, feedlots, and ranching.

The Base was established in 1942 as the Clovis Army Air Base. B-17, B-24, and B-29 air crews trained there during World War II. The facility was renamed Cannon AFB in 1957. It currently maintains a combat-ready force providing training to F-16 fighter combat aircrews for tactical organizations worldwide.

2.2 SWMU 129, Facility 244

Facility 244 consisted of five 5,000-gallon aboveground storage tanks supported on reinforced concrete saddles. The tanks were surrounded by a 30-foot x 50-foot (approximate) concrete containment pad. A 9-inch retaining curb, designed to contain liquids released in the event of an accidental release or ruptured tank, surrounded the containment area. Photograph 1 is a view of Facility 244 prior to start of the removal action (tanks, saddles, and chain-link fence are intact). Photograph 2 is a view of the Facility with the fence fabric removed and temporary orange security webbing in place.

The storage tanks were filled through a network of supply pipes entering the tops of the tanks (Photograph 3 shows the distribution piping and valves). These pipes, controlled by manual gate valves, were connected to a central O/W separator located in the north end of the containment pad. Bulk waste oil was brought to Facility 244 and dumped into adjacent collection pits equipped with strainers. From the pits the oil drained into the O/W separator and was then pumped into the appropriate storage tanks. The water fraction, segregated by the O/W separator, exited through a port in the west-side of the structure.

The water flowed into a leach field, located to the southeast of the Facility. The leach field consisted of perforated plastic piping surrounded by crushed stone that allowed the water to be discharged into the subsurface and percolate into underlying soils without impacting the groundwater. Figure 2-3 is a plan view of Facility 244 showing the original locations of the storage tanks and temporary staging area after removal.

Each storage tank had an exterior fill gauge equipped with an indicator arrow connected to a float inside the tank. As the volume of liquid inside the tank fluctuated, the position of the float changed resulting in a corresponding change in the position of the indicator arrow on the fill gauge. This device provided a continuous indication of the quantity of liquid stored in each tank.

the fill gauge. This device provided a continuous indication of the quantity of liquid stored in each tank.

3.0 FACILITY DEMOLITION AND REMOVAL ACTIONS

Prior to site access, Base representatives located the various utilities and disconnected electrical service to pumps, valves, and facility lighting. The Parallax site health and safety officer (SHSO) accompanied the Base electrician to physically inspect electrical power disconnects at the nearest supply transformer and ensured that fuses and circuit breakers were removed from all junction boxes prior to commencement of demolition activities. Electricity was the only utility of concern. There was no active water service to the Facility. A telephone trunk line was located west of the site, in the parking lot, but was sufficiently separated from the work area to not pose a problem.

Facility demolition and removal actions were managed by the Parallax Project Manager (PM). Actual field actions (e.g., dismantling of the tanks and piping, and demolition of the concrete structures) were subcontracted to Omegasys, Inc., Tucker, Georgia. The subcontractor site superintendent reported directly to the Parallax PM. Omegasys used a trackhoe and backhoe to complete all removal and demolition activities. Construction rubble and scrap metal were transported using a flatbed dump truck. The Parallax SHSO observed all field activities to ensure safe work practices and compliance with all relevant Office of Safety and Health Administration (OSHA) laws.

Excavated areas were backfilled using crushed caliche, a local "hardpan" material formed in arid/semi-arid regions as a result of leaching calcium-rich salts from surface soils by percolating rainwater and other surface water and then precipitation of an impervious, coherent chalky layer at a shallow depth below grade. The caliche is used extensively in the region as a road sub-base material because of its reaction with water to form an extremely hard backfilled surface.

3.1 Removal of Aboveground Storage Tanks and Associated Piping

Omegasys used a trackhoe to complete all tank removals. A steel chain connected to lifting lugs on each tank-facilitated removal from its respective concrete support saddles. The tanks were staged in an adjacent area south of Facility 244 for disposal, as surplus, by the USAF DRMO. Before tank removals, associated fill pipes coming from the O/W sump distribution system were disconnected for later decontamination and disposal. Also, the interior of each storage tank was pressure-washed to remove scale/corrosion accumulation. Photograph 4 shows Omegasys personnel using the manway on top of a tank for access to pressure wash the interior walls, and recovery of sludges and rinse water at the tank drain. Sludges and rinse waters were containerized in 55-gallon drums for transfer to the designated on-Base RCRA waste accumulation facility.

3.2 Demolition of Concrete Saddles and Containment Pad

After dismantling the tanks, demolition began with removal of the concrete support saddles. There were two saddles per tank. Each support contained approximately one cubic yard of concrete. Saddles were dislodged by placing the trackhoe bucket on one end and lifting upward and backward. Photograph 5 shows a saddle being lifted from its foundation. Removal of the structures was hampered by the containrnent pad that surrounded each support, and the fact that the saddles had spread footings. The adjacent concrete had to be crushed so that each footing could be removed.

The saddles were generally removed intact, loaded directly onto the dump truck, and transported to the construction rubble storage area. Photograph 6 shows saddles stockpiled at the designated storage area. After removal of the saddles, the remaining portions of the containment pad and retaining curb were broken into manageable pieces by dropping the trackhoe bucket onto the concrete surface or lifting the edge of the pad until cracks developed (Photograph 7). Number 3 reinforcing steel rods were embedded in the pad and curb structures, but were readily snapped by creating tension with the trackhoe. The resulting construction debris was also transported to the rubble staging area. After removal of the O/W separator, the concrete vaults and dump pits were removed and transported to the storage area. Photograph 8 is a view of the exposed soil surface at Facility 244 after removal of the concrete containment pad and curb.

3.3 Removal of O/W Separator

The O/W separator consisted of a rectangular quarter-inch thick sheet metal box (approximately 7 feet long, 2 feet wide, and 4 feet high). The interior of the separator contained a series channels and baffles. Oil entered the separator at the north end of the structure and flowed toward a collection sump on the south end. As the oil flowed through the separator, over the baffles, any water present was skimmed-off due to its immiscibility and channeled through an exit port in the south end of the structure. The recovered water flowed into the leach field, located to the southeast, for release into the underlying soils.

The separator was located in a liquid-tight concrete vault below ground surface. The vault was covered by a quarter-inch thick sheet metal cover plate (Photograph 9). Supply and distribution pipes were disconnected from the separator, and capped if leading away from the Facility. The top panel was removed to allow inspection. Photograph 10 shows Omegasys personnel removing the O/W cover panel and piping. There was a large deposit of sludge in the bottom, approximately 12 inches thick, and the baffles were heavily coated with oily residues. Photograph 11 is a view of the interior of the O/W separator showing the thick sludge deposit and the oil-coated baffles. The entire separator was lifted from the vault to allow easy access for cleaning and decontamination (Photograph 12). Shovels, scoops, and similar tools were used to remove the sludge. Photograph 13 shows removal of the sludges and oil residues. The entire interior was then pressure washed, and the rinse water containerized for disposal. The O/W separator was sold to a local metal recycler. The

concrete O/W vault and dump pits were removed (Photograph 14) and transported to the rubble storage area.

3.4 Disposal of Construction Debris and Waste Water

The technical SOW required Parallax to transport all construction rubble to a designated staging area. Waste concrete was stockpiled on an abandoned aircraft runway, as directed. Figure 3-1 shows the haul route from Facility 244 to the debris storage area. Photograph 14 is a view of stockpiled construction rubble. Base representatives then assumed responsibility for disposal of the material. When sufficient quantities of waste concrete were accumulated, the rubble was scheduled to be crushed and used in backfilling projects on-Base. No hydrocarbon contamination was detected during the PSA; therefore, no soils were removed.

A large quantity of metal scrap resulted from the Facility 244 removal action. All metal surfaces were pressure washed/decontaminated, as necessary, prior to release for disposal. A total of 6,070 pounds of scrap metal consisting of piping, valves, the O/W separator, miscellaneous frames and metal shapes, and the chain-link fencing fabric, gates, and poles were sold to Ed's Recycling, Inc., Clovis, New Mexico, for $75.87. Photograph 16 is a view of the scrap metal loaded on the flatbed truck. Arrival at Ed's Recycling, Inc., with the metal is depicted in Photograph 17. Figures 3-2 and 3-3 are copies of the front and back of the receipt, showing value of the metal and weight tally stamps, respectively, from the metal recycler documenting disposal of the scrap metal. Check number 3156 was issued for this amount, payable to Parallax (Figure 3-4).

All pressure wash rinse/decontamination water, sludge and tank residues, used personnel protective equipment, and associated project-related wastes were containerized in 55gallon steel drums. The drums were sealed and transported to the on-Base RCRA 90-day waste accumulation facility. Approximately 15 drums were delivered to the collection facility. Photograph 18 shows subcontractor personnel unloading waste drums for storage. Base representatives then assumed responsibility for drum labeling, characterization of contents through sampling and analysis, manifesting, and shipping to an appropriate disposal facility.

Photograph 19 shows the former site of Facility 244 after completion of removal and investigation activities. The backfilled portion is identified by the light tan area of compacted caliche, in the foreground. The storage tanks temporarily staged in an area southeast of the Facility are shown in Photograph 20.

4.0 PRELIMIINARY SITE ASSESSMENT

The current project consisted of two tasks: 1) removal of the aboveground storage tanks and associated concrete structures; and 2) a PSA. This section addresses the site characterization that involved field observations, instrumentation surveys for volatile organic vapors, and collection of representative soil samples along with requisite QC duplicate samples for laboratory analyses.

4.1 Investigation Overview

Prior to demolition of the containment pad, the entire Facility was inspected for indications of spills on the concrete pad and ground surfaces outside of the retaining curb. No discoloration was observed. Due to the infrequent use of the storage facility, the non-availability of historical operational records, and the apparent integrity of the containment structure, no significant subsurface contamination was anticipated.

After removal of the containment pad, the exposed soil surfaces were examined visually and representative grab soil samples collected from each corner, the center, and in selected areas with highest potential to exhibit petroleum contaminated soils (PCSs) (e.g., adjacent to and underlying the O/W separator vault, oil dump pits, and surface areas adjacent to the retaining curbs at ground level). Through both field screening and laboratory analyses, the soils underlying Facility 244 were thoroughly characterized and therefore permitted a clean closure with a high degree of confidence.

4.2 Field Observations

After removal of the overlying containment pad and appurtenances, the field geologist inspected the underlying exposed soils to determine the indication of petroleum hydrocarbon contamination. The soils were visually examined for the presence of discoloration due to petroleum staining or characteristic odors. No staining or odors were detected. The ambient atmospheres directly above the ground surfaces in areas most likely to exhibit contamination (e.g., soils under the O/W separator, dump pits, and areas surrounding the outside of the retaining curbs) were monitored for volatile organic vapors by the SHSO using a PID and Draeger® contaminant-specific (benzene) colormetric tubes. None of these instrumentation surveys indicated concentrations of volatile hydrocarbon contaminants exceeding USEPA risk-based concentrations (RBCs).

4.3 Sampling and Analysis

A total of ten representative soil samples, including eight grab from various locations throughout the Facility and two requisite QC samples (i.e., field duplicate and MS/MSD), were collected and shipped to Accura Analytical Laboratory for analyses. Each sample

consisted of 250 milligrams of soil placed in a pre-cleaned glass jar furnished by the laboratory. This quantity was sufficient to perform all required analyses. Each sample container was assigned a unique identification (ID) number; labeled indicating location, date, and time; and placed on ice for preservation. The samples were entered on the chain-of-custody along with required analytical parameters. Figure 4-1 is a copy of the chain of custody. The samples and custodial documentation were shipped by overnight express carrier to the analytical laboratory.

Eight sampling locations were selected to represent the entire surface of the Facility 244 soils. Figure 4-2 is a plan view of the Facility showing sarnpling locations. When the samples were collected, an error was made in interpreting the geographic orientation of Facility 244. The front fence segment, containing the gates, was recorded as facing north. Instead, the proper orientation was west; therefore, all sample location notations will be rotated 90 degrees clock-wise (e.g., a sample point originally recorded as the southeast corner is actually the northeast corner. The former and corrected sample locations, and ID numbers are presented in the following table:

Sample ID	Former Sample Location	Corrected Sample Location
244SS001	Southeast corner of pad	Northeast corner of pad
244SS002	Southwest corner of pad	Southeast corner of pad
244SS003	Center of pad	Center of pad
244SS004	Northeast corner of pad	Northwest corner of pad
244SS004-FD	Northeast corner of pad	Northwest corner of pad
244SS004-MS	Northeast corner of pad	Northwest corner of pad
244SS005	Northwest corner of pad	Southwest corner of pad
244SS006	East of O/W separator	North of O/W separator
244SS007	West of O/W separator	South of O/W separator
244SS008	South of O/W separator	East of O/W separator

As stipulated in the *Facility 244 Scope of Services,* Site-Specific Requirements, line item 11, "Sampling and Analysis," the soil samples were analyzed for the following COCs: total petroleum hydrocarbons (TPHs), metals, pesticides, and polychlorinated biphenyls (PCBs). The samples were analyzed according to the following laboratory methods:

Method	Description
SW 7471A	Mercury in Solid or Semi-Solid Waste (Manual Cold-Vapor Technique)
SW 6010B	Inductively Coupled Plasma-Atomic Emission Spectrometry - RCRA Metals
SW 3050B	Acid Digestion of Sediments, Sludges, and Soils
SW8081A	Organochlorine Pesticides by Gas Chromatography
SW 8082	PCBs by Gas Chromatography
USEPA 418.1	Total Recoverable Petroleum Hydrocarbons

The analytical data received from Accura Laboratory for the various parameters are attached in Appendix A, Tables A- 1 through A-4. The analytical results of these samples indicated that there were no COCs present in the soils underlying Facility 244 that exceeded USEPA RBCs.

The analytical data received from Accura Laboratory for the various parameters are attached in Appendix A, Tables A- 1 through A-4. The analytical results of these samples indicated that there were no COCs present in the soils underlying Facility 244 that exceeded USEPA RBCs.

4.4 Data Quality Assessment

Data review and validation were performed by applying the QC limits defined in the quality assurance project plan (QAPjP). Data validation consisted of a review of holding times, method blanks, field duplicates, surrogates spikes, MS/MSDs, and a case narrative review including sample receipt forms and chain of custody. Validation guidelines from the National Functional Guidelines for Organic Data Review (USEPA 1994a) and the National Functional Guidelines for Inorganic Data Review (USEPA 1994b) were used as reference resources to define the validation criteria.

4.4.1 Quality Assessment Summary

Data accuracy and precision were within control guidelines and therefore were considered acceptable, with one exception. Samples were collected and analyzed according to specifications provided in the project-specific QAPjP. The relative recovery differences in analyses between a sample and the respective sample replicate were outside the method specified limit for arsenic, cadmium, chromium, and lead. Sample results associated with non-compliance QC data were qualified in accordance with the QAPjP. Sample results flagged as estimated (J or UJ) were useable for the intended purpose of this project. No sample results were flagged as unusable (R) thereby indicating that all sample data generated during this project are usable. A summary of qualified sample results is presented in Appendix B, Table B-1. Data flags used in the data validation process are listed at the end of Table B-1. Specific data validation considerations are presented in the following sections.

A. Holding Times

Due to limited information concerning retention times for non-aqueous samples, a period of 14 days was selected as a maximum allowable holding time for soil samples from collection to analysis during this project. The 14-day limitation was not exceeded for any sample.

B. Method SW 8082, PCBs

There were no problems associated with the sample analyses for PCBs; therefore, these data are fully useable for the purposes of this project.

C. Method SW 8081A, Organochlorine Pesticides

Sample 244SS006 required dilution due to matrix interference resulting in elevated detection limit for organochlorine pesticides. The target compounds analyzed for in this sample were not detected. The sample quantitation limits for the target compounds were estimated quantities; however, this was considered to be a minor problem. The results are fully useable for the purposes of this project.

D. Method EPA 418.1, Total Recoverable Petroleum Hydrocarbons

Samples 244SS006 and 244SS007 required dilution due to high analyte concentrations resulting in elevated detection limits for TPHs. The quantity of TPH measured in each of the two samples was significantly above the elevated detection limit; therefore, this is not considered to be a problem. The results are fully useable for the purposes of this project.

E. Method SW 7471A, Mercury in Solid or Semi-Solid Waste

There were no problems encountered during sample analyses for mercury. These data are fully useable for the purposes of this project.

F. Method SW 6010B, Metals RCRA/Method SW 3050B, Acid Digestion of Soil

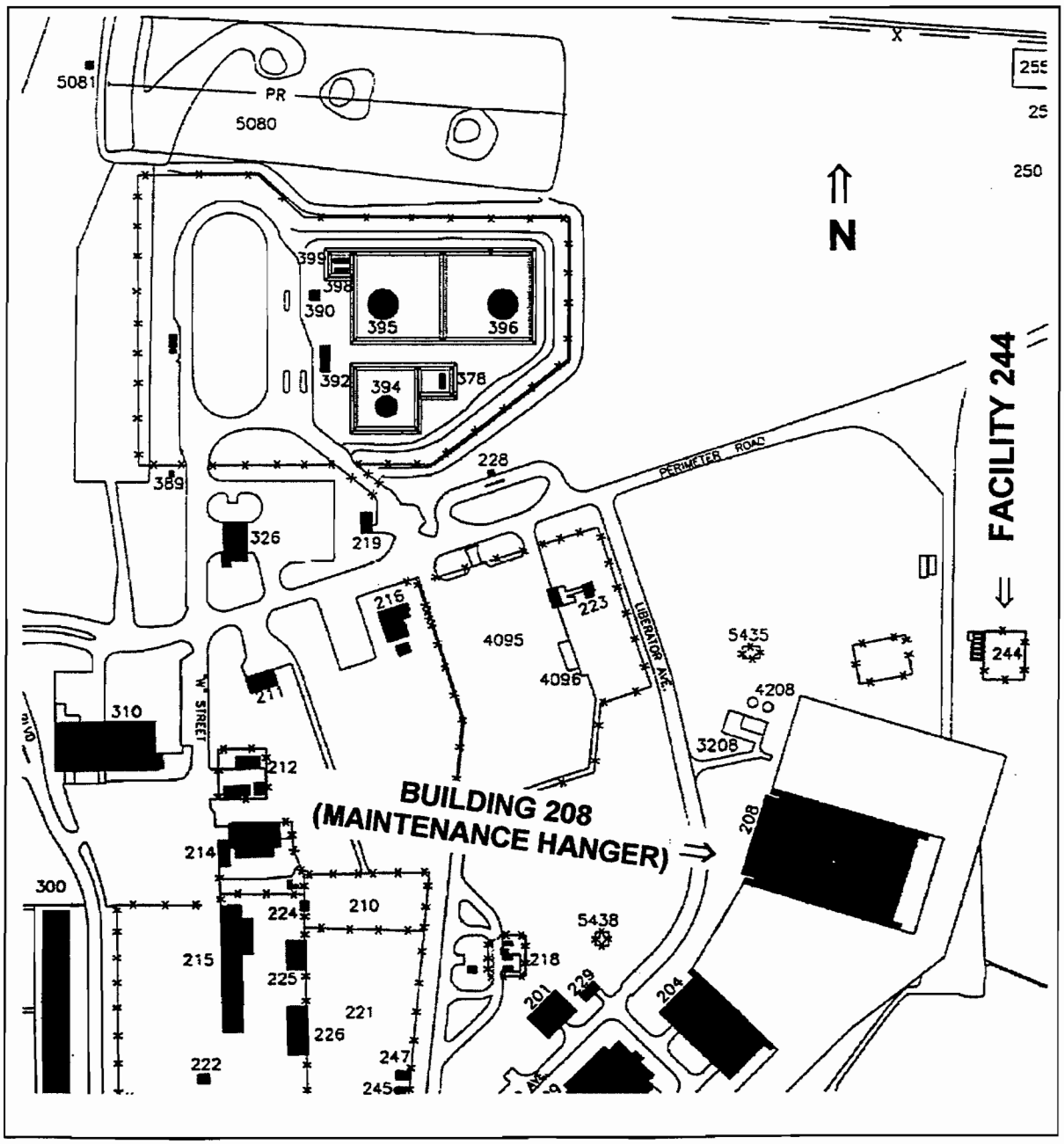
A duplicate for sample 244SS004 was analyzed. The relative difference in percentage of recovery between the sample and duplicate sample analyses was outside of method specified limits for arsenic, cadmium, chromium, and lead. This relative difference in recovery was attributed to sample heterogeneity. These results were considered to be a minor problem, and were therefore flagged as estimated (J or UJ). The data are useable for the intended purpose of this project.

G. Field Duplicate Precision

Field sampling precision was determined from the results of the field duplicate QC sample 244SS004. With the exception of the metals discussed in the above section, overall instrumentation method replication was within precision limits.

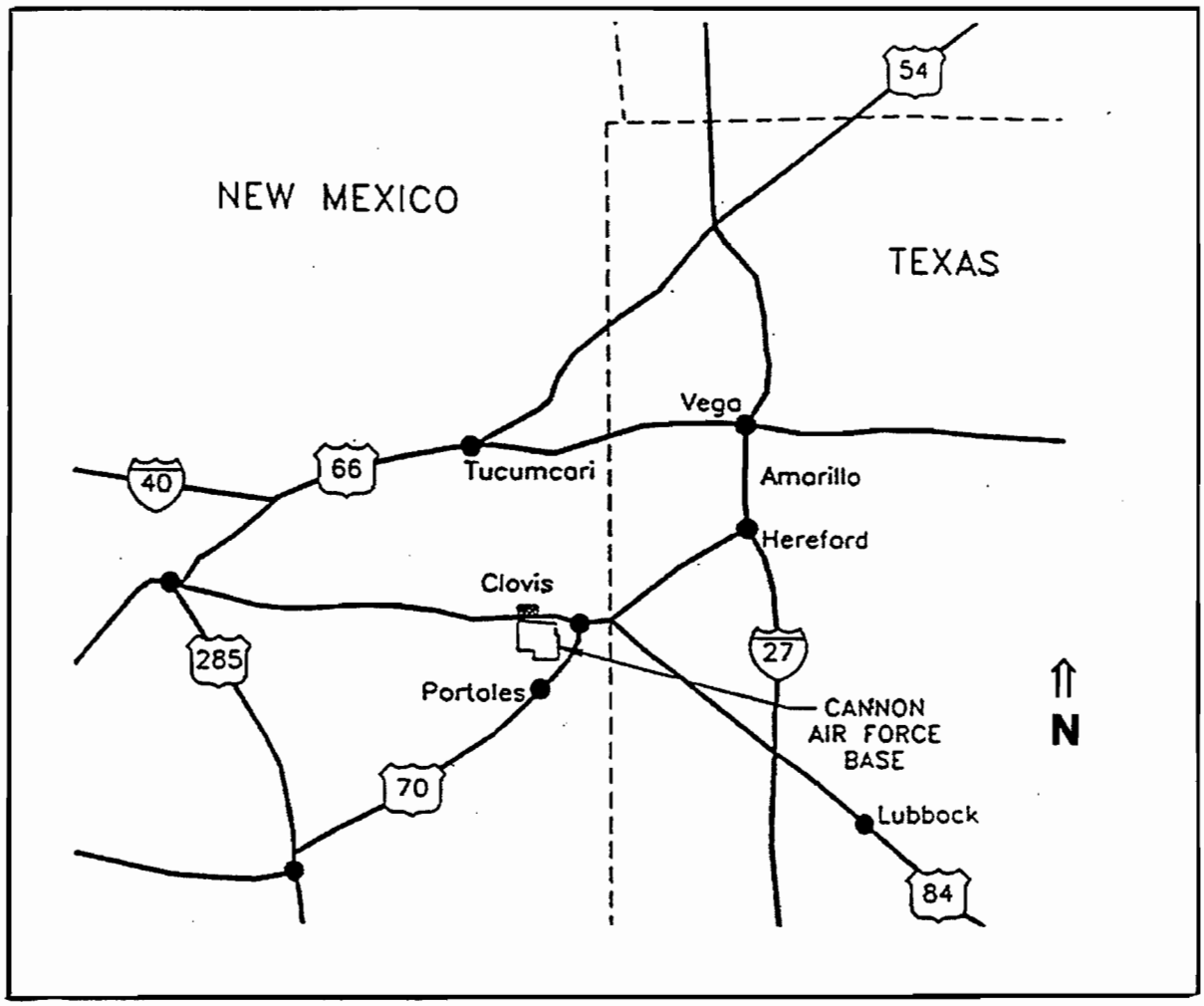
5.0 SUMMARY AND CONCLUSIONS

Based upon field observations and laboratory analyses, the removal action at Facility 244 resulted in a clean closure, as indicated by the PSA; therefore, no further action is anticipated.



- NOT TO SCALE -

Figure 2-1: Location Map of Facility 244 and Adjacent Structures.



- NOT TO SCALE -

Figure 2-2: Map of Cannon AFB and Surrounding Area.

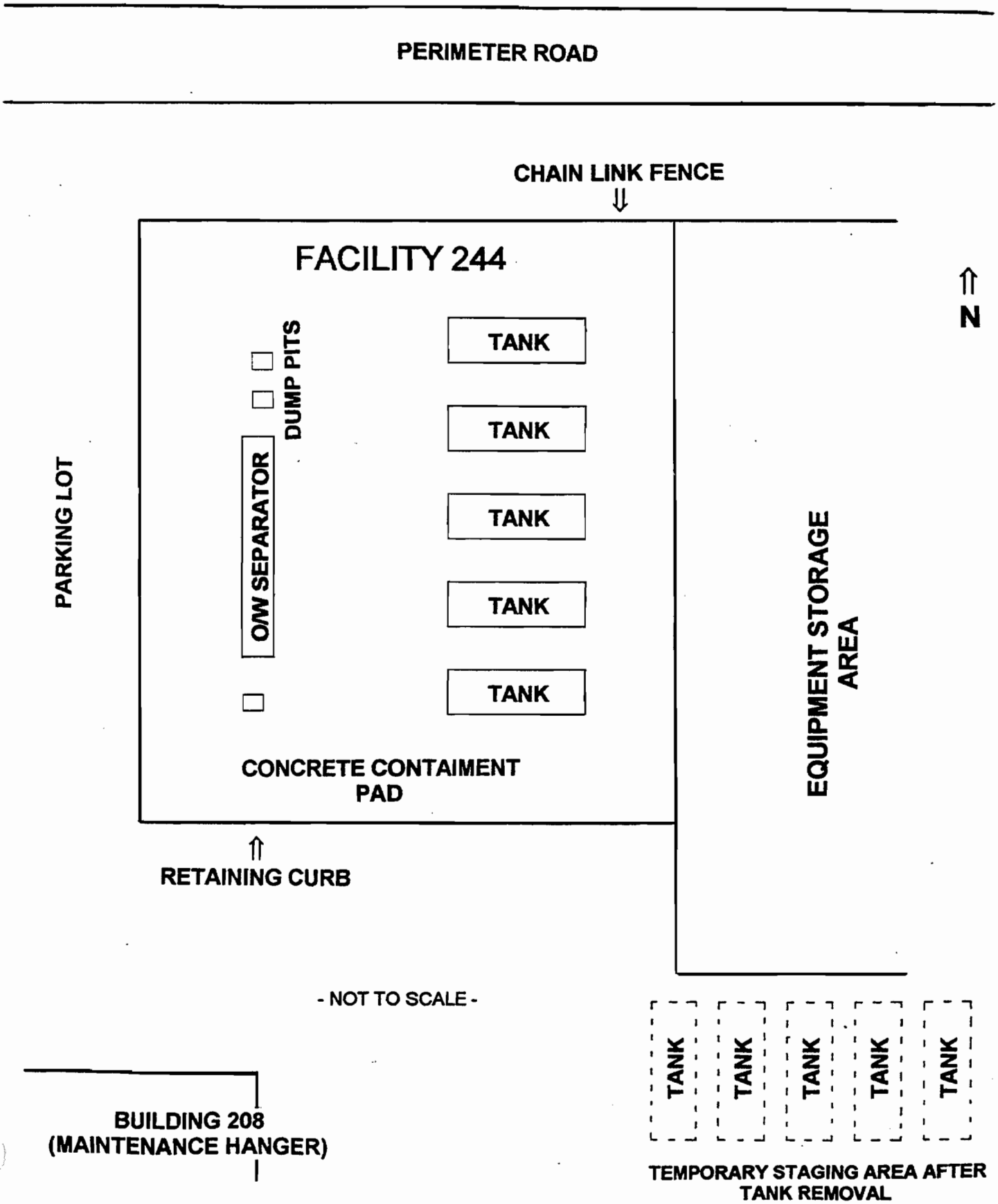
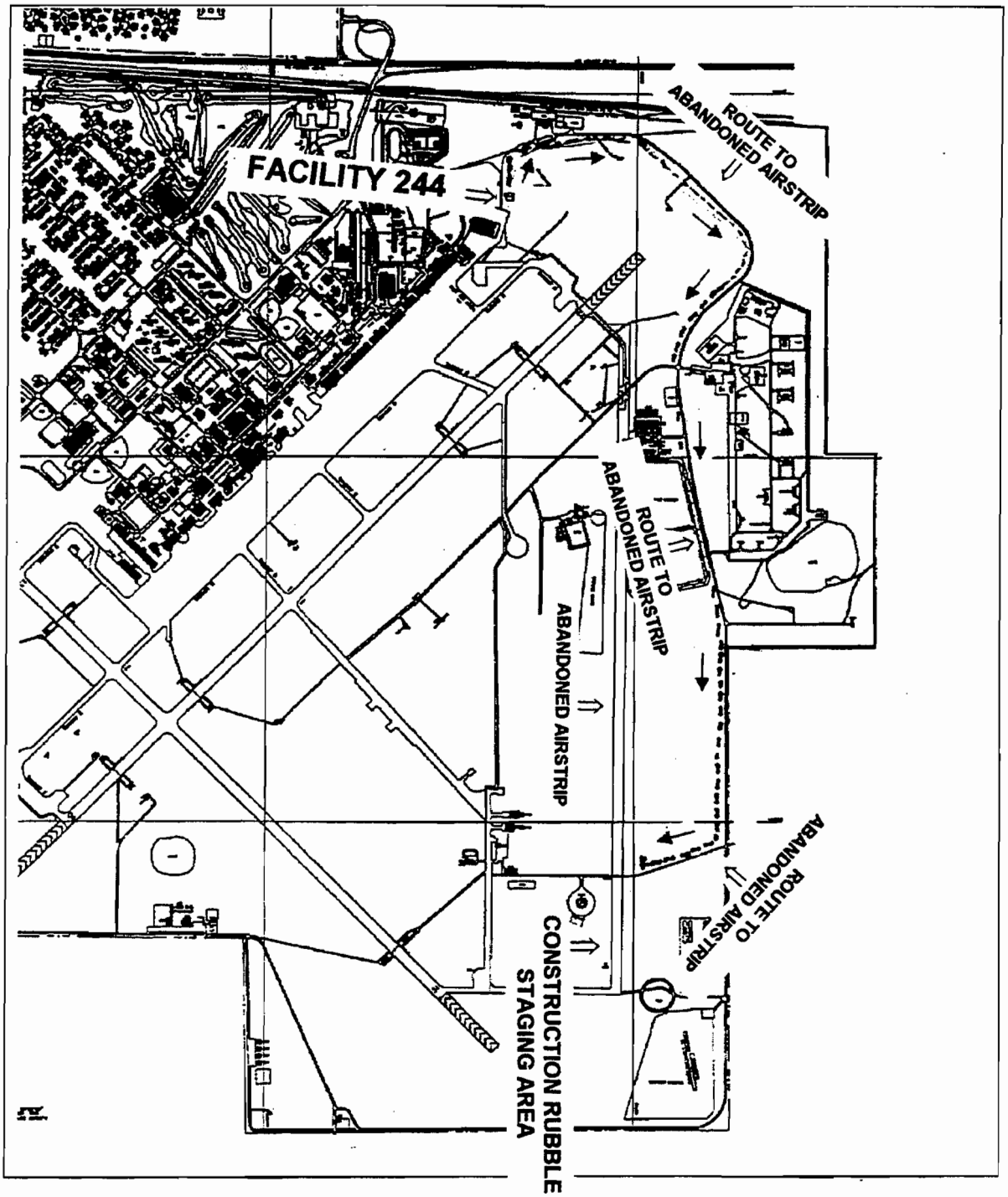


Figure 2-3: Diagram of Tank Locations and Associated Features.



- NOT TO SCALE -

Figure 3-1: Map of Haul Route to Abandoned Airstrip/Rubble Storage Area.

ED's RECYCLING CENTER

605 South Prince
Clovis, NM 88101
Phone (505) 762-7699 • Fax (505) 762-7607

Date 12-15 19 99

Name

Address

City State

Quantity	Description		
	Alum. Cans		
	Alum. Clean		
	Alum. Dirty		
	Alum. Breakage		
	Alum. Cast		
	Alum. Pipe		
	#1 Copper		
	#2 Copper		
	Ins. Copper		
	Red Brass		
	Yellow Brass		
	Radiators		
	Lead		
	Die Cast		
	Stainless Steel		
	Batteries		
6070	Iron	75	87
	Motors		
	Cast Iron		
	Tin		
	Cardboard		

Received By

Figure 3-2: Copy of Receipt from Ed's Recycling Center for Scrap Metal.

ED'S
RECYCLING CENTER

605 South Prince
Clovis, NM 88101
Phone (505) 762-7699 • Fax (505) 762-7607

Date 12-15 19 97

Name

Address

City State

Quantity	Description		
	Alum. Cans		
	Alum. Clean		
	Alum. Dirty		
	Alum. Breakage		
	Alum. Cast		
	Alum. Pipe		
	#1 Copper		
	#2 Copper		
	Ins. Copper		
	Red Brass		
	Yellow Brass		
	Radiators		
	Lead		
	Die Cast		
	Stainless Steel		
	Batteries		
6070	Iron	75	87
	Motors		
	Cast Iron		
	Tin		
	Cardboard		

Received By

Figure 3-3: Weight Tally Sheet, Ed's Recycling Center, Showing 6070 Pounds.

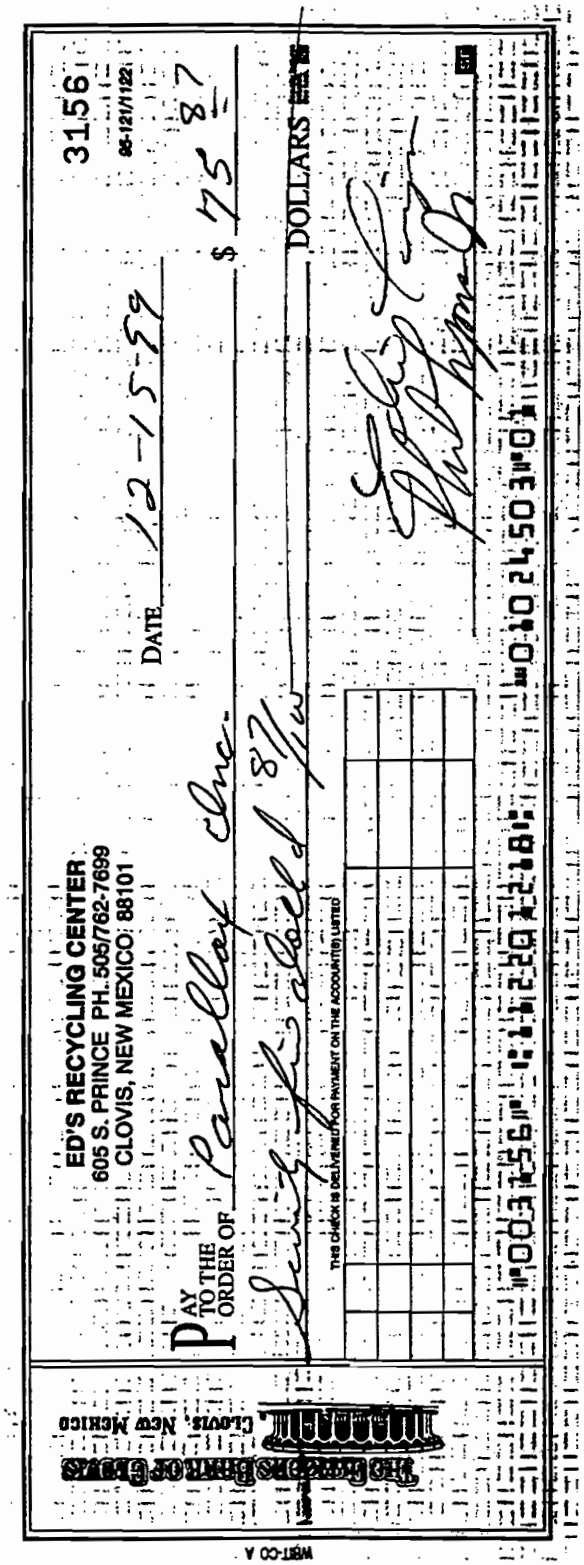


Figure 3-4: Reproduction of Check # 3156 Received for Scrap Metal.

23808

ACCURA ANALYTICAL LABORATORY, INC.

Environmental Analytical Services

6017 Financial Drive, Norcross, GA 30071
Phone # (770) 449-8800 Fax # (770) 449-5477

CHAIN OF CUSTODY

Company Name: Parallax, Inc.
Address: 795 W. Main St., Oak Ridge, TN 37830
Report Sent to: (Client Contact): David R. Finney
Contact Phone # (423) 481-8285 Fax # (423) 481-
Project Name: Cannon AFB – AOCJ, Facility 244
Project Number: 2829-001

Billing address:
Client P.O. #

For Laboratory Use Only
Custody Seal: Y N Page 1 OF
QC Level: N 1 2 3 4 Int/Temp: 4°C
Sample Condition: AAL Lab Project: 23176

Samplers: (signature) David R. Finney
Samplers: (printed) All Soil RF David R. Finney

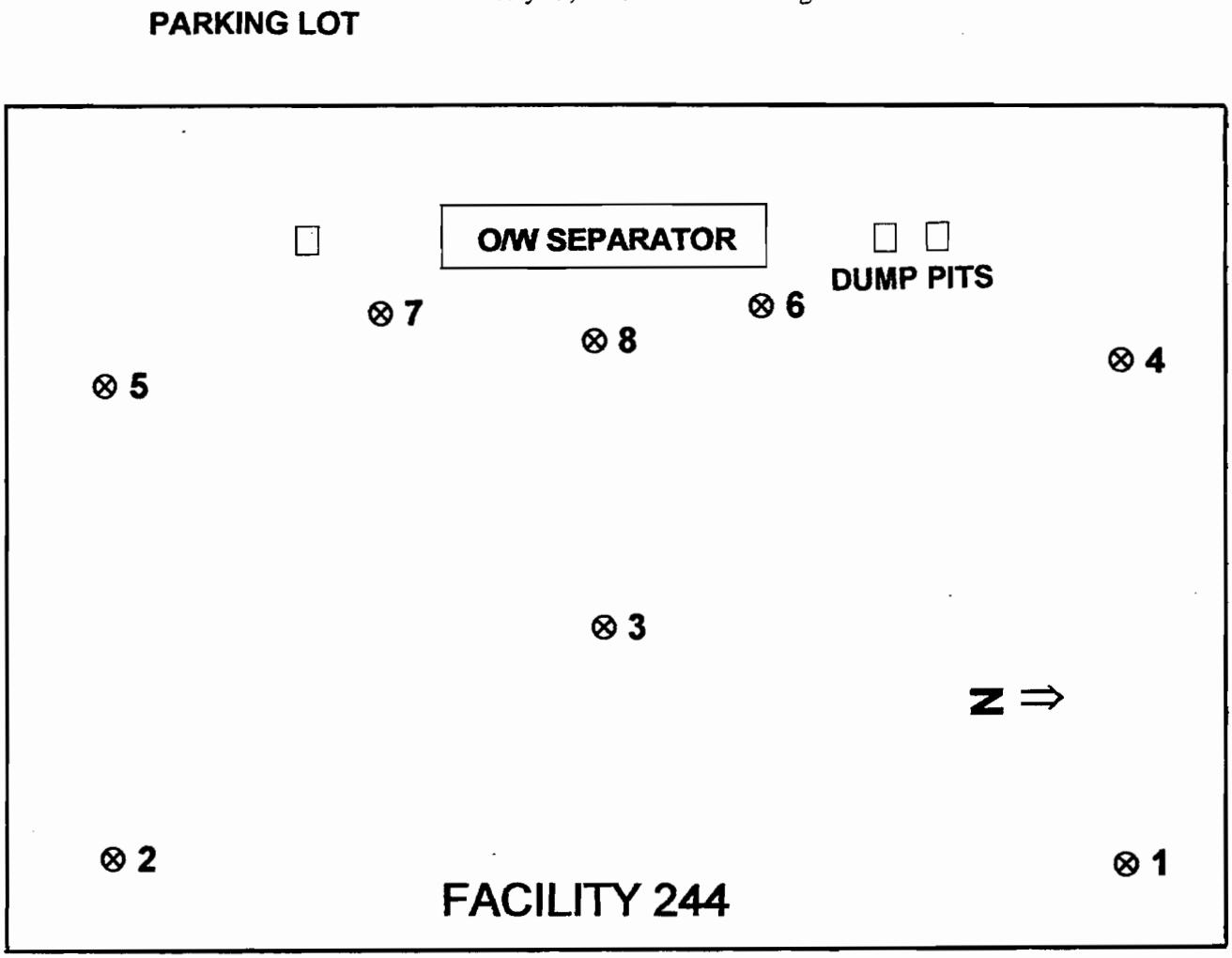
Sample ID #	Sample Date / Time	Comp	Grab	Matrix	Preserved	Sample Location:	No. of Containers	Metals	PCB	Pesticides	Herbicides					Remarks	Accura Sample ID No. AB
24455001	12-14-99 1320MST		✓			SE Corner	1	✓	✓	✓	✓						83221
24455002	12-14-99 1328MST		✓			SW Corner	1	✓	✓	✓	✓						83222
24455003	12-14-99 1313MST		✓			Center	1	✓	✗	✓	✓						83223
24455004	12-14-99 1335MST		✓			NE Corner	1	✓	✓	✓	✓						83224
24455004*	12-14-99 1335MST		✓			NE Corner	1	✓	✓	✓	✓					*Field Duplicate	83225
24455004**	12-14-99 1335MST		✓			NE Corner	1	✓	✓	✓	✓					**MS/MSD	83226
24455005	12-14-99 1355MST		✓			NW Corner	1	✓	✓	✓	✓						83227
24455006	12-14-99 1420MST		✓			E of QWSD	1	✓	✓	✓	✓						83228
24455007	12-14-99 1430MST		✓			W of QWSD	1	✓	✓	✓	✓						83229
24455008	12-14-99 1445MST		✓			S of QWSD	1	✓	✓	✓	✓						83230

Relinquished By:	Date / Time	Received By:	Date / Time	Special Requirements Or Remarks:
David R. Finney	12-14-99 1630MST	Fedex	12/15/99 09:30	
Relinquished By:	**Date / Time**	**Received By:**	**Date / Time**	**Turnaround Time Requested:**

Matrix Guide: (S = Soil) (W = Water) (L = Liquid) (C = Cartridge) (SL = Sludge) (A = Air Sample) (F = Foods) (M = Miscellaneous)

CC097.2 VLS

Figure 4-1: Copy of Chain of Custody for Soil Samples Collected 12-14-99.



⊗ SAMPLE LOCATION

- NOT TO SCALE -

SAMPLE LOCATIONS:

Sample 1: Northeast corner of pad - 5 feet south of north fence; 6 feet, 9 inches west of east fence. Depth - surface of excavation. Time: 1320 MST.

Sample 2: Southeast corner of pad - 3 feet north of south fence; 4 feet, 3 inches west of east fence. Depth - surface of excavation. Time: 1328 MST.

Sample 3: Center of pad - 25 feet south of north fence; 17 feet west of east fence. Depth - surface of excavation. Time: 1313 MST.

Sample 4: Northwest corner of pad - 6 feet, 4 inches south of north fence; 29 feet west of east fence. Depth - surface of excavation. Time: 1335 MST. (Field Duplicate and MS/MSD.)

Sample 5: Southwest corner of pad - 6 feet, 6 inches north of south fence; 22 feet, 6 inches west of east fence. Depth - surface of excavation. Time: 1358 MST.

Sample 6: Adjacent to northeast corner of O/W separator vault - 18 feet south of north retaining curb; 7 feet, 9 inches east of asphalt parking lot. Depth - surface of excavation (in 4-foot deep pit). Time: 1420 MST.

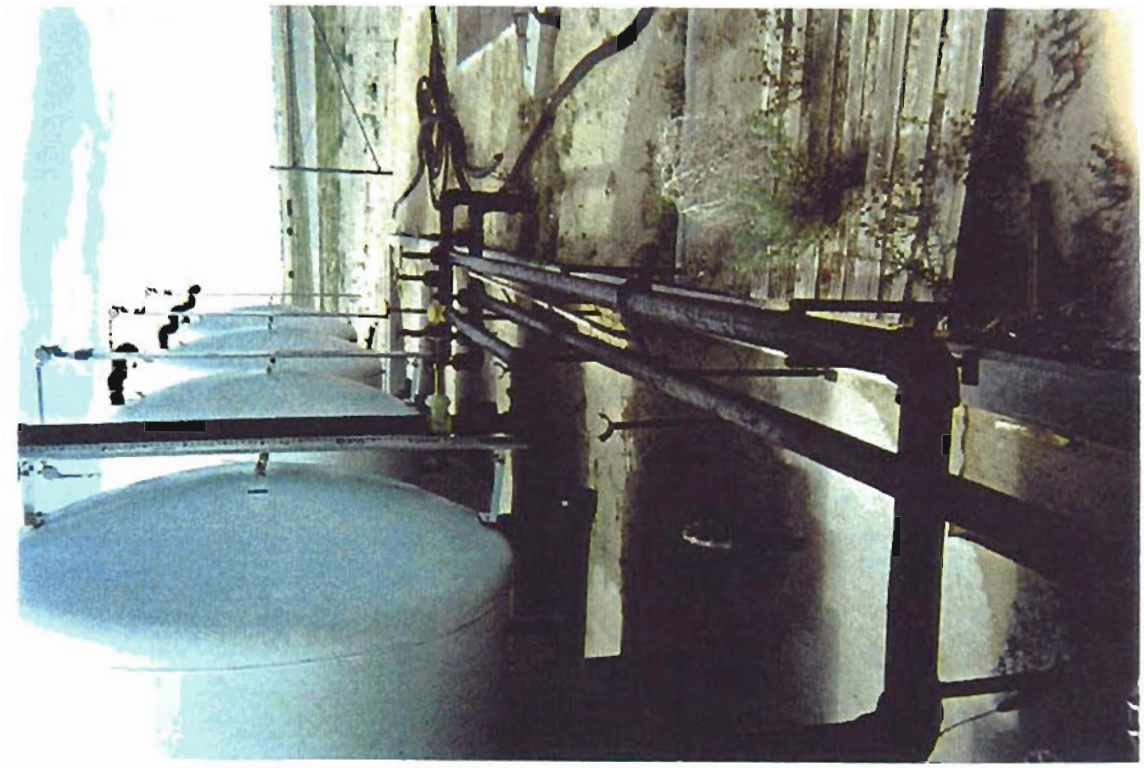
Sample 7: Adjacent to southeast corner of O/W separator vault - 6 feet south of south wall of O/W separator vault; 8 feet, 6 inches east of asphalt parking lot. Depth - surface of excavation (in 2-foot, 6-inch deep pit). Time: 1430 MST.

Sample 8: East of mid-line of O/W separator vault - 5 feet south of north end of O/W separator vault; 5 feet, 6 inches east of east wall of vault. Depth - surface of excavation (3-foot, 6-inch deep pit). Time: 1445 MST.

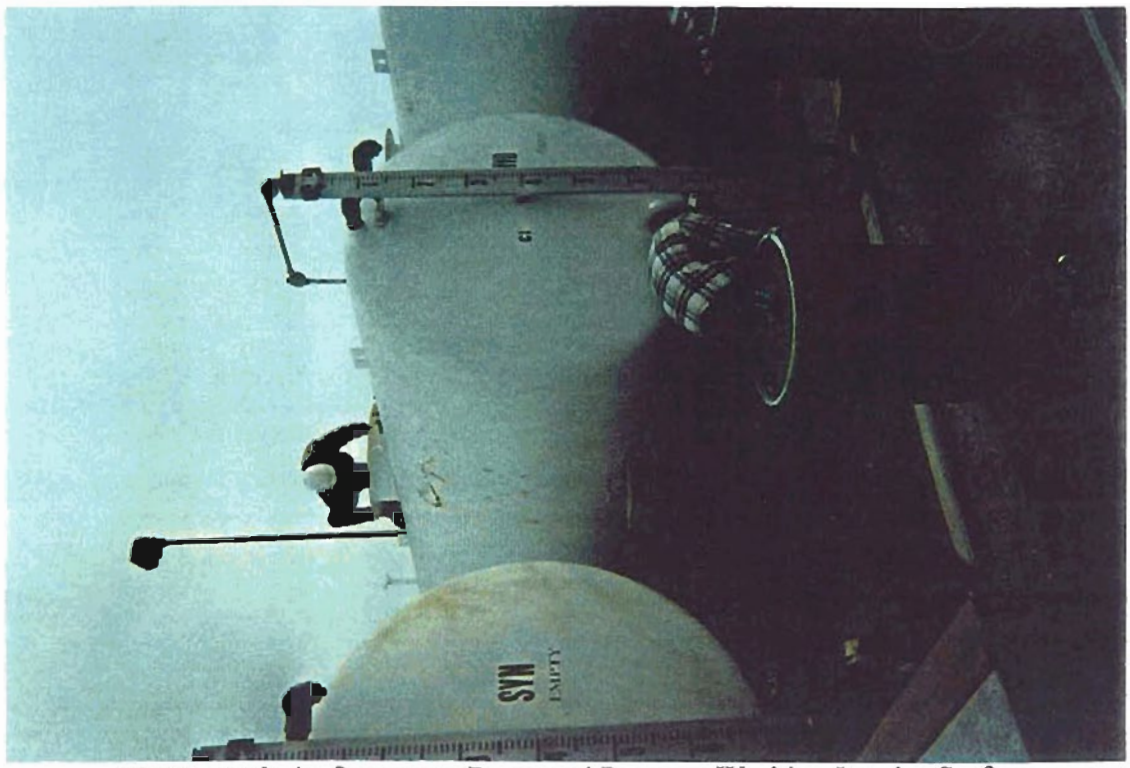
Figure 4-2: Plan View of Facility 244 Showing Soil Sampling Locations.

Photograph 1: View of Facility 244 Prior to Start of Dismantling Operations Showing Tank Locations and Fencing.

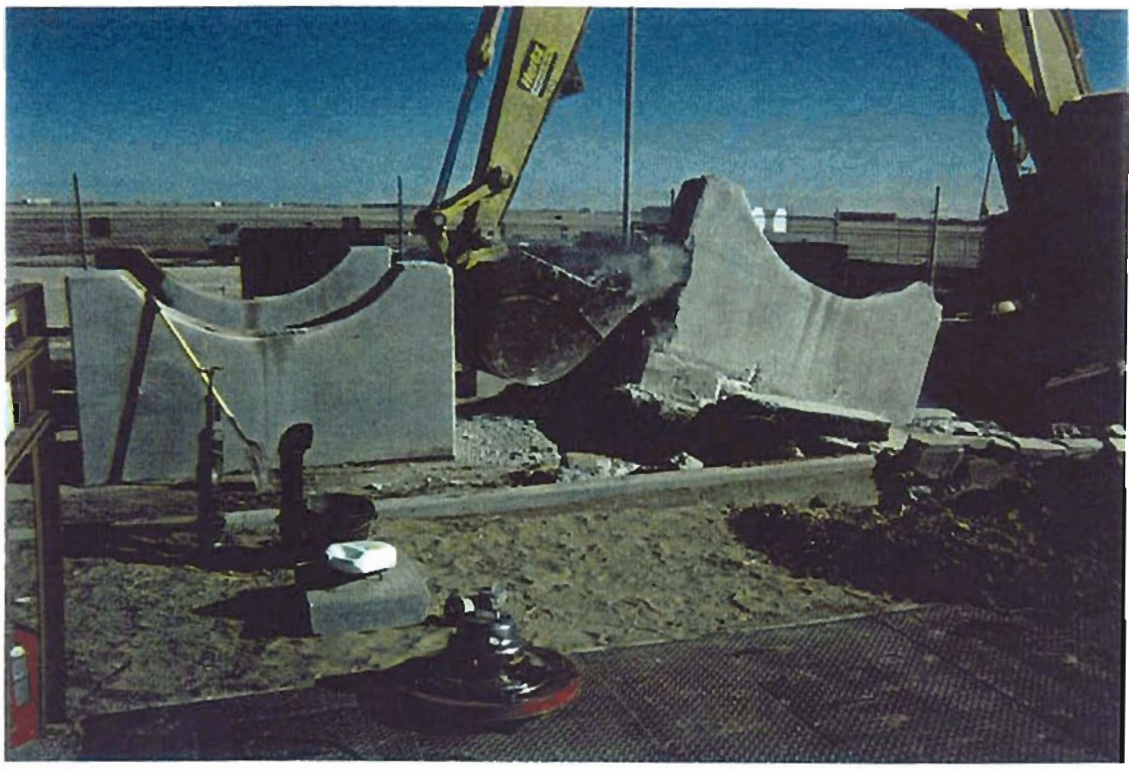
Photograph 2: Alternate View of the Facility with Fence Fabric Removed and Orange Safety Webbing Stretched.



Photograph 3: Associated Distribution Piping and Manual Valves.



Photograph 4: Omegasys Personnel Pressure Washing Interior Surfaces of Tank and Using Drain Valve to Remove Sludges and Rinse Water.

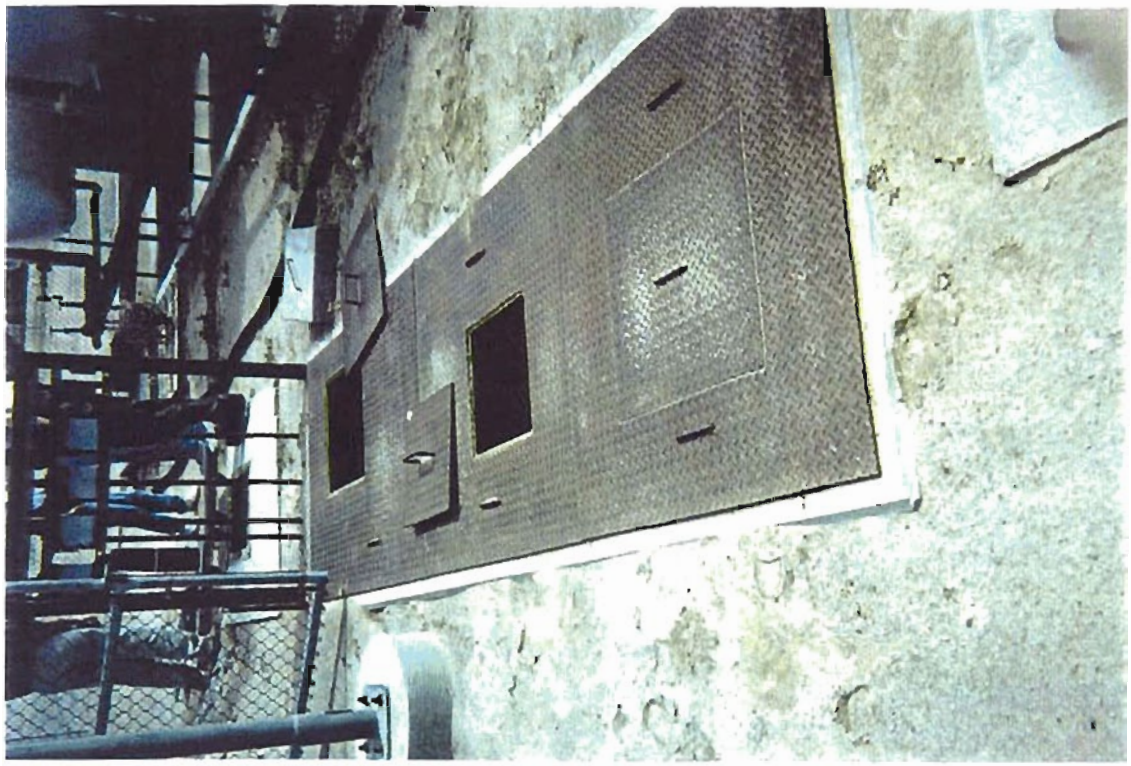


Photograph 5: Removal of Tank Support Saddle with Trackhoe Bucket.

Photograph 6: Stockpiling Concrete Support Saddles at the Designated Staging Area.

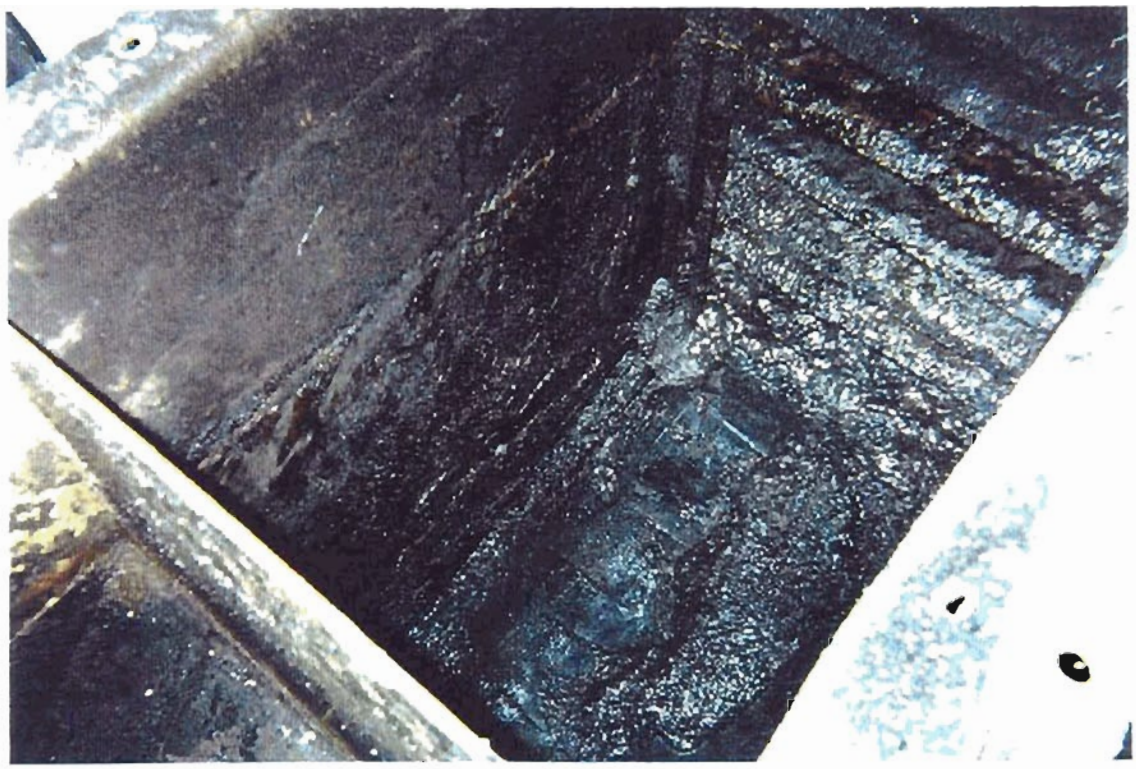
Photograph 7: Removal of Remaining Portions of the Concrete Containment Pad and Retaining Curb.

Photograph 8: View of Soil Surface after Removal of the Containment Pad.



Photograph 9: Sheet Metal Cover, with Accessways, for the O/W Separator and Concrete Vault.

Photograph 10: Omegasys Personnel Removing Top Plate of O/W Separator and Disconnecting Supply/Distribution Pipes.



Photograph 11: View of O/W Separator Interior Structure Showing Thick Deposits of Sludge and Oil-Coated Baffles.

Photograph 12: The Trackhoe Bucket Is Used to Lift the O/W Separator from the Concrete Vault.

Photograph 13: Field Personnel Use Shovels and Scoops to Remove Sludge Prior to Pressure Washing Interior Surfaces.

Photograph 14: The Concrete O/W Separator Vault and Associated Dump Pits Are Demolished after Removal of Piping.

Photograph 15: View of Construction Rubble Stockpiled at the Designated Abandoned Airstrip.

Photograph 16: Scrap Metal Loaded on Flatbed Truck Ready for Transport to the Scrap Metal Recycler.

Photograph 17: Delivery of Scrap Metal to Ed's Recycle Center, Clovis, New Mexico.

Photograph 18: Omegasys Personnel Unloading Drums of Decontamination and Rinse Waters, and Residual Sludges at the On-BaseRCRA 90-Day Storage Facility.

Photograph 19: View of Facility 244 Location upon Completion of Removal Activities; Light Tan Area in Foreground Is Backfilled Area.

Photograph 20: View of Tanks Removed from Facility 244, Temporarily Staged Prior to Sale as Surplus Material.

APPENDIX A

SOIL SAMPLE ANALYTICAL DATA

PRELIMINARY SITE ASSESSMENT
SWMU 129, FACILITY 244
CANNON AFB, CLOVIS, NEW MEXICO

Table A-1
Facility 244, Cannon AFB, Clovis, New Mexico
Soil Sample Results
RCRA Metals

Medium	Sample ID	Sample Date	Mercury (mg/Kg)	Arsenic (mg/Kg)	Barium (mg/Kg)	Cadmium (mg/Kg)	Chromium (mg/Kg)	Lead (mg/Kg)	Selenium (mg/Kg)	Silver (mg/Kg)
Soil	244SS001	12/14/99	<0.58	7.8	79	1.2	7.7	7.3	<5.8	<5.8
Soil	244SS002	12/14/99	<0.55	7.0	46	0.85	<5.5	5.9	<5.5	<5.5
Soil	244SS003	12/14/99	<0.59	12	130	1.6	9.6	10	<5.9	<5.9
Soil	244SS004	12/14/99	<0.56	5.8	48	0.9	<5.6	6.2	<5.6	<5.6
Soil	244SS004 FD	12/14/99	<0.56	8	61	0.99	6.7	6.4	<5.6	<5.6
Soil	244SS004 MS	12/14/99	<0.56	6.3	52	1.1	6.2	7.4	<5.6	<5.6
Soil	244SS005	12/14/99	<0.56	8.4	55	1.1	6.9	9.4	<5.6	<5.6
Soil	244SS006	12/14/99	<0.55	7.6	380	1.1	5.6	13	<5.5	<5.5
Soil	244SS007	12/14/99	<0.57	11	170	1.8	8.5	13	20	<5.7
Soil	244SS008	12/14/99	<0.56	6.6	120	1.6	7.3	9.4	17	<5.6
	Total Detects	----	0	10	10	10	8	10	2	0
	Total Analyses	----	10	10	10	10	10	10	10	10
	Average Result	----	<RDL	8.05	114.1	1.224	7.3125	8.8	18.5	<RDL
	Maximum Detect	----	<RDL	12	380	1.8	9.6	13	20	<RDL
	Minimum Detect	----	<RDL	5.8	46	0.85	5.6	5.9	17	<RDL
	Industrial RBC	----	61	3.8	140000	1000	610	1,200	10,000	10000
	Residential RBC	----	2.3	0.43	5500	39	23	400	390	390

Table A-2
Facility 244, Cannon AFB, Clovis, New Mexico
Soil Sample Results
PCBs

Medium	Sample ID	Sample Date	Aroclor-1016 (ug/Kg)	Aroclor-1221 (ug/Kg)	Aroclor-1232 (ug/Kg)	Aroclor-1242 (ug/Kg)	Aroclor-1248 (ug/Kg)	Aroclor-1254 (ug/Kg)	Aroclor-1260 (ug/Kg)
Soil	244SS001	12/14/99	<19	<38	<38	<19	<19	<19	<19
Soil	244SS002	12/14/99	<19	<36	<36	<19	<19	<19	<19
Soil	244SS003	12/14/99	<20	<39	<39	<20	<20	<20	<20
Soil	244SS004	12/14/99	<19	<37	<37	<19	<19	<19	<19
Soil	244SS004-FD	12/14/99	<19	<37	<37	<19	<19	<19	<19
Soil	244SS004-MS/MSD	12/14/99	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Soil	244SS005	12/14/99	<19	<37	<37	<19	<19	<19	<19
Soil	244SS006	12/14/99	<19	<36	<36	<19	<19	<19	<19
Soil	244SS007	12/14/99	<19	<38	<38	<19	<19	<19	<19
Soil	244SS008	12/14/99	<19	<37	<37	<19	<19	<19	<19
	Total Detects	----	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Total Analyses	----	**10**	**10**	**10**	**10**	**10**	**10**	**10**
	Average Result	----	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**
	Maximum Detect	----	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**
	Minimum Detect	----	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**
	Industrial RBC	----	**82000**	**2900**	**2900**	**2900**	**2900**	**2900**	**2900**
	Residential RBC	----	**5500**	**320**	**320**	**320**	**320**	**320**	**320**

RDL – Reported Detection Limit

Figure A-3
Facility 244, Cannon AFB, Clovis, New Mexico
Soil Sample Results
Pesticides

MEDIUM	Sample ID	Sample Date	4,4'-DDD (ug/Kg)	4,4'-DDE (ug/Kg)	4,4'-DDT (ug/Kg)	Aldrin (ug/Kg)	alpha-BHC (ug/Kg)	alpha-Endosulfan (ug/Kg)	beta-BHC (ug/Kg)	beta Endosulfan (ug/Kg)	delta-BHC (ug/Kg)	Dieldrin (ug/Kg)	Endosulfan sulfate(ug/Kg)	Endrin (ug/Kg)	Endrin aldehyde (ug/Kg)	GammaBHC(Lindane)(ug/Kg)	Heptachlor (ug/Kg)	Heptachlor epoxide (ug/Kg)	Methoxychlor (ug/Kg)	Total Chloradane (Technical) (ug/Kg)	Toxaphene (ug/Kg)
Soil	244SS001	12/14/99	<1.9	<1.9	<3.8	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.4	<19	<94
Soil	244SS002	12/14/99	<1.9	<1.9	<3.6	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.1	<19	<91
Soil	244SS003	12/14/99	<2.0	<2.0	<3.9	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<9.8	<20	<98
Soil	244SS004	12/14/99	<1.9	<1.9	<3.7	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.2	<19	<92
Soil-FD	244SS004	12/14/99	<1.9	<1.9	<3.7	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.2	<19	<92
Soil-MS	244SS004	12/14/99	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Soil	244SS005	12/14/99	<1.9	<1.9	<3.7	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.3	<19	<93
Soil	244SS006	12/14/99	<19	<19	<36	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<91	<190	<910
Soil	244SS007	12/14/99	<1.9	<1.9	<3.8	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.5	<19	<95
Soil	244SS008	12/14/99	<1.9	<1.9	<3.7	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.2	<19	<92
	Industrial RBC		**24000**	**17000**	**17000**	**340**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**360**	**N/A**	**610000**	**N/A**	**N/A**	**1300**	**630**	**1xE⁴**	**N/A**	**52000**
	Residential RBC		**2700**	**1900**	**1900**	**38**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**40**	**N/A**	**23000**	**N/A**	**N/A**	**0.14**	**70**	**3.9XE⁴**	**N/A**	**580**

N/A – Not Available

Figure A-4
Facility 244, Cannon AFB, Clovis, New Mexico
Soil Sample Results
Total Petroleum Hydrocarbons

Medium	Sample ID	Sample Date	Total Petroleum Hydrocarbons (mg/Kg)
Soil	244SS001	12/14/99	<10
Soil	244SS002	12/14/99	<10
Soil	244SS003	12/14/99	<10
Soil	244SS004	12/14/99	<10
Soil	244SS004 FD	12/14/99	<10
Soil	244SS004 MS/MSD	12/14/99	<10
Soil	244SS005	12/14/99	<10
Soil	244SS006	12/14/99	300
Soil	244SS007	12/14/99	100
Soil	244SS008	12/14/99	40
	Soil Cleanup Standard TPH-gasoline *		600
	Soil Cleanup Standard TPH-diesel *		800

* *Journal of Soil Contamination*, 2 (2): (1993)

APPENDIX B
SOIL SAMPLE VALIDATION QUALIFIERS SUMMARY
PRELIMINARY SITE ASSESSMENT
SWMU 129, FACILITY 244
CANNON AFB, CLOVIS, NEW MEXICO

Table B-1
Facility 244, Cannon AFB, Clovis, New Mexico
Data Validation Qualifiers Summary
Soil Samples

Sample Identification	Metals RCRA 3050B/6010B	Mercury 7471A	PCBs 8082	Pesticides 8081A	TPH 418.1
244SS001	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS002	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS003	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS004	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS004 FD	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS004 MS/MSD	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS005	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS006	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	All - UJ	----
244SS007	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS008	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----

Table B-1 (Continued)

Data Qualifiers:

U - The material was analyzed for, but was not, detected. The associated numerical value is the sample quantitation limit.

J - The associated numerical value is an estimated quantity.

R - The data are unusable (compound may or may not be present). Re-sampling and reanalysis is necessary for verification.

N - Presumptive evidence of presence of material.

NJ - Presumptive evidence of the presence of the material at an estimated quantity.

UJ - The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.

JN - Tentatively identified with estimated concentrations.

CC - Chain of custody irregularities that impact the legal defensibility of the analytical results.

ND - Non-detect

Comment / Response Form

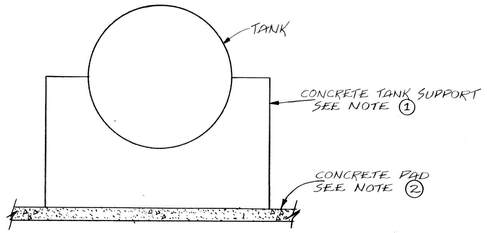
Parallax INC.

Comments made by: Sanford Hutsell
Company: Cannon Air Force Base

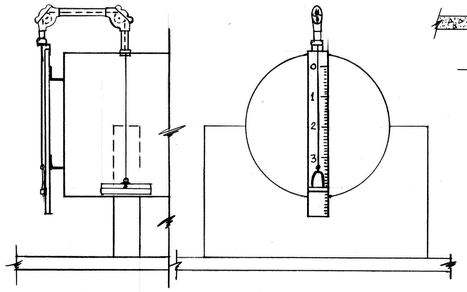
No	Section	Comments	Response
1	All	The facility was Area of Concern I, not J. It has now been designated as SWMU 129 so change AOC J throughout to SWMU 129.	The change in facility identification to SWMU 129 has been made throughout the report.
2	1.1	Delete reference to removal of monitoring wells associated with Facility 244. There are no monitoring wells associated with Facility 244 and I don't want any reference in the literature to confuse the issue.	Reference to monitoring well removal has been deleted.
3	2.2	In tact should have space removed. Intact is one word.	Change made as indicated.
4	3.2	Intact is one word. Remove space between in and tact.	Change made as indicated.
5	Figure 3-3	Photocopy is reversed.	The copy has been corrected.

TANK SUPPORT NOTES:

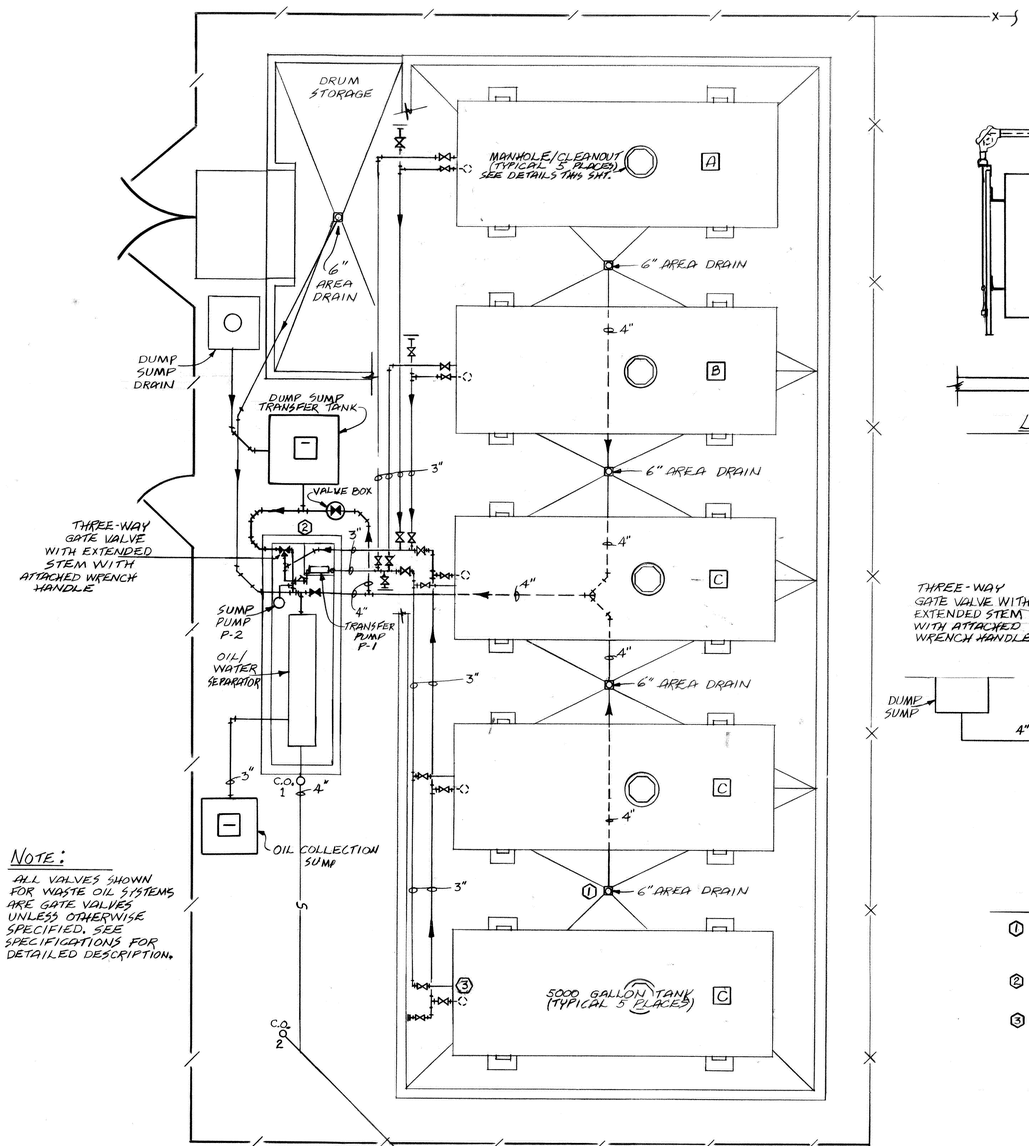
1. TANK TO BE SUPPLIED COMPLET WITH SADDLES AND CONCRETE SUPPORTS AS REQUIRED. TANK SADDLES AND SUPPORTS TO BE SPECIFICALLY DESIGNED FOR THE TANKS SUBMITTED SEE SPECIFICATIONS SECTION 10 D - STORAGE TANKS FOR DETAILS.
2. CONCRETE TANK SUPPORTS TO BE IN PLACE PRIOR TO POURING CONCRETE DRAINAGE PAD.

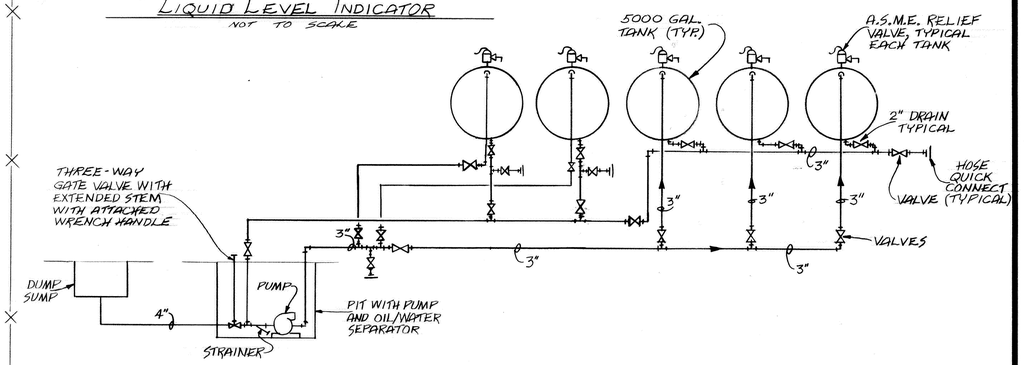


TANK SUPPORT DETAIL
NOT TO SCALE

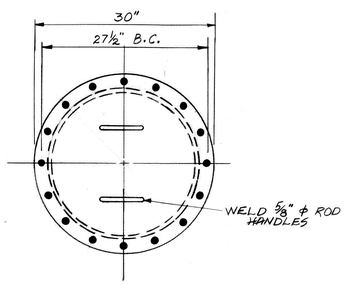


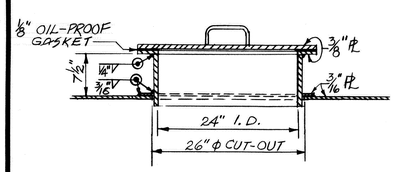
LIQUID LEVEL INDICATOR
NOT TO SCALE





WASTE OIL PIPING DIAGRAM
NOT TO SCALE





TANK ACCESS MANHOLE FOR SINGLE DECK

24" BOLTED COVER TYPE MANHOLE
NOT TO SCALE

NOTE:

ALL VALVES SHOWN FOR WASTE OIL SYSTEMS ARE GATE VALVES UNLESS OTHERWISE SPECIFIED. SEE SPECIFICATIONS FOR DETAILED DESCRIPTION.

KEY NOTES:

1. PROVIDE SURFACE AREA DRAIN PLUGS AT EACH DRAIN (5 REQUIRED). SAID DRAIN PLUGS SHALL BE SUFFICIENT TO TRAP ALL LIQUIDS AT SURFACE.
2. A COMPLETE SET OF COLOR CODED VALVE SCHEMATIC AND PUMP INSTRUCTIONS ARE TO BE ATTACHED TO PUMP STATION. SAID INSTRUCTIONS SHALL BE WEATHERPROOF.
3. PROVIDE LIQUID LEVEL INDICATORS AS SPECIFIED. (5 REQUIRED)

SEWER LINE TO PASS EXISTING FENCE LINE APPROXIMATELY 5 FEET FROM CORNER POST

TO NEW ABSORPTION FIELD - SEE SHEET 8 FOR DETAILS 95' FROM CLEAN-OUT 2 TO DISTRIBUTION BOX

ALL VALVES TO BE COLOR CODED AS FOLLOWS:

ALL VALVES ASSOCIATED WITH TANK A SHALL BE PAINTED GREEN
ALL VALVES ASSOCIATED WITH TANK B SHALL BE PAINTED YELLOW
ALL VALVES ASSOCIATED WITH TANKS C SHALL BE PAINTED RED
ALL OTHER VALVES SHALL BE PAINTED BLACK

SPECIAL NOTE:

EACH COLOR CODED VALVE SHALL BE IDENTIFIED WITH A BRASS OR ALUMINUM TAG NOT LESS THAN 1 3/8" IN DIAMETER, CORRECTLY STAMPED TO EXPLAIN THE VALVE FUNCTION, AND WITH A NUMBER FOR IDENTIFICATION. TAGS SHALL BE SECURED TO THE VALVE WITH 18 GAGE COPPER OR BRASS WIRE.

PLUMBING PLAN AND DETAILS
SCALE — 1/4" = 1'-0"

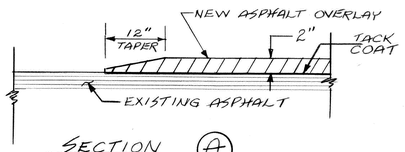
REV	DATE	DESCRIPTION	BY	APPROVED
	15 MAY 90	As-Built	RMD	MRC

DEPARTMENT OF THE AIR FORCE
TACTICAL AIR COMMAND
CANNON AFB, NM
CIVIL ENGINEER OFFICE
USED PETROLEUM MANAGEMENT FACILITY

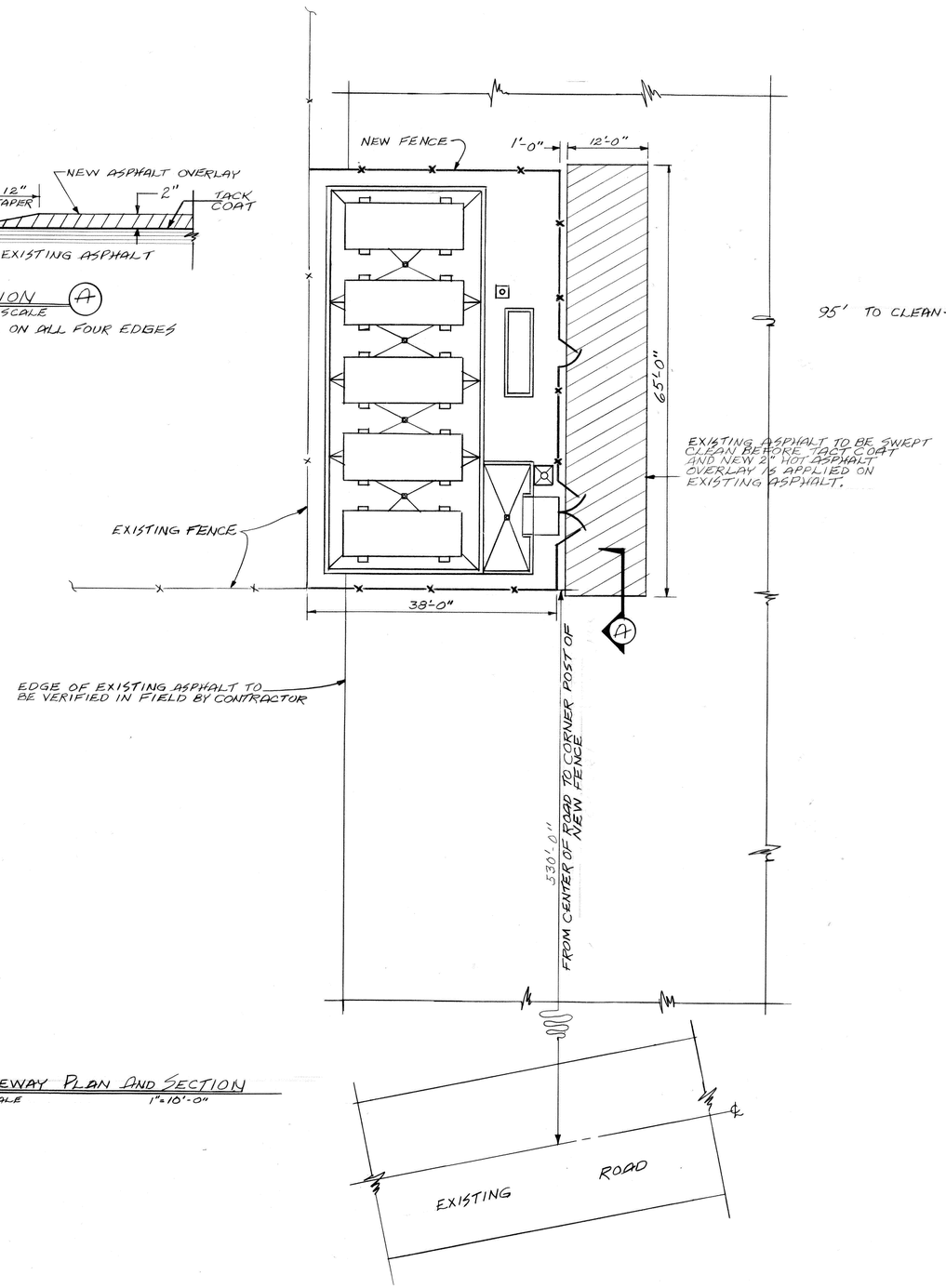
PLUMBING PLAN AND DETAILS

CHECKED BY	DRAWN BY	DATE	SCALE
J. McCLAIN	R. D. CREERY	5 MAR 86	AS NOTED
PROJECT NO. 82-0078	DRAWING NO. 2020.07	SHEET 7 of 8	

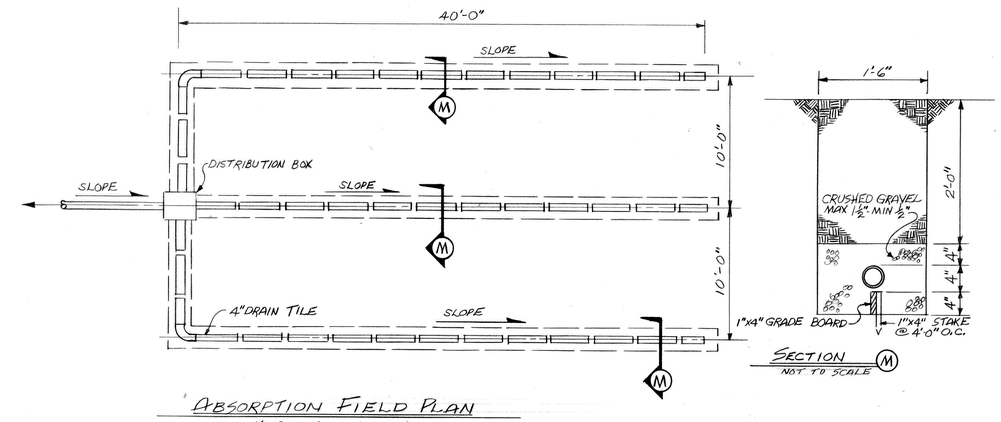
82314
OZALID



SECTION (A)
NOT TO SCALE
TYPICAL ON ALL FOUR EDGES



DRIVEWAY PLAN AND SECTION
SCALE 1"=10'-0"



ABSORPTION FIELD PLAN
NOT TO SCALE

SECTION (M)
NOT TO SCALE

REV	DATE	DESCRIPTION	BY	APPROVED
	15 MAY 90	AS-BUILT	[illegible]	[illegible]

DEPARTMENT OF THE AIR FORCE
TACTICAL AIR COMMAND

CANNON AFB, NM
CIVIL ENGINEER OFFICE

USED PETROLEUM MANAGEMENT FACILITY

DRIVEWAY PLAN, ABSORPTION FIELD PLAN AND SECTIONS

CHECKED BY	DRAWN BY	DATE	SCALE
LT DORAN	R. D. CREERY	7 AUG 86	AS NOTED
PROJECT NO. 82-0078	DRAWING NO. 2020.08		SHEET 8 of 8

82314
OZALID

CANNON AFB
NEW MEXICO

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 1473

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

September 14, 2009

Mr. Ronald A. Lancaster
27 SOCES/CEA
506 N DL Ingram Blvd
Cannon Air Force Base, New Mexico 88103-5003

RE: REQUIREMENT FOR FURTHER CORRECTIVE ACTION, CORRECTIVE ACTION COMPLETE PROPOSALS, JULY 2008 CANNON AIR FORCE BASE, EPA ID NO. NM7572124454 HWB-CAFB-08-004

Dear Mr. Lancaster:

The New Mexico Environment Department (NMED) has completed its review of Cannon Air Force Base's (Permittee) *Corrective Action Completion Proposals,* dated July 2008. Based on the review, one Solid Waste Management Unit (SWMU 129) and one Area of Concern (AOC A) proposed by the Permittee are not appropriate for Corrective Action Complete (CAC) status.

AOC A, MOGAS Spill Site (SS-19)

AOC A is the site of two motor gasoline (MOGAS) spills that occurred in the early 1960s. The site is relatively flat and much of it is paved with asphalt. The portion not paved is a drainage swale extending to the southeast through a grassy area in the southern portion of the site. Construction of a gymnasium and associated pavement along Argentia Avenue changed the physical features of the spill area. Part of the drainage swale where the spills occurred is now located beneath pavement and a portion of the area exists as a small depression along the side of Argentia Avenue.

The Permittee's proposal that AOC A is appropriate for CAC status is based on results of investigations conducted in 1985 and in 2005. Results of the investigations were reported in the Permittee's *Decision Document, MOGAS Spill AOC A/IRP No. SS-19, Cannon Air Force Base, HARZA Environmental Services, January 1997* and in *Supplemental Assessment of Areas of Concern A, B, & C, Cannon Air Force Base, URS Group, Inc. December 2005*. Results of both investigations indicate that lead and various volatile organic compounds (VOCs) were detected at concentrations below NMED soil screening levels (SSLs) for a residential land use scenario. However, no ecological risk screening was conducted by the Permittee.

Since the Permittee does not have eco risk screening values for the facility, NMED compared the maximum concentrations of detected lead and VOCs to the Los Alamos National Laboratory Ecorisk Database (Version 2.3, October 2008) and determined that lead detected in surface soil in 1985 exceeds the risk-based ecological screening level (range of 14 to 21 mg/kg). The surface soil sample where an elevated lead concentration was detected was collected in the drainage swale that runs alongside Argentia Avenue and is not covered by asphalt. The Permittee must conduct ecological risk screening for AOC A.

The lead contamination was a result of a surface spill, but only one surface soil sample (0-1.0 feet below ground surface) was collected in 1985 and no surface soil samples were collected in the 2005 investigation. The Permittee did not define the lateral extent of lead contamination for surface soil. It is not clear if lead-contaminated soil was removed and/or diluted by construction activities conducted subsequent to the 1985 investigation.

Further, analyses of soil samples collected in 2005 indicated that chloroform concentrations exceed the New Mexico generic Migration to Groundwater Dilution Attenuation Factor (DAF) of 20 SSL. Use of the SSL listed for a DAF of 20 for comparison is advised unless site-specific data on hydrologic conditions are available indicating that the DAF of 20 is not representative of site conditions. The Permittee must generate and compare a site-specific DAF for chloroform.

Until such time that (1) the surface soil in the drainage swale alongside Argentia Avenue is sampled and results indicate that lead is not present in concentrations exceeding the risk-based ecological screening level for lead or until the Permittee provides documentation indicating that lead-contaminated soil was removed or substantially disturbed during construction activities since 1985, and (2) comparison of chloroform concentrations to a site-specific DAF indicates that site conditions are protective of ground water, AOC A will not be considered for Corrective Action Complete status.

SWMU 129, Reported Oil/Water Separator and Associated Leach Field

Bulk waste oil was dumped into collection pits equipped with strainers at SWMU 129. From the pits, oil drained into the oil/water (O/W) separator which was then pumped through supply pipes into five above ground storage tanks. The water fraction, segregated by the O/W separator, exited through a port in the west side of the structure and flowed into a leach field located to the southeast of the facility. The leach field consisted of perforated plastic piping surrounded by crushed stone that allowed the water to be discharged into the subsurface and percolate into underlying soils.

The Permittee's proposal that SWMU 129 is appropriate for CAC status is based on results presented in its *Closeout Report / Contamination Assessment, SWMU 129 – Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, July 19, 2000.* The NMED reviewed the cited report and could not determine if the leach field was sampled for presence of potential contaminants. The report described soil sample locations as: northeast corner of pad, southeast corner of pad, center of pad, northwest corner of pad, southwest corner of pad, north of O/W separator, south of O/W separator and east of O/W separator. The soil sample location nearest the leachfield appears to be Sample Number 2, Southeast Corner of Pad. Sample Number 2 was further described in Figure 4-2, Plan View of Facility 244 Showing Soil Sampling Locations, as "3 feet north of south fence, 4 feet, 3 inches west of east fence". Figure 4-2 indicates that it is not to scale. Figure 4-2 does not indicate the location of the referenced south fence or east fence nor does it indicate the position of the leach field.

It is unclear whether or not the leach field was sampled. If the leach field was not sampled or was not adequately investigated, the NMED considers the investigation of SWMU 129 incomplete. Until such time that the Permittee provides documentation that the leach field was adequately sampled and the results of such sampling demonstrate that contaminants are not present at concentrations exceeding appropriate cleanup criteria, SWMU 129 will not be considered for Corrective Action Complete status.

NMED will proceed with preparation of a Statement of Basis and Public Notice to change the status of the other twelve sites proposed for Corrective Action Complete in the Permittee's July 2008 submittal.

If you have any questions regarding the content of this letter, please call Pat Stewart at (505) 476-6059.

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

cc: P. Stewart, NMED HWB
N. Dhawan, NMED HWB
D. Cobrain, NMED HWB
H. Hanson, CAFB
File: CAFB 2009 and Reading
CAFB-08-004

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE

SITE INVESTIGATION AT EIGHT SITES PROJECT ACTIVITIES WORK PLAN

CANNON AIR FORCE BASE NEW MEXICO

~~April~~ December 2012

Prepared for:

Air Force Special Operations Command

27th Special Operations Wing

Under contract to:

Air Force Civil Engineer Center
~~for Engineering and the Environment~~

URS
12120 Shamrock Plaza, Suite ~~300~~100
Omaha, Nebraska 68154

Table of Contents

Section 1 Introduction 1-1
1.1 Authority 1-1
1.2 Purpose and Scope 1-1
1.3 Facility Description and Background 1-3
1.3.1 Setting – Physical Geography 1-3
1.3.2 Demographics and Land Use Near Cannon AFB 1-3
1.3.3 Climatology 1-3
1.3.4 Geology 1-4
1.3.5 Hydrogeology 1-6
1.3.6 Soils 1-7
1.3.7 Background Metals Concentrations in Soil 1-8
1.3.8 Water Quality 1-8
1.4 Project Schedule 1-8

Section 2 Project/Task Organization 2-1
2.1 Roles And Responsibilities 2-1
2.1.1 Cannon Air Force Base 2-1
2.1.2 AFCEE 2-1
2.1.3 NMED 2-1
2.1.4 URS 2-1
2.2 Contractor Responsibilities 2-3
2.2.1 EMAX Laboratories Project Manager 2-3
2.2.2 Laboratory QA Officer 2-4
2.2.3 Direct Push Services 2-4
2.2.4 Drill Rig Services 2-4

Section 3 Decision Process 3-1
3.1 Description of Decision Process 3-1
3.2 Development of Preliminary Site Conceptual Exposure Models 3-2
3.3 Critical Data 3-4
3.4 Detection Limits 3-5
3.5 Evaluation of Background Concentrations 3-5
3.6 Human Health Screening-Level Evaluation Methodology 3-5
3.7 Ecological Screening-Level Evaluation Methodology 3-7

Section 4 Site Descriptions and Background 4-1
4.1 Former AGE Dispatch Facility Spills Site (SS-C501) 4-1
4.1.1 Site Description and Background (SS-C501) 4-1
4.1.2 Previous Investigation Results (SS-C501) 4-2
4.2 Former Gas Station Site (ST-C502) 4-2
4.2.1 Site Description and Background (ST-C502) 4-2
4.2.2 Previous Investigation Results (ST-C502) 4-3
4.3 Base Support/Operations Generator Former UST Site (ST-C503) 4-4
4.3.1 Site Description and Background (ST-C503) 4-4

4.3.2 Previous Investigation Results (ST-C503) 4-5
4.4 Hospital Abandoned UST Site (ST-C504) 4-6
4.4.1 Site Description and Background (ST-C504)..... 4-6
4.4.2 Previous Investigation Results (ST-C504)..... 4-7
4.5 Flightline Generator Underground Storage Tanks Site (ST-C505) 4-8
4.5.1 Site Description and Background (ST-C505)..... 4-8
4.5.2 Previous Investigation Results (ST-C505)..... 4-9
4.6 Former POL Yard Refueling Area Site (SS-C507).....4-11
4.6.1 Site Description and Background (SS-C507).....4-11
4.6.2 Previous Investigation Results (SS-C507) 4-15
4.7 Surface Disposal Area Site (SD-C508) 4-15
4.7.1 Site Description and Background (SD-C508) 4-15
4.7.2 Previous Investigation Results (SD-C508) 4-16
4.8 Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129) ...4-16
4.8.1 Site Description and Background (TA/AS-C129).....4-16
4.8.2 Previous Investigation Results (TA/AS-C129) 4-18

Section 5 Field Sampling Plan.....5-1
5.1 Mobilization 5-1
5.1.1 Acquire Base Passes 5-1
5.1.2 Facility Safety Requirements 5-2
5.1.3 Locate Utilities 5-3
5.1.4 Surveying of Soil Borings..... 5-3
5.2 Surface Soil Sample Collection 5-3
5.3 Subsurface Drilling and Soil Sampling 5-5
5.3.1 Direct Push Sampling Procedures..... 5-6
5.3.2 Drill Rig Sampling Procedures..... 5-6
5.3.3 Subsurface Soil Analytical Sample Collection..... 5-6
5.4 Field Screening and Headspace Analysis 5-7
5.5 Sample Identification, Handling, and Documentation 5-8
5.5.1 Field Documentation..... 5-8
5.5.2 Sample Identification 5-9
5.5.3 Sample Labeling and Handling 5-10
5.6 Quality Assurance/Quality Control Samples.....5-10
5.7 Equipment and Personnel Decontamination.....5-11
5.7.1 Sampling Equipment.....5-11
5.7.2 Drilling and Heavy Equipment.....5-12
5.7.3 Equipment Leaving the Site 5-12
5.7.5 Responsible Authority.....5-12
5.7.6 Wastewater 5-13
5.7.7 Documentation.....5-13
5.8 Investigation-Derived Waste.....5-13
5.9 Former AGE Dispatch Facility Spills Site (SS-C501) 5-14
5.9.1 Sampling Objectives and Rationale (SS-C501).....5-14
5.9.2 Sampling Locations, Frequencies and Analysis (SS-C501).....5-14
5.10 Former Gas Station Site (ST-C502) 5-14

5.10.1 Sampling Objectives (ST-C502).....5-14
5.10.2 Sampling Locations, Frequencies, and Analysis (ST-C502) 5-15
5.11 Base Support/Operations Generator Former UST Site (ST-C503).....5-16
5.11.1 Sampling Objectives and Rationale (ST-C503) 5-16
5.11.2 Sampling Locations, Frequencies and Analysis (ST-C503) 5-16
5.12 Hospital Abandoned UST Site (ST-C504) 5-17
5.12.1 UST Location (ST-C504).....5-17
5.12.2 Sampling Objectives (ST-C504).....5-17
5.12.3 Sampling Locations, Frequencies and Analysis (ST-C504) 5-17
5.13 Flightline Generator Underground Storage Tanks Site (ST-C505) 5-18
5.13.1 Sampling Objectives (ST-C505).....5-18
5.13.2 Sampling Locations, Frequencies and Analysis (ST-C505) 5-19
5.14 Former POL Yard Refueling Area Site (SS-C507).....5-19
5.14.1 Sampling Objectives (SS-C507).....5-19
5.14.2 Sampling Locations, Frequencies and Analysis (SS-C507).....5-20
5.15 Surface Disposal Area Site (SD-C508) 5-21
5.15.1 Sampling Objectives (SD-C508) 5-21
5.15.2 Sampling Locations, Frequencies and Analysis (SD-C508).....5-22
5.16 Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129) ...5-22
5.16.1 Sampling Objectives (TA/AS-C129).....5-22
5.16.2 Sampling Locations, Frequencies and Analysis (TA/AS-C129).....5-23

Section 6 Project Documentation and Reporting.....6-1
6.1 Project Monitoring 6-1
6.2 Field Form Management..... 6-1
6.3 SI at Eight Sites Report..... 6-1
6.4 Project File 6-2

Section 7 References.....7-1

List of Appendices

Appendix A Uniform Federal Policy–Quality Assurance Project Plan
Appendix B Site Safety and Health Plan
Appendix C Standard Operating Procedures
Appendix D Site Background Information

List of Tables (Tables are included at the end of each section.)

Table 1-1 Summary of Background Elemental Concentrations in Soil Samples at Cannon AFB, New Mexico
Table 2-1 Key Project Personnel

Table 2-2 Field Personnel

Table 4-1 Summary of Previous Samples for Chemical Analysis, Former AGE Dispatch Facility Spills Site (SS-C501)

Table 4-2 Summary of Previous Analytical Data and Screening Results, Former AGE Dispatch Facility Spills Site (SS-C501)

Table 4-3 Summary of Previous Samples for Chemical Analysis, Former Gas Station Site (ST-C502)

Table 4-4 Summary of Previous Analytical Data and Screening Results, Former Gas Station Site (ST-C502)

Table 4-5 Summary of Previous Samples for Chemical Analysis, Base Support/Operations Generator Former UST Site (ST-C503)

Table 4-6 Summary of Previous Analytical Data and Screening Results, Base Support/Operations Generator Former UST Site (ST-C503)

Table 4-7 Summary of Previous Samples for Chemical Analysis, Hospital Abandoned UST Site (ST-C504)

Table 4-8 Summary of Previous Analytical Data and Screening Results, Hospital Abandoned UST Site (ST-C504)

Table 4-9 Summary of Previous Samples for Chemical Analysis, Flightline Generator UST Site (ST-C505)

Table 4-10 Summary of Previous Analytical Data and Screening Results, Flightline Generator UST Site (ST-C505)

Table 4-11 Summary of Previous Samples for Chemical Analysis, Former POL Yard Refueling Area Site (SS-C507)

Table 4-12 Summary of Previous Analytical Data and Screening Results, Former POL Yard Refueling Area Site (SS-C507)

Table 4-13 Summary of Previous Samples for Chemical Analysis, Surface Disposal Area Site (SD-C508)

Table 4-14 Summary of Previous Analytical Data and Screening Results, Surface Disposal Area Site (SD-C508)

Table 4-15 Summary of Previous Samples for Chemical Analysis, Waste Oil Storage Facility 244 And Leach Field Site (TA/AS-C129)

Table 4-16 Summary of Previous Analytical Data and Screening Results, Waste Oil Storage Facility 244 And Leach Field Site (TA/AS-C129)

Table 5-1 Summary of Planned Sampling Locations and Analytical Parameters, Former AGE Dispatch Facility Spills Site (SS-C501)

Table 5-2 Summary of Planned Sampling Locations and Analytical Parameters, Former Gas Station Site (ST-C502)

Table 5-3 Summary of Planned Sampling Locations and Analytical Parameters, Base Support/Operations Generator Former UST Site (ST-C503)

Table 5-4 Summary of Planned Sampling Locations and Analytical Parameters, Hospital Abandoned UST Site (ST-C504)

Table 5-5 Summary of Planned Sampling Locations and Analytical Parameters, Flightline Generator UST Site (ST-C505)

Table 5-6 Summary of Planned Sampling Locations and Analytical Parameters, Former POL Yard Refueling Area Site (SS-C507)

Table 5-7 Summary of Planned Sampling Locations and Analytical Parameters, Surface Disposal Area Site (SD-C508)

Table 5-8 Summary of Planned Sampling Locations and Analytical Parameters, Waste Oil Storage Facility 244 And Leach Field Site (TA/AS-C129)

List of Figures (Figures are included at the end of each section.)

Figure 1-1 Installation Location Map

Figure 1-2 Site Location Map

Figure 1-3 Generalized Geologic Strata at Cannon Air Force Base

Figure 1-4 Elevation and Configuration of the Water Table in the Region of Cannon Air Force Base

Figure 1-5 Water Well Locations on and near Cannon Air Force Base

Figure 1-6 Distribution of Soils by Type at Cannon Air Force Base

Figure 1-7 Project Schedule

Figure 2-1 Project Team and Lines of Authority

Figure 3-1 Decision Diagram for Site Investigation at Eight Sites

Figure 3-2 Preliminary Site Conceptual Exposure Model (ST-C501)

Figure 3-3 Preliminary Site Conceptual Exposure Model (ST-C502)

Figure 3-4 Preliminary Site Conceptual Exposure Model (ST-C503)

Figure 3-5 Preliminary Site Conceptual Exposure Model (ST-C504)

Figure 3-6 Preliminary Site Conceptual Exposure Model (ST-C505)

Figure 3-7 Preliminary Site Conceptual Exposure Model (ST-C507)

Figure 3-8 Preliminary Site Conceptual Exposure Model (ST-C508)

Figure 3-9 Preliminary Site Conceptual Exposure Model (TA/AS-C129)

Figure 4-1a Site Map with Previous Investigation Locations (Base Map) (SS-C501)

Figure 4-1b Site Map with Previous Investigation Locations (Aerial Photo Map) (SS-C501)

Figure 4-2a Site Map with Previous Investigation Locations (Base Map) (ST-C502)
Figure 4-2b Site Map with Previous Investigation Locations (Aerial Photo Map) (ST-C502)
Figure 4-3a Site Map with Previous Investigation Locations (Base Map) (ST-C503)
Figure 4-3b Site Map with Previous Investigation Locations (Aerial Photo Map) (ST-C503)
Figure 4-4a Site Map with Previous Investigation Locations (Base Map) (ST-C504)
Figure 4-4b Site Map with Previous Investigation Locations (Aerial Photo Map) (ST-C504)
Figure 4-5a Site Map with Previous Investigation Locations (Base Map) (ST-C505)
Figure 4-5b Site Map with Previous Investigation Locations (Aerial Photo Map) (ST-C505)
Figure 4-6a Site Map with Previous Investigation Locations (Base Map) (SS-C507)
Figure 4-6b Site Map with Previous Investigation Locations (Aerial Photo Map) (SS-C507)
Figure 4-7a Site Map with Previous Investigation Locations (Base Map) (SD-C508)
Figure 4-7b Site Map with Previous Investigation Locations (Aerial Photo Map) (SD-C508)
Figure 4-8a Site Map with Previous Investigation Locations (Base Map) (TA/AS-C129)
Figure 4-8b Site Map with Previous Investigation Locations (Aerial Photo Map) (TA/AS-C129)
Figure 5-1a Planned Soil Sampling Locations (Base Map) (SS-C501)
Figure 5-1b Planned Soil Sampling Locations (Aerial Photo Map) (SS-C501)
Figure 5-2a Planned Soil Sampling Locations (Base Map) (ST-C502)
Figure 5-2b Planned Soil Sampling Locations (Aerial Photo Map) (ST-C502)
Figure 5-3a Planned Soil Sampling Locations (Base Map) (ST-C503)
Figure 5-3b Planned Soil Sampling Locations (Aerial Photo Map) (ST-C503)
Figure 5-4a Planned Soil Sampling Locations (Base Map) (ST-C504)
Figure 5-4b Planned Soil Sampling Locations (Aerial Photo Map) (ST-C504)
Figure 5-5a Planned Soil Sampling Locations (Base Map) (ST-C505)
Figure 5-5b Planned Soil Sampling Locations (Aerial Photo Map) (ST-C505)
Figure 5-6a Planned Soil Sampling Locations (Base Map) (SS-C507)
Figure 5-6b Planned Soil Sampling Locations (Aerial Photo Map) (SS-C507)
Figure 5-7a Planned Soil Sampling Locations (Base Map) (SD-C508)
Figure 5-7b Planned Soil Sampling Locations (Aerial Photo Map) (SD-C508)
Figure 5-8a Planned Soil Sampling Locations (Base Map) (TA/AS-C129)
Figure 5-8b Planned Soil Sampling Locations (Aerial Photo Map) (TA/AS-C129)

Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
µg	microgram
27 SOCES	27th Special Operations, Civil Engineer Squadron
AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
AGE	Aerospace Ground Equipment
ANSI	American National Standards Institute
AST	aboveground storage tank
bgs	below ground surface
B.P.	before the present
BRA	Baseline Risk Assessment
BTEX	benzene, toluene, ethylbenzene and total xylenes
CAC	corrective action complete
CADD	computer-aided design and drafting
CDRL	Contract Data Requirements List
CEC	cation exchange capacities
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CoC	chain of custody
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CPSMR	Contractor's Progress, Status, and Management Report
CSEM	conceptual site exposure model
DERA	Defense Environmental Restoration Account
DL	detection limit
DQO	data quality objective
DRO	diesel range organics
EMAX	EMAX Laboratories
EOD	Explosives Ordnance Disposal

ERPIMS	Environmental Resources Program Information Management Systems
ESL	ecological screening level
ESSL	Ecological Soil Screening Level
FIPS	Federal Information Processing Standard
FMER	Funds and Man-Hour Expenditure Report
FSP	Field Sampling Plan
ft	feet
FTL	Field Team Leader
gal	gallon
gpm	gallon per minute
GPS	global positioning system
GRO	gasoline range organics
HQ	hazard quotient
hr	hour
HSO	Health and Safety Officer
IDW	investigation-derived waste
IRP	Installation Restoration Program
JP	jet propellant
Keers	Keers Technical Services
kg	kilogram
km	kilometer
L	liter
Lee Wan	Lee Wan Associates, Inc.
m	meter
MEC	munitions and explosives of concern
mg	milligram
min	minute
mm	millimeter
MOGAS	motor gasoline
mph	miles per hour
MS/MSD	matrix spike/matrix spike duplicate
msl	mean sea level

NAD83	North American Datum of 1983
NMED	New Mexico Environment Department
No.	number
ORO	oil range organics
OSHA	Occupational Safety and Health Administration
OWS	oil/water separator
Parallax	Parallax, Inc.
PAWP	Project Activities Work Plan
PCB	polychlorinated biphenyl
PE	proficiency evaluation
PES	Plains Environmental Services
PID	photoionization detector
PM	Project Manager
POC	point of contact
POL	petroleum, oil and lubricants
PPC	Project Planning Chart
PPE	personal protective equipment
PSA	preliminary site assessment
QA	quality assurance
QC	quality control
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RPM	Restoration Program Manager
RSL	Regional Screening Level
SC	clayey sand
SCEM	site conceptual exposure model
SCFS	Sample Collection Field Sheet
sec	second
SI	Site Investigation
SLERA	Screening Level Ecological Risk Assessment
SM	silty sand
SOP	standard operating procedure

SOW	statement of work
SSHP	Site Safety and Health Plan
SSL	soil screening level
SSO	Site Safety Officer
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TBD	to be determined
TCL	target compound list
TCLP	Toxicity Characteristic Leaching Procedure
TPH	total petroleum hydrocarbon
TRPH	total recoverable petroleum hydrocarbons
TTCP	Technical Cooperation Program
UFP-QAPP	Uniform Federal Policy–Quality Assurance Project Plan
URS	URS Group, Inc.
U.S.	United States
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
UTL	upper tolerance limit
UXO	unexploded ordnance
VOC	volatile organic compound
W-C	Woodward-Clyde

This document presents the Project Activities Work Plan (PAWP) Addendum (Air Force Center for Engineering and the Environment [AFCEE] Contract Data Requirements List [CDRL] A007) for the Site Investigation (SI) at eight sites at Cannon Air Force Base (AFB) near Clovis, New Mexico (**Figure 1-1**). The eight sites include the following:

- **The Former Aerospace Ground Equipment (AGE) Dispatch Facility Spills Site (SS-C501)** includes at least two diesel fuel spills (up to 60 gallons each) that occurred on the asphalt parking lot to the northeast of Building 186.
- **The Former Gas Station Site (ST-C502)** includes the three former 10,000-gallon motor gasoline (MOGAS) and diesel fuel underground storage tanks (USTs), and associated fuel lines and dispensers, where fuel spills or leaks may have occurred.
- **The Base Support/Operations Generator Former Underground Storage Tank (UST) Site (ST-C503)** includes a former 500-gallon diesel fuel UST that may have leaked.
- **The Hospital Abandoned UST Site (ST-C504)** includes an abandoned in place 25,000-gallon diesel fuel UST that may have leaked.
- **The Flightline Generator USTs Site (ST-C505)** includes two former 500-gallon diesel fuel USTs that may have leaked.
- **The Former Petroleum, Oil and Lubricants (POL) Yard Refueling Area Site (SS-C507)** includes historical fuel spills or leaks associated with fuel unloading areas, refueling stations, fuel pumps, aboveground storage tanks (ASTs), and aboveground and below ground fuel piping.
- **The Surface Disposal Area Site (SD-C508)** includes visible burned debris disposed at the surface.
- **The Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129 [Solid Waste Management Unit (SWMU) 129])** includes a waste oil disposal/storage area, a former oil/water separator (OWS), and an associated leach field used to discharge water from the former OWS.

1.1 AUTHORITY

URS Group, Inc. (URS) has been contracted by the AFCEE under Contract Number (No.) FA8903-08-D-8783, Task Order 0169 to complete an SI at eight sites at Cannon AFB. This SI is being addressed under the Environmental Restoration Program for Cannon AFB.

1.2 PURPOSE AND SCOPE

This PAWP describes the field sampling requirements to complete an SI at eight sites at Cannon AFB. The site location map (**Figure 1-2**) shows the locations of the eight sites that are the subject of this investigation. This PAWP also describes the investigative activities that will be used to provide the information necessary to further define the horizontal and vertical extent of known soil contamination, determine the presence or absence of other chemicals of potential

concern (COPC) in soil, and determine if unacceptable risks to human health or the environment exists at these eight sites.

This PAWP provides the technical approach, rationale, field procedures, and data quality objectives (DQOs) to be followed to achieve the objectives of the SI in accordance with the AFCEE statement of work (SOW) dated January 19, 2011. This project will include preparing planning documents, completing a field investigation (discrete surface and subsurface soil sampling), analyzing soil samples for site-specific analytical parameters, evaluating the chemical data, comparing the analytical results to established soil screening criteria and ecological screening criteria, updating the preliminary site conceptual exposure models (SCEMs) and preparing the SI Report.

This PAWP is organized as follows:

- **Section 1** presents the authority, purpose and scope, facility description and background, and anticipated project schedule.
- **Section 2** lists the project and task organization for this SI at eight sites, including roles and responsibilities.
- **Section 3** presents the decision process, including DQOs developed for this project, a description of SCEM development, evaluation of background concentrations, and screening level evaluation methodology.
- **Section 4** presents the site description and backgrounds, including summaries of previous investigations conducted at each site.
- **Section 5** presents the Field Sampling Plan (FSP) (AFCEE CDRL A005) to be used for this project.
- **Section 6** provides the project documentation and reporting requirements.
- **Section 7** provides references used to develop the PAWP.

The appendices contain the following information:

- **Appendix A** – Uniform Federal Policy–Quality Assurance Project Plan (UFP–QAPP) (AFCEE CDRL A004)
- **Appendix B** – Site Safety and Health Plan (SSHP) (AFCEE CDRL A004)
- **Appendix C** – Standard Operating Procedures (SOPs)
- **Appendix D** – Historical Site Information (Previous Site Documentation, Historical Aerial Photos, As-built Drawings, Photographic Logs)

1.3 FACILITY DESCRIPTION AND BACKGROUND

1.3.1 Setting – Physical Geography

Cannon AFB is situated in the Southern High Plains Physiographic Province in the Llano Estacado subprovince. The Llano Estacado is a nearly flat plain sloping gently (10 to 15 feet per mile) to the east and southeast. Elevations in the eastern New Mexico portion of the Llano Estacado exceed 4,000 feet above mean sea level (msl). In the vicinity of Cannon AFB, elevations range from 4,250 feet to 4,350 feet above msl.

The most prominent geomorphic features in the vicinity of Cannon AFB are blowouts and broad, widely spaced valleys. Less common landforms are relict sand dunes located along the northern side of the Portales Valley to the south of the base. Relict dunes are not found on or near Cannon AFB.

Blowouts are broad shallow depressions, which form as the result of soil eroded by wind. Blowouts commonly collect surface runoff from small to moderate sized drainage areas. During periods of rainfall, runoff collects in blowouts to form ephemeral playa lakes. Playas have no external surface drainage. Water is lost by infiltration to the soil and evaporation; without recharge, playa lakes persist for only a few days or weeks. Three playas are located within the base, and several more are found to the north and east of the base.

Stream valleys tend to be fairly broad and widely spaced. Streams are ephemeral and drainages are poorly developed. No streams exist on or near Cannon AFB. Running Water Draw and Frio Draw (located about 10 and 20 miles, respectively, north of Cannon AFB) are the nearest streams. These are second-order streams. Both streams are very straight, flow southeast, and have rectilinear drainage patterns with short laterals (Woodward-Clyde [W-C] 1991).

1.3.2 Demographics and Land Use Near Cannon AFB

Cannon AFB is located just west of the City of Clovis, New Mexico, and just south of United States (U.S.) Highway 60/84 in a farming and ranching area. The majority of the land surrounding Cannon AFB is productive, irrigated farmland or grassland. The major crops are wheat, sorghum, sugar beets, corn, cotton, alfalfa, barley, and peanuts. The land is also used for cattle grazing, both beef and dairy, and Clovis is considered the "Cattle Capital of the Southwest." There were 33,063 people living in Clovis in 2004, according to U.S. Census data, while the Cannon AFB population was estimated to be 2,600 in 2008.

1.3.3 Climatology

The climate of east-central New Mexico is classified as tropical semi-arid, with summer temperature and precipitation maxima. Average monthly temperatures range from a January low of 12 degrees Celsius (°C) (39 degrees Fahrenheit [°F]) to a July high of 26°C (78°F). Extreme daily temperatures range from –24°C (–11°F) to 41°C (106°F) (Lee Wan Associates, Inc. [Lee Wan] 1990). Average monthly precipitation ranges from 1 centimeter (cm) (0.4 inches) in winter to 6.9 cm (2.7 inches) in July. The maximum-recorded 24-hour rainfall is 12.2 cm

(4.8 inches), which occurred in the month of August. Rainfall occurs on eight or more days per month during the summer precipitation maximum. Mean annual precipitation is approximately 41 cm (16 inches). The mean annual evapotranspiration rate is 181.4 centimeters per year (71.4 inches per year) (Lee Wan 1990). Prevailing winds are from the west at an average of 5 kilometers per hour (km/hr) (3.1 miles per hour [mph]) during fall, winter, and spring. During the summer, winds are from the south at an average of 3.7 km/hr (2.3 mph).

The atmosphere around the area of Cannon AFB is generally well mixed. The seasonal and annual average mixing heights can vary from 400 meters in the morning to 4,000 meters in the afternoon. The afternoon mixing heights are typically greater during the spring and fall seasons. The morning mixing heights are usually low, due to nighttime heat loss from the ground, producing surface-based temperature inversions. After sunrise, these inversions break up, and solar heating of the earth's surface causes vertical mixing in the atmosphere.

Dust is frequently entrained into the atmosphere in this region of the country because of gusty winds and the semiarid climate. The Texas Panhandle-eastern New Mexico area is considered the worst area in the United States for windblown dust. Occasionally, this windblown dust is of sufficient quantity to restrict visibility. Most of the seasonal dust storms occur in March and April, when the wind speeds are typically high (i.e., average 5 km/hr) (W-C 1991).

1.3.4 Geology

A generalized geologic section at Cannon AFB is shown in **Figure 1-3**. The near surface stratigraphic units of interest at Cannon AFB are the Late Miocene-Late Pliocene-age Ogallala Formation and the Early Triassic Dockum Group.

The Dockum Group consists of three formations. Stratigraphically, the lowest unit is the Santa Rosa Sandstone. Overlying the Santa Rosa Sandstone are the Chinle and Redonda Formations. The Chinle and Redonda Formations are composed mainly of red shales with lesser interbedded sands, and are known locally as "redbeds." The top of the Dockum Group is marked by an erosional nonconformity having relief of up to several hundred feet (Lee Wan 1990).

Overlying the Dockum Group redbeds is the Ogallala Formation. The Ogallala Formation extends from eastern New Mexico and Colorado into Texas, Oklahoma, Kansas, Nebraska, and South Dakota. According to Lee Wan and Associates, Inc. (Lee Wan) (1990), drillers' logs from Cannon AFB indicate that the Ogallala Formation varies from 360 feet to 415 feet in thickness. The incised upper surface of Triassic redbeds strongly influences Ogallala thickness. Paleo valleys in the post Triassic nonconformity are deep and trend dominantly east to west. Ogallala thickness may thus vary significantly over short north to south distances.

The Ogallala Formation is erosionally truncated to the south along the abandoned Portales Valley, to the west along the Pecos River Valley, and to the north in a series of ephemeral stream valleys. The Ogallala Formation extends more than 125 miles to the east before terminating as an escarpment in Briscoe County, Texas. Springs and seeps are common along the erosional margins of the Ogallala.

The Ogallala Formation dips gently and monoclinally to the southeast in the vicinity of Cannon AFB. As reported in Lee Wan (1990), data suggest that some quaternary warping may have occurred; however, most of these structures are located well to the northwest and southwest of Cannon AFB. No faults or buried structural lineaments are known to exist in the vicinity of Cannon AFB.

The Ogallala Formation is composed of unconsolidated poorly sorted gravel, sand, silts, and clays. The base of the Ogallala is generally marked by a gravel, cobble, and boulder deposit. This basal member contains sediments derived from igneous and sedimentary rocks transported from the mountains to the west. The Ogallala Formation was laid down as stream and overbank deposits formed within coalescing alluvial fans. These fans form a broad pediment along the eastern flank of the Rocky Mountains. As is typical of alluvial deposits, Ogallala internal stratigraphy varies vertically and horizontally over short distances.

Except where strongly cemented by calcium carbonate (caliche), the sediments of the Ogallala are loose and friable. Authigenic and allogenic clays are found as a trace to abundant matrix mineral (Lee Wan 1990). As reported by Lee Wan (1990), five zones have been distinguished within the Ogallala of east central New Mexico on the basis of clay minerals. Smectites (montmorillonites) and attapulgite (with sepeotite) are the dominant clays throughout the Ogallala. Illite is a lesser, but persistent clay, as is kaolinite. Smectite is a swelling clay, causing deep cracks to form in dry surface soils. Smectite in particular and, to a lesser extent, attapulgite and illite, are clays with moderate to high cation exchange capacities (CEC). The formation as a whole should therefore have a relatively high CEC, which should inhibit the migration of charged contaminants, and especially ionic forms of metals.

Caliche is a major feature of the Ogallala Formation, occurring as nearly continuous to discontinuous layers throughout. Caliche is hard, white to pale tan on fresh surfaces, weathering to gray, and has a chalky appearance. Caliche forms as calcium carbonate, leached from overlying sediments, and precipitates in the pore space of the host sediments. Precipitation is caused by the evaporation of downward percolating water. The caliche may thus mark the position of ancient vadose zones. As reported in Lee Wan (1990) radiocarbon dates for the upper “climax” caliche range from approximately 27,000 years before the present (B.P.) to approximately 42,000 years B.P.

Caliche is relatively soluble in acidic water (i.e., water with a pH less than 7) or in waters containing dissolved carbon dioxide. The top surface of the uppermost or “climax” caliche in a fresh outcrop typically shows solution etching.

The Ogallala has numerous continuous to discontinuous caliche layers throughout its thickness. The climax caliche is pisolitic (i.e., consisting of spherical concentrically laminated aggregates 1 to 10 millimeters [mm] in diameter) (Lee Wan 1990). The pisolites are thought to have formed as the caliche was repeatedly chemically weathered and brecciated during Pleistocene pluvials (wet climate episodes) and later recemented during drier intervals. This upper caliche crops out around playas and the bounding escarpments of the Ogallala, and is locally termed “caprock.” The climax caliche is typically 3 to 5 feet thick. Caliches that occur lower in the Ogallala are platy and harder. Caliche may be thin or absent below playas (W-C 1991).

1.3.5 Hydrogeology

The lower portion of the Ogallala Formation is the primary regional aquifer for both potable and irrigation water. No deeper aquifers are utilized in the vicinity of Cannon AFB. The Ogallala aquifer is part of the High Plains Aquifer that extends continuously from Wyoming and South Dakota into New Mexico and Texas. In east-central New Mexico, the Ogallala aquifer rests on Dockum Group redbeds, which serve as the basal confining layer. The Ogallala is a water table, or unconfined, aquifer (Lee Wan 1990). The Ogallala aquifer has a southeasterly regional gradient of about 17 feet per mile (0.0032 meters per meter, see **Figure 1-4**). Well yields vary from less than 1 gallon per minute (gpm) in thin silts and sands, and up to 1,600 gpm in thick sands and gravels (Lee Wan 1990). Water quality is generally good, with hardness and fluorides being somewhat high (Lee Wan 1990).

At Cannon AFB, the depth to groundwater is greater than 200 feet, and the Ogallala aquifer has an average saturated thickness of 120 feet based on mid-1960s data. Saturated thickness ranges from 93 to 143 feet, and is influenced by the configuration of the erosional nonconformity surface marking the top of the Dockum Group. The local groundwater gradient is southeasterly at 7.5 feet per mile (Lee Wan 1990). Yields in tests of Cannon AFB water wells have ranged from 776 liters per minute (L/min) (205 gpm) to 4,353 L/min (1,150 gpm). Specific capacities range from 0.14 cubic meters per meter (m^3/m) (11.4 gallons per foot [gal/ft]) to 0.35 m^3/m (27.9 gal/ft) (Lee Wan 1990).

Very rough estimates of hydraulic conductivity were made from well pump tests in water wells 5 and 9 (**Figure 1-5**) using the Theis equation. An estimate of hydraulic conductivity for water well 8 was based on water level recovery data using the Bouwer and Rice approach (Lee Wan 1990). The data used in these calculations were obtained to evaluate pump rates, efficiency, and well yield, and were not intended for use in calculating aquifer properties. The results of these calculations should therefore be considered as first approximations.

Hydraulic conductivity values for water wells 5 and 9 were found to be approximately 2.0 x 10^{-3} centimeters per second (cm/sec). Calculations for water well 8 resulted in a hydraulic conductivity of 2.0 x 10^{-2} cm/sec. In addition, slug testing of two monitoring wells (MW-O and MW-N) was completed by W-C in February 1995 (W-C 1995a). The estimated hydraulic conductivities from these slug tests were both 3 x 10^{-3} cm/sec. These estimates appear to be low when compared to published hydraulic conductivity data for sands and gravels. As reported in Lee Wan (1990), a groundwater flow velocity of about 45 meters per year (150 feet per year) has been estimated. This calculates out to a hydraulic conductivity of approximately 1.4 x 10^{-4} cm/sec. Again, this appears to be low when compared with published data (Freeze and Cherry 1979).

The presence of interstitial clays may account for both the variability and the low values of hydraulic conductivities. Boring logs from Cannon AFB projects and published reports (Lee Wan 1990) indicated that interstitial and interstratified clays are abundant in the Ogallala Formation.

Recharge to the Ogallala is primarily through precipitation. As reported in Lee Wan (1990), a recharge rate of 0.5 inches/year was calculated using the Theis equation. Lee Wan (1990) reported that the recharge rate may be as much as 1.0 inches/year. Due to the high evapotranspiration rate and low precipitation, recharge probably occurs only during heavy rainfall events in which the infiltration capacity of the soil is exceeded and runoff occurs, or during cool months when precipitation exceeds evapotranspiration. Excess runoff flows to playas, and the presence of water in playas may allow deep percolation to the aquifer. The occurrence of this process is evidenced by the presence of clay deposits in, and thin or nonexistent caliche layers directly below, playas. Caliche is soluble in acidic rainwaters, and is leached over time to form percolation pathways.

Discharge from the Ogallala occurs through well pumping and springs along the eroded margins of the formation. Spring discharge does not occur on or near Cannon AFB. Domestic and irrigation water wells are common on and around the base, however. The rate of discharge exceeds the rate of recharge. Water levels in the Ogallala have declined steadily from the 1930s to the present. A decline of 50 to 100 feet has been observed in the area around Clovis, New Mexico for the period from the 1930s to 1980. Lee Wan (1990), states "the largest area of water level decline exceeding 100 feet occurs south of the Canadian River extending from Curry County, New Mexico to Crosby County, Texas."

The dominant uses of groundwater in the Cannon AFB area are as potable and irrigation water. Numerous wells are found in the Cannon AFB area, most of which provide only irrigation water (**Figure 1-5**).

The Ogallala will continue to be used as the primary source of potable and irrigation water for eastern New Mexico. The New Mexico State Engineer designated Curry County as a Water Basin in 1989. This designation allows for regulation of water rights, usage, and well drilling (W-C 1991).

1.3.6 Soils

Soils in the vicinity of Cannon AFB are classified as silty sand (SM) to clayey sand (SC) under the Unified Soil Classification System, and as aridisols (calciorthids) under the Soil Conservation Service Comprehensive Soil Classification System. The following summary is based on the Soil Conservation Service Curry County Soil Survey as reported in Lee Wan (1990).

The most common soil type on the base is the Amarillo fine sandy loam, 0- to 2-percent slope phase (map symbol Ab on **Figure 1-6**). This soil consists of a thin sandy A horizon, well-defined clayey B1-3 horizons, with a calcic B3 horizon at depths below 40 inches. The calcic B3 horizon lies on a calcic C horizon, or on caliche. The Amarillo fine sandy loam is present on all relatively flat surfaces at the base, but is also found on slopes associated with playas (map symbol Ac).

Clovis fine sandy loams, 0- to 2-percent slope phase (map symbol Cb) and 2- to 5-percent slope phase (map symbol Cc), are very similar to Amarillo fine sandy loams. In the Clovis soils, the

depth to the calcic C horizon ranges from 28 to 56 inches. The depth to caliche exceeds 56 inches. Clovis and Amarillo fine sandy loams occur in close association.

In a few limited areas, particularly along the steeper slopes around playas, Mausker fine sandy loam, 0- to 2-percent slope phase (map symbol Ma), and 2- to 5-percent phase (map symbol M6) are found. Mausker fine sandy loams have no B horizons and are very calcareous. The calcic C horizon is within 2 feet of the surface.

The A and B horizons of Amarillo and Clovis fine sandy loams are rapidly to moderately permeable. Mausker fine sandy loam A and Ac horizons are rapidly permeable. Permeabilities in calcic B and C horizons are moderate (Lee Wan 1990).

1.3.7 Background Metals Concentrations in Soil

The natural soils in the vicinity of Cannon AFB are alkaline and generally rich in metals. Typically high concentrations of aluminum, iron, magnesium, manganese, and potassium combine with elevated levels of many other metals in the natural soils. Calcium is naturally present in the soils at levels up to nearly 2.00E+05 milligrams per kilogram (mg/kg). Tightly cemented layers of "caliche" are present in several horizons in the natural soils and the Ogallala aquifer below. As stated in **Section 1.3.4**, the Ogallala Formation as a whole should have a relatively high CEC, which should, in turn, inhibit the migration of charged contaminants, especially the ionic forms of metals.

The background levels of inorganic compounds in surface and subsurface soil at Cannon AFB are presented in **Table 1-1** in the form of a mean value and statistical information on the ranges encountered for each element. **Table 1-1** has been adapted from a final report by W-C dated September 1997 entitled "Naturally Occurring Concentrations of Inorganics and Background Concentrations of Pesticides at Cannon Air Force Base, New Mexico." This report summarizes background data for soil from numerous past investigations in the vicinity.

The upper tolerance limits (UTLs) presented in **Table 1-1** will be the background levels used in the screening of surface and subsurface soil chemical results for this SI at eight sites.

1.3.8 Water Quality

The groundwater quality at Cannon AFB is generally good, with dissolved solids ranging from 2.50E+02 to 5.00E+02 milligrams per liter (mg/L) (Gutentag, et al. 1984) and fluorides ranging from 2.2E+00 to 2.7E+00 mg/L (William Matotan and Associates, Inc. 1985).

1.4 PROJECT SCHEDULE

Fieldwork is scheduled for the spring/summer of 2012. Preparation for field sampling activities including mobilization, acquisition of base passes and utility locates is described in **Section 5** of this PAWP. The proposed project schedule (i.e., Project Planning Chart [PPC]) (AFCEE CDRL B002) is provided in **Figure 1-7**. The PPC will be updated on a monthly basis, and will be

provided with the monthly Contractor's Progress, Status, and Management Report (CPSMR) (AFCEE CDRL B004).

TABLE 1-1

SUMMARY OF BACKGROUND ELEMENTAL CONCENTRATIONS[1] IN SOIL SAMPLES[2] AT CANNON AFB, NEW MEXICO

	Mean (x)		Standard Deviation (s)		95% Upper Tolerance Limit of Background Concentrations	
Element	Surface Soil	Subsurface Soil	Surface Soil	Subsurface Soil	Surface Soil	Subsurface Soil
Aluminum	5,508	5,932	1,964	2,183	8,950	12,214
Antimony	ND (3)	ND (3)	ND (3)	ND (3)	3.15 (3)	16 (3)
Arsenic	2.1	2.1 (4)	0.48	0.96 (4)	3.6	4.3 (4)
Barium	100	210	165	199	670	890
Beryllium	0.35 (4)	0.35 (4)	0.13 (4)	0.17 (4)	0.78 (4)	0.73 (4)
Cadmium	ND (3)	ND (3)	ND (3)	ND (3)	0.435 (3)	1.3 (3)
Calcium	5,645	89,410	11,366	64,611	44,800	237,498
Chromium (total)	7.1	5.6	1.3	2.33	10.5	13.3
Cobalt	2.9	2.6 (4)	1.0	1.4 (4)	6.6	4.7 (4)
Copper	6.8	3.8 (4)	4.6	1.97 (4)	18.3	8.3 (4)
Iron	6,458	5,148	1,349	2,262	10,100	13,148
Lead	6.8	4.7	1.6	1.7	12	8.7
Magnesium	1,066	4,260	390	3,856	1,930	19,300
Manganese	139	83	51	50	307	333
Mercury	0.025 (4)	ND (3)	0.016 (4)	ND (3)	0.056 (4)	0.019 (3)
Nickel	5.5	5.9 (4)	1.6	2.41 (4)	11	14.9 (4)
Potassium	1,345	1,222	413	417	2,691	2,512
Selenium	ND (3)	0.47 (4)	ND (3)	0.31 (4)	0.26 (3)	1.1 (4)
Silver	--- (5)	ND (3)	--- (5)	ND (3)	0.4 (5)	2.65 (3)
Sodium	91	351 (4)	10	253 (4)	102	1,227 (4)
Thallium	ND (3)	ND (3)	ND (3)	ND (3)	0.6 (3)	2.65 (3)
Vanadium	14.9	16	2.8	5.2	23.3	32.8
Zinc	15.4	12.1	5.2	4.8	32.2	30.6

Notes:

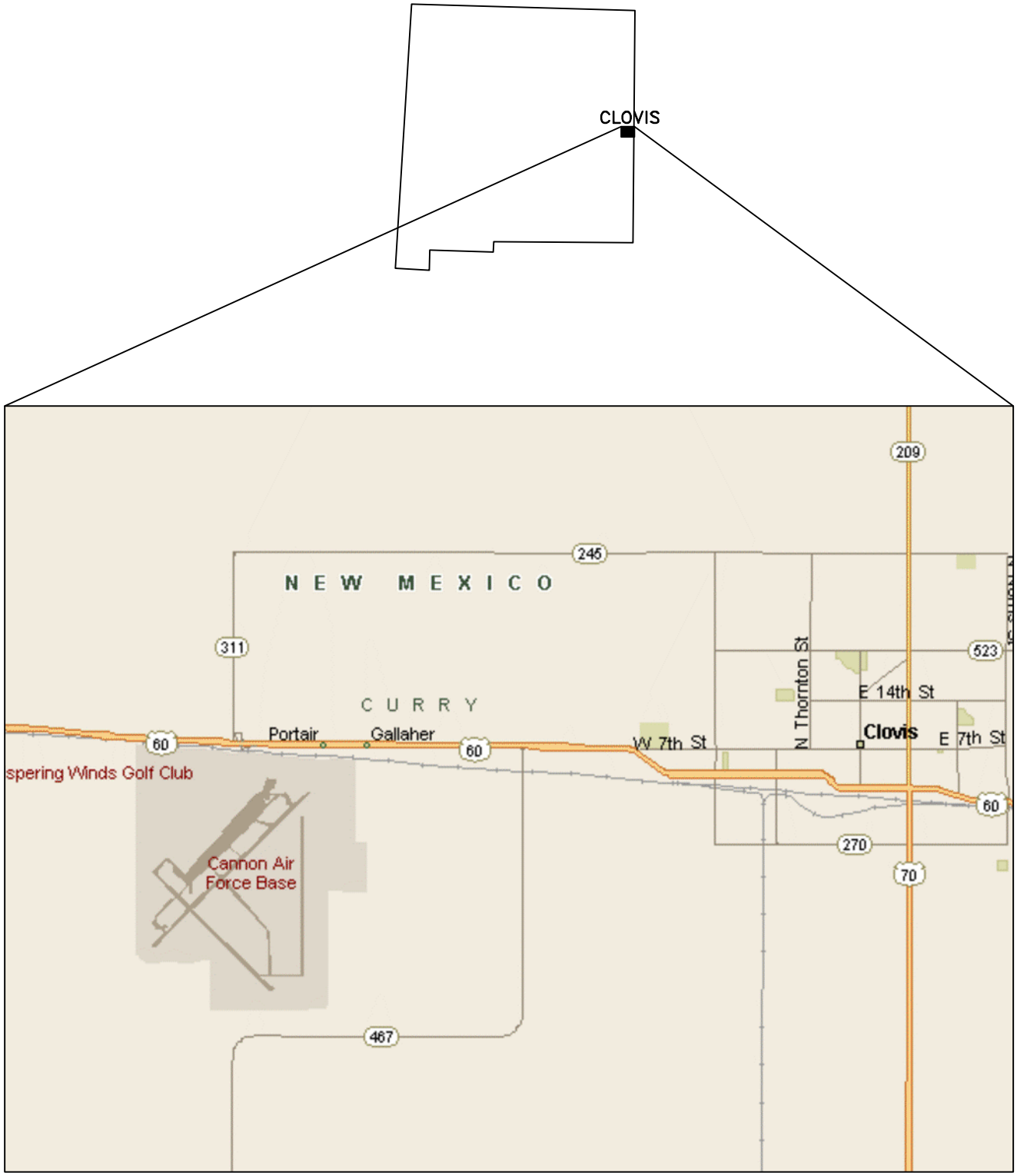
(1) All concentrations are in mg/kg.

(2) From report entitled "Naturally Occurring Concentrations of Inorganics and Background Concentrations of Pesticides at Cannon Air Force Base, New Mexico" (W-C 1997).

(3) All analytical samples were nondetect; therefore, a mean and standard deviation were not calculated. One-half the highest reporting limit is used as the 95% UTL. The actual mean, standard deviation, and UTL may be less than these values.

(4) Values determined from a data set including one-half of the reporting limits for nondetects.

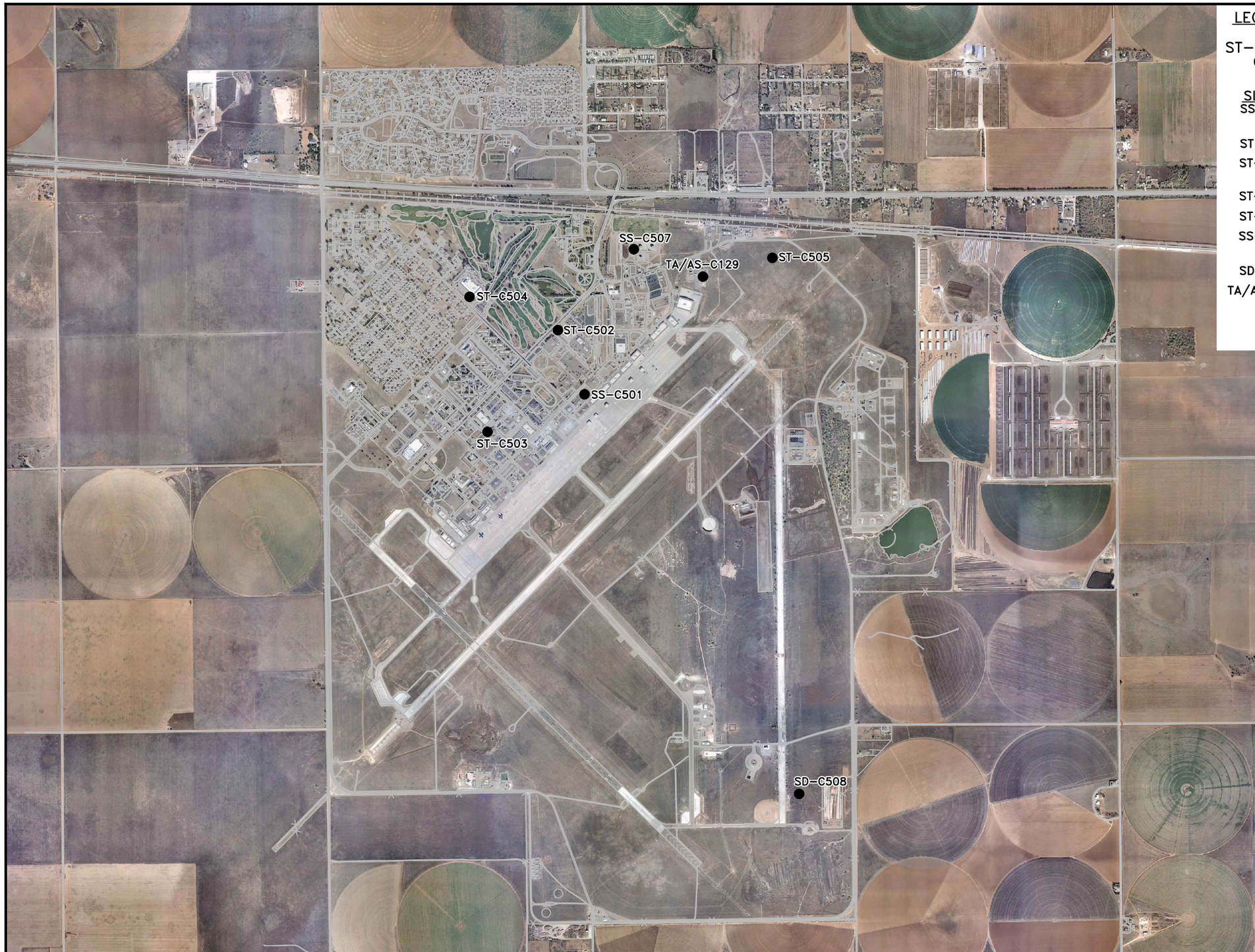
(5) Silver was detected in only one sample; therefore, a mean and standard deviation were not calculated. The single detected concentration is used as the 95% UTL.



INSTALLATION LOCATION MAP
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 05/16/11	PROJECT NO. 16170622	FIG. NO. 1-1
CHK'D. BY: CSA	REVISION: 0		

June 10, 2011 3:57:42 p.m.
Drawing: T:\CANNON\16170622\200\1-1.dwg



LEGEND

ST-C505 ● SITE LOCATION AND IDENTIFIER

SITE ID	DESIGNATED AREA
SS-C501	FORMER AEROSPACE GROUND EQUIPMENT (AGE) DISPATCH FACILITY SPILLS SITE
ST-C502	FORMER GAS STATION SITE
ST-C503	BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE
ST-C504	HOSPITAL ABANDONED UST SITE
ST-C505	FLIGHTLINE GENERATOR UST SITE
SS-C507	FORMER PETROLEUM, OIL AND LUBRICANTS (POL) YARD REFUELING AREA SITE
SD-C508	SURFACE DISPOSAL AREA SITE
TA/AS-C129	WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE

N

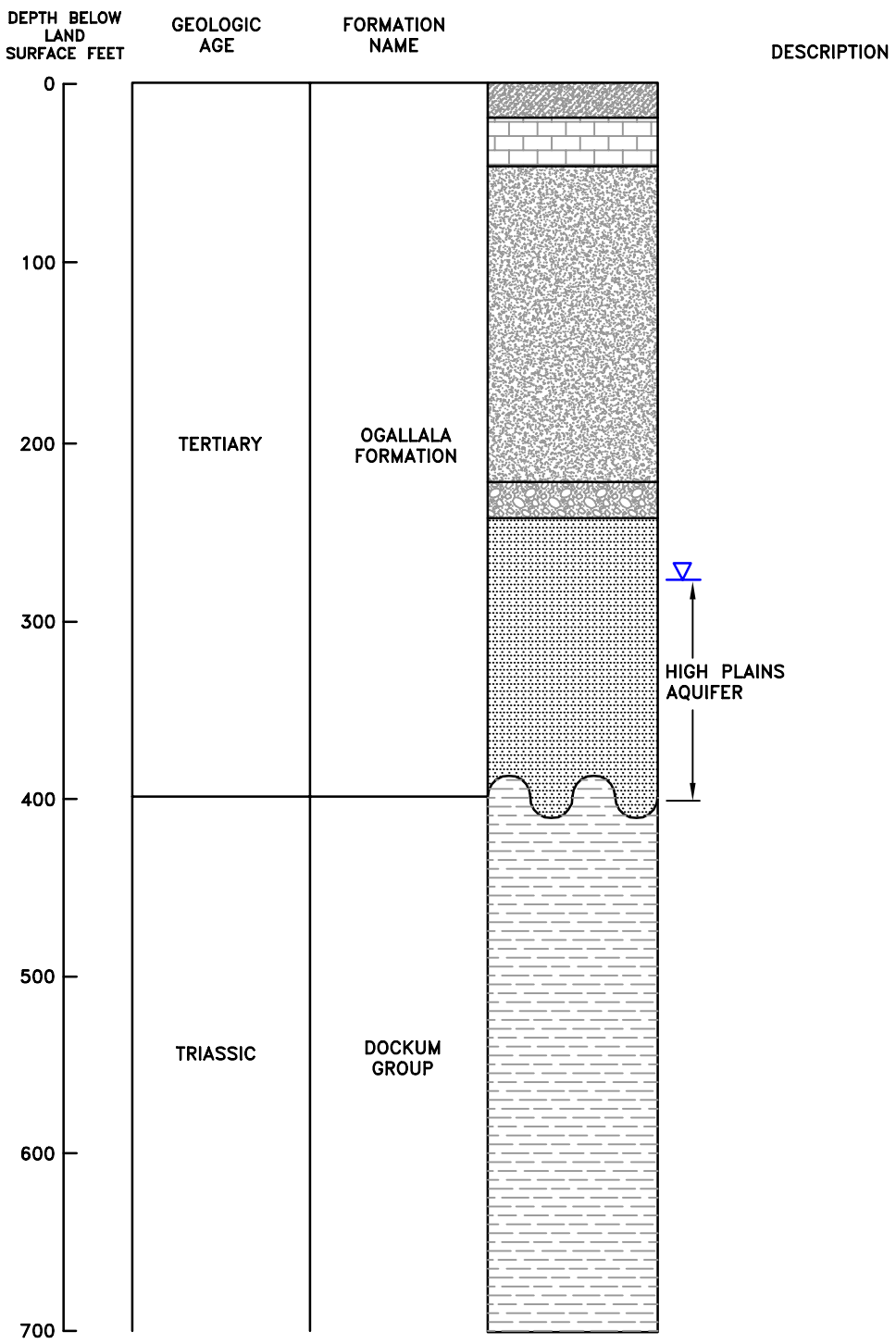
2000 1000 0 2000

SCALE IN FEET

SITE LOCATION MAP
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/05/11	PROJECT NO. 16170622	FIG. NO. 1-2
CHK'D. BY: CSA	REVISION: 0		

August 08, 2011 3:50:28 p.m.
Drawing: T:\CANNON\16170622\200\1-2.dwg



LEGEND

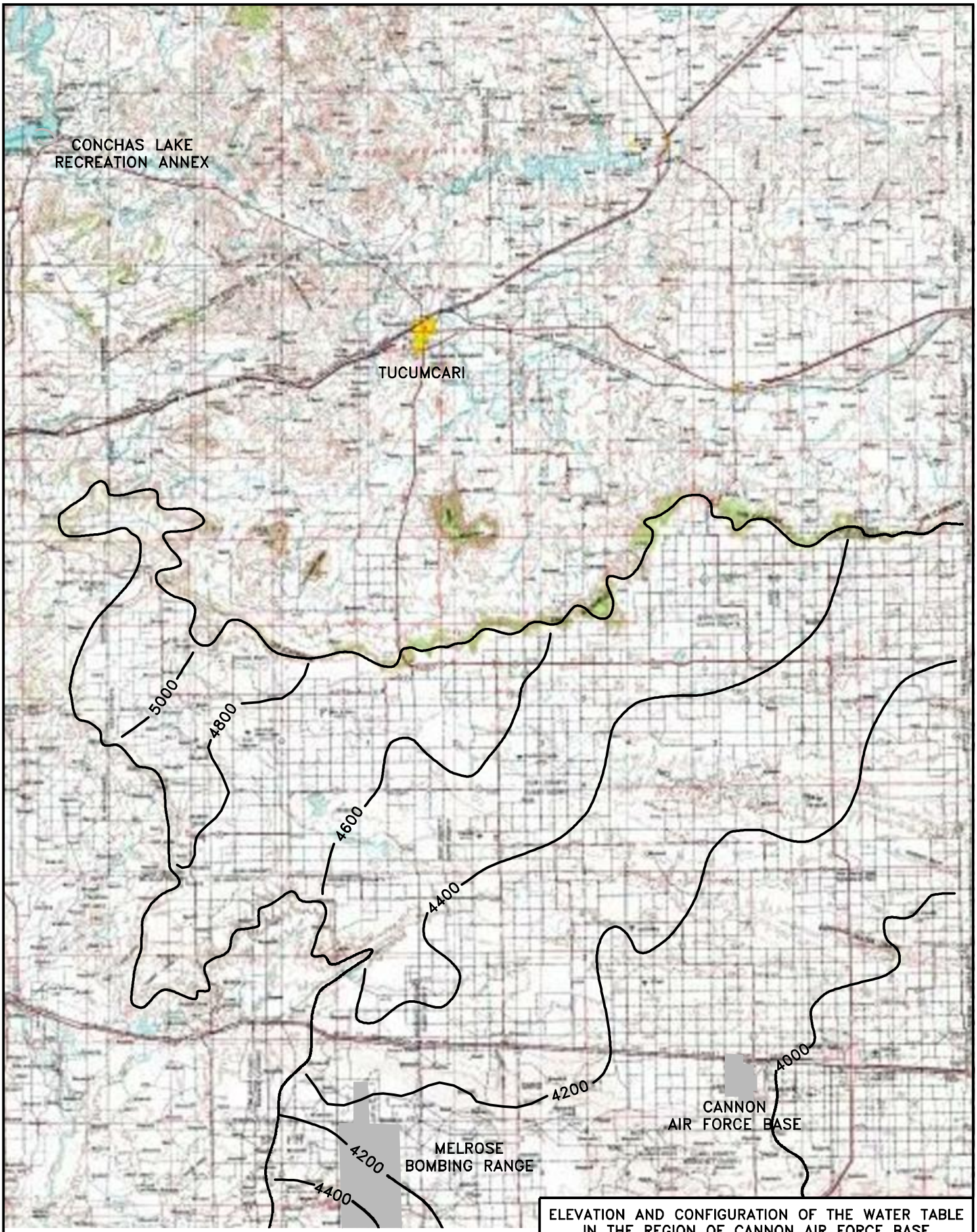
- SILTY SAND WITH CALICHE
- CALICHE
- SAND AND SILTY SAND
- SANDY GRAVEL
- SAND
- SANDSTONE (RED BEDS)
- LITHOLOGIC CONTACT
- EROSIONAL UNCONFORMITY
- WATER LEVEL

SOURCE: MODIFIED FROM GUTENTAG ET.AL., 1984

GENERALIZED GEOLOGIC STRATA AT CANNON AIR FORCE BASE
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/11/11	PROJECT NO. 16170622	FIG. NO. 1-3
CHK'D. BY: CSA	DATE: 04/11/11		

June 10, 2011 4:03:00 p.m.
Drawing: T:\CANNON\16170622\200\1-3.dwg



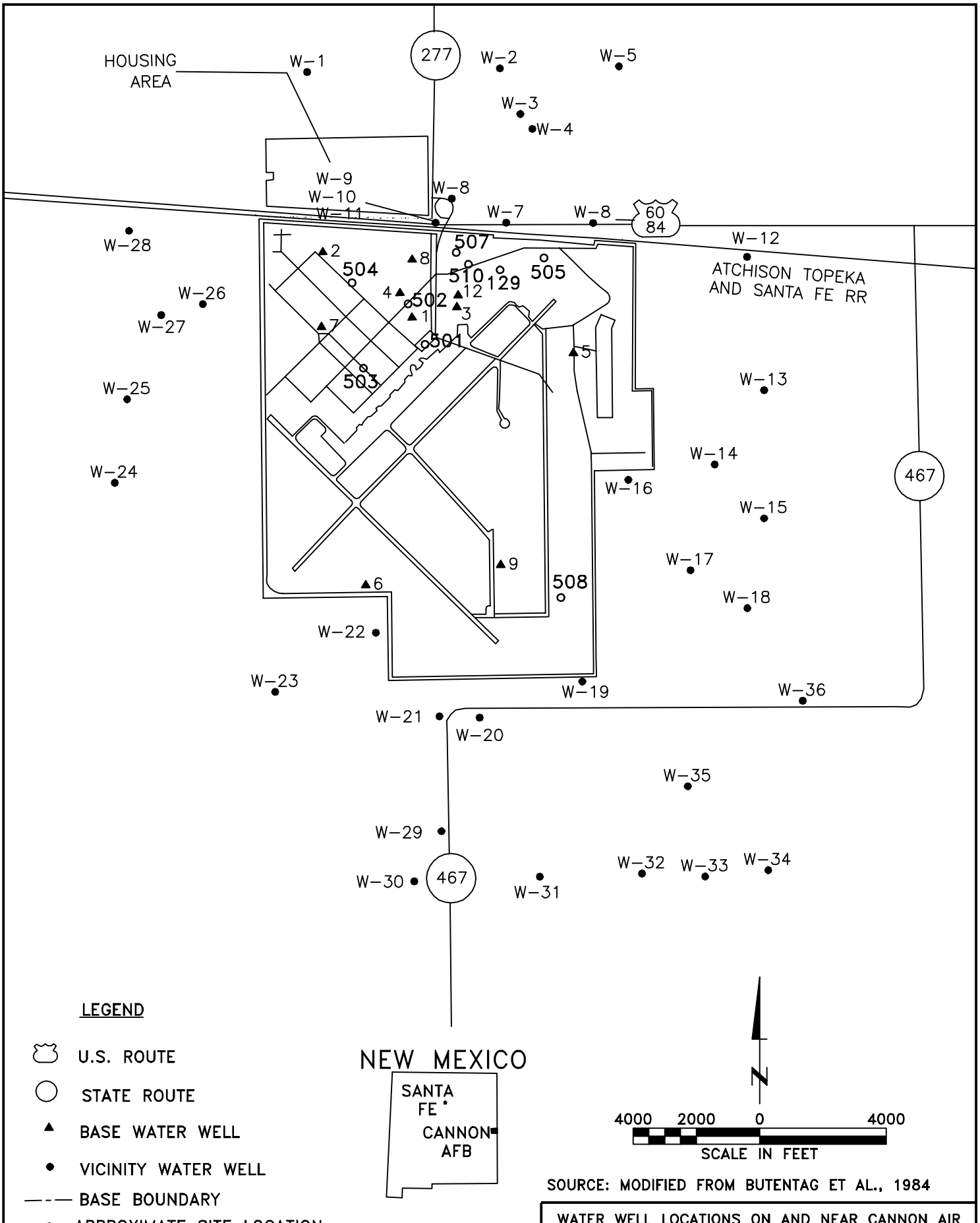
NOTE: ADAPTED FROM LEE WAN AND ASSOCIATES 1990
ORIGINAL SOURCE: USGS

8 4 0 8
SCALE IN MILES

June 10, 2011 4:03:55 p.m.
Drawing: T:\CANNON\16170622\200\1-4.dwg

ELEVATION AND CONFIGURATION OF THE WATER TABLE
IN THE REGION OF CANNON AIR FORCE BASE
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/11/11	PROJECT NO. 16170622	FIG. NO. 1-4
CHK'D. BY: CSA	REVISION: 0		

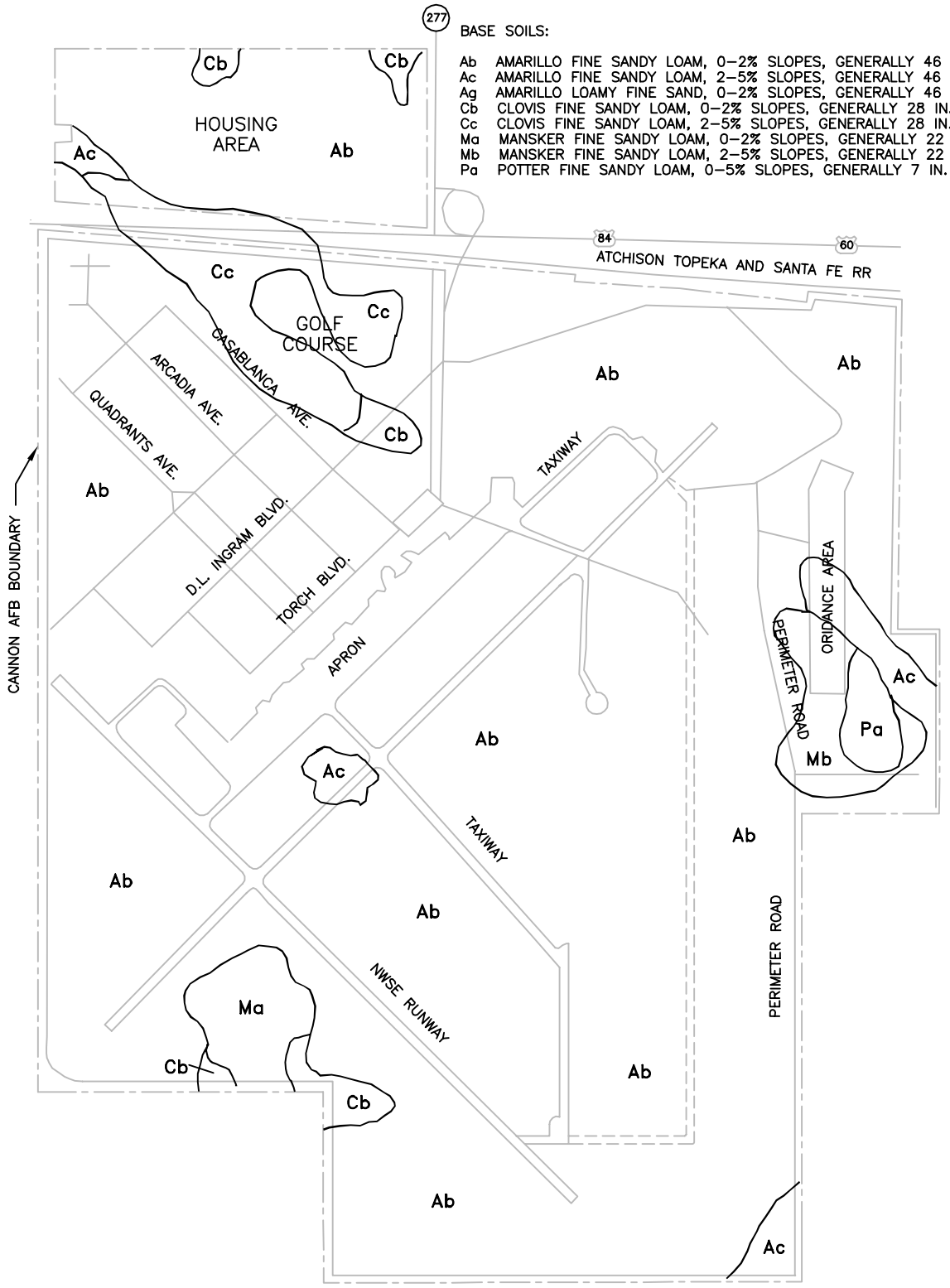


SOURCE: MODIFIED FROM BUTENTAG ET AL., 1984

WATER WELL LOCATIONS ON AND NEAR CANNON AIR FORCE BASE
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 05/16/11	PROJECT NO. 16170622	FIG. NO. 1-5
CHK'D. BY: CSA	DATE: 05/16/11		

June 10, 2011 4:05:16 p.m.
Drawing: T:\CANNON\16170622\200\1-5.dwg



BASE SOILS:

Ab AMARILLO FINE SANDY LOAM, 0–2% SLOPES, GENERALLY 46 IN. THICK
Ac AMARILLO FINE SANDY LOAM, 2–5% SLOPES, GENERALLY 46 IN. THICK
Ag AMARILLO LOAMY FINE SAND, 0–2% SLOPES, GENERALLY 46 IN. THICK
Cb CLOVIS FINE SANDY LOAM, 0–2% SLOPES, GENERALLY 28 IN. THICK
Cc CLOVIS FINE SANDY LOAM, 2–5% SLOPES, GENERALLY 28 IN. THICK
Ma MANSKER FINE SANDY LOAM, 0–2% SLOPES, GENERALLY 22 IN. THICK
Mb MANSKER FINE SANDY LOAM, 2–5% SLOPES, GENERALLY 22 IN. THICK
Pa POTTER FINE SANDY LOAM, 0–5% SLOPES, GENERALLY 7 IN. THICK

N

2000 1000 0 2000
SCALE IN FEET

SOURCE: USDA–S.C.S., SOIL SURVEY OF CURRY COUNTY N.M., 1958

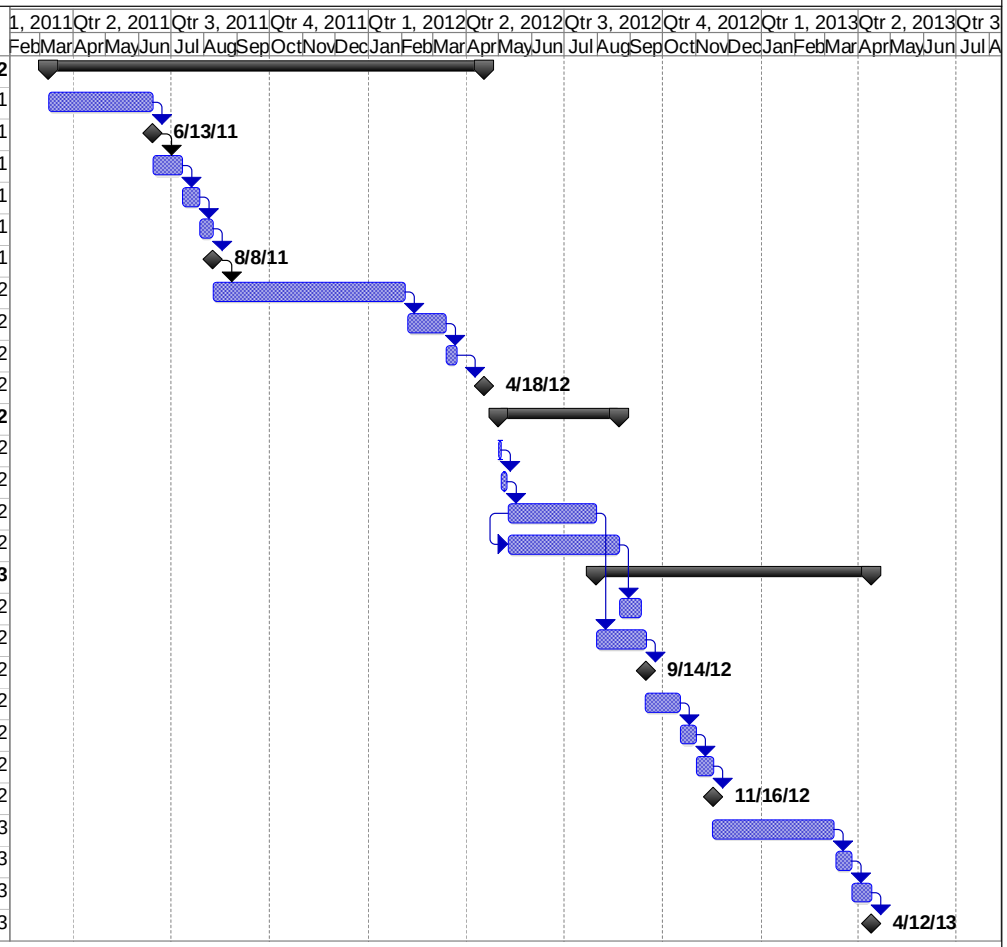
DISTRIBUTION OF SOILS BY TYPE AT
CANNON AIR FORCE BASE
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/11/11	PROJECT NO. 16170622	FIG. NO. 1–6
CHK'D. BY: CSA	DATE: 04/11/11		

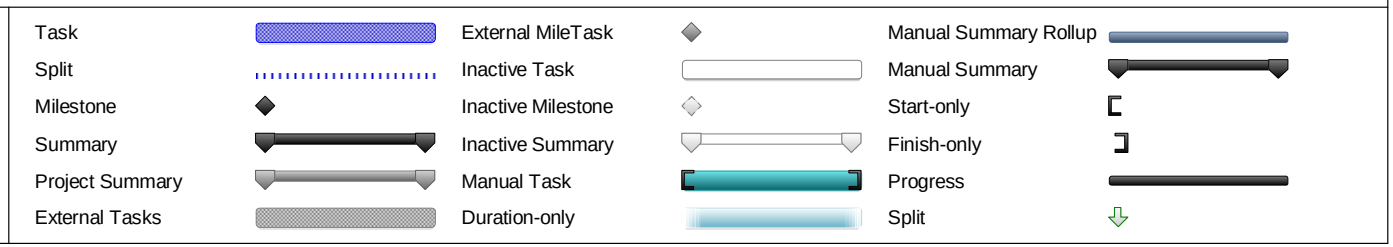
June 10, 2011 4:05:41 p.m.
Drawing: T:\CANNON\16170622\200\1-6.dwg

FIGURE 1-7
SI AT EIGHT SITES
CANNON AIR FORCE BASE, NEW MEXICO

Task Name	Duration	Start	Finish
Project Activities Work Plan, HSP, and SAP	**406 days**	**Wed 3/9/11**	**Wed 4/18/12**
Complete Draft Version	97 days	Wed 3/9/11	Mon 6/13/11
Submit Draft	0 days	Mon 6/13/11	Mon 6/13/11
Cannon AFB Review of Draft	28 days	Tue 6/14/11	Mon 7/11/11
RTCs on Draft	16 days	Tue 7/12/11	Wed 7/27/11
Cannon AFB Concurrence on RTCs	12 days	Thu 7/28/11	Mon 8/8/11
Submit Draft Final	0 days	Mon 8/8/11	Mon 8/8/11
Cannon AFB and NMED Review of Draft Final	179 days	Tue 8/9/11	Fri 2/3/12
RTCs on Draft Final	36 days	Mon 2/6/12	Mon 3/12/12
Cannon AFB Concurrence on RTCs	10 days	Tue 3/13/12	Thu 3/22/12
Submit Final	0 days	Wed 4/18/12	Wed 4/18/12
Field Sampling and Analysis	**112 days**	**Tue 5/1/12**	**Mon 8/20/12**
Obtain Base Passes	2 days	Tue 5/1/12	Wed 5/2/12
Utility Clearances	6 days	Thu 5/3/12	Tue 5/8/12
Field Sampling	82 days	Thu 5/10/12	Mon 7/30/12
Laboratory Analysis	103 days	Thu 5/10/12	Mon 8/20/12
Site Investigation Report	**256 days**	**Tue 7/31/12**	**Fri 4/12/13**
Analytical Data Review and Validation	21 days	Tue 8/21/12	Mon 9/10/12
Complete Draft Version	46 days	Tue 7/31/12	Fri 9/14/12
Submit Draft	0 days	Fri 9/14/12	Fri 9/14/12
Cannon AFB Review of Draft	33 days	Fri 9/14/12	Tue 10/16/12
RTCs on Draft	15 days	Wed 10/17/12	Wed 10/31/12
Cannon AFB and NMED concurrence on RTCs	16 days	Thu 11/1/12	Fri 11/16/12
Submit Draft Final	0 days	Fri 11/16/12	Fri 11/16/12
Cannon AFB and NMED review of Draft Final	113 days	Fri 11/16/12	Fri 3/8/13
RTCs on Draft Final	15 days	Mon 3/11/13	Mon 3/25/13
Cannon AFB and NMED concurrence on RTCs	18 days	Tue 3/26/13	Fri 4/12/13
Submit Final	0 days	Fri 4/12/13	Fri 4/12/13



Notes:
-Draft versions will be submitted to AFCEE and Cannon AFB.
-Draft Final and Final versions will be submitted to AFCEE, Cannon AFB, and NMED.
-This schedule includes approximately 100 days for NMED review. By law NMED has 270 days to perform its review.
-This schedule will be updated monthly based on actual NMED review times.



The project management team and lines of authority are presented in **Figure 2-1**. This chart includes all individuals discussed below. The names of all key participants identified in **Figure 2-1**, including organization names and telephone numbers for project, field, and laboratory project managers, are presented in **Table 2-1** and will be updated as needed.

2.1 ROLES AND RESPONSIBILITIES

2.1.1 Cannon Air Force Base

The Cannon AFB Restoration Program Manager (RPM) has the overall responsibility for all activities associated with the SI at eight sites as it pertains to Cannon AFB.

2.1.2 AFCEE

The AFCEE Project Manager (PM) will oversee all aspects of the investigation and serve as a point of contact (POC) who will communicate directly with the Cannon AFB RPM and the URS Program Manager. In addition, the AFCEE PM will maintain approval authority for all subcontractors and suppliers used to complete the SI at eight sites. The AFCEE PM has the authority, with Cannon AFB and New Mexico Environment Department (NMED) approval, to modify the field activities specified in this PAWP. The AFCEE PM is also responsible for project quality, as well as budget and schedule control. The AFCEE PM will coordinate with Cannon AFB representatives, AFCEE staff, NMED, and URS to ensure that the AFCEE field work meets quality objectives, budget, and schedule.

2.1.3 NMED

The NMED PM has overall responsibility to ensure the environmental program at Cannon AFB, including the field work for this project, complies with the State of New Mexico's environmental program. NMED is the lead regulatory agency for this field work. The NMED PM will coordinate NMED's involvement and receive all notices, reports, plans, and other documents prior to, during, and following the project. Where necessary, NMED will be responsible for coordinating efforts of other regulatory agencies. In addition to the NMED PM, other NMED personnel may be involved in this project and may be on site during all or part of the AFCEE field work.

2.1.4 URS

2.1.4.1 Program Manager

The URS Program Manager will be responsible for monitoring the overall progress of the project, reviewing monthly progress reports, and ensuring that necessary resources are available to the URS PM. The URS Program Manager will also maintain close communication with AFCEE, Cannon AFB, and the NMED to assess client satisfaction during performance on this contract.

2.1.4.2 Project Manager

The URS PM is responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements. The URS PM's primary function is to ensure technical, financial, and scheduling objectives are achieved successfully. The URS PM is responsible for the following:

- Define project objectives and develop a detailed work schedule.
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
- Develop site specific DQOs and ensure compliance with project DQOs.
- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints.
- Orient all support staff concerning the project's special considerations.
- Monitor and direct the project staff.
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness.
- Review and analyze overall task order performance with respect to planned requirements and authorizations.
- Approve all reports (deliverables) before their submission to AFCEE, Cannon AFB, and NMED.
- Ultimately be responsible for the preparation and quality of draft, draft final, and final reports.
- Represent the project team at meetings.
- Update and submit the project schedule as necessary (i.e., PPC [AFCEE CDRL B002]).
- Submit monthly progress reports (i.e., CPSMR [AFCEE CDRL B005] and Funds and Man-Hour Expenditure Reports [FMER] [AFCEE CDRL C001]).

2.1.4.3 URS Field Team Leader

The URS Field Team Leader (FTL) reports directly to the URS PM and is responsible for completion of his assigned activities (i.e., site visits, report preparation, etc.). The FTL is responsible for understanding and implementing provisions of the project documents as they apply to project activities.

2.1.4.4 URS Project Chemist

The URS Project Chemist reports to the URS PM and also works directly with other project personnel. This person is responsible for the data review of all sample results from the analytical laboratories. The URS Chemist will be the POC for subcontractor laboratories.

2.1.4.5 URS Health and Safety Officer

The URS Health and Safety Officer (HSO) will advise the URS PM on health and safety issues; however, the HSO operates independently of the URS PM and can also work directly with the URS Site Safety Officer (SSO). The URS HSO has the responsibility to monitor and verify work is performed in accordance with URS safety requirements.

2.1.4.6 URS Site Safety Officer

The SSO monitors all site activities and is responsible for the implementation of and compliance with URS safety requirements. The SSO reports to the HSO.

2.1.4.7 URS Quality Assurance/Quality Control Officer

The Quality Assurance/Quality Control (QA/QC) Officer will ensure that all QA/QC procedures for this project are being followed.

2.1.4.8 URS Senior Technical Reviewer

The URS Senior Technical Reviewer will be responsible for reviewing project documents prior to delivery. The review will be conducted to ensure that the data presented and conclusions made are reasonable and accurate.

2.1.4.9 URS Risk Assessor

The URS Risk Assessor will be involved in determining risks to human health and/or the environment based on the results of the investigation.

2.2 CONTRACTOR RESPONSIBILITIES

All subcontractors chosen for the project will meet pre-established industry standards of quality criteria and experience for the types of work to be completed. Subcontractors for the project will include analytical laboratories and direct push services.

2.2.1 EMAX Laboratories Project Manager

The EMAX Laboratories (EMAX) PM will report the laboratory results to the URS Project Chemist and will communicate with the URS Project Chemist to facilitate the completion of laboratory activities for the project.

2.2.2 Laboratory QA Officer

The laboratory QA Officer has the overall responsibility for data generated by the laboratory, as well as the adherence to acceptable practice. The laboratory QA Officer will communicate data issues through the laboratory PM. In addition, the laboratory QA Officer will:

- Oversee laboratory QA.
- Oversee QA/QC documentation.
- Conduct detailed data review.
- Determine whether to implement laboratory corrective actions, if required.
- Define appropriate laboratory QA procedures.
- Prepare laboratory SOPs.

2.2.3 Direct Push Services

The direct push subcontractor will be Plains Environmental Services (PES). They will be responsible for adhering to all PAWP procedures according to contractual arrangements and all other associated plans.

2.2.4 Drill Rig Services

The drill rig subcontractor (if necessary) will be Talon/LPE, Ltd. (Talon). They will be responsible for adhering to all PAWP procedures according to contractual arrangement and all other associated plans.

TABLE 2-1
KEY PROJECT PERSONNEL
CANNON AFB, NEW MEXICO

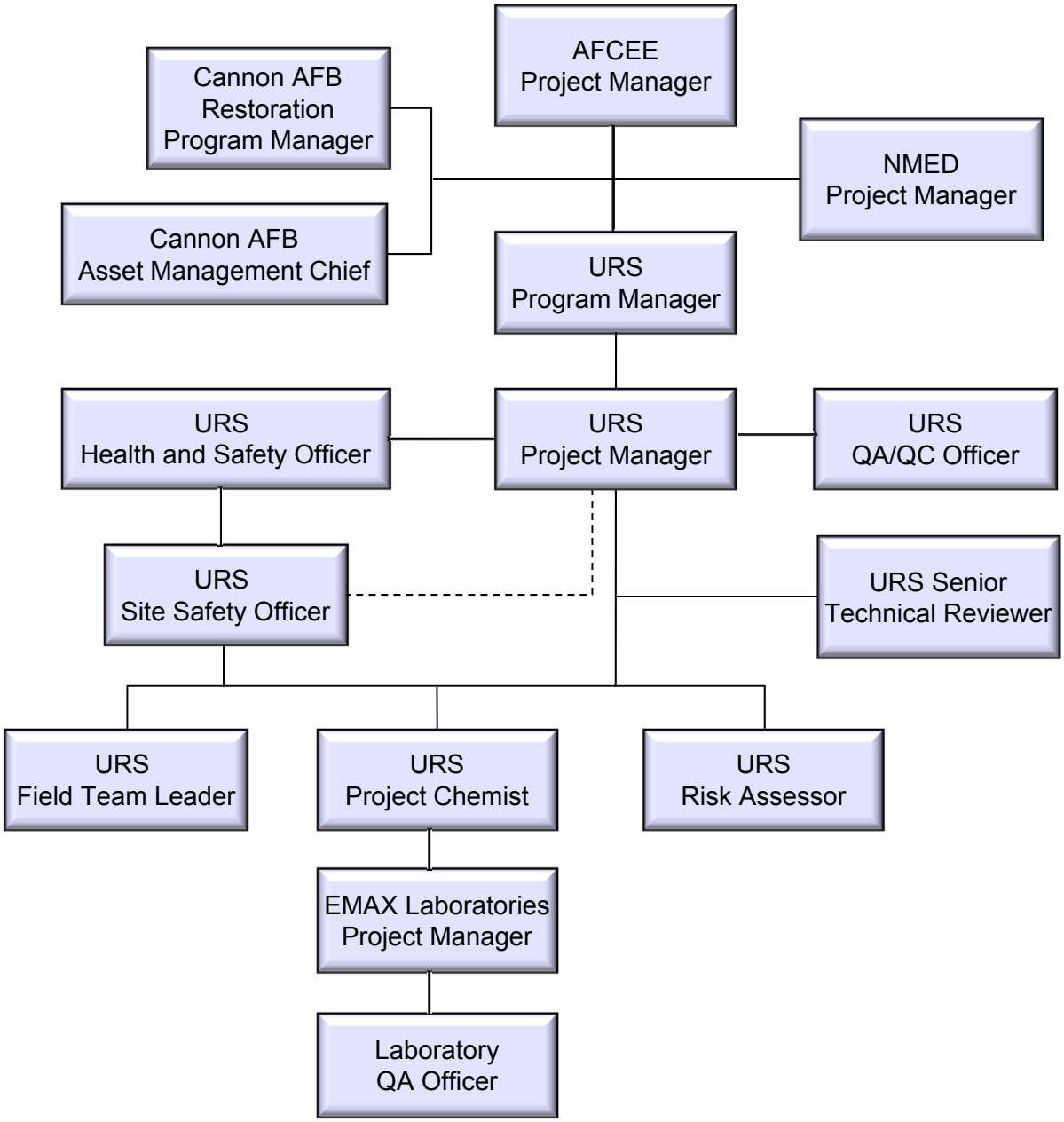
Name	Title	Address	Phone Number
Eliud Burgos	Project Manager AFCEE	2261 Hughes Avenue, Suite 155 Lackland AFB, TX 78236-9854	(210) 395-8626
Ron Lancaster	Asset Management Flight Chief Cannon AFB	27 SOCES, 506 North DL Ingram Boulevard Cannon AFB, New Mexico 88103-5003	(575) 784-1146
Matthew Higginbotham	Restoration Program Manager Cannon AFB	27 SOCES, 506 North DL Ingram Boulevard Cannon AFB, New Mexico 88103-5003	(575) 784-1092
Anita Lafuente	TSCA Program Manager Cannon AFB	27 SOCES/CEAN, 506 North DL Ingram Boulevard Cannon AFB, New Mexico 88103-5003	(575) 784-6391
John E. Kieling	Program Manager, Hazardous Waste Bureau, NMED	2905 Rodeo Park Drive East, Building 1 Santa Fe, New Mexico 87505-6303	(505) 476-6035
Jeff Voelker	Program Manager URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2558
Dennis Day	Health and Safety Officer URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2525
Corey Anderson	Project Manager URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2551
Juan Szymanski	QA/QC Officer URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2510
Jennifer Allen	Site Safety Officer URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2574
Stephen Jacobson	Field Team Leader URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2544
Tony Sedlacek	Project Chemist URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2532
Ryan Carpenter	URS Senior Technical Reviewer URS Corporation	12120 Shamrock Plaza, Suite 300 Omaha, NE 68154	(402) 952-2538
Christine Copenhaver	URS Risk Assessor URS Corporation	1000 Corporate Center Drive, Suite 250 Franklin, TN 37067	(615) 224-2106
Molly Nguyen	Project Manager EMAX Laboratories	1835 West 205th Street Torrance, CA 90501	(310) 618-8889
Kennette Pimentel	Laboratory QA Manager EMAX Laboratories	1835 West 205th Street Torrance, CA 90501	(310) 618-8889
Lynn Newcomer	Office Manager Plains Environmental Services	1900 Tony's Road Salina, KS 67401	(785) 827-4545
Simon Walshe	Project Manager Talon/LPE, Ltd.	921 North Bivins Amarillo, TX 79107	(806) 467-0607

TABLE 2-2
FIELD PERSONNEL
CANNON AFB, NEW MEXICO

Field Personnel	Company	Field Position	8-Hour Supervisor	40-Hour Training	8-Hour Refresher	First Aid	CPR	Medical Clearance
Jeff Voelker	URS Corporation	Program Manager	Sep-00	Mar-96	Feb-12	Mar-11	Mar-11	Mar-12
Corey Anderson	URS Corporation	Project/Technical Manager	Mar-01	Mar-98	Feb-12	Feb-10	Feb-10	Mar-12
Stephen Jacobson	URS Corporation	Field Team Leader	Aug-10	Dec-04	Feb-12	Feb-12	Feb-12	Sep-12
Jennifer Allen	URS Corporation	Sampling Team Member	Mar-10	May-06	Feb-12	Jul-10	Jul-10	Feb-12
Shavi Challa	URS Corporation	Alternate Sampling Team Member	Nov-08	Sep-03	Feb-12	Feb-12	Feb-12	Nov-12

Notes:
Medical clearance, First Aid certification and CPR certification are valid for two years.

FIGURE 2-1
PROJECT TEAM AND LINES OF AUTHORITY
CANNON AFB, NEW MEXICO



This section present the decision process that will be used to assess the data needs and approach at the eight sites. The soils investigation decision process is designed to identify appropriate actions for each of the eight sites based on three potential recommendations: corrective action complete (CAC) without controls, CAC with controls, or further investigation and evaluation. Due to the small size and highly developed nature of six of the eight sites, these six sites do not support suitable habitat for ecologically sensitive species and, therefore, do not support suitable habitat for ecological receptors. Two of the sites (SS-507 and SD-508) are considered potential habitat for ecological receptors, and therefore COPCs at these sites will be evaluated using screening methods for ecological receptors. Site-specific recommendations for the selection of an appropriate action will depend on whether COPCs are detected in soils at each site at levels that may pose an unacceptable risk to human health or the environment. This section provides a summary of the decision making process that will be used.

3.1 DESCRIPTION OF DECISION PROCESS

The following decision process will be used to assess the data needs and investigative approach for the eight sites. The DQO evaluation process is designed to provide soil data of sufficient quality and quantity to evaluate whether a release has occurred that could pose a risk to human health and to evaluate the need for further evaluation, such as collection of additional data, completion of a Baseline Risk Assessment (BRA), or completion of a Feasibility Study.

A general decision diagram (**Figure 3-1**) was developed for the eight sites to present a logical decision process that will be used to evaluate the data resulting from the investigation to ensure that project objectives are met.

The decision process will be implemented by first evaluating and summarizing existing historical information and analytical data. Historical information will be used to identify COPCs and to identify potential sites of chemical release.

Surface and subsurface soil will be sampled and analyzed for COPCs. COPCs are defined as chemicals that are site-related If COPCs without appropriate toxicity criteria are identified at concentrations exceeding background levels during this investigation, additional evaluation of COPCs may be recommended. Lead will be evaluated quantitatively using screening levels developed using the IUEBK model. COPCs were derived from the analyte list described in the Uniform Federal Policy–Quality Assurance Project Plan (UFP-QAPP), included as **Appendix A** of this PAWP.

The potential for site-related contaminants to impact groundwater will be assessed by evaluating the vertical distribution of contaminants in the soil column. If the concentrations of COPCs decrease with depth and the concentrations are below levels that are likely to migrate to groundwater (based on fate and transport properties of the contaminant and the vadose zone), then the potential for transport to groundwater will be considered insignificant and no further action will be recommended. If the concentrations do not decrease with depth, further evaluation of the groundwater pathway will be recommended. If concentrations are at levels that could potentially migrate to groundwater (based on comparison to appropriate screening levels), fate

and transport modeling will be recommended to evaluate the potential for contaminant transport to groundwater.

Concentrations of COPCs will be evaluated for potential risks by comparing maximum detected concentrations to risk screening criteria. This conservative screening approach will identify the sites that pose no unacceptable risk under highly conservative exposure assumptions and, therefore, warrant no further evaluation or action. This approach will also identify sites that may warrant further evaluation based on exceedance of stringent risk based concentrations. Derivation of human health and ecological risk screening criteria are presented in **Sections 3.6.1** and **3.6.2**, respectively.

The results of this evaluation will be used to make recommendations regarding the two alternatives stated above. The recommendations will be made on the following basis:

- If the vertical and lateral extent of contamination has been defined, no threat to human health exists above residential screening criteria, and no potential threat to the environment is apparent, then CAC without controls will be recommended.
- If the vertical and lateral extent of contamination has been defined, no threat to human health exists above other screening criteria, and no potential threat to the environment is apparent, then CAC with controls will be recommended.
- If there is a potential threat to human health or the environment, then further investigation and/or evaluation will be recommended for the site. Further investigation and/or evaluation may include additional field investigation and/or a BRA.

3.2 DEVELOPMENT OF PRELIMINARY SITE CONCEPTUAL EXPOSURE MODELS

The initial step in the evaluation of each of the eight sites is the development of a preliminary SCEM, which provides a framework for evaluating potential risks associated with the site, aids in the identification of data needs, and assists in the identification of appropriate preliminary remediation goals targeted at significant exposure pathways. The preliminary SCEMs for the eight sites are presented in **Figures 3-2** through **3-9**. Upon completion of the field sampling program, the SCEMs will be reviewed and modified (if necessary) in order to reevaluate the sites, taking into consideration the analytical results of all chemicals of concern for surface and subsurface soil.

The SCEMs present chemical release sources and transport media, potential human or ecological receptors, and intake-mechanisms for each potential exposure pathway. An exposure pathway describes the means by which release, transport, and intake by receptor populations of COPCs occurs. An exposure pathway consists of four necessary elements:

- A source and transport mechanism of chemical release to the environment
- An environmental exposure medium for the released chemical (e.g., surface or subsurface soil)

- A point of potential human or ecological exposure to transported chemicals (e.g., a domestic drinking water well)
- A human or ecological intake mechanism (e.g., inhalation or ingestion) at the point of exposure

All four elements must be present for an exposure pathway to be complete and for chemical exposure to occur. In the SCEMs, potentially significant pathways are denoted with solid lines.

Potential exposure pathways are evaluated with respect to potential chemical sources at the eight sites. Exposure pathways are considered to be potentially complete if there are chemical release and transport mechanisms and identified exposure points and receptors for that exposure pathway. Incomplete exposure pathways do not result in actual exposure to human or ecological receptors and, therefore, do not pose a potential risk. Partial or possible pathways are those that could conceivably be complete and result in an exposure, but the resulting exposure would undoubtedly be at levels that would not pose a significant risk.

The primary sources at each of the eight sites are provided below:

- **The Former AGE Dispatch Facility Spills Site (SS-C501)** – primary sources include at least two diesel fuel spills (up to 60 gallons each) that occurred on the asphalt parking lot.
- **The Former Gas Station Site (ST-C502)** – primary sources include the three former 10,000-gallon MOGAS and diesel fuel USTs, and associated fuel lines and dispensers, where fuel spills or leaks may have occurred.
- **The Base Support/Operations Generator Former UST Site (ST-C503)** – primary source includes a former 500-gallon diesel fuel UST that may have leaked.
- **The Hospital Abandoned UST Site (ST-C504)** – primary source includes an abandoned in place 25,000-gallon diesel fuel UST that may have leaked.
- **The Flightline Generator USTs Site (ST-C505)** – primary source includes two former 500-gallon diesel fuel USTs that may have leaked.
- **The Former POL Yard Refueling Area Site (SS-C507)** – primary sources include historical fuel spills or leaks associated with fuel unloading areas, refueling stations, fuel pumps, and above and below ground fuel piping.
- **The Surface Disposal Area Site (SD-C508)** – primary source includes visible burned debris disposed at the surface.
- **The Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129 [SWMU 129])** – primary sources include historical spills or leaks associated with a waste oil disposal/storage area, a former OWS, and an associated leach field used to discharge water from the former OWS.

Chemicals from the primary sources may be transported away from the primary source areas, affecting other media that may in turn act as secondary sources. Leaching of the chemicals to the subsurface soil are shown as primary chemical release mechanisms. Subsurface soils are an

important secondary source of potential chemical releases. COPCs in surface and subsurface soils could leach or percolate through the subsurface soil and be released to groundwater, even though the depth to groundwater is nearly 300 feet.

Other release mechanisms, such as direct contact (soil ingestion and dermal contact), surface runoff, wind erosion, or volatilization to the atmosphere, are also depicted in the SCEMs. Transport by storm runoff is not considered a significant pathway for human exposure at the eight sites because there are no developed drainageways at the sites and portions of the sites are covered with pavement.

Surface soils may provide exposures to base workers (occupational exposures), hypothetical future construction workers, future trespassers, or residents. Air emissions (volatile and particulates) from surface soil may also expose base workers, construction workers, trespassers, and residents. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may expose construction workers. Groundwater is used for domestic purposes on and off base, but the depth to groundwater in the area is nearly 300 feet.

Contact with surface soil is considered to be the only complete and significant pathway for ecological receptors. However, due to the small size and highly developed nature at six of the eight sites, these six sites do not support suitable habitat for ecologically sensitive species and, therefore, do not support suitable habitat for ecological receptors. Two of the sites (SS-C507 and SD-C508) are considered potential habitat for ecological receptors. Therefore, preliminary ecological screening levels for any detected COPCs will be used to determine whether further investigation at these sites is necessary.

3.3 CRITICAL DATA

Critical data are data that are crucial for decision-making (e.g., determining whether a site warrants no further investigation or whether additional investigation should be considered). Critical data may be from a select sampling location or from a selected subset of samples from locations of roughly equal importance. Data from a specific field sample, such as a soil sample immediately downgradient of a discharge point, may be designated as critical if it is necessary to evaluate contaminant concentrations at that specific location for source or exposure pathway characterization. In other cases, data from a select number of field samples (e.g., a subset of all surface soil samples collected at a site) may be designated as critical when the objective is to estimate mean contaminant concentrations over an area.

Following USEPA guidelines (USEPA 2001, 2004), critical data must be from environmental media representing each major exposure pathway and must be 100-percent complete, that is, valid results must be obtained for all data deemed critical. A complete set of critical data may be taken from more than one sample (i.e., if one sample has missing or rejected analytes, data from another comparable sample can be used to complete the critical data set). If the missing or rejected data do not hinder the decision-making process (e.g., they are not COPCs), they are not considered critical data, and the critical data set is still 100-percent complete. If decisions cannot be made because of missing or rejected data, a recommendation for an appropriate corrective

action will be made. This allows for the retention of valid data from the original data set and compiling a complete, representative, and valid set of critical data without unnecessary resampling.

3.4 DETECTION LIMITS

To select appropriate analytical methods, detection limits (DLs) have been compared with analyte-specific concentrations of concern. Analytical methods selected for this SI at eight sites, and their associated DLs, are presented in Worksheet #15 of the UFP-QAPP (**Appendix A**).

3.5 EVALUATION OF BACKGROUND CONCENTRATIONS

At sites where metals are detected in surface and/or subsurface soil, the metals concentration data will be compared to established background concentrations to determine whether metals detected are site-related.

Soils are derived from parent geologic materials as a result of physical, chemical, and biological processes. The soil system is naturally a highly heterogeneous matrix of inorganic and organic components. The relative proportions of these components are dependent upon factors influencing soil formations, such as topography, climate, depositional processes, and time (Sposito and Page 1984). Total concentrations of metals in soils may vary depending upon location; for example, at the surface, soils are influenced by leaching, runoff, atmospheric deposition, and biotic uptake, as well as anthropogenic activity. The ranges of naturally occurring or "background" concentrations of metals in soils vary greatly due to the composition of parent material; therefore, care must be taken in the interpretation of metals data generated during an investigation.

Metals concentrations identified in soil samples during this investigation will be compared to background soils concentrations presented in "Naturally Occurring Concentrations of Inorganics and Background Concentrations of Pesticides at Cannon Air Force Base, New Mexico" (W-C 1997). Background concentrations of metals at Cannon AFB are summarized in **Table 1-1**. The approach will compare the maximum concentrations detected at a given site to the 95-percent UTL of the background concentrations. Using this technique, individual samples at the sites with high concentrations relative to background levels (i.e., which could represent a site-related release) can be identified.

3.6 HUMAN HEALTH SCREENING-LEVEL EVALUATION METHODOLOGY

This section describes the approach used in the screening level human health risk evaluation for the eight sites, as well as the screening level ecological risk evaluation for SS-C507 and SD-C508. Potential human health impacts will be evaluated by comparing maximum chemical concentrations (above background) found at the site with NMED human health soil screening levels (SSLs) for residential exposure (NMED 2012). Where SSLs are not available, concentration data will be compared with USEPA human health Regional Screening Levels

(RSLs) for residential exposure (USEPA 2011). In addition, total petroleum hydrocarbons (TPH) data will be compared to NMED TPH screening guidelines for Vapor Migration and Inhalation of Groundwater – Residential Direct Exposure for Unknown Oil (Table 6-3) (NMED 2012).

Although none of the sites that are a part of this SI are used for residential purposes, the residential SSLs are more stringent than other SSLs (e.g., occupational, construction worker). Screening against residential SSLs would account for possible future changes in land use. If residential SSLs are exceeded, then existing concentrations will be compared to industrial SSLs in order to determine the level of potential risk present.

In general, soil may be considered a potential exposure interval for construction workers and residents at depths from 0 to 10 feet below ground surface (bgs). If any surface or subsurface soil COPC exceeds background and the human health screening criteria, then additional investigation and/or evaluation will be recommended. If no potential human health risks are indicated for a site using these conservative criteria, then CAC without controls will be recommended for the site based on human health exposure.

The SSLs and RSLs provided in Worksheet #15 of the UFP-QAPP (**Appendix A**) are based on 1×10^{-5} excess cancer risk, or a hazard quotient (HQ) equal to 1.0 for noncarcinogens. This is a highly conservative approach used for screening purposes only; risks estimated in a site-specific quantitative BRA are likely to be much lower than the risk levels calculated using these screening criteria. A maximum chemical concentration that exceeds a human health screening level does not mean that a health risk exists because the maximum concentration detected is not the concentration to which people would routinely be exposed, and the exposure assumptions used to derive the human health screening levels are not site-specific.

A range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) is USEPA's target excess cancer risk range for cleanup under both the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA) (USEPA 1991). NMED SSLs are based on a 1×10^{-5} (1 in 100,000) target excess cancer risk. Therefore, SSLs and RSLs are conservative (protective) values, and exceedances of these do not necessarily mean that a health risk is present. However, exceeding the SSLs and RSLs does mean that further evaluation of chemical concentrations, exposure assumptions, and carcinogenicity may be warranted.

For noncarcinogens, SSLs and RSLs are the concentrations in soil estimated to result in an HQ of 1.0. An HQ is the ratio of the estimated daily dose from the assumed exposure to a reference dose, which is considered safe for a lifetime of daily exposure. An HQ of 1.0 means that no toxic effects are likely to occur, even to sensitive individuals exposed for a lifetime. An HQ above 1.0 does not mean that toxic effects will necessarily occur, but that further evaluation of exposures and chemical toxicity may be warranted. It should be noted that unlike the risks for multiple carcinogens, the HQs for multiple noncarcinogens could not simply be added together to account for the additive risks associated with chemical mixtures. If necessary, effects of noncarcinogenic chemicals will be evaluated on an additive basis (as a first-tier screening approach) (NMED 2012).

SSLs and RSLs for soil exposures are based on the ingestion, inhalation, and dermal exposure routes. Soil SSLs and RSLs are available for residential and industrial scenarios. The eight sites are located in industrialized areas of the base; however, for the initial assessment of investigation data, residential SSLs and RSLs will be used for screening.

It is important to note that SSLs and RSLs are not cleanup goals. Cleanup goals are determined on a site-specific basis. Instead, comparing soil concentrations to SSLs and RSLs is used as a means of determining whether the chemicals in soils could pose a threat to human health. If the SSLs and RSLs are not exceeded, CAC without controls will be recommended. If the SSLs and RSLs are exceeded, further investigation and/or evaluation of potential risks will be recommended.

3.7 ECOLOGICAL SCREENING-LEVEL EVALUATION METHODOLOGY

The ecological evaluation will be conducted consistent with NMED's Risk Assessment Guidance for Investigations and Remediation, Volume 2, Tier 1: Screening-Level Ecological Risk Assessment, Phase I, Scoping Assessment (NMED 2012). NMED screening guidance consists of four components:

1. Scoping Assessment – in which basic site information will be presented, contaminants of potential ecological concern (COPECs) will be identified, and a preliminary conceptual site exposure model (CSEM) will be developed (i.e., relevant transport and exposure routes will be described).
2. Site Exclusion Criteria.
3. Technical Decision Point – a decision is made: 1) for no further ecological evaluation; 2) further evaluation; or, 3) a removal or remedial action.
4. Screening-Level Ecological Risk Assessment (SLERA).

As part of the scoping assessment, site history and information on suspected contaminants have been reviewed and site reconnaissance has been conducted. At six of the eight sites, viable ecological habitat and potential ecological receptors are absent and no complete exposure pathways exist at or in the locality of the sites. These six sites meet the ecological site exclusion criteria, which will be summarized in the ecological scoping assessment in the SI Report. For the two sites being considered as potential habitat for ecological receptors (SS-C507 and SD-C508), this SI will attempt to obtain enough information to determine if a SLERA is necessary, or if one or both sites may be eliminated from further ecological consideration based on a lack of suspected ecological risk. If determined necessary, a SLERA may be conducted for one or both of these sites.

Preliminary SCEMs have been developed and relevant potential transport and exposure routes have been described in **Section 3.2**. Preliminary SCEMs for SS-C507 and SD-C508 are provided in **Figures 3-7** and **3-8**, respectively. In regards to ecological receptors, soil from 0 to 5 feet bgs is considered a potential source of exposure to non-burrowing animals; 0 to 10 feet bgs for plants and burrowing animals.

Similar to the human health evaluation, potential ecological impacts at SS-C507 and SD-C508 will be evaluated by comparing maximum chemical concentrations (above background) found at the sites with USEPA Ecological Soil Screening Levels (ESSLs) (USEPA 2010). Where ESSLs are not available, concentration data will be compared with other available ecological screening levels. Ecological screening levels will be selected from the following sources in order of priority:

1. USEPA (2005-2007) Ecological Soil Screening Levels (ESSLs); the lowest of plant, soil invertebrate, bird and mammal ESSLs
2. The lower of:
   a. Technical Cooperation Program – Energetic Materials (TTCP 2009)
   b. Los Alamos National Laboratory Ecological Screening Levels (ESLs) (LANL 2011)
3. USEPA Region 5 ESLs (USEPA 2003);
4. Other published literature (for example, Efroymson et al. 1997).

The selected ESSLs and ESLs are provided in Worksheet #15 of the UFP-QAPP (**Appendix A**). As described previously for the human health risk, screening criteria are intended to be highly conservative and used for screening purposes only; risks estimated in a site-specific quantitative Baseline Ecological Risk Assessment are likely to be much lower than the risk calculated using these screening criteria. A maximum chemical concentration that exceeds an ESSL or ESL does not mean that an ecological risk exists because the maximum concentration detected is not the concentration to which ecological receptors would routinely be exposed, and the exposure assumptions used to derive the ESSLs and ESLs are not site-specific. It is important to note that ESSLs and ESLs are not cleanup goals. Cleanup goals are determined on a site-specific basis.

If ESSLs or ESLs (or background concentrations) are not exceeded, ecological exposure pathways will be considered incomplete and the technical decision point will be that no further ecological evaluation will be conducted. This action will be documented in the SI Report. A CAC without controls will be recommended. Chemicals exceeding ESSLs or ESLs will be considered chemicals of potential ecological concern (COPECs) and further evaluation of potential risks will be recommended.

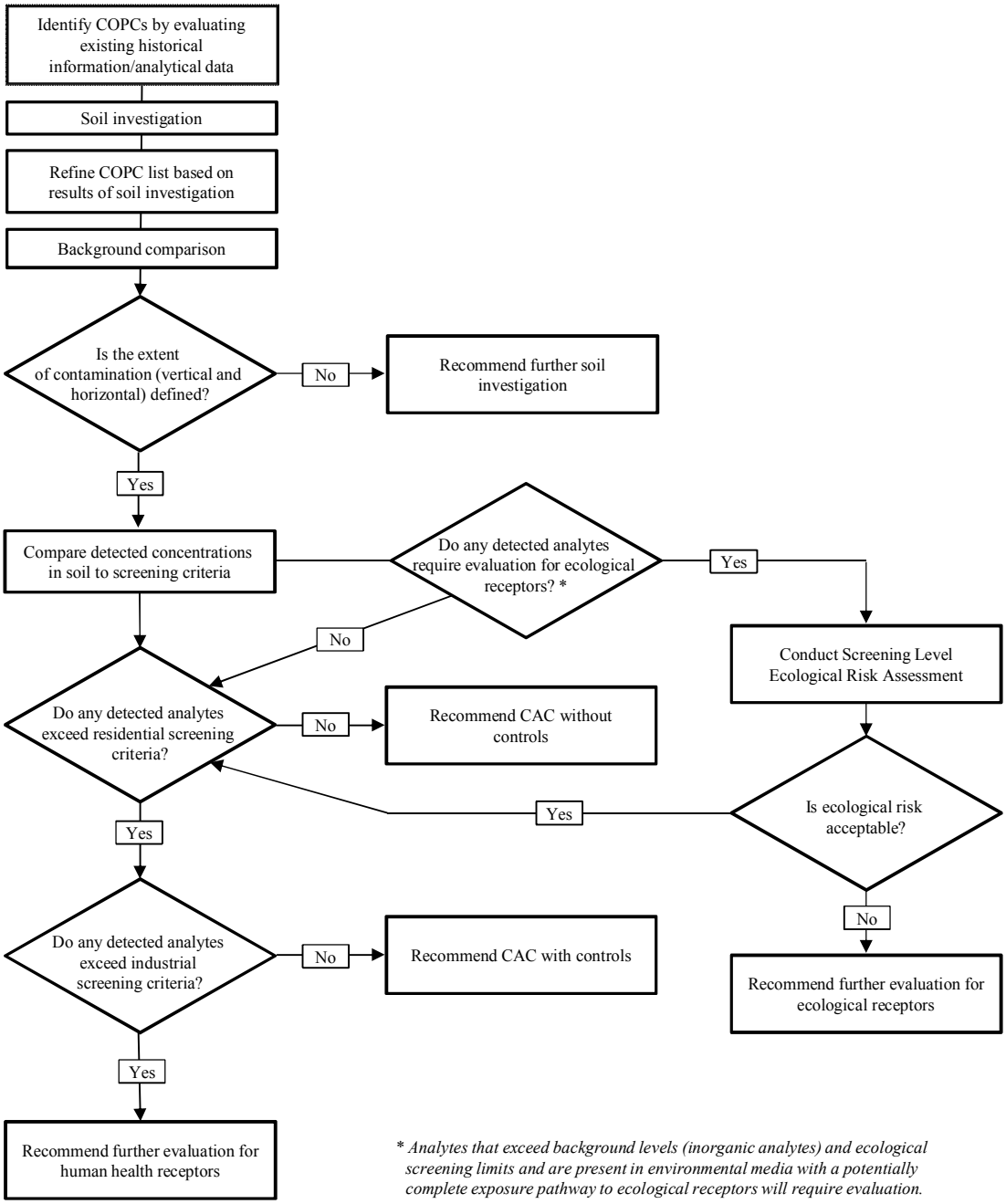
Specifically, if the preliminary SCEM and COPEC screening indicate the potential presence of complete exposure pathways, a screening-level risk assessment (SLERA) will be considered (NMED 2012). In the SLERA, the environmental setting of the site will be more completely described, potential receptors and assessment endpoints will be identified and the preliminary SCEM will be refined.

Evaluation of ecological exposure pathways will include identification of valued biological resources potentially associated with the site and potentially exposed to unreasonable adverse effects from releases of hazardous substances associated with Air Force operations. Such biological resources may include special-status plant and animal species identified by the State of New Mexico and/or the federal government. Unless otherwise identified as special status, soil invertebrates and small mammals will not be considered a "valued biological resource;"

however, they will be considered as potential prey or forage (i.e., contaminant transport pathways) for higher trophic-level receptors, if present.

Once assessment endpoints have been selected and representative receptors identified, the SLERA will proceed as outlined in NMED's ecological risk assessment guidance (NMED 2012). The SLERA will include an Exposure Assessment, Effects Assessment and Risk Characterization.

FIGURE 3-1
DECISION DIAGRAM FOR SITE INVESTIGATION AT EIGHT SITES



** Analytes that exceed background levels (inorganic analytes) and ecological screening limits and are present in environmental media with a potentially complete exposure pathway to ecological receptors will require evaluation.*

FIGURE 3-2
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
FORMER AEROSPACE GROUND EQUIPMENT (AGE) DISPATCH FACILITY SPILLS SITE (SS-501)

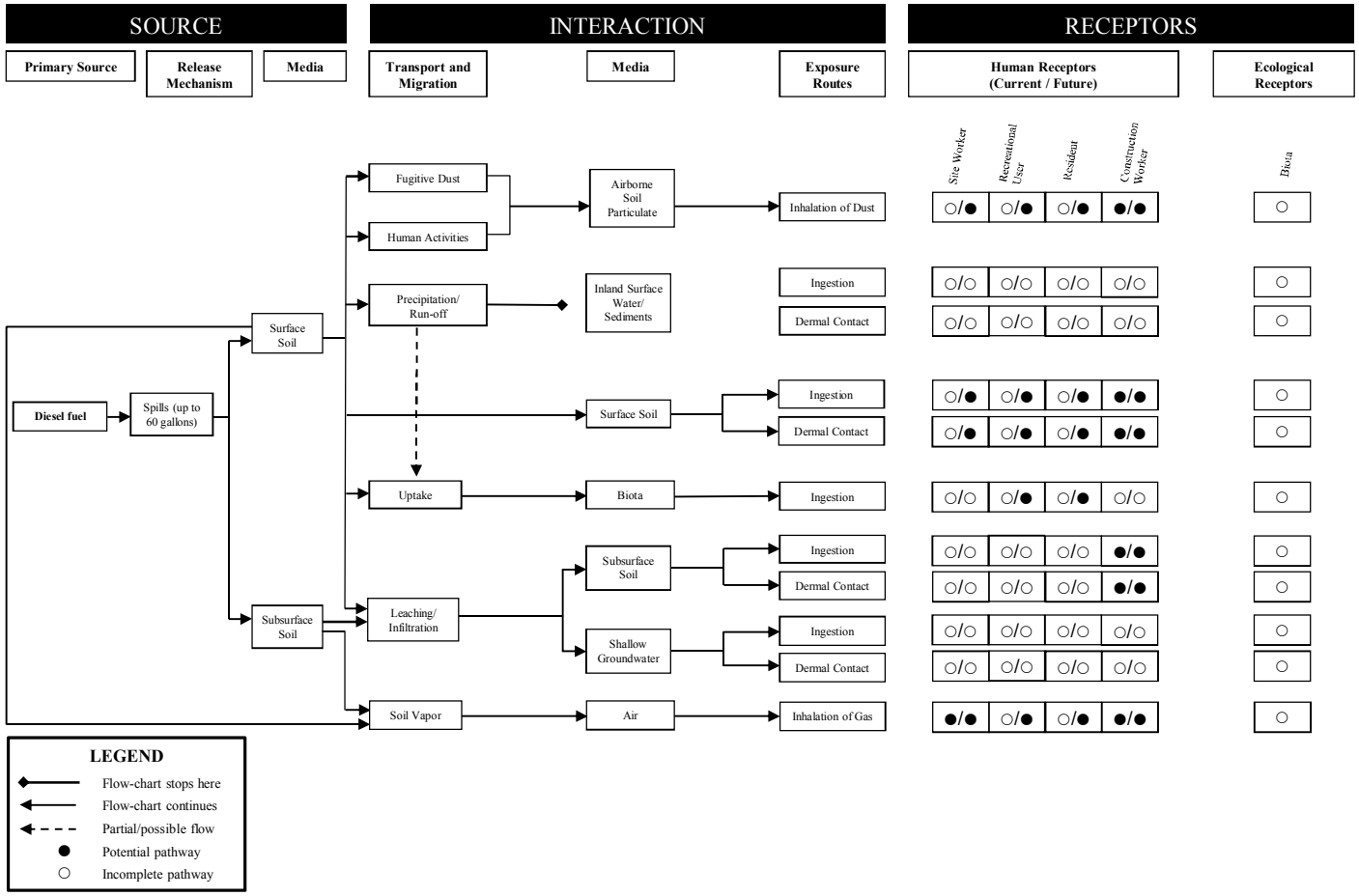


FIGURE 3-3
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
FORMER GAS STATION SITE (ST-502)

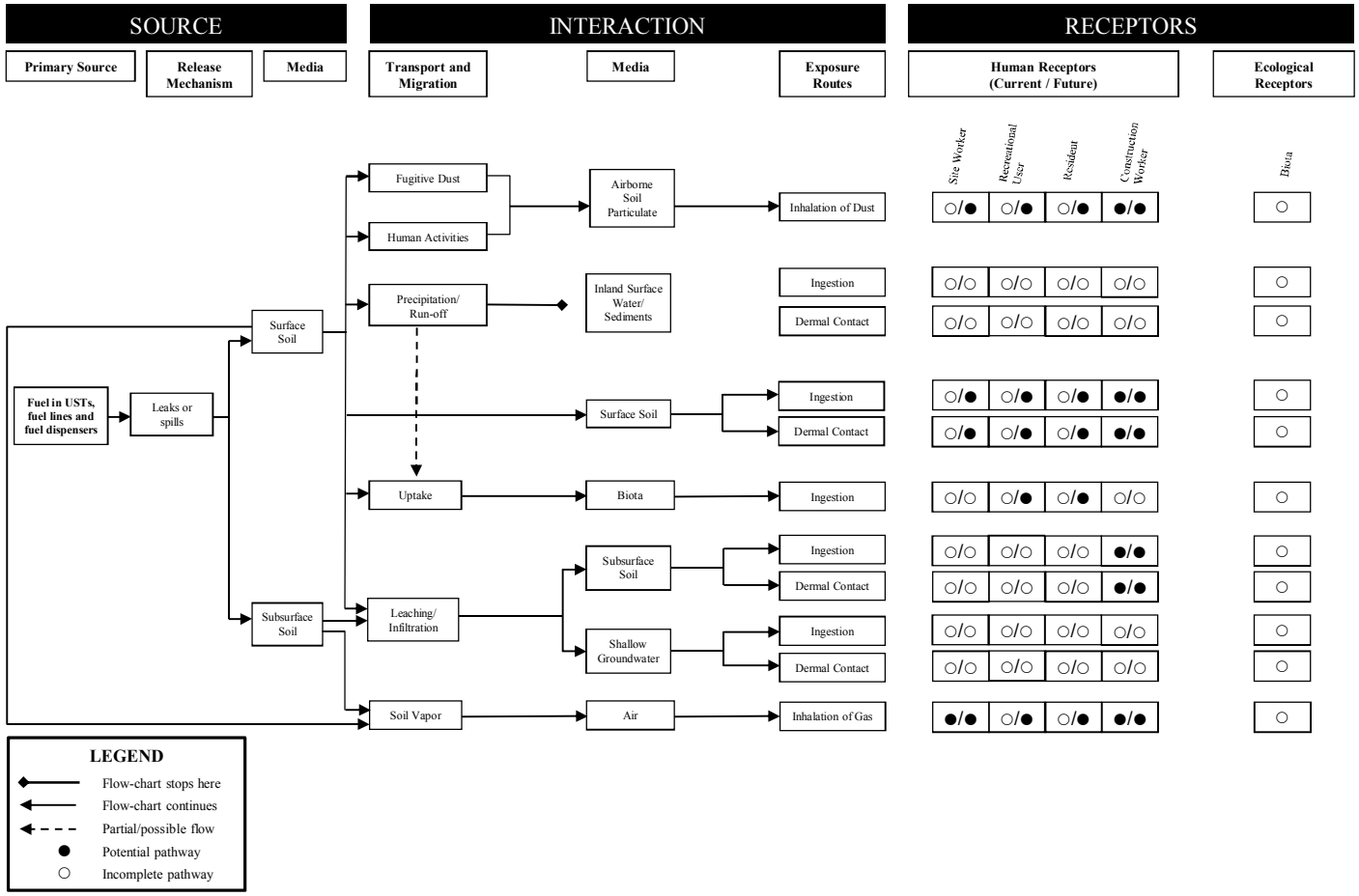


FIGURE 3-4
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-503)

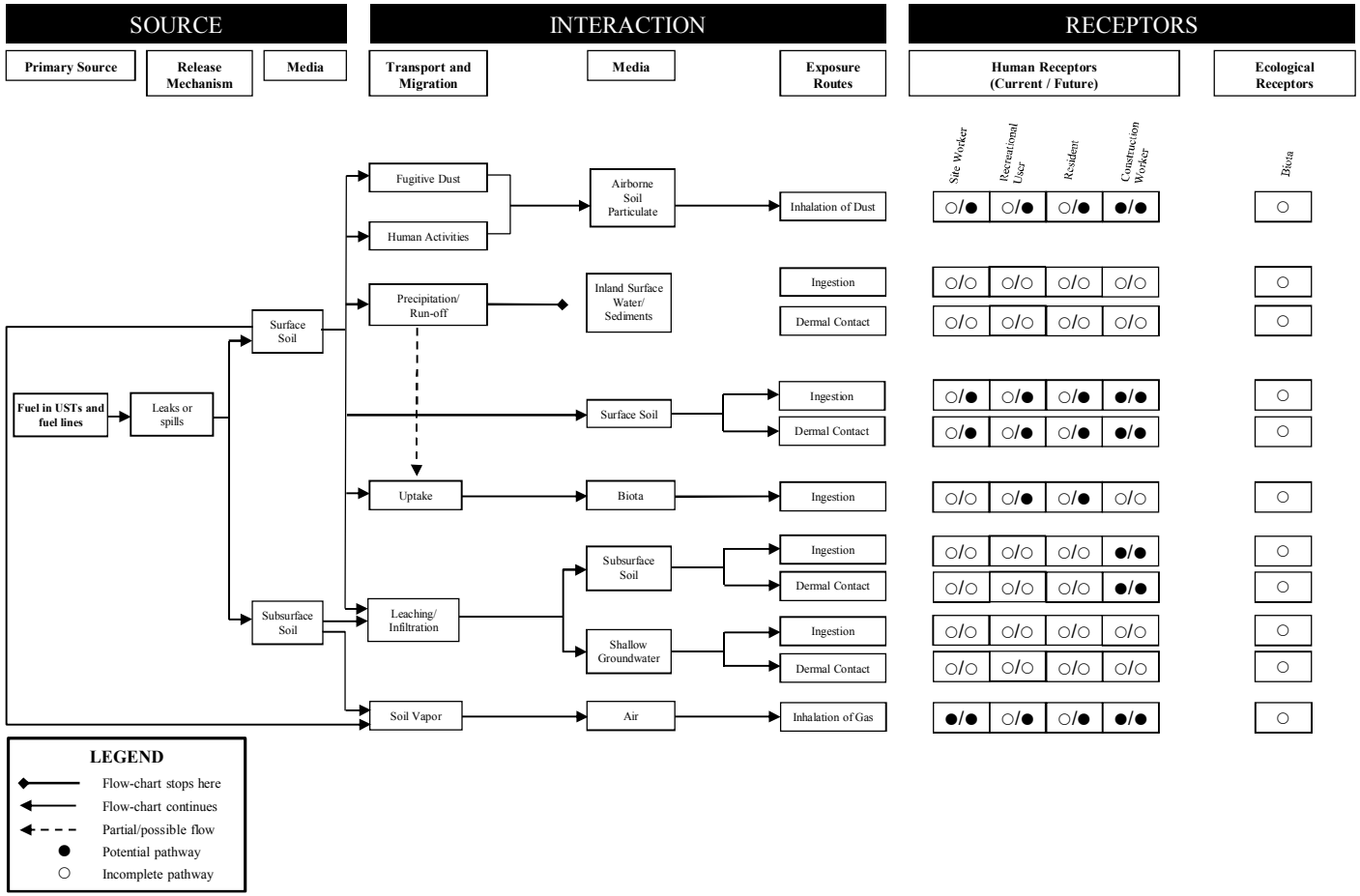


FIGURE 3-5
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
HOSPITAL ABANDONED UST SITE (ST-504)

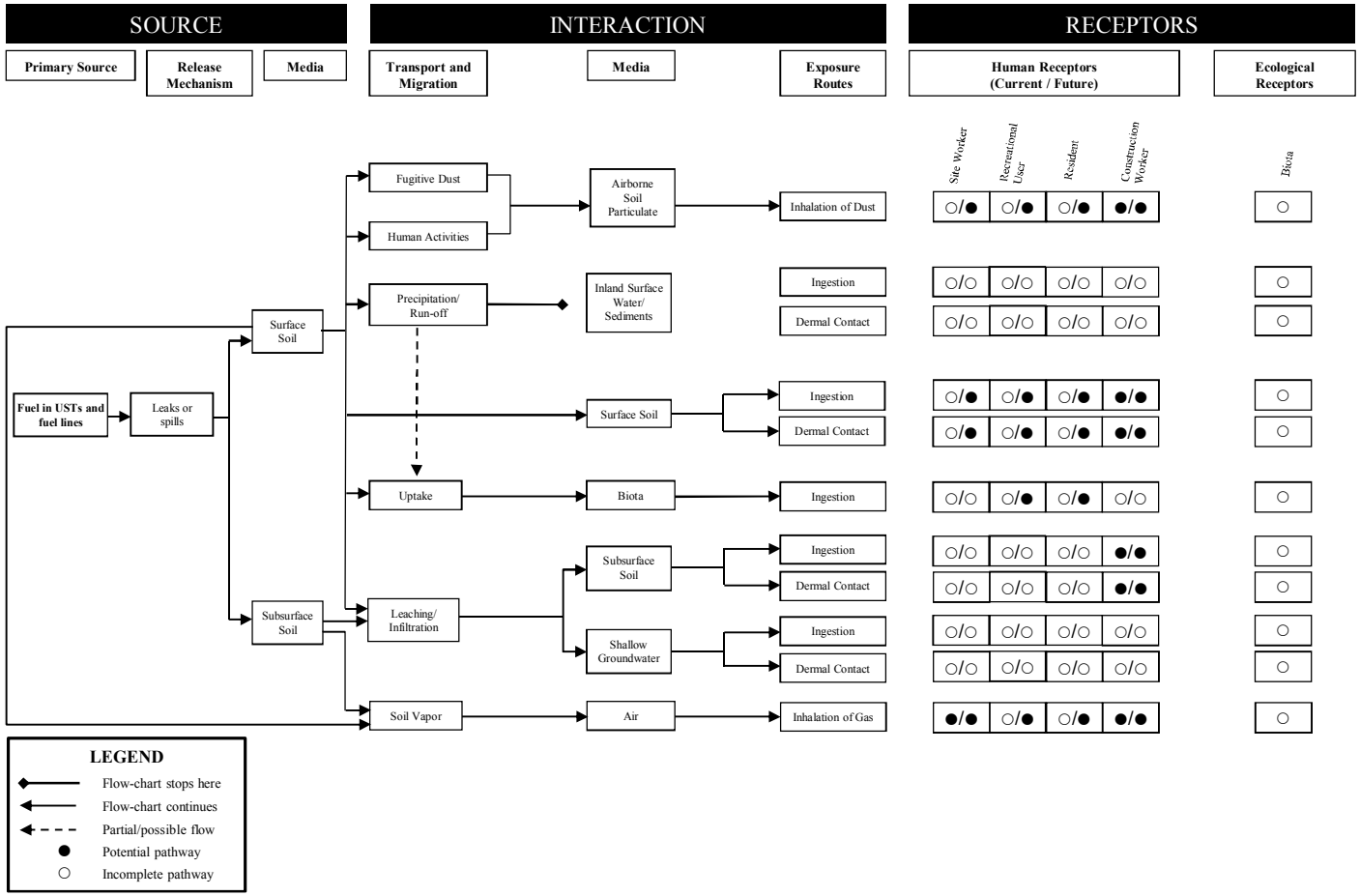


FIGURE 3-6
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
FLIGHTLINE GENERATOR USTs SITE (ST-505)

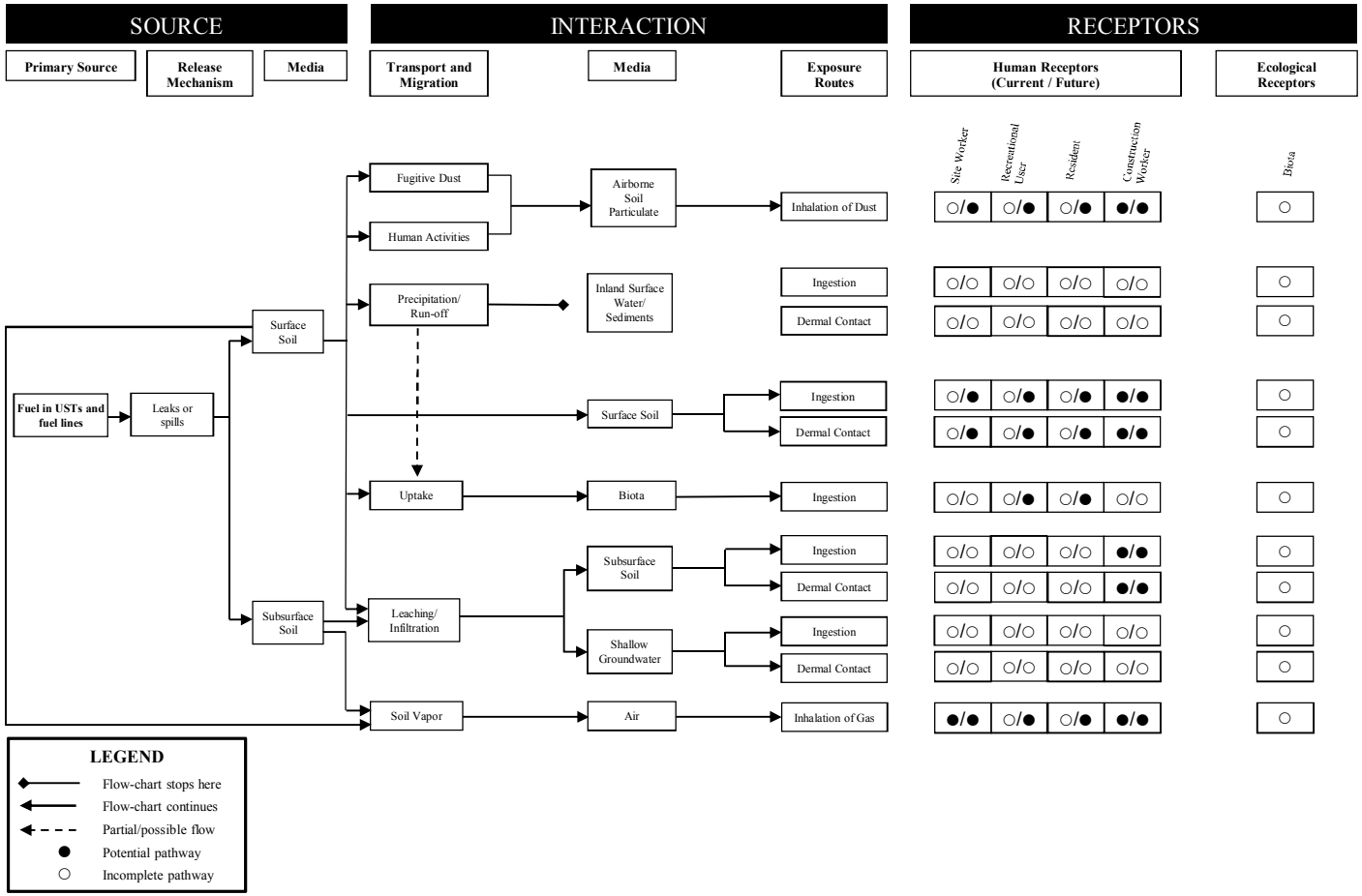


FIGURE 3-7
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
FORMER PETROLEUM, OIL AND LUBRICANTS (POL) YARD REFUELING AREA SITE (SS-507)

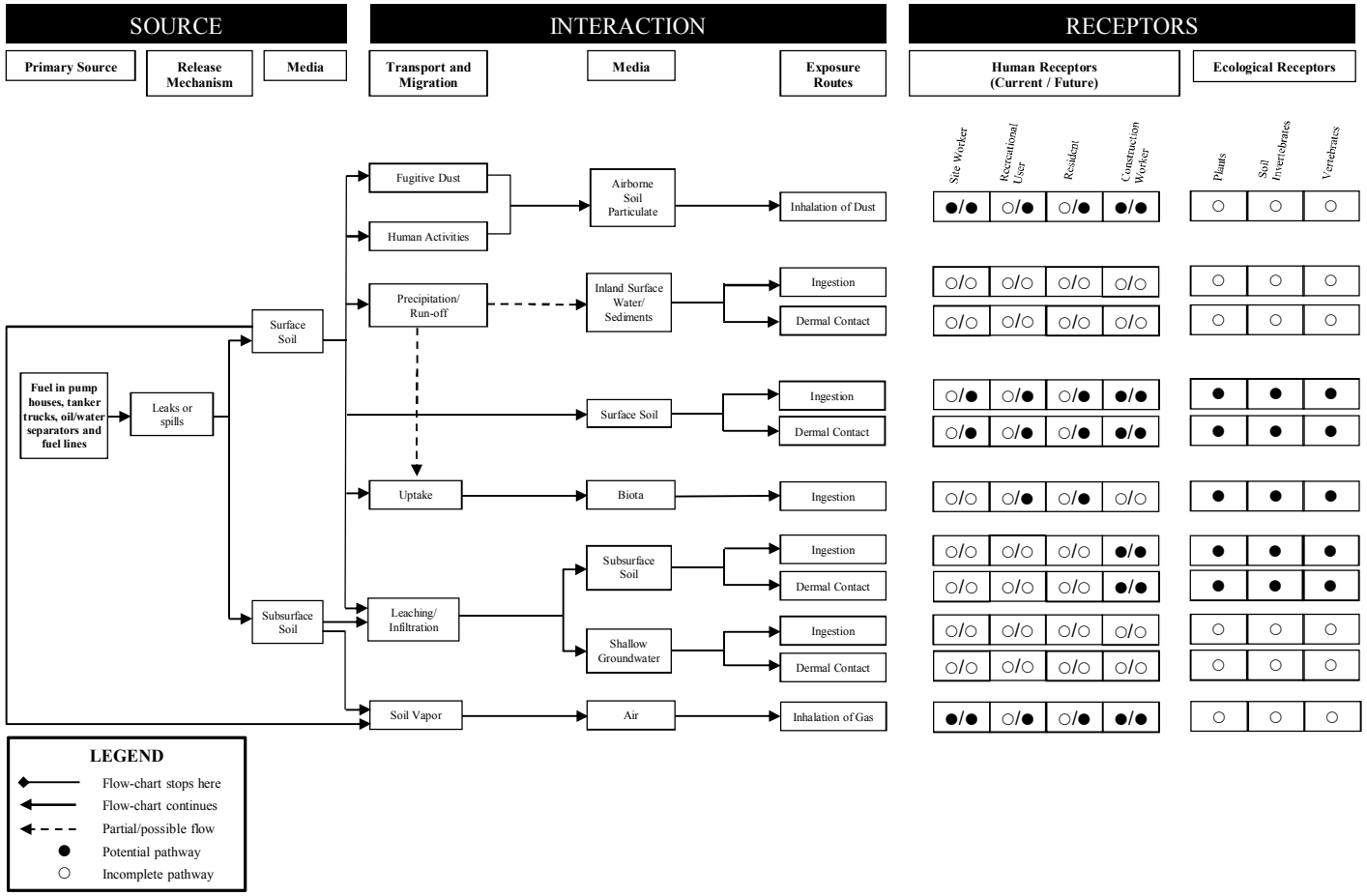


FIGURE 3-8
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
SURFACE DISPOSAL SITE (SD-508)

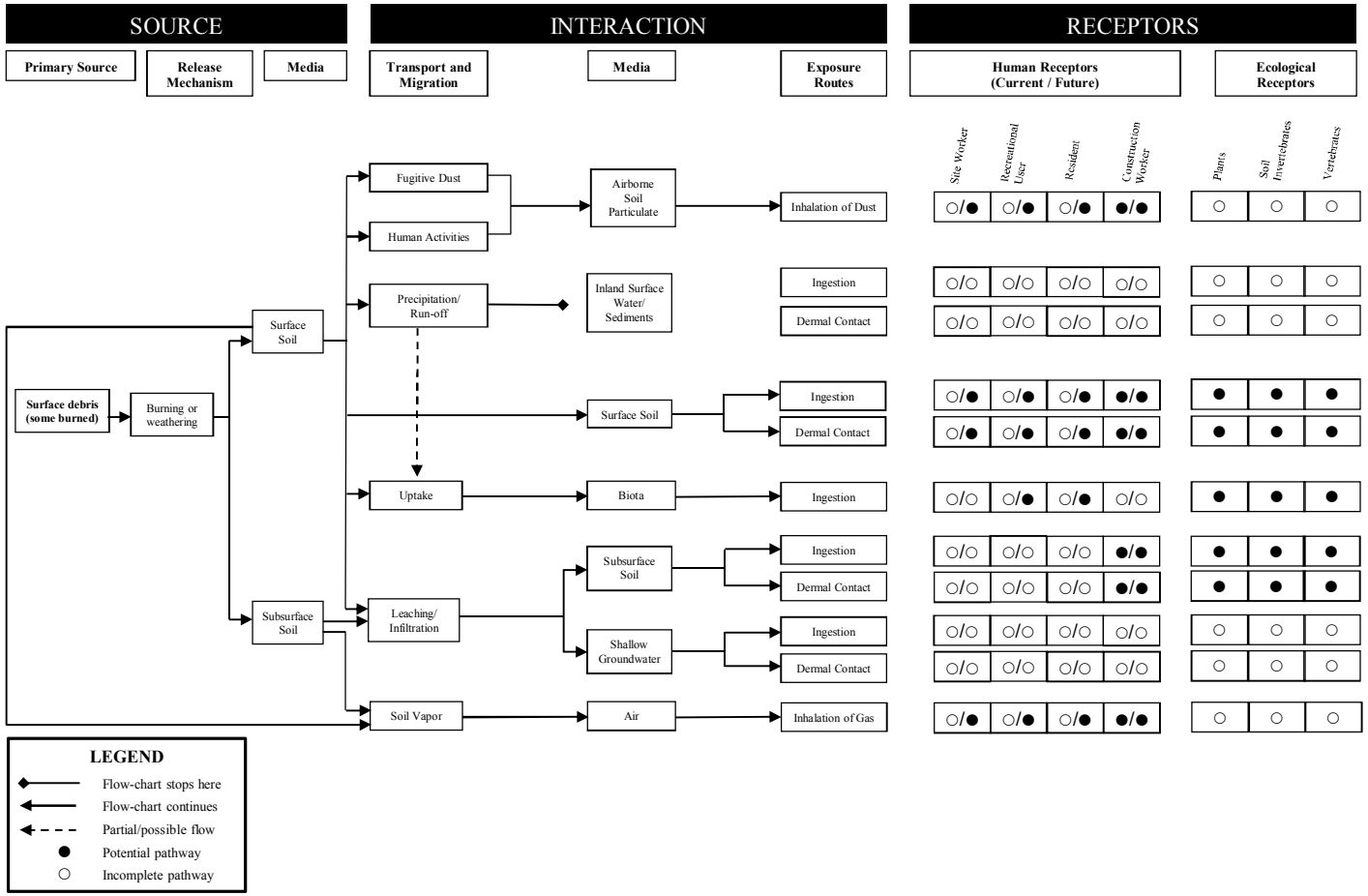
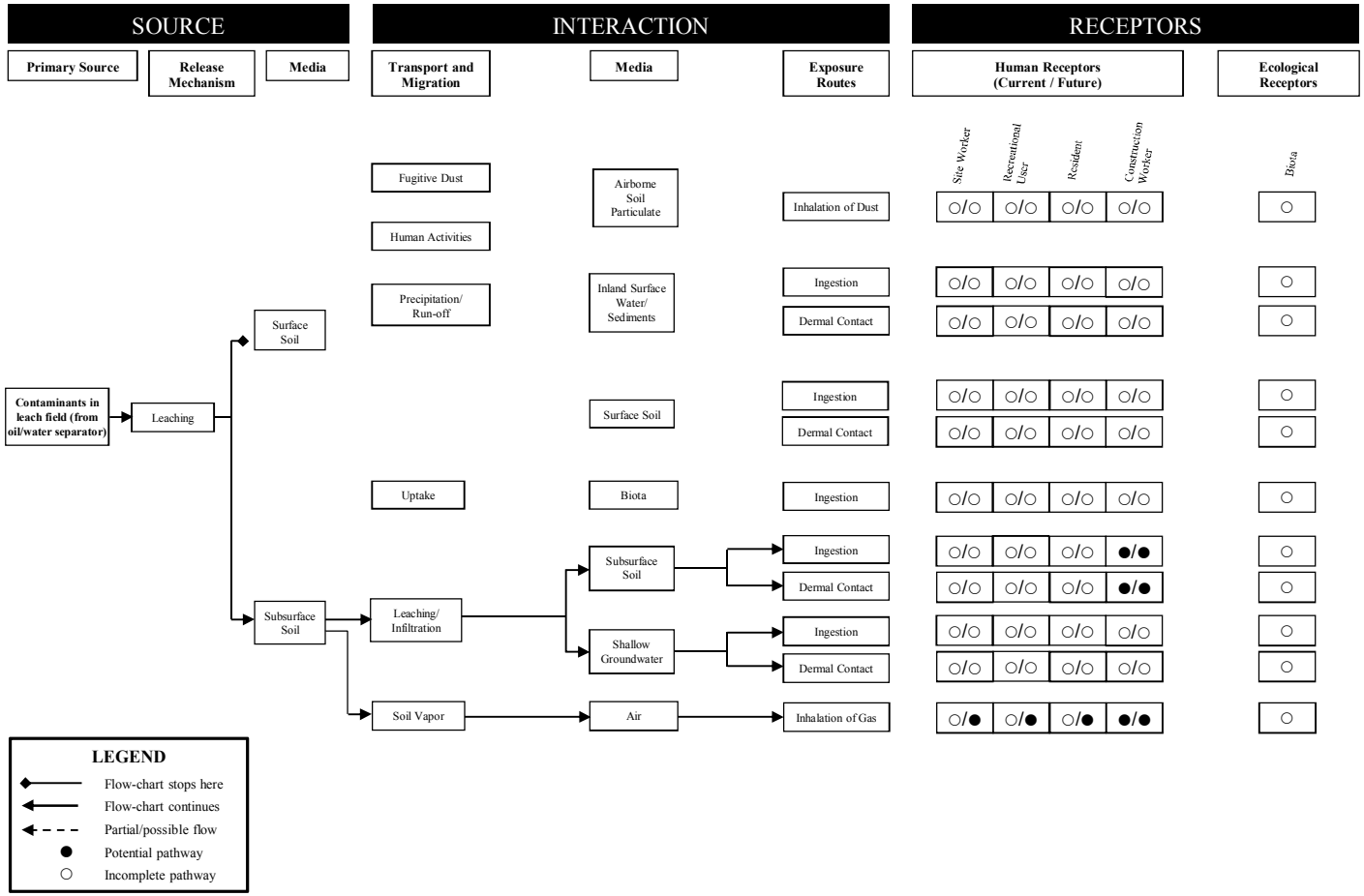


FIGURE 3-9
PRELIMINARY SITE CONCEPTUAL EXPOSURE MODEL
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)



This section provides site descriptions and backgrounds for the eight sites included in this investigation. Site history and background information is from historical documents (e.g., available written communication between Cannon AFB and NMED regarding notification of a petroleum release, available tank closure and tank excavation worksheets, previous environmental investigation documents, and as-built drawings) and interviews with Cannon AFB personnel conducted by URS during the 2011 site visit. Additionally, historical aerial photographs, historical site photographs, and current site photographs were obtained and reviewed in order to help identify any additional areas of potential concern at each site. Available historical documentation, Cannon AFB personnel interviews, historical aerial photographs, and historical/current site photographs are provided in **Appendix D**. The eight sites being investigated for this project include the following: SS-C501, ST-C502, ST-C503, ST-C504, ST-C505, SS-C507, SD-C508, and TA/AS-C129 (SWMU 129).

4.1 FORMER AGE DISPATCH FACILITY SPILLS SITE (SS-C501)

4.1.1 Site Description and Background (SS-C501)

The Former AGE Dispatch Facility Spills Site (SS-C501) is located in the central portion of Cannon AFB, northeast of Building 186, and adjacent to Torch Boulevard. The site (for purposes of this investigation) includes only the asphalt parking lot formerly used to store AGE. The site is approximately 450 feet long and 120 feet wide (approximately 1.2 acres). The site map with the site boundary (shown in red) is shown on **Figures 4-1a** and **4-1b**.

In June 2009, the asphalt parking lot, formerly used to store AGE equipment, was repaved. Prior to 2009, Buildings 191 and 193 (located south and east of the parking lot) were removed and a canopy structure, used for personnel training, was constructed near the former location of Building 191. Buildings 191 and 193 were used as staging areas for transferring personnel and gear on and off of airplanes, previously had no known or suspected potential contamination associated with them, and are not part of the site. The former buildings and the canopy structure are mentioned only as geographic references.

Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), the site was formerly used as an AGE dispatch facility where AGE was stored. At the time AGE was stored at the site the asphalt pavement was cracked in several areas. At least two diesel fuel spills (up to 60 gallons each) have historically occurred at this site. Although the exact locations are not known, the spills reportedly occurred in the north-central and south-central portions of the site.

The only environmental site investigation completed to date at SS-C501, was a shallow soil sampling investigation conducted as part of the 2009 Compliance Clean-up Site Identification and Evaluation of DERA Eligibility for AFCEE project (URS 2009). Results of this investigation are discussed in **Section 4.1.2**.

4.1.2 Previous Investigation Results (SS-C501)

During the 2009 shallow soil sampling investigation (URS 2009), a total of four soil samples were collected, via hand augering, from depths of 1 to 3 feet below ground surface (bgs). Samples were analyzed for TPH–diesel range organics (TPH-DRO), benzene, toluene, ethylbenzene, and xylene (BTEX), and polychlorinated biphenyls (PCBs). Samples were nondetect for BTEX and PCBs. Results indicated a release of TPH-DRO at two sample points (maximum concentration of 1.10E+01 mg/kg at SS-C501-100, and 6.00E+00 mg/kg at SS-C501-103) (URS 2009). **Table 4-1** summarizes previous samples collected for chemical analysis. **Table 4-2** summarizes the previous analytical data and screening results. **Figures 4-1a** and **4-1b** show the previous sampling locations.

4.2 FORMER GAS STATION SITE (ST-C502)

4.2.1 Site Description and Background (ST-C502)

The Former Gas Station Site (ST-C502) is located in the north central portion of Cannon AFB, on the east corner of DL Ingram Boulevard and Kermit Evans Avenue (formerly Argentia Avenue). The site boundary (for purposes of this investigation) encompasses all of the former site features and the asphalt parking area surrounding the former gas station. The site is approximately 145 feet by 165 feet (approximately 0.5 acres) and is bound by the sidewalk adjacent to DL Ingram Boulevard to the northwest, the curb of Kermit Evans Avenue to the southwest, the end of the asphalt parking lot to the southeast, and the edge of the asphalt parking lot to the northeast. The site currently contains the Cannon Federal Credit Union building (Building 368), a grassed area northwest of Building 368, an asphalt parking lot, and drive-thru lanes adjacent to Building 368 (to the northeast). The site map with the site boundary (shown in red) is shown on **Figures 4-2a** and **4-2b**.

This site formerly functioned as a gas station and vehicle service center. Based on three NMED UST Inspection Reports obtained during the April 2011 site visit (see **Appendix D**), the site formerly contained three 10,000-gallon MOGAS USTs, which were located in the southern corner of the site. The UST Inspection Reports indicate that the USTs were constructed of steel and upon inspection, were found to contain no holes. These reports indicate the USTs contained only MOGAS; however, based on the fact that THP-DRO has been previously detected at the site (see results in **Section 4.2.2**), it is likely diesel fuel may also have been stored and dispensed at the site. The site also contained two pump islands with four fuel dispensers, which were located to the northwest of Building 368 (USGS 1995). Additionally, two vehicle service bays were located adjacent to Building 368, which contained two hydraulic lifts, used to service vehicles. Presumably, various POLs were stored and handled frequently at the vehicle service bays. The two bays are currently used as the drive-thru lanes for the Cannon Federal Credit Union. The location of the former site features and the limits of the former UST excavation (shown on **Figures 4-2a** and **4-2b**) are based on an as-built drawing of the Former Gas Station (see **Appendix D**) and the 1995 USGS site map (USGS 1995).

The three USTs were removed in January 1995 and the soil within the excavation was sampled. The bases of the tanks were approximately 12 feet bgs. Samples were collected from approximately 2 feet below the bottom of the excavation. Sample results indicated that a release had occurred during the service life of the tank; however, excavation activities were terminated at that time, and the open excavation was backfilled (USGS 1995).

An investigation of the former UST excavation area was conducted by the USGS in April 1995 to confirm the analytical results obtained from the samples collected during the January 1995 UST removal action (USGS 1995). Following the removal of the fuel dispensers and associated underground fuel lines in July 1995, the USGS completed a follow-up investigation of the fuel pump islands. Sample results from the pump island areas indicated that a release occurred during the service life of the fuel dispensers and underground piping (USGS 1995). It does not appear that any soil sampling has been conducted in the two vehicle service bays adjacent to Building 368 to date. Results of the previous UST and pump island investigations are discussed in **Section 4.2.2**.

4.2.2 Previous Investigation Results (ST-C502)

Previous investigation results summarized in this section were taken from the 1995 USGS data submission entitled "Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico, Volume 1" (USGS 1995). **Table 4-3** summarizes previous samples collected for chemical analysis. **Table 4-4** summarizes the previous analytical data and screening results. **Figures 4-2a** and **4-2b** show the previous sampling locations.

During the January 1995 UST removal action, a private contractor collected six soil samples from the open excavation, following the removal of the three USTs. Samples were taken from the corners and sides of the excavated area at a depth 2 feet below the bottom of the tanks (approximately 14 feet bgs). One sample taken from the southwest end of the excavation had a concentration of 2.45E+03 mg/kg total recoverable petroleum hydrocarbons (TRPH). No other samples contained TRPH concentrations that exceeded reporting limits.

On April 13 and 14, 1995, the USGS conducted an investigation of the former location of the three USTs in order to validate the analytical results from soil samples taken during the UST removal action. Nine soil borings were completed and 11 subsurface soil samples were collected within and around the limits of the previous UST excavation, from depths ranging from 10 to 16 feet bgs (i.e., near the base of the former USTs). The results from the field screening (gas chromatography) indicated no contamination, and lab analysis (gasoline range organics [GRO] method) confirmed that concentrations were below reporting limits.

On July 1 and 2, 1995, the USGS began an investigation of the pump island area. Eight soil borings were advanced, and eight subsurface soil samples were collected in order to determine whether or not the recently removed fuel dispensers had leaked. Four samples were initially taken, one from each end of the two pump islands. Field screening indicated high concentrations of contamination in CAFB-FAC0368-10 (at the northeast end of the southeast island). Laboratory results identified a TPH-GRO concentration of 1.00E+03 mg/kg at a depth of 24 to

25 feet bgs at CAFB-FAC0368-10. Based on the field screening, four additional samples were taken approximately 7 feet from CAFB-FAC0368-10 at 90 degree angles to one another. All four samples were nondetect for TPH-GRO, although one sample contained 5.10E+00 mg/kg of TPH-DRO. These four samples were taken from a maximum depth of 15 feet bgs. Due to the presence of hard caliche, present in varying degrees from approximately 15 to 50 feet bgs in this area, direct push samples could not be readily obtained from depths greater than 16 feet bgs. To determine the extent of downward migration of the contamination at CAFB-FAC0368-10, a Mobile B53 drill rig was used to collect samples at this location on August 25 and 26, 1995. TPH-GRO concentrations decreased with depth, and, at 50 to 52 feet bgs, the concentration of TPH-GRO was below reporting limits (1.00E+00 mg/kg).

4.3 BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)

4.3.1 Site Description and Background (ST-C503)

The Base Support/Operations Generator Former UST Site (ST-C503) is located in the west-central portion of Cannon AFB, south and east of the intersection of DL Ingram Boulevard and Sextant Avenue, and to the southeast of Building 600. The site boundary (for purposes of this investigation) includes only the limits of the previous UST removal excavation. The site is approximately 22 by 25 feet (0.1 acres), and is bound by a brick wall to the northwest, the edge of the asphalt pavement to the southwest, a fence to the southeast, and a grass area to the northeast. The site map with the site boundary (shown in red) is shown on **Figures 4-3a** and **4-3b**.

Currently, the majority of the site is covered with sparse grass. A concrete containment area and associated active diesel fuel AST is located directly adjacent to site ST-C503 (to the southeast). The active diesel fuel AST is surrounded by a fence, and is not part of site ST-C503. Two dumpsters are also located inside the fenced area, southeast of the active diesel fuel AST. A brick wall located to the northwest of the grassed area encloses a cooling tower and an emergency generator used by Building 600. The area enclosed by the brick wall is not considered likely to be impacted by the previous UST release, based on analytical results from samples collected adjacent to the brick wall during the 1995 USGS investigation (see results in **Section 4.3.2**). An asphalt-paved service driveway associated with Building 600 is located to the southwest of the grassed area. Between the asphalt curb and the grassed area is a concrete trench with a metal cover that contains the existing diesel fuel line from the active AST to the emergency generator inside the brick wall (URS 2011).

This site formerly contained a 500-gallon diesel UST, which fueled the emergency generator, prior the UST removal in October 1994. The base of the tank was located approximately 7 feet bgs. During the UST removal action, four soil samples were taken from a depth of 2 feet below the base of the tank (approximately 9 feet bgs). Analytical results indicated that a release had occurred during the service life of the tank. Upon receipt of these results, the contractor removed an additional 2 feet of soil (down to approximately 9 feet bgs) and collected two additional samples from 4 feet below the base of the tank (approximately 11 feet bgs). Both samples had

elevated TPH concentrations; however, excavation activities were terminated at that time, and the open excavation was backfilled (USGS 1995).

An investigation of the former UST area was conducted by the USGS between April and August 1995 to confirm the analytical results of samples collected during the October 1994 UST removal action (USGS 1995). Photographs of the site were taken following the 1995 USGS investigation and are provided in **Appendix D**. In these site photographs the 1995 USGS sampling locations are marked with pin flags within an area of bare soil matching the limits of the UST excavation depicted in the 1995 USGS report. Based on results from the 1995 USGS investigation, it appears that the primary source of soil contamination was a leak in the bottom of the west side of the former UST. Additionally, results indicated soil contamination existed below the limits of the previous excavation. Results of the previous UST investigations are discussed in **Section 4.3.2**.

4.3.2 Previous Investigation Results (ST-C503)

Previous investigation results summarized in this section were taken from the 1995 USGS data submission entitled "Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico, Volume 1" (USGS 1995). **Table 4-5** summarizes previous samples collected for chemical analysis. **Table 4-6** summarizes the previous analytical data and screening results. **Figures 4-3a** and **4-3b** show the previous sampling locations.

During the October 1994 UST removal action, four soil samples were taken from a depth 2 feet below the base of the tank. The base of the tank was approximately 7 feet bgs. Three of these samples had concentrations above reporting limits, with a maximum concentration of 1.81E+04 mg/kg TPH. Following the removal of an additional 2 feet of soil, two additional soil samples were collected from 4 feet below the base of the tank. Both of these samples had elevated TPH concentrations: 7.05E+02 mg/kg on the north end of the excavation and 1.37E+03 mg/kg on the south end.

Between April and August 1995, the USGS completed an investigation of the area formerly containing the UST. Eight soil borings were advanced and 21 subsurface soil samples were collected from depths ranging from 10 to 21 feet bgs (i.e., near the base of the former UST and below the limits of the former excavation). Analytical results from these samples indicated contamination existed below the limits of the excavation. A maximum TPH-DRO concentration of 3.50E+03 mg/kg was discovered in CAFB-FAC0600-03 at a depth of 14 to 16 feet bgs. A sample from 19 to 21 feet bgs at this location contained 7.80E+00 mg/kg TPH-DRO. A concentration of 8.20E+02 mg/kg TPH-DRO was identified at CAFB-FAC0600-05 at a depth of 10-12 feet bgs. A sample from 14-16 feet bgs at this location contained 1.40E+01 mg/kg TPH-DRO. At the other six sample locations, the highest detected concentration of TPH-DRO was 1.80E+01 mg/kg at CAFB-FAC0600-07 at 14-16 feet bgs.

4.4 HOSPITAL ABANDONED UST SITE (ST-C504)

4.4.1 Site Description and Background (ST-C504)

The Hospital Abandoned UST Site (ST-C504) is located in the northwestern portion of Cannon AFB, near the northern corner of the hospital (Building 1400), and adjacent to the access road behind the hospital. The site boundary (for purposes of this investigation) includes portions of the grassed and asphalt paved areas around the abandoned UST. The site also encompasses several cooling towers, a transformer, and several concrete pads (previously used for aboveground utilities). These aboveground utilities are located inside a chain-link fence. The site is approximately 95 by 60 feet (approximately 0.13 acres), and is bordered by the hospital to the southeast, a utility garage connected to the hospital to the southwest, and hospital driveways and parking areas to the north, east, and west. The site map with the site boundary (shown in red) is shown on **Figures 4-4a** and **4-4b**.

A UST (1400B) was removed from an area to the northeast of ST-C504 on November 17, 1994. This UST was not located at ST-C504. Since this UST was not located at ST-C504 and no signs of leakage were recorded during tank removal, UST 1400B does not present a potential source of contamination to ST-C504. The tank closure documentation for UST 1400B is included in **Appendix D**.

Deleted: N

Deleted: ; therefore

Based on the Tank Closure Worksheet for UST 1400A (see **Appendix D**), the 25,000-gallon diesel UST was abandoned in place on October 5, 1994. The UST was formerly associated with an emergency generator at the hospital. The UST is constructed of steel and its base is approximately 18 feet bgs (USGS 1995). The abandoned UST dimensions are roughly 12 feet wide by 38 feet long (taken from the 1995 USGS site map). The exact location of the abandoned UST is unknown; however, the approximate location of the abandoned UST (shown on **Figures 4-4a** and **4-4b**) is based on a pre-1995, partial utility plan of Building 1400 (see **Appendix D**) and the 1995 USGS site map. These two maps indicate the aboveground cooling towers, located to the east of the UST, are outside the footprint of the abandoned UST. This is in contrast to the January 2008 aerial photograph (shown on **Figure 4-4b**), which shows the northeast corner of the abandoned UST underling the concrete slab that supports the westernmost cooling tower. Based on these images, it is likely that the previous cooling towers have been replaced with larger units, which now overlie the abandoned UST.

Prior to abandonment of the UST, Keers Technical Services (Keers) completed a subsurface investigation of the UST in August 1994 (Keers 1994a). Initially, a backhoe was used to locate the north and south ends of the UST. Three subsurface soil samples were then collected adjacent to the north, west-central, and southwest edge of the UST. Results of this investigation indicated that a release had occurred on the north and possibly west-central side of the UST. The Keers August 1994 report is provided in **Appendix D**.

In September 1994, Keers completed a follow-up subsurface investigation to confirm the analytical results from previously collected samples (Keers 1994b). Four subsurface soil samples were collected adjacent to and around the UST. Analytical results from the soil sample

collected on the northwest side of the UST confirmed that a release had occurred in this area. The Keers September 1994 report is provided in **Appendix D**.

An investigation of the abandoned UST area was conducted by the USGS between April and December 1995 to confirm the analytical results from samples collected by Keers. Results of the 1995 USGS investigation indicated that high concentrations of contamination existed on all sides of the abandoned UST with the exception of the southwest corner. Due to the presence of hard caliche at several intervals below 20 feet bgs, a Mobile B53 auger drilling rig and a Gardner-Denver 17W rotary drilling rig were used to obtain deeper soil samples. Based on the USGS investigation, the primary source of contamination at this site appears to be from leaks located to the northwest of the northern part of the UST and southeast of the middle part of the UST. Results of the previous UST investigations are discussed in **Section 4.4.2**.

4.4.2 Previous Investigation Results (ST-C504)

Previous investigation results summarized in this section were taken from the "Subsurface Investigation of 25,000 gallon UST Report" (Keers 1994a), the "Limited Subsurface Investigation for the Evaluation of Suspect Subsurface Contamination Report" (Keers 1994b), and the "Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico, Volume 1" (USGS 1995). **Table 4-7** summarizes previous samples collected for chemical analysis. **Table 4-8** summarizes the previous analytical data and screening results. **Figures 4-4a** and **4-4b** show the previous sampling locations.

On August 17, 1994, Keers collected three subsurface soil samples adjacent to the UST at a depth of approximately 14 feet bgs. A maximum TRPH concentration of 2.80E+03 mg/kg was detected at soil boring 94600-081794-01 located on the north side of the UST. A detection of 6.40E+02 mg/kg was also detected at soil boring 94600-081794-02 on the west-central side of the UST. The sample from soil boring 94600-081794-03 was nondetect (Keers 1994a).

On September 22, 1994, Keers collected four soil samples around the UST from depths between 18 and 20 feet bgs. Two samples were collected adjacent to the UST and two were collected to the north and northeast of the UST. A maximum TPRH concentration of 8.20E+03 mg/kg was detected at soil boring 94600-092294-02 located on the northwest side and adjacent to the UST. The three other samples collected were nondetect (Keers 1994b).

On April 12 and 14, 1995, the USGS advanced six soil borings and collected 10 subsurface soil samples in order to validate the existence of contamination at this site. Results indicated that TPH-DRO was detected at five of the six soil borings. Soil boring CAFB-FAC1400-5 was sampled at 10 feet bgs and was found to be nondetect (result was from field screening only; sample was not submitted for laboratory analysis). The highest concentrations of TPH-DRO was detected at CAFB-FAC1400-3 (located adjacent to the west-central portion of the UST) at 18 to 20 feet bgs (9.90E+03 mg/kg). Results at soil borings CAFB-FAC1400-1 (southwest), CAFB-FAC1400-2 (east-central), and CAFB-FAC1400-4 (northeast) indicated that TPH-DRO contamination existed on all sides of the abandoned UST.

In July and August 1995, USGS further investigated soil boring location CAFB-FAC1400-3 using a Mobile B53 auger drilling rig. Samples were collected vertically at 36 to 37 feet bgs, 49.5 to 50.5 feet bgs, and 65 to 66 feet bgs. Results indicated that TPH-DRO contamination extended to 66 feet bgs. The highest concentration of TPH-DRO detected at CAFB-FAC1400-3 was at 50.5 feet bgs (1.10E+04 mg/kg). Additionally, a direct push rig was used to collect shallow samples (ranging from 19 to 26 feet bgs) at step out locations CAFB-FAC1400-7 (south–southeast), -8 (northeast), and -9 (northwest). These three locations were completed 10 to 25 feet from the UST to help further define the horizontal extent of TPH-DRO contamination. Results indicated TPH-DRO contamination was present to the east and west, but at significantly lower concentrations (ranging from 2.00E+01 mg/kg to 8.90E+02 mg/kg).

In December 1995, USGS again conducted additional sampling at soil boring location CAFB-FAC1400-3 using a Gardner-Denver 17W rotary drilling rig. Samples were collected vertically at 75 feet bgs, 83 feet bgs, and 91 to 92 feet bgs. Results indicated that TPH-DRO contamination extended to 75 feet bgs (9.30E+03 mg/kg), but was not present (nondetect) at 83 and 91 to 92 feet bgs. Additionally, a direct push rig was used to collect shallow samples (ranging from 23 to 26 feet bgs) at step out locations to the west. The three step out locations were completed 10 to 15 feet to the west of previous soil boring CAFB-FAC1400-9. Results at soil borings CAFB-FAC1400-10 (west) and -11 (northwest) were nondetect for TPH-DRO. A small detection of TPH-DRO (1.60E+01 mg/kg) was present at 24 to 26 feet bgs at soil boring CAFB-FAC1400-12 (north).

Conclusions presented in the 1995 USGS report indicated that the horizontal and vertical migration of TPH-DRO contamination had been defined. Northwest and western movement of the contamination was limited to the middle of the hospital's paved road. Contamination to the north and east was within a few feet of the UST. Based on the close proximity of the impacted soil borings, it was determined that one deep soil boring would be significant in order to define the vertical migration of TPH-DRO contamination. The vertical extent of TPH-DRO contamination at deep soil boring CAFB-FAC1400-3 was determined to be approximately 75 feet bgs.

4.5 FLIGHTLINE GENERATOR UNDERGROUND STORAGE TANKS SITE (ST-C505)

4.5.1 Site Description and Background (ST-C505)

The Flightline Generator USTs Site (ST-C505) is located in the northeast portion of Cannon AFB, due north of the north end of the main runway, and approximately 300 feet south of North Perimeter Road. The site boundary (for purposes of this investigation) encompasses only the previous USTs excavation area. The site is approximately 22 by 23 feet (0.01 acres) and is bound to the west by Building 3060, an existing UST located in a concrete vault, and a concrete trench between the two. To the north, east, and south, the site boundary extends approximately 10 feet beyond the limits of the former USTs excavation. Building 3060 houses an emergency generator used in case of a power loss to the flightline electrical systems. A concrete trench covered with steel plates houses the diesel fuel line that connects the existing UST to the

generator. The site map with the site boundary (shown in red) is shown on **Figures 4-5a** and **4-5b**.

This site formerly contained two 500-gallon diesel USTs associated with the emergency generator at Building 3060. The USTs were removed in December 1994 and January 1995. The exact dimensions of the former USTs are unknown; however, the USTs bases were approximately 9 feet bgs (USGS 1995). The exact location of the two USTs and the exact limits of the USTs excavation shown on **Figures 4-5a** and **4-5b** are also unknown; however, the approximate locations are based on two Excavation Site Worksheets completed on December 14 and 15, 1994 (see **Appendix D**). These two worksheets indicate the limit of the excavation was approximately 14 by 12 feet, 9 feet deep. The approximate limits of excavation were also based on site photographs taken following the 1995 USGS investigation, which show an area of bare soil, east of Building 3060, matching the excavation dimensions on the worksheets.

The two Excavation Worksheets indicate that at UST 1A (western UST), none of the soil was contaminated. At UST 2B (eastern UST), approximately 48 cubic yards of soil removed during the excavation was deemed contaminated and removed from the site. NMED was notified of the release in a 7-Day Release Notification letter from Cannon AFB to NMED dated December 21, 1994 (see **Appendix D**). The letter indicated the release appeared to be from overflow of the UST. Following the excavation, eight soil samples were collected on December 15, 1994, and submitted to Cardinal Laboratories for analysis. Based on the sample results, additional contaminated soil was excavated and removed from the UST 2B excavation. After additional excavation, two samples were collected from the east and west sides of the UST 2B excavation on December 28, 1994. Analytical results from the 10 samples collected on December 15 and 28, 1994, are provided in **Table 4-10**. Sample location maps were not provided with the sample results, only approximate locations (e.g., northeast corner of UST). Based on the approximate nature of the sample locations, they are not shown on **Figures 4-5a** and **4-5b**. Results provided in the December 1994 analytical data reports indicated contaminated soil remained at the site; however, excavation activities were terminated at that time, and the open excavation was backfilled.

An investigation of the site was conducted by the USGS between April and August 1995 to confirm the results of previous sampling conducted at the site. Results of the 1995 USGS investigation indicated the primary source of contamination at this site was from a leak from the bottom of the west side of UST 2B. Another source appears to have been a leak from the southwest side of UST 1A. The extent of the contamination associated with UST 1A appears to be less than the extent associated with UST 2B. Results of the previous site investigations are discussed in **Section 4.5.2**.

4.5.2 Previous Investigation Results (ST-C505)

Previous investigation results summarized in this section were taken from a 7-Day Release Notification letter from Cannon AFB to NMED (December 1994) and the "Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico, Volume 1" (USGS 1995). **Table 4-9** summarizes previous samples collected for chemical analysis. **Table 4-10** summarizes the previous analytical data and screening results.

Figures 4-5a and **4-5b** show the approximate locations of the samples previously collected by the USGS. Because the exact excavation footprint was not able to be determined, soil sample locations collected during the 1994 UST removal action are not shown.

During the removal of the two USTs, eight soil samples were collected from the four corners of each tank. The bases of the two USTs were approximately 9 feet bgs. Samples were collected from 2 feet below the bases of the USTs. Results from the soil samples indicated that UST 1A samples were all below reporting limits (concentrations ranged from 6.30E+00 and 1.96E+01 mg/kg); however, UST 2B samples were all above reporting limits for TRPH. TRPH concentrations ranged from 1.19E+02 to 1.78E+03 mg/kg, with detectable concentrations of toluene (maximum of 3.40E-02 mg/kg), ethylbenzene (maximum of 7.40E-02 mg/kg), and total xylenes (maximum of 7.40E-02 mg/kg). Following the receipt of these analytical results, additional contaminated soil was excavated and removed from the UST 2B excavation. After additional excavation, results from another round of sampling identified TRPH in concentrations of 1.03E+03 mg/kg on the west end, and 1.07E+02 mg/kg on the east end of this excavation.

On April 11, 1995, the USGS completed seven soil borings (CAFB-FAC3060-01 through -07) and collected nine subsurface soil samples from this site in order to validate the analytical results from soil samples collected during the removal of the USTs. Subsurface soil sample depths ranged from 9 to 16 feet bgs. Although field screening indicated low levels of contamination, TPH-DRO laboratory results identified high levels of contamination at 9 to 11 feet bgs in two soil borings (1.30E+03 mg/kg at CAFB-FAC3060-02 and 5.30E+03 mg/kg at CAFB-FAC3060-03). TPH-DRO concentrations were significantly lower in deeper samples (14 to 16 feet bgs) collected at CAFB-FAC3060-02 (8.70E+00 mg/kg) and CAFB-FAC3060-03 (2.30E+01 mg/kg).

On June 28, 1995, the USGS completed four additional soil borings (CAFB-FA3060-08, -09, -10, and -11) and collected four subsurface soil samples to help further define the horizontal extent of contamination. Subsurface soil sample depths ranged from 9 to 13 feet bgs. Results indicated the contamination extended further to the north and west. The maximum TPH-DRO concentration in the four samples was 1.60E+02 mg/kg at CAFB-FAC3060-10.

On July 25, 1995, the USGS further investigated soil boring location CAFB-FAC3060-03 using a Mobile B53 auger drilling rig. One sample was collected vertically at 24 feet bgs, and TPH-DRO was detected at 7.80E+01 mg/kg.

On August 23, 1995, the USGS completed two additional soil borings (CAFB-FA3060-12 and -13) and collected two subsurface soil samples to help further define the northern extent of contamination. Subsurface soil sample depths ranged from 11 to 13 feet bgs. Results were nondetect for TPH-DRO.

4.6 FORMER POL YARD REFUELING AREA SITE (SS-C507)

4.6.1 Site Description and Background (SS-C507)

The Former POL Yard Refueling Area Site (SS-C507) is located near the northern boundary of Cannon AFB, southeast of the main entrance, and west of the active POL Yard. The Former POL Yard refueling area is located inside the fence that surrounds the active POL Yard. The site is approximately 580 feet by 410 feet (approximately 5.5 acres) and is bound by the POL Yard existing fence to the north, south and west, and the base of several concrete berms to the east. The concrete berms are part of the active POL Yard AST secondary containment system. The site map with the investigation site boundary (shown in red) is shown on **Figures 4-6a** and **4-6b**.

The former POL Yard Refueling Area was closed in June/July 2009 and has remained inactive. Most aboveground site features, structures, and piping have been removed. Underground piping is still present at the site, but has been properly drained and capped. An active OWS, located in a below ground concrete vault, and adjacent to a 55-gallon drum concrete secondary containment area, is still present at the site. Four other below ground concrete vaults, three containing fuel piping and one formerly containing an OWS, are also still present at the site.

Historical site activities included delivery and dispensing of fuels (diesel fuel, MOGAS, jet propellant [JP]-4, and JP-8). Delivery to the site occurred via 8,000 gallon tanker trucks, train tanker cars, and pipelines. Pipelines carried fuels from a former pipeline to the north of the site, and from the unloading areas to the various ASTs located inside the existing concrete containment berms to the east. No fuels were stored in the former POL Yard Refueling Area.

Deleted: , storage,

The aerial photograph, shown on **Figure 4-6b**, was taken in January 2008 when the site was still active. The various site features are labeled on **Figures 4-6a** and **4-6b,** and are described in detail below:

- The asphalt, oval shaped driveway and concrete curb surrounding the driveway are still present at the site. During the 2011 site visit (URS 2011), the asphalt was found to be in good condition with few cracks. The asphalt is sloped so that runoff is diverted to various breaks in the concrete curb, where runoff is discharged to unpaved areas. These breaks in the concrete curb are shown on **Figure 4-6a** and **4-6b**. A concrete drainage trench covered with a metal grate also exists in the asphalt driveway, south of the unpaved oval shaped area. This drainage trench slopes to the south towards a break in the concrete curb, where runoff is discharged to an unpaved area. Inside the asphalt oval shaped driveway is an unpaved, sparsely vegetated area that contains a pond and landscaped area to the north. Reportedly, both the pond and the small landscaped area were purely aesthetical and served no purpose at the POL Yard refueling area. Three gated entrance/exit points are still present at the site (one to the northwest and two to the south).
- Just inside the southeast gate is the former MOGAS unloading and dispensing area. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), vehicles would pull onto the 45-foot by 10-foot concrete area with concrete curb to unload or receive MOGAS. The aboveground fuel unloading port and a dispenser were located in an

unpaved area to the east of the concrete area. Currently, the only remaining visible feature at the MOGAS unloading and dispensing area is the capped unloading port. All underground MOGAS lines leading to the former location of Building 390 are still present at the site. The MOGAS fuel dispenser has been removed. The asphalt and concrete in the area slopes due west toward a break in the concrete curb.

- A below ground concrete vault formerly containing an OWS, and an adjacent aboveground concrete containment area for 55-gallon drums are located between the MOGAS unloading and dispensing area and the former location of Building 390. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), the OWS and drum containment area have not been used in several years. The drum containment area was built to store drums of POL and water generated by the OWS. Cannon AFB personnel also indicated that there is no leach field associated with the OWS. Currently, the only remaining visible features at this OWS location are the below ground concrete vault containing the OWS and the aboveground drum containment area.
- Two pump islands formerly containing fuel dispensers used to dispense JP-4 and JP-8 are located just southwest of the former location of Building 390. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), aircraft refueling trucks would pull onto the approximately 70-foot by 70-foot concrete area to receive either JP-4 (prior to its phase out in the mid-1990s) or JP-8. The fuel dispensers were located on the northern half of the pump islands. Currently, the only visible features remaining at the JP-4 and JP-8 refueling area are the two concrete pump islands. All underground JP-4/JP-8 lines between the pump island and the former location of Building 390 are still present at the site. The JP-4/JP-8 dispensers have been removed. The asphalt and concrete pavement in the area slopes to the west toward a concrete drainage swale. This concrete drainage swale leads to a break in the concrete curb where runoff is discharged to an unpaved area.
- Building 390 was the main pump house and fuel distribution hub for the entire former POL Yard Refueling Area. Just north of Building 390 was a canopy structure covering the aboveground fuel transfer piping. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), Building 390 previously received fuel from the MOGAS unloading area (located to the south), Building 392 (located to the west), pipelines from the north (from the city of Clovis), and diesel fuel from two unloading ports and aboveground piping located to the north. Building 390 also fed and received fuels from the POL Yard ASTs. Currently, the only visible features remaining near the former location of Building 390 are seven capped fuel lines (marked JP-8 and MOGAS) sticking out of the ground surface and a below ground concrete vault (reportedly used to remove water from the fuel lines). Underground fuel lines between Building 390 and the various fuel unloading areas are still present at the site. Building 390, the canopy structure, and all aboveground fuel lines leading to the POL Yard ASTs have been removed from the site.
- The diesel fuel unloading and dispensing area is located to the northwest of the former location of Building 390. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), diesel fuel tanker trucks would unload at one of two unloading ports (unloading port 398 to the south and 399 to the north). The unloading ports were located on the concrete driveway. The unloading ports were protected by metal bollards to

the west and a concrete curb to the east. From the unloading ports, the diesel fuel was transferred to a canopy structure covering the aboveground fuel transfer piping, formerly located to the north. Aboveground lines transferred diesel fuel between the covered diesel fuel lines and the POL Yard ASTs. To the north of the unloading ports, and east of the former location of the covered diesel fuel lines, is the diesel fuel pump island. The diesel fuel pump island is located on an approximately 60-foot by 40-foot concrete area. The dispensers were located in the center of the pump island. Currently, the only visible features remaining at the diesel refueling area are the capped diesel fuel unloading ports with protective bollards and the concrete pump island. All underground diesel fuel lines between the pump island and former location of the covered diesel fuel lines are still present at the site. The diesel fuel dispensers, canopy structure, and aboveground diesel fuel lines between the former canopy structure and the POL Yard ASTs have been removed. The asphalt and concrete pavement around the diesel fuel pump islands slopes to the west towards a break in the concrete curb where runoff is discharged to an unpaved area.

- The former fuel unloading area is located on the west side of the site. Based on Cannon AFB personnel interviews conducted during the 2011 site visit (URS 2011), prior to 1992, JP-4, JP-8, and MOGAS were delivered to the fuel unloading area via train tanker cars. Based on the 1991 historical aerial photograph, a railroad spur existed between the main railroad lines along Highway 60 (to the north) and the fuel unloading area. Train tanker cars were unloaded on the west side of Building 392. A railroad yard existed further to the west (outside the current fenced area). This railroad yard was used to deliver supplies to the base. The railroad yard reportedly was not used by train tanker cars. After approximately 1994, JP-4, JP-8, and MOGAS were delivered to the fuel unloading area via 8,000-gallon tanker trucks through the northwest gate. Tanker trucks would unload on one of two concrete unloading areas located to the east of Building 392. Train tanker cars and tanker trucks would unload fuel to one of four unloading ports. The four unloading ports and associated piping were contained in concrete trenches to the west. Fuel was received at Building 392 (located between the two concrete unloading areas) and pumped to the east to Building 390. A below ground concrete vault (reportedly used to remove water from the fuel lines) existed between Buildings 392 and 390. A canopy structure, covering the aboveground fuel transfer piping, was located to the north of Building 392. On the tanker truck side (east side), potential spills that may have occurred during unloading, and stormwater runoff, would flow to shallow concrete trenches located down the center of the truck unloading areas. These shallow concrete trenches were less than 6 inches deep and were covered with metal grates. A drain at the low point of each trench (located in the middle of each trench) would receive runoff, which was piped to the east, and ultimately to an OWS contained in a below ground concrete vault. Cannon AFB personnel indicated that there was no leach field associated with the OWS. Currently, the only visible features remaining at the former fuel unloading area are the two truck unloading areas (each approximately 140 feet long and 20 feet wide) and the concrete trenches formerly containing the unloading ports and associated piping. Underground fuel lines between the former location of Building 392 and 390, and stormwater lines between the east unloading area drains and the former OWS are still present at the site. Unloading ports and associated piping formerly contained in the concrete trenches, Building

392, the canopy structure covering aboveground piping, and the OWS and OWS concrete vault have all been removed from the site.

Based on historical records and interviews with Cannon AFB personnel conducted during the 2011 site visit (URS 2011), the following spills/releases have previously occurred at the site:

- Two reported MOGAS spills (estimated at 20 gallons each) at the former MOGAS unloading and dispensing area. Spills occurred on concrete and on unpaved area to the east. No excavation was completed following the spills. The approximate location of the MOGAS spills is shown on **Figures 4-6a** and **4-6b**.
- Multiple reported JP-4 and JP-8 spills (15 spills, for an estimated total of 130 gallons) onto the concrete surrounding the two JP-4/JP-8 pump islands. No excavation was completed following the spills. The approximate location of the spills is shown on **Figures 4-6a** and **4-6b**.
- Reported JP-8 spill (approximately 400 gallons) to the north of the area formerly occupied by Building 390 and the canopy structure. A soil excavation was conducted to remove visible contaminated soil (red soil backfill is still visible at surface). The approximate JP-8 spill location and soil excavation boundary is shown on **Figures 4-6a** and **4-6b**.
- One reported JP-8 spill (estimated at 30 gallons) in the immediate vicinity of the former Building 390 and the canopy structure due to breaks in the fuel pump seals. No excavation was completed following the spill. The approximate location of the spill is shown on **Figures 4-6a** and **4-6b**.
- Reported JP-8 spill (approximately 400 gallons) on the south side of Building 392. A soil excavation was conducted to the south and west of Building 392. Approximate JP-8 spill location and soil excavation boundary is shown on **Figures 4-6a** and **4-6b**.

Additional areas that have the highest probability of containing potential contamination, and may be potential areas of concern, include the following:

- The former fuel unloading and refueling areas, including the MOGAS unloading and refueling area, the diesel fuel unloading and refueling pump islands, the JP-4/JP-8 train tanker car and tanker truck unloading area, and the JP-4/JP-8 refueling pump islands.
- The former location of aboveground fuel piping adjacent to Building 390 and under the adjacent canopy structure.
- The former location of aboveground fuel piping adjacent to Building 392 and under the adjacent canopy structure.
- The former location of the aboveground diesel fuel piping under the canopy structure.
- Break in concrete curb receiving runoff from MOGAS unloading and dispensing area and JP-4/JP-8 pump islands.
- Concrete drainage swale leading to break in the concrete curb receiving runoff from JP-4/JP-8 pump islands.

- Break in concrete curb receiving runoff from diesel fuel pump islands.
- Underground MOGAS line connecting MOGAS unloading port to MOGAS vault (approximately 130 feet long).
- Underground fuel line connecting Building 392 to Building 390 (approximately 280 feet long).

The only environmental site investigation completed to date at SS-C507 was a shallow soil sampling investigation completed as part of the 2009 Compliance Clean-up Site Identification and Evaluation of DERA Eligibility for AFCEE project (URS 2009). Results of this investigation are discussed in **Section 4.6.2**.

4.6.2 Previous Investigation Results (SS-C507)

In 2009, subsurface soil samples were collected from eight locations at and around the site. One sample (SS-C507-103) was taken from an area outside of the current site boundary. Samples were collected via hand augering to depths of 1 to 3 feet bgs and analyzed for TPH-DRO, BTEX, and PCBs. Results indicated the presence of DRO at three sample points (maximum concentration of 7.10E+00 mg/kg at SS-C507-104, 6.30E+00 mg/kg at SS-C507-100, and 5.80E+00 mg/kg at SS-C507-102) and PCB-1260 at one sampling location (2.80E-02 mg/kg at SS-C507-106). All samples were nondetect for BTEX (URS 2009). **Table 4-11** summarizes previous samples collected for chemical analysis. **Table 4-12** summarizes the previous analytical data and screening results. **Figures 4-6a** and **4-6b** show the locations of the URS previous soil sampling locations.

4.7 SURFACE DISPOSAL AREA SITE (SD-C508)

4.7.1 Site Description and Background (SD-C508)

The Surface Disposal Area Site (SD-C508) is located in the southeast portion of Cannon AFB, east of the former north-south runway and north of SWMU 107. This site is located approximately 600 feet north of an area of the base used by Cannon AFB Explosives Ordnance Disposal (EOD) personnel. The EOD site is well marked by warning signs placed 500 feet from the site. None of the SD-C508 sampling activities will be completed within the area marked with the warning signs. The site includes an area of visible debris on the ground surface (some burned), including an ammunition can lid, metal slag, and mechanical parts. The source of the visible surface debris and the history of this site are unknown. The surface disposal site was identified in 2009 while URS was conducting an investigation at an adjacent site. The site is not currently used by Cannon AFB.

During the April 2011 site visit (URS 2011) the location of the previously identified surface debris was found, the location was photographed, and coordinates were collected with a handheld global positioning system (GPS). During the site walk, burned debris was visible at the surface throughout the grassed field. The extent of the visible surface debris identified during the April 2011 site visit was found to be within a circular shaped area where the ground surface

was slightly elevated (i.e., mounded). This mounded area also had visibly different vegetation at the surface compared to the rest of the grassed field. The vegetation on the mounded area was noticeably shorter and sparser compared to the surrounding vegetation. The extent of this area was tracked with the handheld GPS, and was found to be approximately 200 by 240 feet (approximately 1 acre). The site boundary at SD-C508 was arbitrarily added to encompass the sparsely vegetated mounded area, and extends approximately 20 to 40 feet outside that area. The sparsely vegetated mounded area and site boundary (shown in red) are shown on **Figures 4-7a** and **4-7b**.

The only environmental site investigation completed to date at SD-C508, was a shallow soil sampling investigation completed as part of the 2009 Compliance Clean-up Site Identification and Evaluation of DERA Eligibility for AFCEE project (URS 2009). Results of this investigation are discussed in **Section 4.7.2**.

4.7.2 Previous Investigation Results (SD-C508)

During the 2009 shallow soil sampling investigation (URS 2009), a total of three soil borings were completed and six soil samples were collected, via hand augering, from depths of 1 to 3 feet bgs. Samples were analyzed for TPH-DRO, BTEX, PCBs, and RCRA metals. TPH-DRO was detected in four of the six soil samples, and various metals were detected. TPH-DRO was detected at a maximum concentration of 1.20E+02 mg/kg (at SD-C508-100-HA-01). Maximum concentrations of the following constituents were identified at the following locations: arsenic (3.30E+00 mg/kg at SD-C508-102-HA-01), barium (3.07E+02 mg/kg at SD-C508-100-HA-01), cadmium (2.00E+00 mg/kg at SD-C508-102-HA-01), chromium (1.08E+01 mg/kg at SD-C508-102-HA-01), lead (2.80E+01 mg/kg at SD-C508-102-HA-01), mercury (2.70E-02 mg/kg at 101-HA-01), selenium (3.70E-01 mg/kg at SD-C508-100-HA-03), and silver (1.00E+00 mg/kg at SD-C508-101-HA-01) (URS 2009). **Table 4-13** summarizes previous samples collected for chemical analysis. **Table 4-14** summarizes the previous analytical data and screening results. **Figures 4-7a** and **4-7b** show the locations of the URS previous soil sampling locations.

4.8 WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)

4.8.1 Site Description and Background (TA/AS-C129)

The Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129) is located in the northeast portion of the Cannon AFB, approximately 300 feet north of Building 208, and just south of the contractor storage area located south of North Perimeter Road. The site consists of two main areas, including the former Facility 244 and the former leach field located to the southeast. The former Facility 244 site boundary is approximately 65 by 50 feet, and is bound to the west by a fenced-in storage area that currently contains several pumps, piping, and related equipment. The former leach field site boundary is approximately 40 by 50 feet and encompasses the portions of the former leach field containing perforated piping used to discharge water into the subsurface. The site map with site boundaries (shown in red) is shown on **Figures 4-8a** and **4-8b**.

The Waste Oil Storage Facility 244 was originally built in 1991 to store waste petroleum products generated during routine maintenance of aircraft and service vehicles. The facility was used infrequently due to design and operational problems. Historically, lubricating oils, hydraulic fluids, and solvents were reportedly stored in tanks at this site. Fuels were reportedly never stored at this site (Parallax, Inc. [Parallax] 2000).

The Facility 244 site previously consisted of five 5,000-gallon ASTs supported on reinforced concrete saddles. The tanks were surrounded by an approximately 30-foot by 50-foot concrete containment pad with a 9-inch retaining curb (Parallax 2000). A fence surrounded the containment pad and a gate was located on the west side, near the northwest corner of the fence. An OWS was present on the west side of the site, with dump pits to the north. A cleanout to the south of the OWS was connected by a pipeline to a leach field.

The leach field, located to the southeast of the facility, received the water fraction from a central OWS. The leach field consisted of perforated plastic piping surrounded by crushed stone (Parallax 2000).

Deleted: that allowed the water to be discharged into the subsurface and percolate into underlying soils without impacting the groundwater

During the April 2011 site visit, historical records were reviewed, Cannon AFB personnel were interviewed about the site, and a site walk was conducted. Information gathered regarding the site included the following:

- An as-built drawing showing the location and dimensions of the leach field was obtained. The leach field is located approximately 95 feet southeast of the formerly present cleanout in the southeast corner of the former Facility 244. The as-built drawing depicts the main drain pipe (95 feet long) located between the cleanout and the leach field distribution box. At the distribution box, three branches of perforated pipe, each 40 feet long and spaced 10 feet apart, are aligned parallel and slope to the southeast. The as-built also depicts the leach field in cross-section, which shows the perforated pipe (4-inches in diameter), surrounded by 4 inches of 1.5- to 0.5-inch diameter crushed gravel, at a depth of 2.0 feet bgs. The as-built drawing is provided in **Appendix D**.
- A noticeable line of vegetation was present at the surface between Facility 244 and the presumed location of the former leach field. This line of vegetation is also visible on the aerial photograph on **Figure 4-8b**. Because this line of vegetation has a similar orientation and length as the main drain pipe leading to the former leach field, it is assumed that this line of vegetation is likely directly over the trench that would have been excavated to install the main drain pipe. This visible line of vegetation and the as-built drawing were used to confirm the exact location of the former leach field.
- The area around the former Facility 244 is generally paved with remnant asphalt and crushed gravel. Southeast, and near the location of the former leach field, the area is grassed. Various types of debris are present at the ground surface near the former leach field, including plastic and metal debris, dried paint, and an area covered with an approximately 6-inch layer of previously liquefied, dried soil, which appears to have been dumped at this location.

Parallax completed a voluntary corrective action at the site in 1999, which included the decommissioning of Facility 244 and a preliminary site assessment (PSA) of the underlining soils (Parallax 2000). Based on the results of the 1999 PSA, Corrective Action Complete without Controls was proposed for the site in July 2008 (URS 2009). The site was considered closed with no need for further evaluation and CAC without controls status pending, but the NMED disapproved the request for CAC without controls status, and requested additional soil sampling of the leach field that forms part of the site. In a letter from NMED to Cannon AFB dated September 14, 2009, NMED disapproved the CAC proposal based specifically on the absence of soil samples from the leach field area. On page 3 of the letter, NMED states, "If the leach field was not sampled or was not adequately investigated, the NMED considers the investigation of SWMU 129 incomplete. Until such time that the Permittee provides documentation that the leach field was adequately sampled and the results of such sampling demonstrate that contaminants are not present in concentrations exceeding appropriate cleanup criteria, SWMU 129 will not be considered for Corrective Action Complete status." NMED did not request any additional investigation of the AST portion of TA/AS-C129. Based on the results of the Closure Report/Contamination Assessment, the fact that NMED did not request any additional investigation at the AST portion of TA/AS-C129, and NMED's specific statements referenced above, Cannon AFB determined that only the leach field portion of TA/AS-C129 required additional investigation. A copy of NMED's letter is included in **Appendix D**. It does not appear that any soil sampling was conducted in the leach field area during the PSA activities. Results of the previous PSA are discussed in **Section 4.8.2**.

4.8.2 Previous Investigation Results (TA/AS-C129)

After removal of the containment pad at Facility 244, a PSA of the underlying soils was completed. The underlying soil was examined visually and representative grab soil samples were collected from each corner, the center, and in areas likely to have been contaminated (e.g., adjacent to and underlying the OWS vault, oil dump pits, and surface areas adjacent to the retaining curbs at ground level). The ambient atmosphere directly above the ground surfaces in areas of potential contamination was monitored for volatile organic compounds (VOCs) using a photoionization detector (PID) and Draeger® contaminant-specific (benzene) colorimetric tubes. Neither of these instrument surveys indicated concentrations of contaminants exceeding USEPA risk-based concentrations (RBCs) (Parallax 2000). **Table 4-15** summarizes previous samples collected for chemical analysis. **Table 4-16** summarizes the previous analytical data and screening results. **Figures 4-8a** and **4-8b** show the locations of the previous soil sampling locations.

Laboratory analysis indicated that there were no COPCs present in the soils underlying Facility 244 that exceeded USEPA RBCs (Parallax 2000). TRPH were detected at 244SS06 (north of the OWS), 244SS07 (south of the OWS) and 244SS08 (east of the OWS). The maximum TRPH concentration was 3.00E+02 mg/kg at 244SS06. Concentrations of selenium were detected at 244SS07 (2.00E+01 mg/kg) and at 244SS08 (1.70+01 mg/kg).

TABLE 4-1
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
FORMER AGE DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	BTEX (EPA 8260)	PCBs (EPA 8082)	TPH-DRO (EPA 8015)	Note(s)
June 2009							
C501-100	1-3	6/24/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C501-101	1-3	6/24/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C501-102	1-3	6/24/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C501-103	1-3	6/24/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
			Totals	**4**	**4**	**4**	

Source:

URS Group, Inc. 2009. Final Evaluation Report. Cannon Air Force Base. Air Force Compliance Clean-up Sites, Identification and Evaluation of DERA Eligibility for AFCEE, Multiple Locations, Prepared for the United States Army Corps of Engineers, Tulsa District.

Notes:

bgs = below ground surface

BTEX = benzene, toluene, ethylbenzene and total xylenes

DRO = diesel range organics

EPA = Environmental Protection Agency

PCB = polychlorinated biphenyl

PID = photoionization detector

ppm = parts per million

TPH = total petroleum hydrocarbons

URS = URS Group, Inc.

TABLE 4-2
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER AEROSPACE GROUND EQUIPMENT (AGE) DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	C501-100 1-3 June 24, 2009			C501-101 1-3 June 24, 2009			C501-102 1-3 June 24, 2009			C501-103 1-3 June 24, 2009		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)															
All BTEX compounds were nondetect	ND	0/4													
PCBs (mg/kg)															
All PCBs were nondetect	ND	0/4													
TPH-DRO (mg/kg)	1.10E+01 F	2/4	1.00E+03	1.10E+01	1.10E+01	F	<	1.20E+01	U	<	1.20E+01	U	6.00E+00	1.10E+01	F

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
MDL = method detection limit
mg/kg = milligrams per kilogram
ND = not detected
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect

TABLE 4-3
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	TPH-DRO (EPA 8015)	TPH-GRO (EPA 8015)	TRPH	Field Analysis (GC)	Note(s)
January 1995								
N corner of UST excavation	14	1/1995	USGS 1995			X		
S corner of UST excavation	14	1/1995	USGS 1995			X		
E corner of UST excavation	14	1/1995	USGS 1995			X		
W corner of UST excavation	14	1/1995	USGS 1995			X		
SE side of UST excavation	14	1/1995	USGS 1995			X		
NW side of UST excavation	14	1/1995	USGS 1995			X		
April 1995								
CAFB-FAC0368-01	10-12	4/13/1995	USGS 1995		X			
CAFB-FAC0368-01	13-15	4/13/1995	USGS 1995		X			
CAFB-FAC0368-02	10-12	4/13/1995	USGS 1995		X			
CAFB-FAC0368-02	14-16	4/13/1995	USGS 1995		X			
CAFB-FAC0368-03	12-14	4/13/1995	USGS 1995		X			
CAFB-FAC0368-04	11-13	4/13/1995	USGS 1995		X			
CAFB-FAC0368-05	10-11	4/13/1995	USGS 1995		X			
CAFB-FAC0368-06	12-14	4/13/1995	USGS 1995		X			
CAFB-FAC0368-07	13-15	4/14/1995	USGS 1995		X			
CAFB-FAC0368-08	10	4/14/1995	USGS 1995				X	Field screening only, result was nondetect
CAFB-FAC0368-09	10	4/14/1995	USGS 1995				X	Field screening only, result was nondetect
July 1995								
CAFB-FAC0368-01M	13-15	7/1/1995	USGS 1995		X			
CAFB-FAC0368-06M	12-14	7/1/1995	USGS 1995		X			
CAFB-FAC0368-10	12-14	7/1 & 7/2/1995	USGS 1995	X	X			
CAFB-FAC0368-11	10-11	7/1/1995	USGS 1995		X			
CAFB-FAC0368-12	12-14	7/1/1995	USGS 1995		X			
CAFB-FAC0368-13	10-11	7/1/1995	USGS 1995		X			
CAFB-FAC0368-14	13-15	7/1/1995	USGS 1995		X			
CAFB-FAC0368-15	12-14	7/1/1995	USGS 1995		X			
CAFB-FAC0368-16	13-15	7/1/1995	USGS 1995		X			
CAFB-FAC0368-17	13-15	7/2/1995	USGS 1995	X				
August 1995								
CAFB-FAC0368-10	24-25	8/25/1995	USGS 1995		X			Duplicate
CAFB-FAC0368-10	35-36	8/26/1995	USGS 1995		X			
CAFB-FAC0368-10	50-52	8/26/1995	USGS 1995		X			
			Totals	**2**	**21**	**6**	**2**	

Source:
United States Geological Survey. 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico.

Notes:
bgs = below ground surface
DRO = diesel range organics
EPA = Environmental Protection Agency
GC = gas chromatograph
GRO = gasoline range organics
M = resample
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
USGS = United States Geological Survey
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	N corner of UST excavation 14 January 1995			S corner of UST excavation 14 January 1995			E corner of UST excavation 14 January 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	NA			NA			NA		
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	<	unknown	U	<	unknown	U	<	unknown	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	W corner of UST excavation 14 January 1995			SE side of UST excavation 14 January 1995			NW side of UST excavation 14 January 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	NA			NA			NA		
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	**2.45E+03**	unknown		<	unknown	U	<	unknown	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-01 10-12 April 13, 1995			CAFB-FAC0368-01 13-15 April 13, 1995			CAFB-FAC0368-01M 13-15 July 1, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	5.70E-01	5.00E-01	Q	4.40E-01	5.00E-01	QJ	<	1.00E+00	U
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-02 10-12 April 13, 1995			CAFB-FAC0368-02 14-16 April 13, 1995			CAFB-FAC0368-03 12-14 April 13, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	2.70E-01	5.00E-01	QJ	<	5.00E-01	U	<	5.00E-01	U
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-04 11-13 April 13, 1995			CAFB-FAC0368-05 10-11 April 13, 1995			CAFB-FAC0368-06 12-14 April 13, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	2.50E-01	5.00E-01	QJ	5.70E-01	5.00E-01	Q	<	5.00E-01	U
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-06M 12-14 July 1, 1995			CAFB-FAC0368-07 13-15 April 14, 1995			CAFB-FAC0368-10 12-14 July 1 & 2, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			1.60E+02	4.00E+00	Q
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	<	1.00E+00	U	<	5.00E-01	U	8.00E+02	1.00E+02	Q
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-10 24-25 August 25, 1995			CAFB-FAC0368-10 35-36 August 26, 1995			CAFB-FAC0368-10 50-52 August 26, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	**1.00E+03**	5.00E+01		3.70E+01	1.00E+01	Q	9.70E-01	1.00E+00	J
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-11 10-11 July 1, 1995			CAFB-FAC0368-12 12-14 July 1, 1995			CAFB-FAC0368-13 10-11 July 1, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	<	1.00E+00	U	<	1.00E+00	U	1.80E+01	1.00E+00	
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-14 13-15 July 1, 1995			CAFB-FAC0368-15 12-14 July 1, 1995			CAFB-FAC0368-16 13-15 July 1, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	NA			NA			NA		
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	<	1.00E+00	U	<	1.00E+00	U	<	1.00E+00	U
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-4
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0368-17 13-15 July 2, 1995 Result	RL	Qual
TPH-DRO (mg/kg)	1.60E+02	2/2	1.00E+03	5.10E+00	4.00E+00	Q
TPH-GRO (mg/kg)	1.00E+03	16/27	1.00E+03	NA		
TRPH (mg/kg)	2.45E+03	1/6	1.00E+03	NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
GRO = gasoline range organics
ID = identification
J = estimated or below reporting limit
M = resample
mg/kg = milligrams per kilogram
NA = not analyzed
ND = not detected
NE = not established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-5
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	TPH	TPH-DRO (EPA 8015)	Note(s)
October 1994 (pre-remedial excavation)						
Under UST	9	10/1994	USGS 1995	X		
Under UST	9	10/1994	USGS 1995	X		
Under UST	9	10/1994	USGS 1995	X		
Under UST	9	10/1994	USGS 1995	X		
Post-remedial excavation						
Northwest side of UST excavation	11	unknown	USGS 1995	X		
Southeast side of UST excavation	11	unknown	USGS 1995	X		
April 1995						
CAFB-FAC0600-01	10-12	4/9/1995	USGS 1995		X	Duplicate
CAFB-FAC0600-01	14-16	4/9/1995	USGS 1995		X	
CAFB-FAC0600-01	19-21	4/9/1995	USGS 1995		X	
CAFB-FAC0600-02	10-12	4/9/1995	USGS 1995		X	
CAFB-FAC0600-02	14-16	4/9/1995	USGS 1995		X	
CAFB-FAC0600-02	19-21	4/9/1995	USGS 1995		X	
CAFB-FAC0600-03	10-12	4/9/1995	USGS 1995		X	
CAFB-FAC0600-03	14-16	4/9/1995	USGS 1995		X	
CAFB-FAC0600-03	19-21	4/9/1995	USGS 1995		X	
CAFB-FAC0600-04	10-12	4/9/1995	USGS 1995		X	
CAFB-FAC0600-04	14-16	4/9/1995	USGS 1995		X	
CAFB-FAC0600-04	18-20	4/9/1995	USGS 1995		X	
CAFB-FAC0600-05	10-12	4/9/1995	USGS 1995		X	
CAFB-FAC0600-05	14-16	4/9/1995	USGS 1995		X	
CAFB-FAC0600-05	19-21	4/9/1995	USGS 1995		X	
June 1995						
CAFB-FAC0600-06	14-16	6/27/1995	USGS 1995		X	
CAFB-FAC0600-06	19-21	6/27/1995	USGS 1995		X	
CAFB-FAC0600-07	14-16	6/27/1995	USGS 1995		X	
CAFB-FAC0600-07	19-21	6/27/1995	USGS 1995		X	
August 1995						
CAFB-FAC0600-08	15-16	8/23/1995	USGS 1995		X	
			Totals	**6**	**20**	

Source:

United States Geological Survey. 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico.

Notes:

bgs = below ground surface

DRO = diesel range organics

EPA = Environmental Protection Agency

TPH = total petroleum hydrocarbons

USGS = United States Geological Survey

UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	Under UST 9 October 1994			Under UST 9 October 1994			Under UST 9 October 1994		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	NA			NA			NA		
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	**3.94E+03**	unknown		**6.76E+03**	unknown		**1.81E+04**	unknown	

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	Under UST 9 October 1994			NW end of UST excavation 11 Not specified			SE end of UST excavation 11 Not specified			CAFB-FAC0600-01 10-12 April 9, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	NA			NA			NA			2.40E+00	4.00E+00	J
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	<	unknown	U	7.05E+02	unknown		**<u>1.37E+03</u>**	unknown		NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-01 14-16 April 9, 1995		
				Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	<	4.00E+00	U
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-01 19-21 April 9, 1995			CAFB-FAC0600-02 10-12 April 9, 1995			CAFB-FAC0600-02 14-16 April 9, 1995			CAFB-FAC0600-02 19-21 April 9, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	2.60E+00	4.00E+00	J	2.60E+00	4.00E+00	J	<	4.00E+00	U	3.10E+00	4.00E+00	J
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA			NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-03 10-12 April 9, 1995		
				Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	**2.80E+03**	4.00E+02	
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-03 14-16 April 9, 1995			CAFB-FAC0600-03 19-21 April 9, 1995			CAFB-FAC0600-04 10-12 April 9, 1995			CAFB-FAC0600-04 14-16 April 9, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	**3.50E+03**	4.00E+02		7.80E+00	4.00E+00	Q	4.10E+00	4.00E+00	Q	2.90E+00	4.00E+00	J
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA			NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-04 18-20 April 9, 1995			CAFB-FAC0600-05 10-12 April 9, 1995			CAFB-FAC0600-05 14-16 April 9, 1995			CAFB-FAC0600-05 19-21 April 9, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	3.80E+00	4.00E+00	J	8.20E+02	8.00E+01	Q	1.40E+01	4.00E+00	Q	7.60E+00	4.00E+00	Q
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA			NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-06 14-16 June 27, 1995			CAFB-FAC0600-06 19-21 June 27, 1995			CAFB-FAC0600-07 14-16 June 27, 1995			CAFB-FAC0600-07 19-21 June 27, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	1.30E+01	4.00E+00	Q	6.50E+00	4.00E+00	Q	1.80E+01	4.00E+00	Q	7.40E+00	4.00E+00	Q
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA			NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-6
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC0600-08 15-16 August 23, 1995		
				Result	RL	Qual
TPH-DRO (mg/kg)	3.50E+03	17/20	1.00E+03	<	4.00E+00	U
TPH (mg/kg)	1.81E+04	5/6	1.00E+03	NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.
< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
U = nondetect
UST = underground storage tank

TABLE 4-7
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	TPH-DRO (EPA 8015)	TRPH (EPA 418.1)	Field Analysis (GC)	Note(s)
August 1994							
94600-081794-01	14	8/17/1994	Keers 1994a		X		
94600-081794-02	14	8/17/1994	Keers 1994a		X		
94600-081794-03	14	8/17/1994	Keers 1994a		X		
September 1994							
94600-092294-02	18-20	9/22/1994	Keers 1994b		X		
94600-092294-04	18-20	9/22/1994	Keers 1994b		X		
94600-092294-06	18-20	9/22/1994	Keers 1994b		X		
94600-092294-08	18-20	9/22/1994	Keers 1994b		X		
April 1995							
CAFB-FAC1400-01	14-16	4/12/1995	USGS 1995			X	Field screening only, result was nondetect
CAFB-FAC1400-01	16-18	4/12/1995	USGS 1995	X			
CAFB-FAC1400-02	18-20	4/12/1995	USGS 1995	X			
CAFB-FAC1400-03	18-20	4/12/1995	USGS 1995	X			
CAFB-FAC1400-03	22-24	4/12/1995	USGS 1995	X			
CAFB-FAC1400-04	17-19	4/12/1995	USGS 1995	X			
CAFB-FAC1400-04	20-22	4/12/1995	USGS 1995	X			
CAFB-FAC1400-05	10	4/14/1995	USGS 1995			X	Field screening only, result was nondetect
CAFB-FAC1400-06	9.5-11.5	4/14/1995	USGS 1995			X	Field screening only, result was nondetect
CAFB-FAC1400-06	20-22	4/14/1995	USGS 1995	X			
July 1995							
CAFB-FAC1400-07	19-20	7/2/1995	USGS 1995	X			
August 1995							
CAFB-FAC1400-03	36-37	8/28/1995	USGS 1995	X			Duplicate
CAFB-FAC1400-03	49.5-50.5	8/28/1995	USGS 1995	X			
CAFB-FAC1400-03	65-66	8/28/1995	USGS 1995	X			
CAFB-FAC1400-08	25-26	8/26/1995	USGS 1995	X			
CAFB-FAC1400-09	25-26	8/27/1995	USGS 1995	X			
December 1995							
CAFB-FAC1400-03	75	12/14/1995	USGS 1995	X			
CAFB-FAC1400-03	83	12/14/1995	USGS 1995	X			
CAFB-FAC1400-03	91-92	12/14/1995	USGS 1995	X			
CAFB-FAC1400-10	23-25	12/12/1995	USGS 1995	X			
CAFB-FAC1400-11	22-24	12/12/1995	USGS 1995	X			
CAFB-FAC1400-12	24-26	12/12/1995	USGS 1995	X			
			Totals	**19**	**7**	**3**	

Sources:
Keers Technical Services. 1994a. Subsurface Investigation 25,000 Gallon UST Cannon AFB.
Keers Technical Services. 1994b. Limited Subsurface Investigation for the Evaluation of Suspected Subsurface Contamination at Cannon AFB, Curry County, New Mexico.
United States Geological Survey. 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico.

Notes:
bgs = below ground surface
DRO = diesel range organics
EPA = Environmental Protection Agency
GC = gas chromatograph
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
USGS = United States Geological Survey

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID			NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	94600-081794-01			94600-081794-02			94600-081794-03			94600-092294-02		
SAMPLE DEPTH (FEET BGS)				14			14			14			18-20		
DATE COLLECTED				August 17, 1994			August 17, 1994			August 17, 1994			September 22, 1994		
	Maximum	Frequency		Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	**2.80E+03**	2.00E+01		6.40E+02	2.00E+01		<	2.00E+01	U	**8.20E+03**	2.00E+01	
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	NA			NA			NA			NA		

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	94600-092294-04 18-20 September 22, 1994			94600-092294-06 18-20 September 22, 1994			94600-092294-08 18-20 September 22, 1994		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	<	2.00E+01	U	<	2.00E+01	U	<	2.00E+01	U
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	NA			NA			NA		

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-01 16-18 April 12, 1995			CAFB-FAC1400-02 18-20 April 12, 1995			CAFB-FAC1400-03 18-20 April 12, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	5.10E+01	8.00E+00	Q	**6.20E+03**	4.00E+02		**9.90E+03**	4.00E+02	

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-03 22-24 April 12, 1995			CAFB-FAC1400-03 36-37 August 28, 1995			CAFB-FAC1400-03 49.5-50.5 August 28, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	3.70E+02	8.00E+00		**8.00E+03**	4.00E+02		**1.10E+04**	4.00E+02	

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-03 65-66 August 28, 1995			CAFB-FAC1400-03 75 December 14, 1995			CAFB-FAC1400-03 83 December 14, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	**5.80E+03**	4.00E+02		**9.30E+03**	4.00E+02		<	4.00E+00	U

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-03 91-92 December 14, 1995			CAFB-FAC1400-04 17-19 April 12, 1995			CAFB-FAC1400-04 20-22 April 12, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	<	1.00E-01	U	1.60E+01	4.00E+00	Q	**2.50E+03**	8.00E+01	

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-06 20-22 April 14, 1995			CAFB-FAC1400-07 19-20 July 2, 1995			CAFB-FAC1400-08 25-26 August 26, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	5.20E+00	4.00E+00	Q	2.00E+01	4.00E+00	Q	<	4.00E+00	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-09 25-26 August 27, 1995			CAFB-FAC1400-10 23-25 December 12, 1995			CAFB-FAC1400-11 22-24 December 12, 1995		
				Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA			NA			NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	8.90E+02	1.60E+01	Q	<	4.00E+00	U	<	4.00E+00	U

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-8
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	CAFB-FAC1400-12 24-26 December 12, 1995 Result	RL	Qual
TRPH (mg/kg)	8.20E+03	3/7	1.00E+03	NA		
TPH-DRO (mg/kg)	1.10E+04	14/19	1.00E+03	1.60E+01	4.00E+00	Q

Notes:

[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)

Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
NA = not analyzed
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not be achieved
Qual = qualifier
RL = reporting limit
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
U = nondetect

TABLE 4-9
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
FLIGHTLINE GENERATOR USTS SITE (ST-C505)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	BTEX (EPA 8020)	TRPH (EPA 418.1)	TPH-DRO (EPA 8015)	Field Analysis (GC)	Note(s)
December 1994								
3060A NE Corner	11	12/15/1994	CAFB 1994	X	X			
3060A SE Corner	11	12/15/1994	CAFB 1994	X	X			
3060A SW Corner	11	12/15/1994	CAFB 1994	X	X			
3060A NW Corner	11	12/15/1994	CAFB 1994	X	X			
3060B NE Corner	11	12/15/1994	CAFB 1994	X	X			
3060B NW Corner	11	12/15/1994	CAFB 1994	X	X			
3060B SE Corner	11	12/15/1994	CAFB 1994	X	X			
3060B SW Corner	11	12/15/1994	CAFB 1994	X	X			
Blg 3060 B East	*	12/28/1994	CAFB 1994	X	X			
Blg 3060 B West	*	12/28/1994	CAFB 1994	X	X			
April 1995								
CAFB-FAC3060-01	9-11	4/11/1995	USGS 1995				X	Field screening only, result was nondetect
CAFB-FAC3060-02	9-11	4/11/1995	USGS 1995			X		
CAFB-FAC3060-02	14-16	4/11/1995	USGS 1995			X		
CAFB-FAC3060-03	9-11	4/11/1995	USGS 1995			X		
CAFB-FAC3060-03	14-16	4/11/1995	USGS 1995			X		
CAFB-FAC3060-04	9-11	4/11/1995	USGS 1995			X		
CAFB-FAC3060-05	9-11	4/11/1995	USGS 1995			X		
CAFB-FAC3060-06	9-11	4/11/1995	USGS 1995			X		
CAFB-FAC3060-07	9-10	4/11/1995	USGS 1995				X	Field screening only, result was nondetect
June 1995								
CAFB-FAC3060-08	10-12	6/28/1995	USGS 1995			X		
CAFB-FAC3060-09	9-11	6/28/1995	USGS 1995			X		
CAFB-FAC3060-10	11-13	6/28/1995	USGS 1995			X		
CAFB-FAC3060-11	10-12	6/28/1995	USGS 1995			X		
July 1995								
CAFB-FAC3060-03	24	7/25/1995	USGS 1995			X		
August 1995								
CAFB-FAC3060-12	12-14	8/23/1995	USGS 1995			X		
CAFB-FAC3060-13	11-13	8/23/1995	USGS 1995			X		Duplicate
			Totals	**10**	**10**	**14**	**2**	

Sources:

United States Geological Survey. 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico.

Cannon Air Force Base. 1994. 7-Day Written Notification for a Petroleum Release at Facility 3060.

Notes:

*Exact depth of these samples is unknown, estimated depth is 11 feet bgs based on tank depth and previous sampling depths.

bgs = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
CAFB = Cannon Air Force Base
DRO = diesel range organics
EPA = Environmental Protection Agency
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbons
USGS = United States Geological Survey

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	3060A NE Corner 11 December 15, 1994			3060A SE Corner 11 December 15, 1994			3060A SW Corner 11 December 15, 1994		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Toluene	3.40E-02	3/10	NE	5.27E+03	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
m-Xylene	3.10E-02	5/10	NE	7.74E+02	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
o-Xylene	5.20E-02	7/10	NE	8.98E+02	<	1.00E-03	U	9.00E-03	1.00E-03		<	1.00E-03	U
p-Xylene	1.70E-02	1/10	NE	NE	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	<	1.00E-03	U	9.00E-03	1.00E-03		<	1.00E-03	U
MTBE	ND	0/10	NE	9.01E+02	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	1.59E+01	unknown		1.08E+01	unknown		1.96E+01	unknown	
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	NA			NA			NA		

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	3060A NW Corner 11 December 15, 1994			3060B NE Corner 11 December 15, 1994			3060B NW Corner 11 December 15, 1994		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Toluene	3.40E-02	3/10	NE	5.27E+03	<	1.00E-03	U	3.40E-02	1.00E-03		1.10E-02	1.00E-03	
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	<	1.00E-03	U	4.00E-02	1.00E-03		7.40E-02	1.00E-03	
m-Xylene	3.10E-02	5/10	NE	7.74E+02	<	1.00E-03	U	1.70E-02	1.00E-03		2.20E-02	1.00E-03	
o-Xylene	5.20E-02	7/10	NE	8.98E+02	<	1.00E-03	U	2.60E-02	1.00E-03		5.20E-02	1.00E-03	
p-Xylene	1.70E-02	1/10	NE	NE	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	<	1.00E-03	U	4.30E-02	1.00E-03		7.40E-02	1.00E-03	
MTBE	ND	0/10	NE	9.01E+02	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	6.30E+00	unknown		3.08E+02	unknown		**1.78E+03**	unknown	
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	NA			NA			NA		

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	3060B SE Corner 11 December 15, 1994			3060B SW Corner 11 December 15, 1994			Blg 3060 B East * December 28, 1994		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Toluene	3.40E-02	3/10	NE	5.27E+03	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	1.10E-02	1.00E-03		<	1.00E-03	U	<	1.00E-03	U
m-Xylene	3.10E-02	5/10	NE	7.74E+02	5.00E-03	1.00E-03		3.00E-03	1.00E-03		<	1.00E-03	U
o-Xylene	5.20E-02	7/10	NE	8.98E+02	1.80E-02	1.00E-03		1.10E-02	1.00E-03		2.80E-02	1.00E-03	
p-Xylene	1.70E-02	1/10	NE	NE	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	2.30E-02	1.00E-03		1.40E-02	1.00E-03		2.80E-02	1.00E-03	
MTBE	ND	0/10	NE	9.01E+02	<	1.00E-03	U	<	1.00E-03	U	<	1.00E-03	U
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	2.31E+02	unknown		1.19E+02	unknown		1.07E+02	unknown	
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	NA			NA			NA		

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	Blg 3060 B West * December 28, 1994 Result	RL	Qual	CAFB-FAC3060-02 9-11 April 11, 1995 Result	RL	Qual	CAFB-FAC3060-02 14-16 April 11, 1995 Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	<	1.00E-03	U	NA			NA		
Toluene	3.40E-02	3/10	NE	5.27E+03	2.90E-02	1.00E-03		NA			NA		
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	4.50E-02	1.00E-03		NA			NA		
m-Xylene	3.10E-02	5/10	NE	7.74E+02	3.10E-02	1.00E-03		NA			NA		
o-Xylene	5.20E-02	7/10	NE	8.98E+02	4.20E-02	1.00E-03		NA			NA		
p-Xylene	1.70E-02	1/10	NE	NE	1.70E-02	1.00E-03		NA			NA		
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	9.00E-02	1.00E-03		NA			NA		
MTBE	ND	0/10	NE	9.01E+02	<	1.00E-03	U	NA			NA		
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	**1.03E+03**	unknown		NA			NA		
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	NA			**1.30E+03**	4.00E+01		8.70E+00	4.00E+00	Q

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	CAFB-FAC3060-03 9-11 April 11, 1995			CAFB-FAC3060-03 14-16 April 11, 1995			CAFB-FAC3060-03 24 July 25, 1995		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	NA			NA			NA		
Toluene	3.40E-02	3/10	NE	5.27E+03	NA			NA			NA		
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	NA			NA			NA		
m-Xylene	3.10E-02	5/10	NE	7.74E+02	NA			NA			NA		
o-Xylene	5.20E-02	7/10	NE	8.98E+02	NA			NA			NA		
p-Xylene	1.70E-02	1/10	NE	NE	NA			NA			NA		
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	NA			NA			NA		
MTBE	ND	0/10	NE	9.01E+02	NA			NA			NA		
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	NA			NA			NA		
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	**5.30E+03**	4.00E+02		2.30E+01	4.00E+00		7.80E+01	4.00E+00	

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	CAFB-FAC3060-04 9-11 April 11, 1995			CAFB-FAC3060-05 9-11 April 11, 1995			CAFB-FAC3060-06 9-11 April 11, 1995		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	NA			NA			NA		
Toluene	3.40E-02	3/10	NE	5.27E+03	NA			NA			NA		
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	NA			NA			NA		
m-Xylene	3.10E-02	5/10	NE	7.74E+02	NA			NA			NA		
o-Xylene	5.20E-02	7/10	NE	8.98E+02	NA			NA			NA		
p-Xylene	1.70E-02	1/10	NE	NE	NA			NA			NA		
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	NA			NA			NA		
MTBE	ND	0/10	NE	9.01E+02	NA			NA			NA		
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	NA			NA			NA		
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	4.30E+00	4.00E+00	Q	3.20E+00	4.00E+00	J	3.70E+01	4.00E+00	

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	CAFB-FAC3060-08 10-12 June 28, 1995			CAFB-FAC3060-09 9-11 June 28, 1995			CAFB-FAC3060-10 11-13 June 28, 1995		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	NA			NA			NA		
Toluene	3.40E-02	3/10	NE	5.27E+03	NA			NA			NA		
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	NA			NA			NA		
m-Xylene	3.10E-02	5/10	NE	7.74E+02	NA			NA			NA		
o-Xylene	5.20E-02	7/10	NE	8.98E+02	NA			NA			NA		
p-Xylene	1.70E-02	1/10	NE	NE	NA			NA			NA		
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	NA			NA			NA		
MTBE	ND	0/10	NE	9.01E+02	NA			NA			NA		
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	NA			NA			NA		
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	1.50E+01	4.00E+00	Q	4.00E+01	4.00E+00	Q	1.60E+02	4.00E+00	Q

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-10
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	CAFB-FAC3060-11 10-12 June 28, 1995			CAFB-FAC3060-12 12-14 August 23, 1995			CAFB-FAC3060-13 11-13 August 23, 1995		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
Benzene	ND	0/10	NE	1.54E+01	NA			NA			NA		
Toluene	3.40E-02	3/10	NE	5.27E+03	NA			NA			NA		
Ethylbenzene	7.40E-02	4/10	NE	6.84E+01	NA			NA			NA		
m-Xylene	3.10E-02	5/10	NE	7.74E+02	NA			NA			NA		
o-Xylene	5.20E-02	7/10	NE	8.98E+02	NA			NA			NA		
p-Xylene	1.70E-02	1/10	NE	NE	NA			NA			NA		
Total Xylenes	9.00E-02	7/10	NE	8.14E+02	NA			NA			NA		
MTBE	ND	0/10	NE	9.01E+02	NA			NA			NA		
TRPH (mg/kg)	1.78E+03	10/10	1.00E+03	NE	NA			NA			NA		
TPH-DRO (mg/kg)	5.30E+03	12/14	1.00E+03	NE	2.20E+01	4.00E+00	Q	<	4.00E+00	U	<	4.00E+00	U

Notes:
*Approximately 11 feet bgs
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
Results that exceed the corresponding screening guideline appear in boldface and are underlined.

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
FID = flame ionization detector
GC = gas chromatograph
ID = identification
J = estimated or below reporting limit
mg/kg = milligrams per kilogram
MTBE = methyl tertiary butyl ether
NA = not analyzed
ND = not detected
NE = none established
NMED = New Mexico Environment Department
Q = this sample has GC/FID characteristics for which reliable identification of a product could not beachieved
Qual = qualifier
RL = reporting limit
SSL = soil screening levels
TPH = total petroleum hydrocarbons
TRPH = total recoverable petroleum hydrocarbon
U = nondetect

TABLE 4-11
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	BTEX (EPA 8260)	PCBs (EPA 8082)	TPH-DRO (EPA 8015)	Note(s)
June 2009							
C507-100	1-3	6/23/2009	URS 2009	X	X	X	MS/MSD, PID reading = 0.0 ppm
C507-101	1-3	6/25/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C507-102	1-3	6/23/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C507-103	1-3	6/25/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C507-104	1-3	6/25/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C507-105	1-3	6/25/2009	URS 2009	X	X	X	Duplicate, PID reading = 0.0 ppm
C507-106	1-3	6/25/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
C501-107	1-3	6/25/2009	URS 2009	X	X	X	PID reading = 0.0 ppm
			Totals	**8**	**8**	**8**	

Source:

URS Group, Inc. 2009. Final Evaluation Report. Cannon Air Force Base. Air Force Compliance Clean-up Sites, Identification and Evaluation of DERA Eligibility for AFCEE, Multiple Locations, Prepared for the United States Army Corps of Engineers, Tulsa District.

Notes:

bgs = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
EPA = Environmental Protection Agency
MS/MSD = matrix spike/matrix spike duplicate
PCB = polychlorinated biphenyl
PID = photoionization detector
ppm = parts per million
TPH = total petroleum hydrocarbons
URS = URS Group, Inc.

TABLE 4-12
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER PETROLEUM, OIL AND LUBRICANTS (POL) YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	C507-100 1-3 June 23, 2009			C507-101 1-3 June 25, 2009			C507-102 1-3 June 23, 2009		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
All BTEX compounds were nondetect	ND	0/8											
PCBs (mg/kg)													
PCB 1016	ND	0/8	NE	3.93E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1221	ND	0/8	NE	1.49E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1232	ND	0/8	NE	1.49E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1242	ND	0/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1248	ND	0/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1254	ND	0/8	NE	1.12E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1260	2.80E-02 F	1/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
TPH-DRO (mg/kg)	7.10E+00 F	3/8	1.00E+03	NE	6.30E+00	1.10E+01	F	<	1.10E+01	U	5.80E+00	1.20E+01	F

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
MDL = method detection limit
mg/kg = milligrams per kilogram
ND = not detected
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyls
Qual = qualifier
RL = reporting limit
SSL = Soil Screening Level
TPH = total petroleum hydrocarbon
U = nondetect

TABLE 4-12
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER PETROLEUM, OIL AND LUBRICANTS (POL) YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	C507-103 1-3 June 25, 2009			C507-104 1-3 June 25, 2009			C507-105 1-3 June 25, 2009		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
All BTEX compounds were nondetect	ND	0/8											
PCBs (mg/kg)													
PCB 1016	ND	0/8	NE	3.93E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1221	ND	0/8	NE	1.49E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1232	ND	0/8	NE	1.49E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1242	ND	0/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1248	ND	0/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1254	ND	0/8	NE	1.12E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
PCB 1260	2.80E-02 F	1/8	NE	2.22E+00	<	5.00E-02	U	<	5.00E-02	U	<	5.00E-02	U
TPH-DRO (mg/kg)	7.10E+00 F	3/8	1.00E+03	NE	<	1.20E+01	U	7.10E+00	1.20E+01	F	<	1.20E+01	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
MDL = method detection limit
mg/kg = milligrams per kilogram
ND = not detected
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyls
Qual = qualifier
RL = reporting limit
SSL = Soil Screening Level
TPH = total petroleum hydrocarbon
U = nondetect

TABLE 4-12
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
FORMER PETROLEUM, OIL AND LUBRICANTS (POL) YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (FEET BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	C507-106 1-3 June 25, 2009			C507-107 1-3 June 25, 2009		
					Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)										
All BTEX compounds were nondetect	ND	0/8								
PCBs (mg/kg)										
PCB 1016	ND	0/8	NE	3.93E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1221	ND	0/8	NE	1.49E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1232	ND	0/8	NE	1.49E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1242	ND	0/8	NE	2.22E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1248	ND	0/8	NE	2.22E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1254	ND	0/8	NE	1.12E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
PCB 1260	2.80E-02 F	1/8	NE	2.22E+00	2.80E-02	5.00E-02	F	<	5.00E-02	U
TPH-DRO (mg/kg)	7.10E+00 F	3/8	1.00E+03	NE	<	1.10E+01	U	<	1.20E+01	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
MDL = method detection limit
mg/kg = milligrams per kilogram
ND = not detected
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyls
Qual = qualifier
RL = reporting limit
SSL = Soil Screening Level
TPH = total petroleum hydrocarbon
U = nondetect

TABLE 4-13
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval (feet bgs)	Sample Date	Source	BTEX (EPA 8260)	PCBs (EPA 8082)	TPH-DRO (EPA 8015)	RCRA Metals (EPA 6010B/7470A/7471A)	Note(s)
June 2009								
C508-100	0-1	6/23/2009	URS 2009	X	X	X	X	PID reading = 0.0 ppm
C508-100	1-3	6/23/2009	URS 2009	X	X	X	X	PID reading = 0.0 ppm
C508-101	0-1	6/23/2009	URS 2009	X	X	X	X	MS/MSD, PID reading = 0.0 ppm
C508-101	1-3	6/23/2009	URS 2009	X	X	X	X	PID reading = 0.0 ppm
C508-102	0-1	6/23/2009	URS 2009	X	X	X	X	PID reading = 0.0 ppm
C508-102	1-3	6/23/2009	URS 2009	X	X	X	X	Duplicate, MS/MSD, PID reading = 0.0 ppm
			Totals	**6**	**6**	**6**	**6**	

Source:

URS Group, Inc. 2009. Final Evaluation Report. Cannon Air Force Base. Air Force Compliance Clean-up Sites, Identification and Evaluation of DERA Eligibility for AFCEE, Multiple Locations, Prepared for the United States Army Corps of Engineers, Tulsa District.

Notes:

bgs = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
EPA = Environmental Protection Agency
MS/MSD = matrix spike/matrix spike duplicate
NA = not applicable
PCB = polychlorinated biphenyl
PID = photoionization detector
ppm = parts per million
RCRA = Resource Conservation and Recovery Act
TPH = total petroleum hydrocarbons
URS = URS Group, Inc.

TABLE 4-14
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	C508-100 0-1 June 23, 2009			C508-100 1-3 June 23, 2009			C508-101 0-1 June 23, 2009		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
All BTEX compounds were nondetect	ND	0/6											
PCBs (mg/kg)													
All PCBs were nondetect	ND	0/6											
RCRA METALS (mg/kg)													
Arsenic	3.30E+00	6/6	NE	3.90E+00	2.60E+00	2.80E-01		2.40E+00	3.00E-01		2.50E+00	2.80E-01	
Barium	3.07E+02	6/6	NE	1.56E+04	3.07E+02	5.70E-02		1.18E+02	6.50E-02		1.14E+02	5.80E-02	
Cadmium	2.00E+00	5/6	NE	7.03E+01	4.50E-01	1.40E-02		1.50E-01	1.50E-02		3.30E-01	1.40E-02	
Chromium	1.08E+01	6/6	NE	1.17E+05	6.70E+00	4.40E-02		9.30E+00	5.00E-02		9.30E+00	4.50E-02	
Lead	2.80E+01	6/6	NE	4.00E+02	1.66E+01	1.10E-01		1.52E+01	1.10E-01		1.71E+01	1.10E-01	
Mercury	2.70E-02	6/6	NE	1.56E+01	1.60E-02	3.80E-03		1.90E-02	3.80E-03		2.70E-02	3.80E-03	
Selenium	ND	0/6	NE	3.91E+02	<	2.40E-01	U	<	2.70E-01	U	<	3.60E-01	U
Silver	1.00E+00	4/6	NE	3.91E+02	6.10E-01	7.40E-02		3.70E-01	8.40E-02		1.00E+00	7.60E-02	
TPH-DRO (mg/kg)	1.20E+02	4/6	1.00E+03	NE	1.20E+02	2.10E+01		5.50E+00	1.10E+01	F	4.50E+01	2.10E+01	

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
J = estimated
MDL = method detection limit
mg/kg = milligrams per kilogram
NA = not available
ND = not detected
NE = not established
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RCRA = Resource Conservation and Recovery Act
RL = reporting limit
SSL = Soil Screening Level
TPH = total petroleum hydrocarbons
U = nondetect

TABLE 4-14
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH (BGS) DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	C508-101 1-3 June 23, 2009			C508-102 0-1 June 23, 2009			C508-102 1-3 June 23, 2009		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
BTEX (mg/kg)													
All BTEX compounds were nondetect	ND	0/6											
PCBs (mg/kg)													
All PCBs were nondetect	ND	0/6											
RCRA METALS (mg/kg)													
Arsenic	3.30E+00	6/6	NE	3.90E+00	2.50E+00	3.00E-01		3.30E+00	2.80E-01		2.40E+00	2.90E-01	
Barium	3.07E+02	6/6	NE	1.56E+04	6.27E+01	6.30E-02		1.14E+02	5.80E-02		7.43E+01	6.20E-02	
Cadmium	2.00E+00	5/6	NE	7.03E+01	<	1.50E-02	U	2.00E+00	1.40E-02		9.30E-02	1.50E-02	
Chromium	1.08E+01	6/6	NE	1.17E+05	8.90E+00	4.80E-02		1.08E+01	4.40E-02		8.00E+00	4.70E-02	
Lead	2.80E+01	6/6	NE	4.00E+02	1.30E+01	1.10E-01		2.80E+01	1.10E-01		1.49E+01	1.10E-01	
Mercury	2.70E-02	6/6	NE	1.56E+01	1.20E-02	3.80E-03		1.40E-02	3.80E-03		9.80E-03	3.80E-03	
Selenium	ND	0/6	NE	3.91E+02	<	2.60E-01	U	<	2.40E-01	U	<	2.50E-01	U
Silver	1.00E+00	4/6	NE	3.91E+02	<	8.10E-02	U	2.70E-01	7.50E-02		<	8.00E-02	U
TPH-DRO (mg/kg)	1.20E+02	4/6	1.00E+03	NE	<	1.10E+01	U	5.70E+01	2.10E+01		<	1.10E+01	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)

< = not detected
BGS = below ground surface
BTEX = benzene, toluene, ethylbenzene and total xylenes
DRO = diesel range organics
F = result between MDL and RL
ID = identification
J = estimated
MDL = method detection limit
mg/kg = milligrams per kilogram
NA = not available
ND = not detected
NE = not established
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RCRA = Resource Conservation and Recovery Act
RL = reporting limit
SSL = Soil Screening Level
TPH = total petroleum hydrocarbons
U = nondetect

TABLE 4-15
SUMMARY OF PREVIOUS SAMPLES FOR CHEMICAL ANALYSIS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

Sample Location/ Identification	Depth Interval	Sample Date	Source	PCBs (EPA 8082)	Pesticides (EPA 8081A)	TPH (EPA 418.1)	RCRA Metals (EPA 6010B/7470A/7471A)	Note(s)
December 1999								
244SS001	surface of excavation	12/14/1999	Parallax 2000	X	X	X	X	
244SS002	surface of excavation	12/14/1999	Parallax 2000	X	X	X	X	
244SS003	surface of excavation	12/14/1999	Parallax 2000	X	X	X	X	
244SS004	surface of excavation	12/14/1999	Parallax 2000	X	X	X	X	MS/MSD, Field Duplicate
244SS005	surface of excavation	12/14/1999	Parallax 2000	X	X	X	X	
244SS006	4 feet bgs	12/14/1999	Parallax 2000	X	X	X	X	
244SS007	2.5 feet bgs	12/14/1999	Parallax 2000	X	X	X	X	
244SS008	3.5 feet bgs	12/14/1999	Parallax 2000	X	X	X	X	
			Totals	**8**	**8**	**8**	**8**	

Source:

Parallax, Inc. 2000. Closeout Report/Contamination Assessment, SWMU 129-Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, Final. July.

Notes:

bgs = below ground surface

EPA = Environmental Protection Agency

MS/MSD = matrix spike/matrix spike duplicate

PCB = polychlorinated biphenyl

RCRA = Resource Conservation and Recovery Act

TPH = total petroleum hydrocarbons

SWMU = Solid Waste Management Unit

TABLE 4-16
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	244SS01 surface of excavation December 14, 1999			244SS02 surface of excavation December 14, 1999			244SS03 surface of excavation December 14, 1999		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
ORGANOCHLORINE PESTICIDES (mg/kg)													
All pesticides were nondetect	ND	0/8											
PCBs (mg/kg)													
All PCBs were nondetect	ND	0/8											
RCRA METALS (mg/kg)													
Arsenic	1.20E+01	8/8	NE	3.90E+00	7.80E+00	unknown		7.00E+00	unknown		1.20E+01	unknown	
Barium	3.80E+02	8/8	NE	1.56E+04	7.90E+01	unknown		4.60E+01	unknown		1.30E+02	unknown	
Cadmium	1.80E+00	8/8	NE	7.03E+01	1.20E+00	unknown		8.50E-01	unknown		1.60E+00	unknown	
Chromium	9.60E+00	6/8	NE	1.17E+05	7.70E+00	unknown		<	5.50E+00	U	9.60E+00	unknown	
Lead	1.30E+01	8/8	NE	4.00E+02	7.30E+00	unknown		5.90E+00	unknown		1.00E+01	unknown	
Mercury	ND	0/8	NE	1.56E+01	<	5.80E-01	U	<	5.50E-01	U	<	5.90E-01	U
Selenium	2.00E+01	2/8	NE	3.91E+02	<	5.80E+00	U	<	5.50E+00	U	<	5.90E+00	U
TPH (mg/kg)	3.00E+02	3/8	1.00E+03	NE	<	1.00E+01	U	<	1.00E+01	U	<	1.00E+01	U

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
bgs = below ground surface
ID = identification
mg/kg = milligrams per kilogram
NA = not available
ND = not detected
NE = not established
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RCRA = Resource Conservation and Recovery Act
RL = reporting limit
SSL = Soil Screening Level
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons
U = nondetect

TABLE 4-16
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

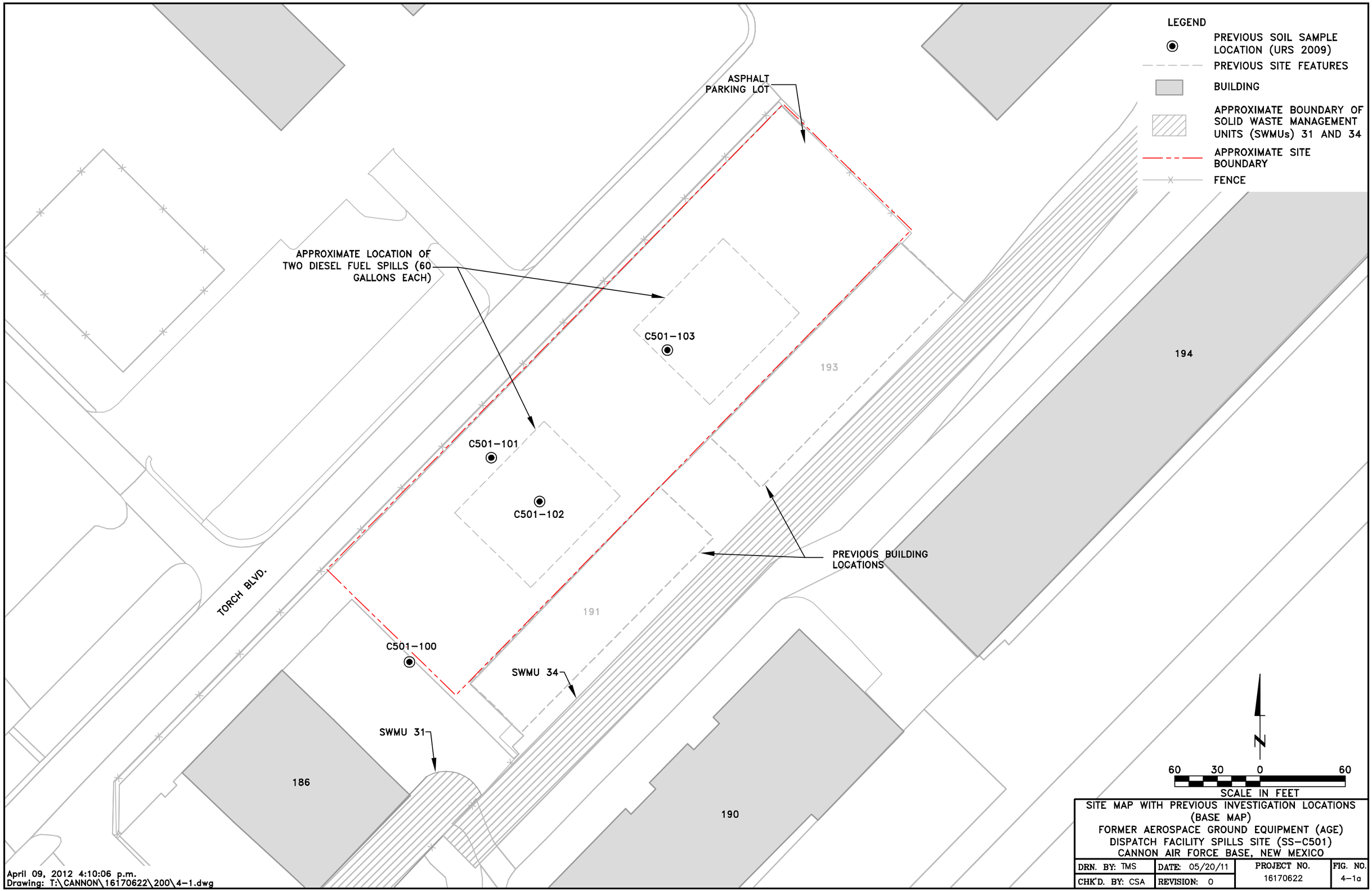
FIELD ID SAMPLE DEPTH DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	244SS04 surface of excavation December 14, 1999			244SS05 surface of excavation December 14, 1999			244SS06 4 feet bgs December 14, 1999		
					Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
ORGANOCHLORINE PESTICIDES (mg/kg)													
All pesticides were nondetect	ND	0/8											
PCBs (mg/kg)													
All PCBs were nondetect	ND	0/8											
RCRA METALS (mg/kg)													
Arsenic	1.20E+01	8/8	NE	3.90E+00	5.80E+00	unknown		8.40E+00	unknown		7.60E+00	unknown	
Barium	3.80E+02	8/8	NE	1.56E+04	4.80E+01	unknown		5.50E+01	unknown		3.80E+02	unknown	
Cadmium	1.80E+00	8/8	NE	7.03E+01	9.00E-01	unknown		1.10E+00	unknown		1.10E+00	unknown	
Chromium	9.60E+00	6/8	NE	1.17E+05	<	5.60E+00	U	6.90E+00	unknown		5.60E+00	unknown	
Lead	1.30E+01	8/8	NE	4.00E+02	6.20E+00	unknown		9.40E+00	unknown		1.30E+01	unknown	
Mercury	ND	0/8	NE	1.56E+01	<	5.60E-01	U	<	5.60E-01	U	<	5.50E-01	U
Selenium	2.00E+01	2/8	NE	3.91E+02	<	5.60E+00	U	<	5.60E+00	U	<	5.50E+00	U
TPH (mg/kg)	3.00E+02	3/8	1.00E+03	NE	<	1.00E+01	U	<	1.00E+01	U	3.00E+02	NA	

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
bgs = below ground surface
ID = identification
mg/kg = milligrams per kilogram
NA = not available
ND = not detected
NE = not established
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RCRA = Resource Conservation and Recovery Act
RL = reporting limit
SSL = Soil Screening Level
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons
U = nondetect

TABLE 4-16
SUMMARY OF PREVIOUS ANALYTICAL DATA AND SCREENING RESULTS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

FIELD ID SAMPLE DEPTH DATE COLLECTED	Maximum	Frequency	NMED TPH Screening Guidelines[1] Residential Direct Exposure - Soil	NMED SSLs[2] for Residential Soil	244SS07 2.5 feet bgs December 14, 1999			244SS08 3.5 feet bgs December 14, 1999		
					Result	RL	Qual	Result	RL	Qual
ORGANOCHLORINE PESTICIDES (mg/kg)										
All pesticides were nondetect	ND	0/8								
PCBs (mg/kg)										
All PCBs were nondetect	ND	0/8								
RCRA METALS (mg/kg)										
Arsenic	1.20E+01	8/8	NE	3.90E+00	1.10E+01	unknown		6.60E+00	unknown	
Barium	3.80E+02	8/8	NE	1.56E+04	1.70E+02	unknown		1.20E+02	unknown	
Cadmium	1.80E+00	8/8	NE	7.03E+01	1.80E+00	unknown		1.60E+00	unknown	
Chromium	9.60E+00	6/8	NE	1.17E+05	8.50E+00	unknown		7.30E+00	unknown	
Lead	1.30E+01	8/8	NE	4.00E+02	1.30E+01	unknown		9.40E+00	unknown	
Mercury	ND	0/8	NE	1.56E+01	<	5.70E-01	U	<	5.60E-01	U
Selenium	2.00E+01	2/8	NE	3.91E+02	2.00E+01	unknown		1.70E+01	unknown	
TPH (mg/kg)	3.00E+02	3/8	1.00E+03	NE	1.00E+02	NA		4.00E+01	NA	

Notes:
[1]Residential Direct Exposure for unknown oil screening guideline (Table 6-3) (NMED 2012)
[2] NMED Residential Soil Screening Levels (NMED 2012)
< = not detected
bgs = below ground surface
ID = identification
mg/kg = milligrams per kilogram
NA = not available
ND = not detected
NE = not established
NMED = New Mexico Environment Department
PCB = polychlorinated biphenyl
Qual = qualifier
RCRA = Resource Conservation and Recovery Act
RL = reporting limit
SSL = Soil Screening Level
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons
U = nondetect



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
FORMER AEROSPACE GROUND EQUIPMENT (AGE) DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO. 16170622	FIG. NO. 4-1a
CHK'D. BY: CSA	REVISION: 0		

April 09, 2012 4:10:06 p.m.
Drawing: T:\CANNON\16170622\200\4-1.dwg

SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
FORMER AEROSPACE GROUND EQUIPMENT (AGE)
DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO. 16170622	FIG. NO. 4-1b
CHK'D. BY: CSA	REVISION: 0		

LEGEND

- PREVIOUS SOIL SAMPLE LOCATION (USGS 1995)
- PREVIOUS SOIL SAMPLE LOCATION (APPROXIMATE) (LCI2 1995)
- PREVIOUS SITE FEATURES
- BUILDING
- APPROXIMATE SITE BOUNDARY
- FENCE

SIDEWALK

D L INGRAM BLVD

SIDEWALK

ASPHALT

GRASS

CAFB-FAC0368-13

CAFB-FAC0368-14

CAFB-FAC0368-12

CAFB-FAC0368-16

CAFB-FAC0368-10

CAFB-FAC0368-17

CAFB-FAC0368-15

CAFB-FAC0368-11

APPROXIMATE LOCATION OF FORMER PUMP ISLANDS

COVERED DRIVE-THRU

APPROXIMATE FORMER LOCATION OF HYDRAULIC LIFTS

368

ASPHALT PARKING LOT

CAFB-FAC0368-08

NC-UST-EX

APPROXIMATE LIMITS OF UST EXCAVATION

CAFB-FAC0368-02

NWS-UST-EX

CAFB-FAC0368-03

APPROXIMATE LOCATION OF FORMER UST C (10,000 GALLON)

WC-UST-EX

EC-UST-EX

CAFB-FAC0368-01

CAFB-FAC0368-04

CAFB-FAC0368-05

SES-UST-EX

CAFB-FAC0368-09

APPROXIMATE LOCATION OF FORMER UST B (10,000 GALLON)

CAFB-FAC0368-07

SC-UST-EX

CAFB-FAC0368-06

APPROXIMATE LOCATION OF FORMER UST A (10,000 GALLON)

SIDEWALK

KERMIT EVANS AVE

N

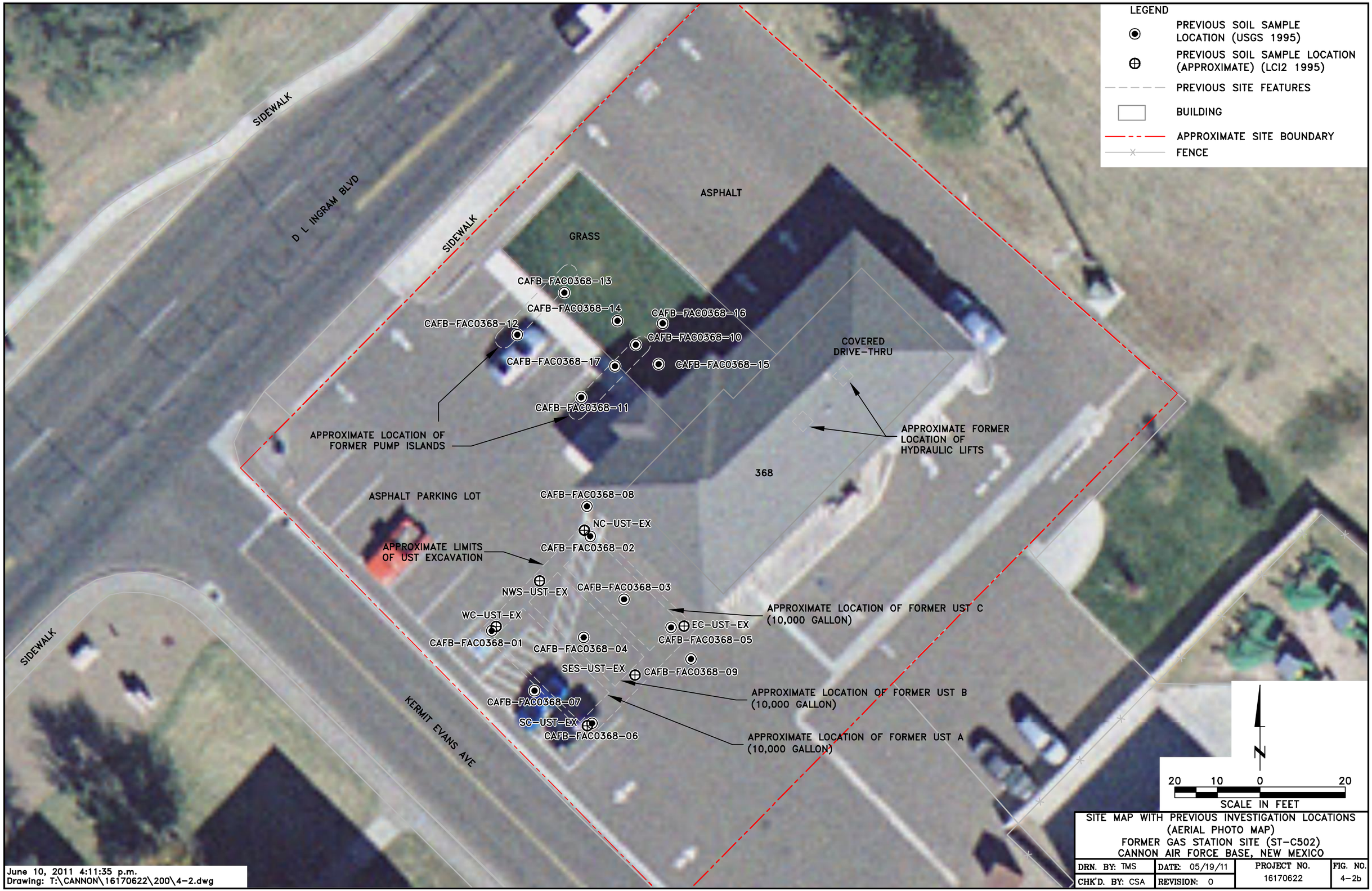
20 10 0 20

SCALE IN FEET

SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
FORMER GAS STATION SITE (ST-C502)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/19/11	PROJECT NO. 16170622	FIG. NO. 4-2a
CHK'D. BY: CSA	REVISION: 0		

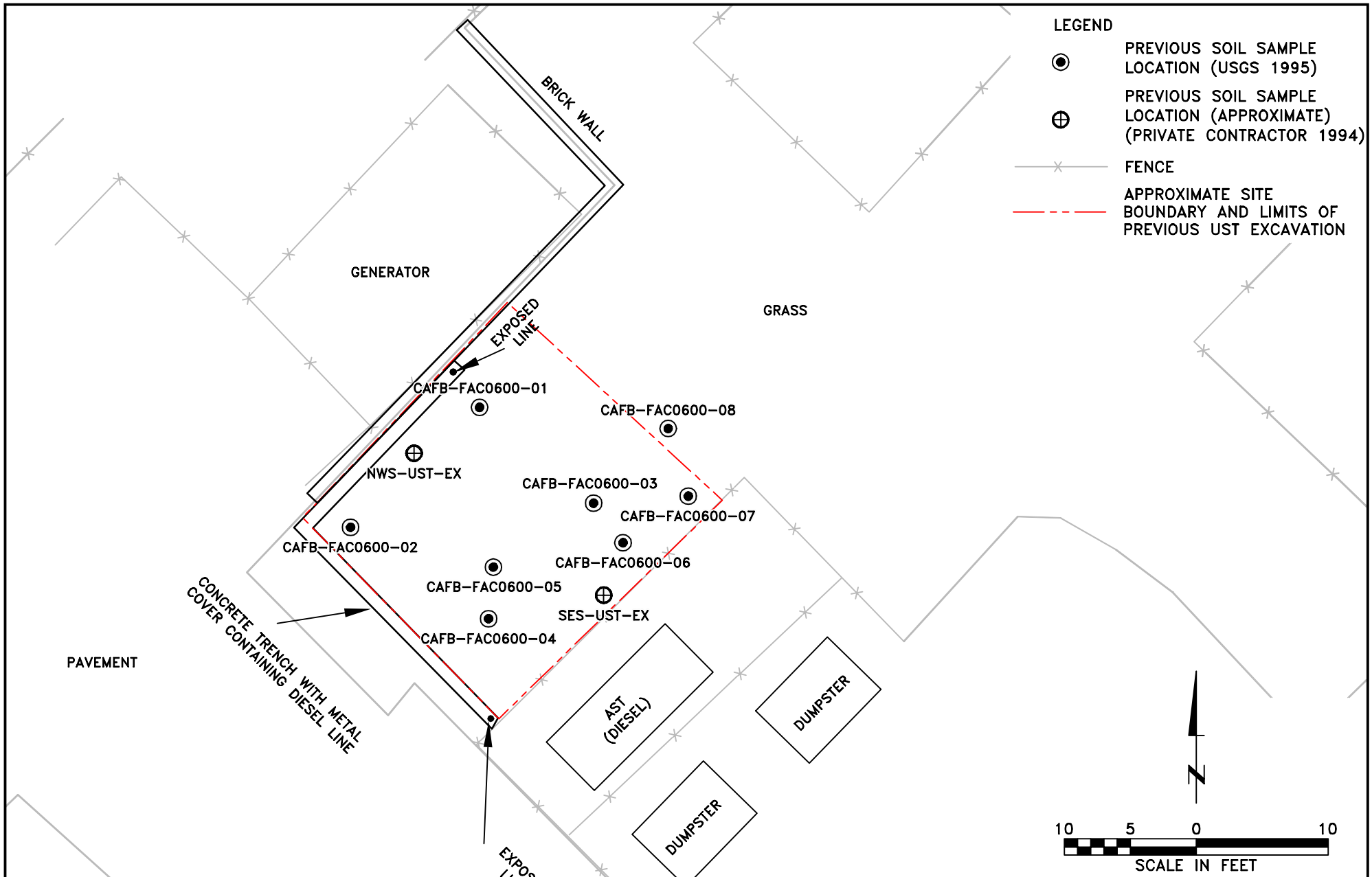
June 10, 2011 4:10:51 p.m.
Drawing: T:\CANNON\16170622\200\4-2.dwg



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
FORMER GAS STATION SITE (ST-C502)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/19/11	PROJECT NO. 16170622	FIG. NO. 4-2b
CHK'D. BY: CSA	REVISION: 0		

June 10, 2011 4:11:35 p.m.
Drawing: T:\CANNON\16170622\200\4-2.dwg



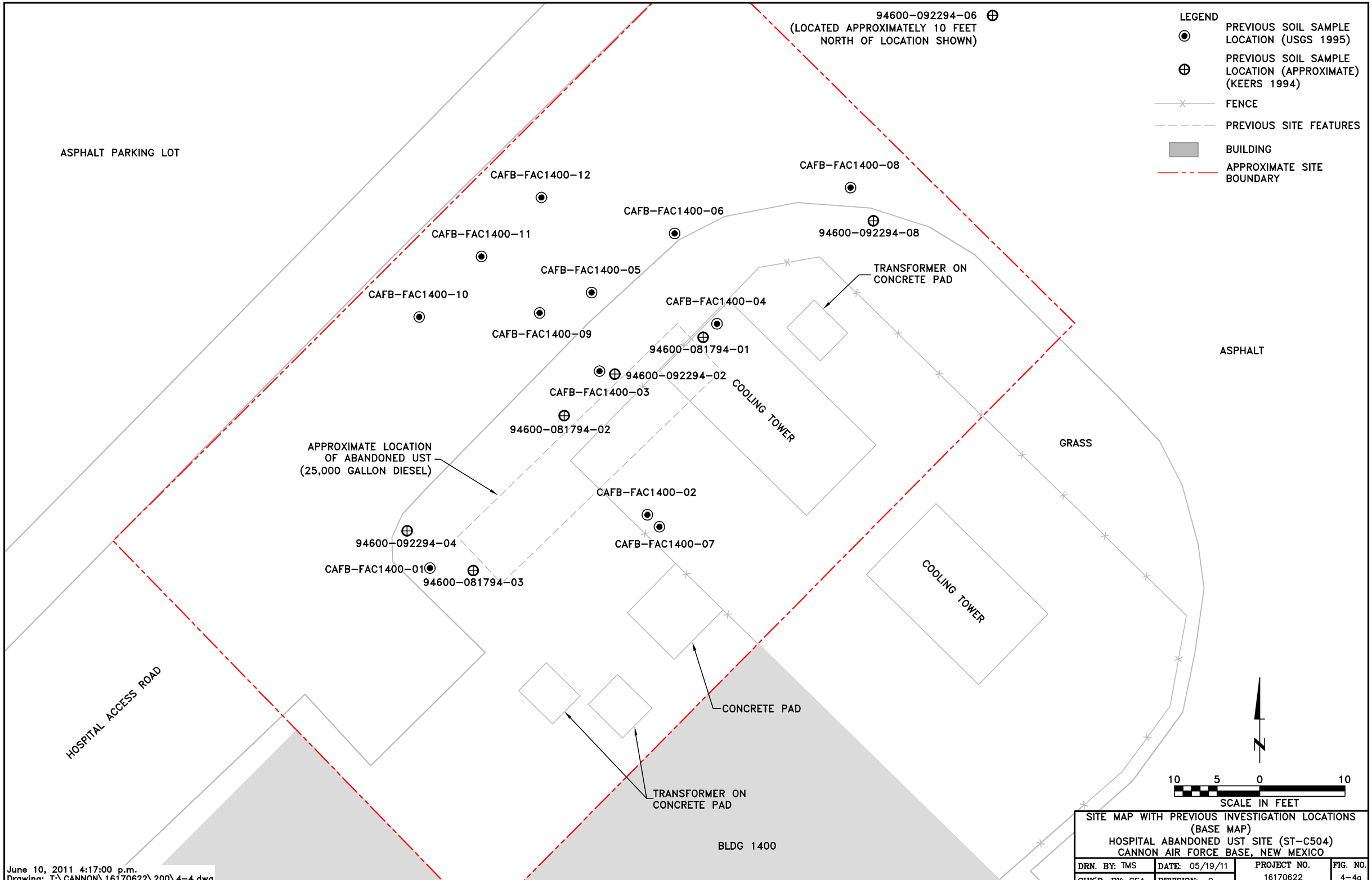
SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	4-3a

April 09, 2012 4:21:00 p.m.
Drawing: T:\CANNON\16170622\200\4-3.dwg

SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (AERIAL PHOTO MAP
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/19/11	PROJECT NO. 16170622	FIG. NO. 4-3b
CHK'D. BY: CSA	REVISION: 0		

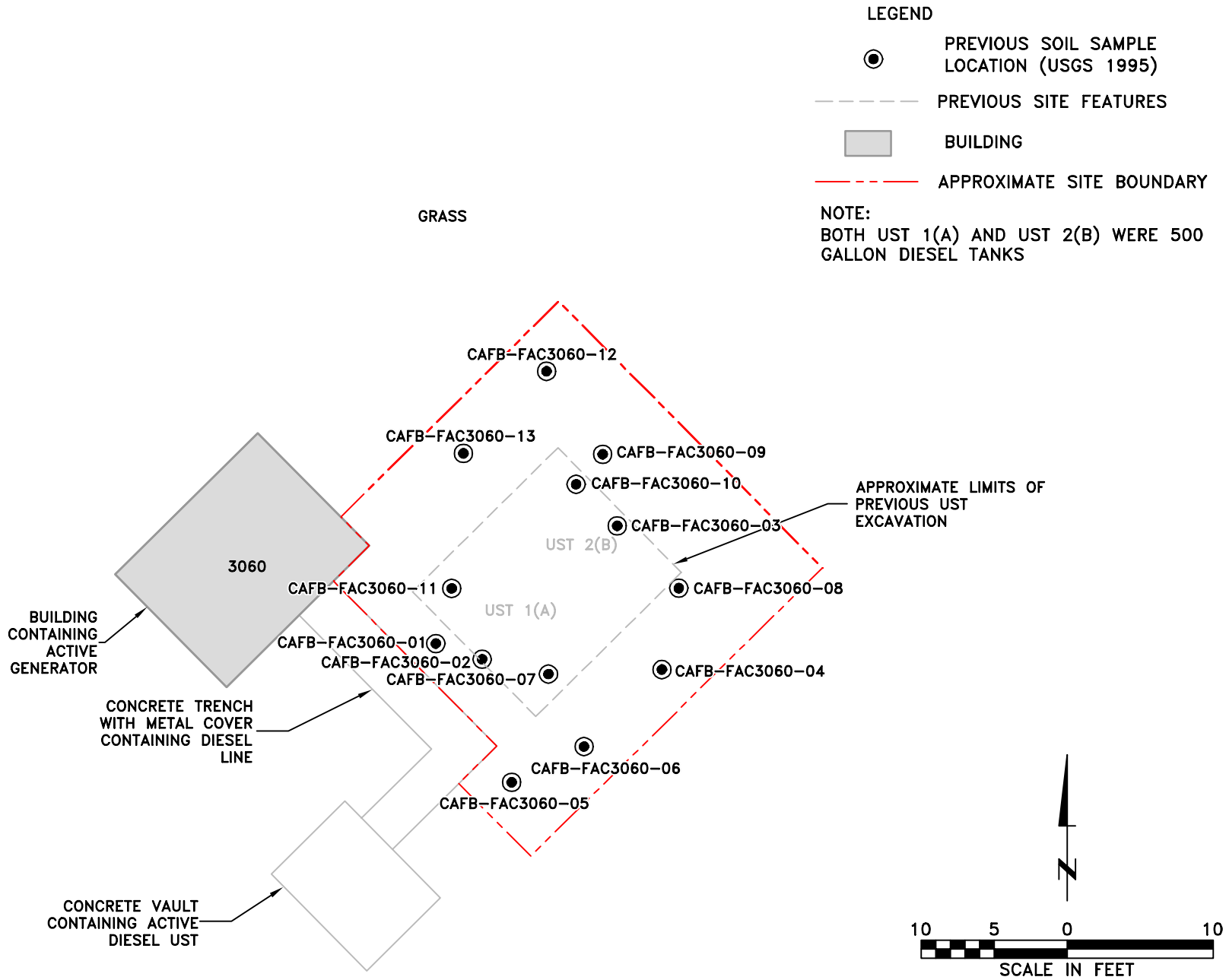


SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/19/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	4-4a

SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AIR FORCE BASE, NEW MEXICO

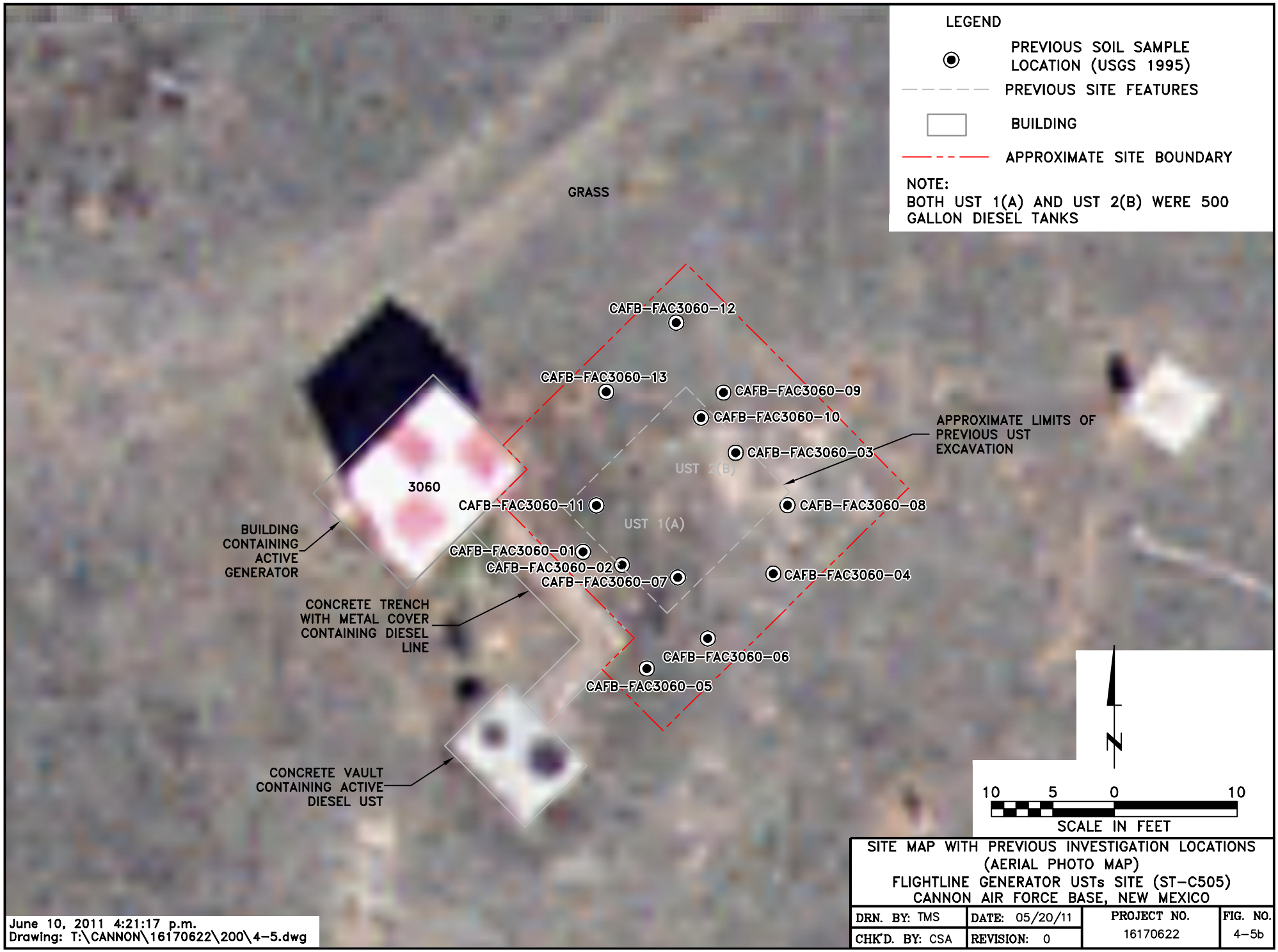
DRN. BY: TMS	DATE: 05/19/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	4-4b



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
FLIGHTLINE GENERATOR USTs SITE (ST-C505)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO. 16170622	FIG. NO. 4-5a
CHK'D. BY: CSA	REVISION: 0		

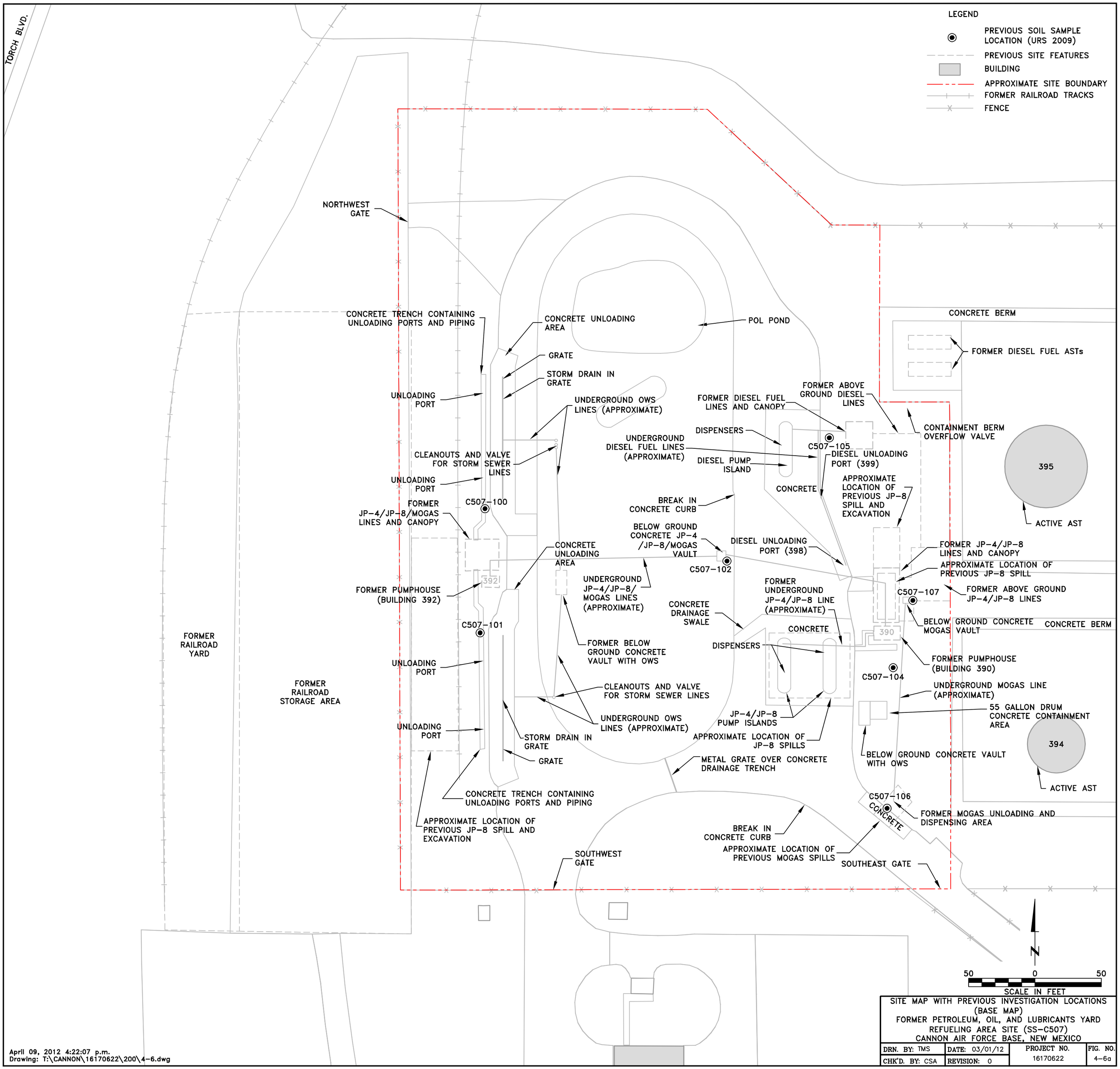
June 10, 2011 4:20:51 p.m.
Drawing: T:\CANNON\16170622\200\4-5.dwg



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
FLIGHTLINE GENERATOR USTs SITE (ST-C505)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	4-5b

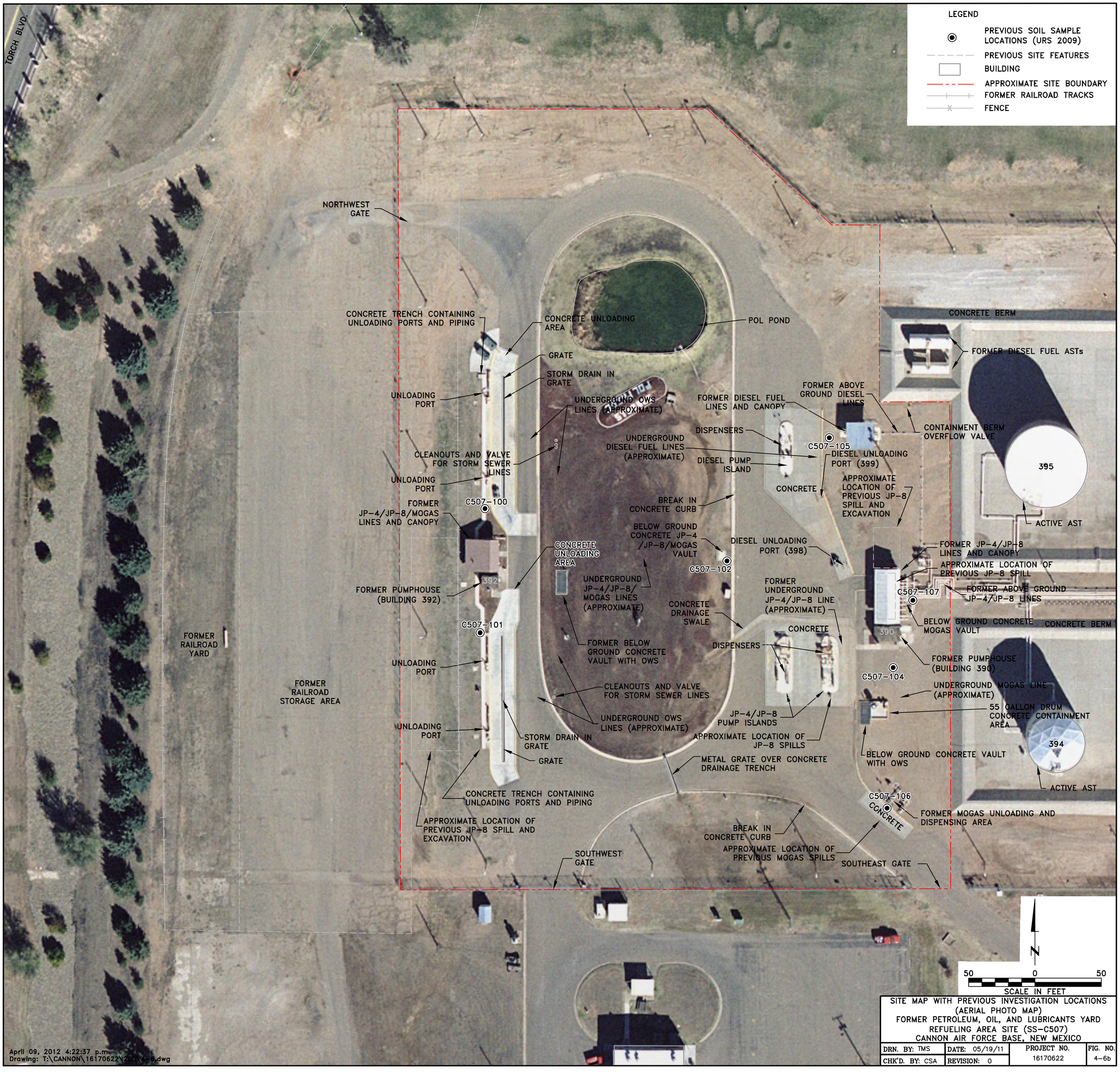
June 10, 2011 4:21:17 p.m.
Drawing: T:\CANNON\16170622\200\4-5.dwg



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
FORMER PETROLEUM, OIL, AND LUBRICANTS YARD REFUELING AREA SITE (SS-C507)
CANNON AIR FORCE BASE, NEW MEXICO

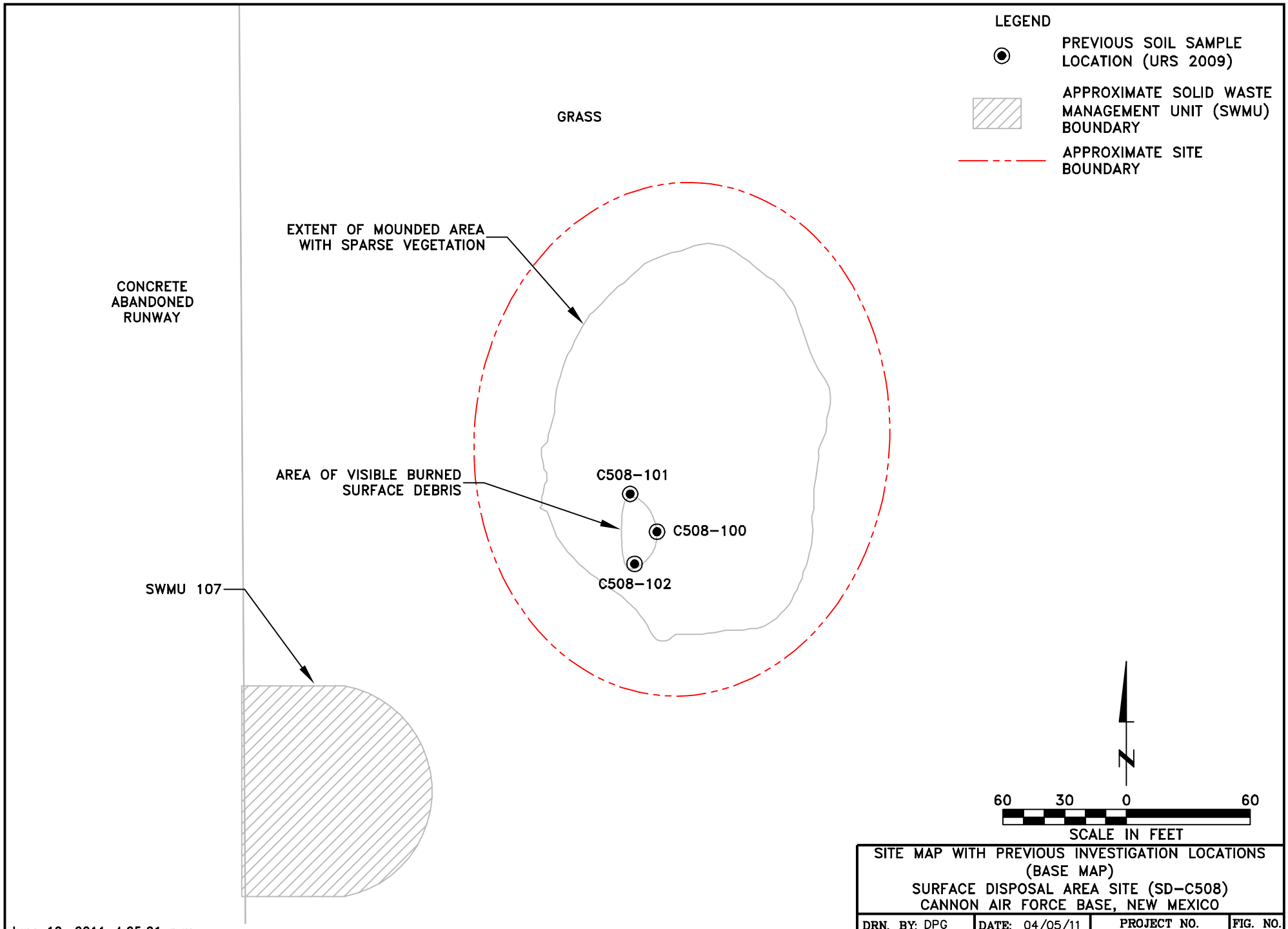
DRN. BY: TMS	DATE: 03/01/12	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	4-6a

April 09, 2012 4:22:07 p.m.
Drawing: T:\CANNON\16170622\200\4-6.dwg



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
FORMER PETROLEUM, OIL, AND LUBRICANTS YARD
REFUELING AREA SITE (SS-C507)
CANNON AIR FORCE BASE, NEW MEXICO

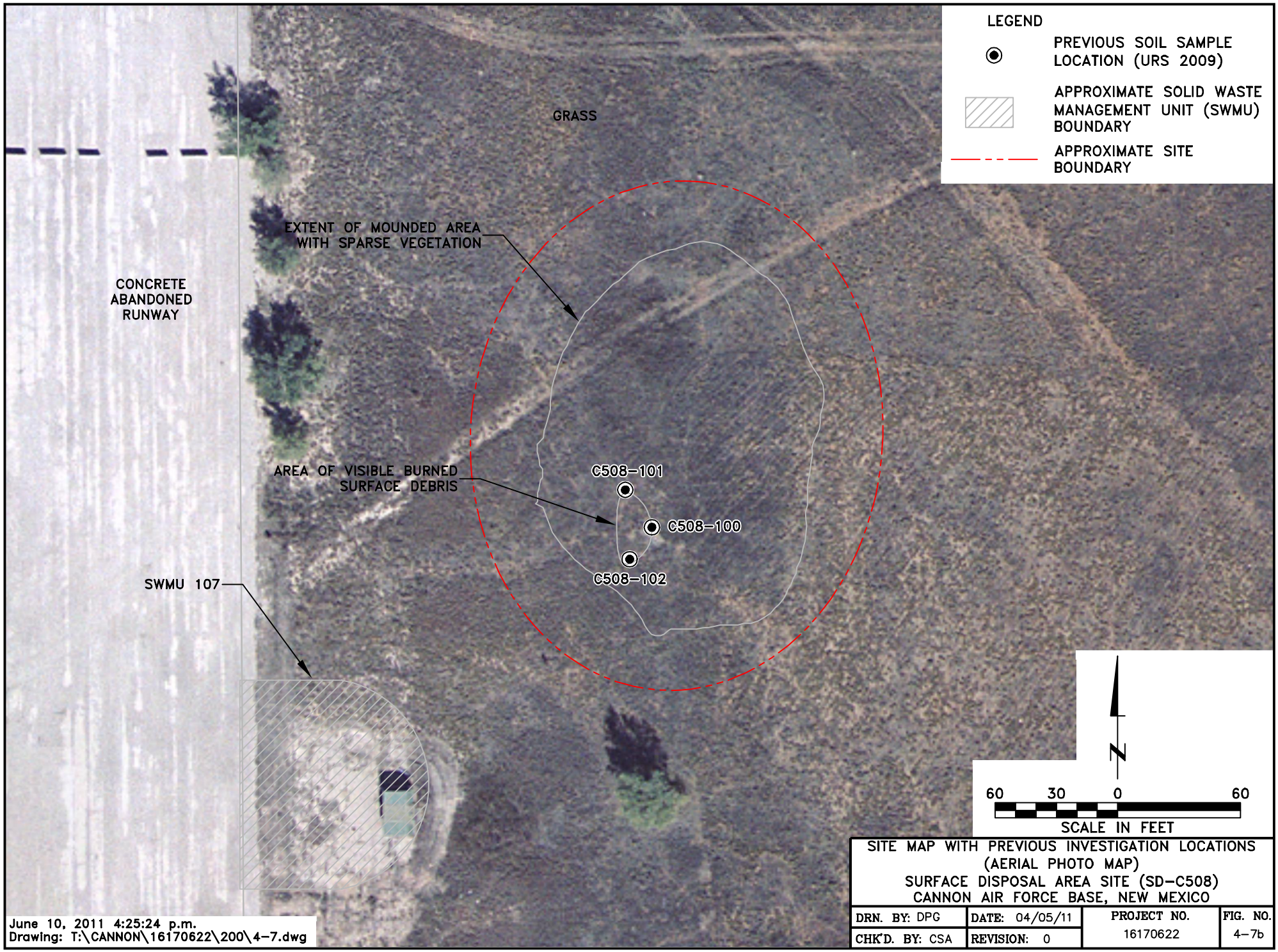
DRN. BY: TMS	DATE: 05/19/11	PROJECT NO. 16170622	FIG. NO. 4-6b
CHK'D. BY: CSA	REVISION: 0		



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/05/11	PROJECT NO. 16170622	FIG. NO. 4-7a
CHK'D. BY: CSA	REVISION: 0		

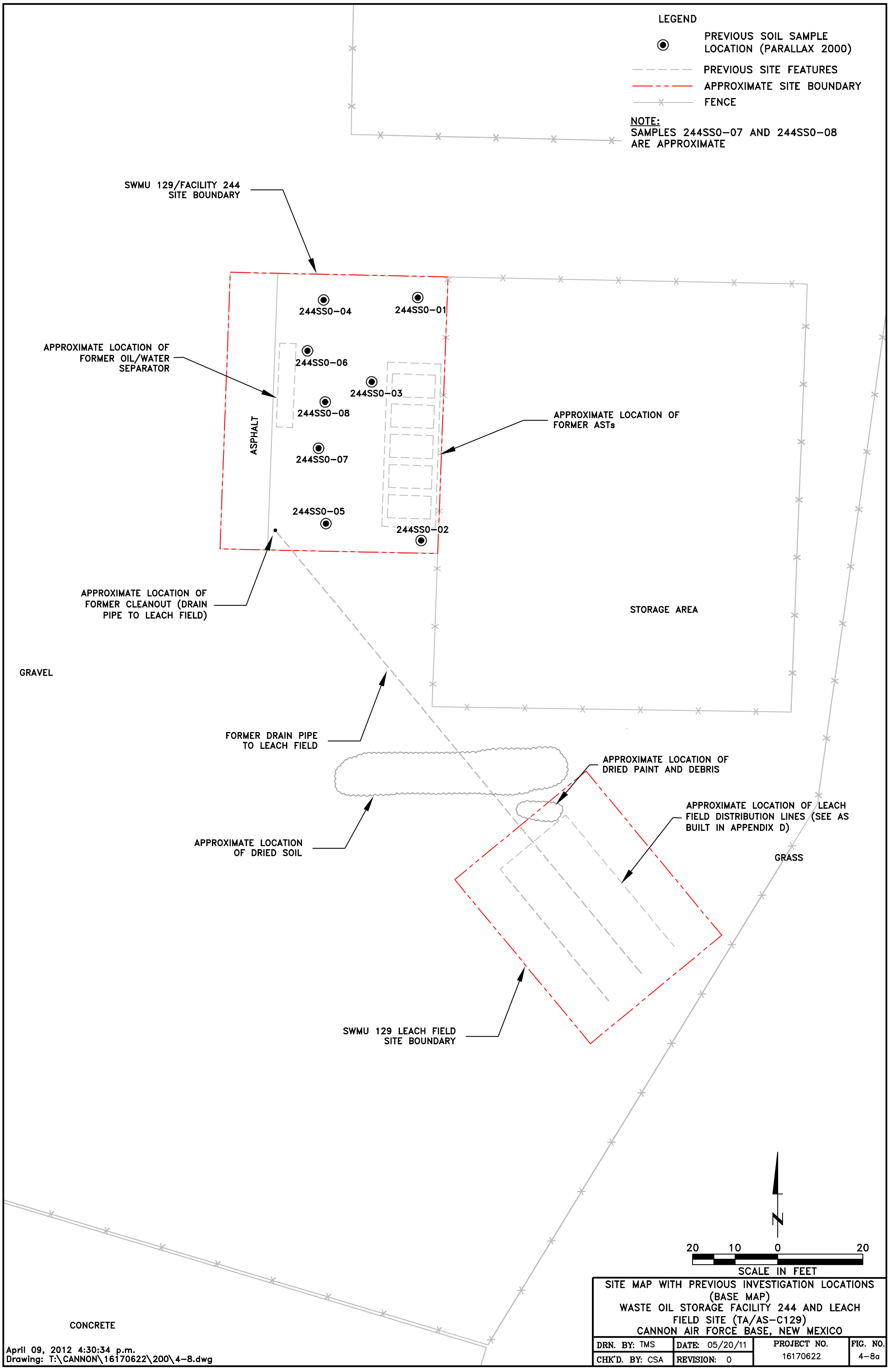
June 10, 2011 4:25:01 p.m.
Drawing: T:\CANNON\16170622\200\4-7.dwg



SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS
(AERIAL PHOTO MAP)
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 04/05/11	PROJECT NO. 16170622	FIG. NO. 4-7b
CHK'D. BY: CSA	REVISION: 0		

June 10, 2011 4:25:24 p.m.
Drawing: T:\CANNON\16170622\200\4-7.dwg


LEGEND
PREVIOUS SOIL SAMPLE LOCATION (PARALLAX 2000)
PREVIOUS SITE FEATURES
APPROXIMATE SITE BOUNDARY
FENCE
NOTE:
SAMPLES 244SS0-07 AND 244SS0-08 ARE APPROXIMATE
SWMU 129/FACILITY 244 SITE BOUNDARY
244SS0-04
244SS0-01
APPROXIMATE LOCATION OF FORMER OIL/WATER SEPARATOR
244SS0-06
244SS0-03
244SS0-08
ASPHALT
APPROXIMATE LOCATION OF FORMER ASTs
244SS0-07
244SS0-05
244SS0-02
APPROXIMATE LOCATION OF FORMER CLEANOUT (DRAIN PIPE TO LEACH FIELD)
STORAGE AREA
GRAVEL
FORMER DRAIN PIPE TO LEACH FIELD
APPROXIMATE LOCATION OF DRIED PAINT AND DEBRIS
APPROXIMATE LOCATION OF LEACH FIELD DISTRIBUTION LINES (SEE AS BUILT IN APPENDIX D)
APPROXIMATE LOCATION OF DRIED SOIL
GRASS
SWMU 129 LEACH FIELD SITE BOUNDARY
N
20 10 0 20
SCALE IN FEET
CONCRETE
April 09, 2012 4:30:34 p.m.
Drawing: T:\CANNON\16170622\200\4-8.dwg
SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (BASE MAP)
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AIR FORCE BASE, NEW MEXICO
DRN. BY: TMS
DATE: 05/20/11
PROJECT NO. 16170622
FIG. NO. 4-8a
CHK'D. BY: CSA
REVISION: 0

SITE MAP WITH PREVIOUS INVESTIGATION LOCATIONS (AERIAL PHOTO MAP)
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: TMS	DATE: 05/20/11	PROJECT NO. 16170622	FIG. NO. 4-8b
CHK'D. BY: CSA	REVISION: 0		

This section provides an overview of the planned field activities for eight sites at Cannon AFB. Planned soil sampling locations, sample depths, analytical parameters, QC and matrix spike/matrix spike duplicate (MS/MSD) sampling locations, and technical rationale are summarized for each site in **Tables 5-1** through **5-8**. Final soil sampling depths will be based on previous sampling results, field observations (e.g., color and odor), and headspace analysis. QC and MS/MSD samples will be collected at a 10 percent frequency. Planned soil sampling locations are shown for each site on **Figures 5-1a** through **5-8b**. Based on the data collected from each site, additional to be determined (TBD) soil borings will be completed at locations to help further define the horizontal and vertical extent of potential contamination at each site. Additional TBD borings may also be used to advance planned borings to deeper depths in order to help define the vertical extent of contamination. Additional TBD borings with sample quantities are provided for each site in **Tables 5-1** through **5-8**.

The initial portion of this FSP describes the general investigative approach and protocols that will be followed during the soil sampling event. Following the general FSP sections, site-specific sampling locations and supporting rationale are provided on a site-by-site basis. Field investigation activities will be completed in accordance with the procedures detailed in this FSP.

5.1 MOBILIZATION

Mobilization of equipment and personnel will be completed prior to the start of field activities. The mobilization activities will include, but are not limited to, the tasks described in the following sections.

5.1.1 Acquire Base Passes

Field personnel and subcontractors will coordinate with the Cannon AFB RPM to acquire passes that will allow entry onto Cannon AFB to complete the planned activities.

5.1.1.1 Contractor Identification

Prior to the initiation of each field investigation, URS personnel and all subcontractors on-site will be identified to appropriate personnel within the 27th Civil Engineer Squadron's Environmental Flight (27 CES/CEV). 27 CES/CEV will make all arrangements to notify base personnel and security of the pending field investigation. It is likely that on-site URS personnel and subcontractors will be issued base visitor passes, which they will be required to have with them at all times while on base. In addition, all URS personnel and URS subcontractors may be required to attend a safety briefing provided by the base.

5.1.1.2 Vehicle Passes

All vehicles that enter the base must be registered at the Main Gate, and obtain and display a vehicle permit tag from base security. The vehicle registration applicant will need to furnish proof of insurance, rental agreement (if applicable), a valid driver's license, and the contract

number to register a vehicle. The tag shall be displayed in the lower driver's side corner of the windshield.

5.1.2 Facility Safety Requirements

URS will take preventative measures required for safe work activities at Cannon AFB. URS will follow all procedures necessary to ensure that the safe practices employed comply with Occupational Safety and Health Administration (OSHA), American National Standards Institute (ANSI), and Cannon AFB regulations.

URS will provide an SSO at all times during completion of the investigations. The SSO, as well as all project personnel, will observe the safety procedures to provide a safe work environment.

Prior to the start of field activities, a site walk will be completed at each site to identify possible safety concerns. Possible safety concerns may include physical hazards (e.g., underground/overhead utilities, holes, or uneven terrain), biological hazards, or explosives hazards (e.g., unexploded ordinance [UXO]). Although UXO is not anticipated during the execution of the project, URS field personnel will contact Cannon AFB EOD personnel to verify there is no possibility of UXO at the sites (primarily the Surface Disposal Area Site [SD-C508]). If UXO is encountered during this or any phase of work at Cannon AFB, all work will stop and the URS PM, Health and Safety Representative, and the UXO Corporate Safety Manager (Mac Reed, 615-224-2148) will immediately be notified. Cannon AFB and AFCEE will immediately be notified by the URS PM. In general, the following MEC safety protocol will be followed:

- DO NOT touch or move any ordnance items regardless of the markings or apparent condition.
- DO NOT be misled by markings on the MEC item stating “practice bomb,” “dummy,” or “inert.” Even practice bombs have explosive charges that are used to mark and/or spot the point of impact; or the item could be marked incorrectly.
- The age or condition of a MEC item does not decrease the effectiveness. MEC that has been exposed to the elements for an extended period of time becomes more sensitive to shock, movement, and friction because the stabilizing agent in the explosives may be degraded.
- Consider MEC that has been exposed to fire as extremely hazardous. Chemical and physical changes to the contents may have occurred that render it more sensitive than it was in its original state.
- DO NOT use radio or cellular phones in the vicinity of suspect MEC items.
- DO NOT drive vehicles into a suspected MEC area; use clearly marked lanes.
- DO NOT carry matches, cigarettes, lighters or other flame-producing devices into a MEC site.
- Always assume MEC items contain a live charge until determined otherwise.

5.1.3 Locate Utilities

URS will obtain utility clearances prior to the start of any intrusive activities. Utility locates will be coordinated with the Cannon AFB RPM. The utility clearances will be requested sufficiently in advance and will be completed by 27th Special Operations, Civil Engineering Squadron (27 SOCES). All underground utilities identified will be marked with flagging, stakes, and/or paint. All utility location tasks will be documented in the field logbook to aid in subsequent work. No intrusive work using heavy equipment will be completed within 5 feet of an active utility.

Digging permits will be obtained for all subsurface activities prior to initiating the work. Digging permits will be obtained through the appropriate United States Air Force (USAF) representative. When any intrusive work is being performed in the vicinity of utility and/or communication cables/lines, Civil Engineering and/or Communication monitoring personnel, as required, will be present. If a utility and/or communication line is damaged, the designated representative of the USAF shall be notified immediately for further directions.

Notice will be given to the monitoring personnel no later than 24 hours prior to work. No work shall start if the required monitoring personnel are not present.

5.1.4 Surveying of Soil Borings

Soil borings will be located in the field using predetermined survey coordinates loaded into a hand held GPS unit. The GPS unit will have sub-meter accuracy. The horizontal survey coordinates will reference the North American Datum of 1983 (NAD83) State Plane Coordinate System (i.e., New Mexico East, Federal Information Processing Standard [FIPS] 3001 [in survey feet]). Prior to the start of field activities, the GPS unit will be calibrated to a known reference point located at Cannon AFB. The results of the calibration will be recorded in the field logbook. Final sampling locations may be adjusted slightly in the field based on site conditions (i.e., underground/overhead utilities, access restrictions, permanent site features, etc.). At the completion of field activities, all final soil boring locations will be surveyed at once, along with a known reference point at Cannon AFB.

5.2 SURFACE SOIL SAMPLE COLLECTION

Surface soil samples (identified as SS) will be collected to determine if potential contamination exists in the upper 0 to 0.5 feet bgs. Surface soil samples will be collected by hand using either stainless-steel hand utensils or hand auger. Surface soil sample collection methods are provided in the following sections.

5.2.1 Surface Soil Sampling Using Hand Utensils

This method of soil sample collection is to be used at Cannon AFB in situations where conditions will not permit the use of auger or drilling methods. Soil samples will be collected from 0 to 0.5 feet bgs using a stainless steel spoon and stainless steel bowl. Before the sampling

begins, vegetation or surface debris such as rock, will be cleared as necessary. When collecting surface soil samples, if additional soil is necessary to fill sample jars, the sample area will be expanded without increasing depth.

5.2.2 Surface Soil Sampling Using a Hand Auger

This method of soil sample collection is to be used at Cannon AFB in situations where conditions will not permit the use of hand utensils or drilling methods. Hand auger samples will be collected at the specified depth using a stainless steel hand auger with a minimum 3-inch outer diameter (OD) bucket. Before the augering activities, vegetation and any surface debris such as rocks will be cleared, as necessary. When collecting surface soil samples, if additional soil is necessary to fill sample jars, an additional borehole will be advanced adjacent to the initial borehole, without increasing depth.

5.2.3 Surface Soil Analytical Sample Collection

Surface soil sample collection will begin by recording the boring location on a site map and in the field logbook. Once the sample has been collected at the specified depths, the recovery will be measured and the soil classified. The sample will be handled quickly, especially if it is loose or crumbling, to avoid losing volatile contaminants. VOCs and BETX+naphthalene will be collected using TerraCore® samplers. The TerraCore® sampler is a single use device and cannot be cleaned and/or reused. The TerraCore® sampler is designed to sample and momentarily hold soil before dispensing soil into sample container. Three separate 5-gram soil plugs from the TerraCore® sampler will be placed in three separate pre-weighed VOA vials. One VOA will contain methanol, and the other two VOA vials will contain organic free water. VOC and BETX+naphthalene samples will be collected in place to minimize the potential for a disturbed sample. Soil to be analyzed for other parameters will be composited by thoroughly mixing the soil from the sampler or auger bucket in a clean stainless steel bowl with a stainless steel spoon. Any required SVOC samples will then be immediately collected from the composited soil. The remaining composited soil will then be transferred to the appropriate laboratory-provided sample containers. Laboratory samples will be placed on ice in a cooler immediately following collection, in order to attain a temperature of 4°C. Site-specific analytical parameters will be selected from the following: TPH-DRO, TPH-GRO, TPH-oil range organics (TPH-ORO), BTEX+napthalene, VOCs, site-related semivolatile organic compounds (SVOCs), SVOCs, pesticides, RCRA metals, lead, PCBs, and dioxins/furans.

Samples will be analyzed using the following methods:

- TPH-DRO by USEPA Method 8015C
- TPH-GRO by USEPA Method 8015C
- TPH-ORO by USEPA Method 8015C
- BTEX+naphthalene by USEPA Method 8260B
- Target Compound List (TCL) VOCs by USEPA Method 8260B

- Site-related SVOCs by USEPA Method 8270D
- TCL SVOCs by USEPA Method 8270D
- TCL pesticides 8081B
- RCRA metals USEPA Method 6020A
- Mercury USEPA Method 7471B
- PCBs by USEPA Method 8082A
- Explosives by USEPA Method 8330
- Dioxins/Furans by USEPA Method 8290

At sites or at locations within a site where petroleum-related contaminants are known to be the main COPCs (e.g., UST site), surface soil samples will be analyzed for BTEX+naphthalene and site-related SVOCs in lieu of TCL VOCs and TCL SVOCs. This will allow for more efficient screenings of petroleum release sites while protecting human health and the environment. The site-related SVOC list is derived from Table 3 of the NMED TPH Screening Guideline (NMED 2006) and includes the following analytes: 2-Methyl naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. A complete list of analytes included in each of the analyte groups listed above is provided in the UFP-QAPP (**Appendix A**) Worksheets 15 and 17.

Surface soil samples will be submitted to EMAX, located at 1835 West 205th Street, Torrance CA 90501, via FedEx. Surface soil samples submitted to EMAX will be extracted and analyzed for analytical parameters within maximum hold times. A complete list of maximum hold times for each analyte is provided in the UFP–QAPP (**Appendix A**) Worksheet 19.

Deleted: on a 21-day turnaround time

Final surface soil sampling locations will be photographed and located using a hand held GPS. Surface soil sample locations will be backfilled with soil. Surface soil samples will be collected at selected sites, as described in the site specific sampling objectives provided in **Sections 5.9** through **5.16**, and in **Tables 5-1** through **5-8**.

5.3 SUBSURFACE DRILLING AND SOIL SAMPLING

Subsurface drilling will be completed using direct push technology. At subsurface sample locations where pavement is present, a core machine with a diamond-tipped core barrel will be used to access the subsurface. Soil borings will be continuously sampled and each boring will be logged by the URS field geologist. Direct push technology was selected as the preferred sampling methodology in lieu of hollow stem auger, based on URS' previous drilling and sampling experience at Cannon AFB. It is also URS' experience that direct push technology is approved by NMED for subsurface soil sampling. PES, Salina Kansas, will complete the direct push sampling with oversight by the URS field manager. If direct push methods are unable to reach required sample depths, then a drilling rig with hollow stem auger and air-rotary capabilities will be used to advance the boring through the caliche layer in order to obtain

samples from the required depths. Talon/LPE of Amarillo, Texas, will complete the drill rig sampling, with oversight by the URS Field Manager.

Subsurface soil samples (identified as SB) will be collected to determine if potential contamination exists in the subsurface and to help further define the extent of known contamination in the subsurface. Subsurface soil samples will be collected using the Geoprobe Macro-Core sampler with 1.5-inch diameter, 5-foot-long, clear acetate liners. If hollow stem auger methods are employed, then samples will be collected continuously using a 2-foot-long, 2-inch diameter stainless steel, split-barrel sampler. As a last resort, air-rotary drilling methods will be employed in order to advance borings through the caliche layer. Subsurface drilling and soil sampling will be completed using the equipment and field procedures described in the following sub-sections.

5.3.1 Direct Push Sampling Procedures

Direct push sampling will be used to collect continuous or discrete soil samples. Direct push technology involves the use of probing tools that are advanced using a combination of the static weight of the carrier vehicle and hydraulic hammer percussion. Continuous soil samples will be collected with a Dual Tube soil sampler or a Macro-Core® sampler (closed-piston system) or equivalent. Discrete soil samples will be collected with a Macro-Core® sampler or equivalent. Direct push soil sample will be collected in clear acetate liners. Sample collection methods will be determined by site-specific geological conditions.

5.3.2 Drill Rig Sampling Procedures

If direct push methods are unable to reach required sample depths, then a drilling rig with hollow stem auger and air-rotary capabilities will be used to advance the boring through the caliche layer in order to obtain samples from the required depths. Hollow stem auger drilling will be accomplished using machine-driven hollow stem flight augers (HSA) with a 4.25-inch minimum inside diameter to accommodate a 2-inch outside diameter stainless-steel split spoon sampler. Where necessary for sample recovery, the sampler will also be equipped with a sample retainer.

As a last resort, air-rotary drilling methods will be employed in order to advance borings through the caliche layer. Air-rotary drilling will be accomplished using a 9-inch diameter wing bit and 4-inch outside diameter rods.

5.3.3 Subsurface Soil Analytical Sample Collection

Analytical soil samples will be collected using continuous sampling methods. Subsurface soil sample collection will begin by recording the boring location on a site map and in the field logbook. Once the sample has been collected at the specified depths, the recovery will be measured and the soil classified. VOC and BTEX+ naphthalene soil samples will be collected immediately after the acetate liner is cut, using the TerraCore® sampling methods (as previously described in **Section 5.2.3**). If the soil consistency precludes use of these samplers, then a 4-ounce glass jar will be used. Soil to be analyzed for other parameters will be composited by thoroughly mixing the soil from the acetate liner in a clean stainless steel bowl with a stainless steel spoon. Any required SVOC samples will then be immediately collected from the

composited soil. The remaining composited soil will then be transferred to the appropriate laboratory provided sample containers. Laboratory samples will be placed on ice in a cooler immediately following collection, in order to attain a temperature of 4°C.

Site specific analytical parameters will be selected from the following: TPH-DRO, TPH-GRO, TPH-ORO, BTEX+naphthalene, VOCs, site-related SVOCs, SVOCs, pesticides, RCRA metals, lead, PCBs, and dioxins/furans. Analytical methods and rationale for analyzing BTEX+naphthalene and site-related SVOCs in lieu of TCL VOCs and TCL SVOCs at petroleum release sites is the the same for subsurface soil samples as presented previously in **Section 5.2**. Samples submitted for laboratory analysis will generally be selected based on the results of field screening, as summarized below:

- If PID field screening results from a particular interval within a 5-foot-long sample are elevated, then the sample will be collected from that interval and the exact interval will be documented.
- If no elevated PID readings are obtained from a 5-foot interval, then the sample will be collected based on visual observations (if possible), and the exact interval will be documented.
- If no elevated PID readings are obtained and no visual evidence of possible contamination is encountered, then the sample for VOC analysis will be taken from the top 1-foot interval, and the sample for the remaining analytical parameters will be a composite sample comprised of several aliquots of soil collected from the entire 5-foot interval.

Subsurface soil samples will be sent to EMAX, located at 1835 West 205th Street, Torrance CA 90501, via FedEx. Subsurface soil samples submitted to EMAX will be extracted and analyzed for analytical parameters within maximum hold times. A complete list of maximum hold times for each analyte is provided in the UFP–QAPP (**Appendix A**) Worksheet 19.

Deleted: on a 21-day turnaround time

Final subsurface soil sampling locations will be photographed and located using a hand held GPS. Subsurface soil sample locations will be abandoned by backfilling the boreholes with hydrated bentonite. Subsurface soil samples will be collected at selected sites, as described in the site specific sampling objectives provided in **Sections 5.9** through **5.16**, and in **Tables 5-1** through **5-8**.

5.4 FIELD SCREENING AND HEADSPACE ANALYSIS

Subsurface soil samples collected in 5-foot-long clear acetate lines will be field screened with a MiniRae 2000 PID (or equivalent) for signs of potential contamination. Field screening will involve placing a small portion of soil from the liner or split-barrel sampler into a plastic sample bag for headspace analysis. The plastic bag containing the headspace sample will be sealed and shaken to expose the soil to air trapped in the bag. After a minimum of 5 minutes, a headspace reading will be taken by inserting the probe of the instrument into the bag through a small opening. The highest reading obtained for each 5-foot interval (and the depth at which the reading was obtained) will be recorded on the boring log and in the field logbook. In addition to the field screening with a PID, any odor or discoloration (from potential contamination) will be

noted in the boring log. Final soil sample depths will be determined in the field based on headspace results and any odors or discoloration observed.

Headspace analysis will also be completed for every surface and subsurface soil sample collected. The results of field screening and headspace analysis will be recorded on the boring logs and in the field logbook.

5.5 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

The following sections briefly describe sample management procedures to be used for the work described in this plan.

5.5.1 Field Documentation

Documentation of observations and data acquired in the field will be of sufficient detail to provide information on the sample acquisition and provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound, weatherproof field logbook with consecutively numbered pages.

5.5.1.1 Field Logbook Modifications and Signatures

Sufficient information will be recorded to allow the sampling event to be reconstructed without relying on the collector's memory. The person making the entry will sign each page in the field book at the end of the day. Changes or deletions in the field logbook will be lined out with a single strike mark and will remain legible. Changes/entries made in another person's field book will be sign and dated.

5.5.1.2 Boring Logs

Boring logs will be completed for each boring by qualified personnel (geologist, geological engineer, or geotechnical engineer). Boring logs will include boring location, boring identification, drilling equipment and method, date started and completed, completion depth, logger, description of lithologies (using Unified Soil Classification System), blow counts (if appropriate), samples collected for laboratory analysis by depth, sample recovery, field screening results, origin of the lithologies (e.g., fill, loess, glacial till, glacial outwash, alluvium or colluvium, etc.), and other remarks or observations.

5.5.1.3 Sample Collection Field Sheets

As part of the field documentation, Sample Collection Field Sheets (SCFSs) will be generated for all soil samples collected for this project. The SCFS will summarize the sample collection data (i.e., parameters), sample identification, time and date collected, container type(s), QA/QC samples, physical description, and name of sampler(s). A copy of the soil SCFS for this project is provided in **Appendix C**.

5.5.1.4 Sample Chain of Custody

During field sampling activities, sample tracking will be maintained from the time the samples are collected until the time at which the laboratory data are issued. Initial information concerning collection of the sample(s) will be recorded in the field logbook as described above. Information on the custody, transfer, handling, and shipping of samples to an off-site laboratory will be recorded on a chain of custody (CoC) form.

The sampler will be responsible for initiating and filling out the CoC form. The person responsible for packaging samples for delivery to the off-site laboratory will sign the CoC form, retain the last copy of the three-part form, document the method of shipment, and send the original and the second copy of the CoC form with the samples. A custody seal will be placed on each sample cooler prior to transfer of the cooler to the delivery company (i.e., FedEx) or the laboratory. Upon receipt of the cooler by the laboratory, the person receiving the samples will sign the CoC form and return the second copy. A copy of the CoC for this project is provided in **Appendix C**.

5.5.2 Sample Identification

Samples collected during site activities will have discrete sample identification numbers. These numbers are necessary to identify and track each of the samples collected for analysis during this project. In addition, the sample identification numbers will be used to identify and retrieve the analytical results received from the laboratory.

Each sample will be identified by a unique code that generally indicates the site, sampling location, sample type, and either sampling event or sampling depth. The sample designation for each analytical and QA/QC sample is a three-letter and seven-digit/letter unique identification (CA###-YYYY-ZZZ). "CA-###" is the facility and site identifier, with "CA" for Cannon AFB and "###" representing the number identifying this site. The sample designation for ST-C502 will start as "CA502-."

The next four characters (YYYY) identify the sampling method and specific sampled locations. The first two characters will present the method of sampling. "SB" for soil boring will be used as the first two characters. The last two characters will identify the sample location. Samples from the second soil boring at ST-C502 would be identified as "CA502-SB02-."

The last set of three numbers (ZZZ) is the sample identifier. The first number indicates the type of sample:

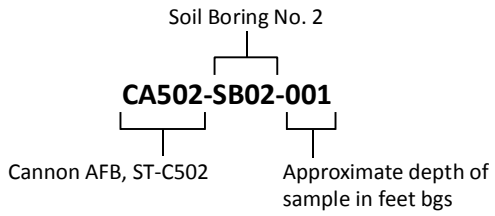
- 0 for a soil (analytical) sample
- 1 for a soil MS/MSD
- 2 for a field duplicate

The last two numbers correspond to the depth of the sample in feet bgs for all soil samples. Multiple soil samples may be collected from the same boring. The last two digits differentiate

among these multiple samples and represent the approximate depth (rounded up to the nearest foot) at which the sample was collected.

The MS/MSD should also be labeled the same as the original sample but will have "MS/MSD" written on the label.

The following is an example of an identification number:



5.5.3 Sample Labeling and Handling

All sample labels will be filled out using waterproof ink, and each label will contain the following information: sampler's initials, project name, sample identification, date and time of sample collection, method of preservation used, and sample matrix. Samples for VOCs and BTEX+naphthalene will be collected using the TerraCore® sampling method, which is described in **Section 5.2.3**. Samples for other constituents will be thoroughly homogenized and transferred to the appropriate sampling containers in accordance with the methods described in **Section 5.2.3**. The analytical laboratory will provide commercially cleaned containers. After collection, samples will be labeled as described above and placed into iced coolers. Coolers will be sealed with a custody seal and shipped to the contract laboratory. CoC forms will be maintained to document sample handling between the field and the laboratory. UFP-QAPP Worksheet #19 (**Appendix A**) summarizes the appropriate sample containers, preservation and holding times for the planned samples to be analyzed by the designated laboratory.

5.6 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

QA/QC samples will be collected according to the following schedule, as presented in the project UFP-QAPP:

- QC blind field duplicates will be collected at a frequency of about 10 percent of the total field samples. These samples will be submitted to the contract laboratory.
- MS/MSD field samples will be collected at a frequency of about 10 percent and will be submitted to the contract laboratory.
- Proficiency evaluation (PE) samples will be obtained from a certified provider and submitted to the contract laboratory as a one-time event. PE samples will be obtained and submitted for the full analyte list presented previously. Additional information regarding PE samples is provided in the UFP-QAPP (**Appendix A**).

The anticipated distribution of the QA/QC samples to be collected is listed in **Tables 5-1** through **5-8**.

5.7 EQUIPMENT AND PERSONNEL DECONTAMINATION

All sampling equipment will be decontaminated before starting work and after the collection of each individual sample. Sampling equipment decontamination will be done at the site.

The overall objective of a multimedia sampling program is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminants can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g. using sampling equipment that is not properly or fully decontaminated). Trace quantities of contaminants can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., all non-disposable equipment that will come in direct contact with samples) and field support equipment (e.g., drill rigs, vehicles) is, therefore, required prior to, between, and after uses at Cannon AFB to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

The following sections present equipment decontamination procedures.

5.7.1 Sampling Equipment

The following steps will be used to decontaminate sampling equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure.
- Gross contamination on equipment will be scraped off at the sampling or construction site.
- Equipment that cannot be damaged by water will be placed in a wash tub containing Alconox or low-sudsing non-phosphate detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub followed by a de-ionized water rinse.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and rinsed with de-ionized water. Care will be taken to prevent equipment damage.
- All reusable sampling equipment that comes in contact with the sample will receive a final rinse with isopropanol.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with contaminated soil. If the equipment is not used immediately after decontamination, the equipment will be covered or wrapped in plastic sheeting, foil, or heavy-duty trash bags to minimize potential contact with contaminants.

5.7.2 Drilling and Heavy Equipment

Drilling rigs and excavating equipment will be decontaminated at the decontamination station located near the staging area. Mobile decontamination trailers may be used to decontaminate heavy equipment at each site. The following steps will be used to decontaminate drilling and heavy equipment:

- Personnel will dress in suitable PPE to reduce personal exposure.
- Personnel will scrape equipment showing gross contamination or having caked-on drill cuttings with a flat-bladed scraper at the sampling or construction site.
- Personnel will wash equipment that cannot be damaged by water, such as drill rigs, augers, drill bits, and shovels, with a hot water, high-pressure sprayer then rinse with potable water. Care will be taken to clean the insides of the HSAs.

Following decontamination, drilling equipment will be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it should be stored in a designated clean area.

5.7.3 Equipment Leaving the Site

Vehicles used for activities in non-contaminated areas will be cleaned on an as-needed basis, as determined by the SSO, using soap and water on the outside and vacuuming the inside. On-site cleaning will be required for very dirty vehicles leaving the area. Construction equipment such as trucks, drilling rigs, trailers, etc., will be pressure washed before the equipment is removed from the site to limit exposure of off-site personnel to potential contaminants.

5.7.4 Decontamination Solutions

A decontamination solution should be capable of removing, or converting to a harmless substance, the contaminant of concern without harming the object being decontaminated. The preferred solution is a mixture of detergent and water, which is a relatively safe option compared to chemical decontaminants. A solution recommended for decontaminating consists of 1 to 1.5 tablespoons of Alconox per gallon of warm water. Skin surfaces will be decontaminated by washing with hand soap and water. The decontamination solution will be changed when it no longer foams or when it becomes extremely dirty. Rinse water will be changed when it becomes discolored, begins to foam, or when the decontamination solution cannot be removed.

5.7.5 Responsible Authority

Decontamination operations at each hazardous waste site will be supervised by the SSO. The SSO is responsible for ensuring that all personnel follow decontamination procedures and that all contaminated equipment is adequately decontaminated. The SSO is also responsible for maintaining the decontamination zone and managing the wastes generated from the decontamination process.

Site activities will be conducted with the general goal of preventing the contamination of people and equipment. Using remote sampling techniques, bagging monitoring instruments, avoiding contact with obvious contamination, and employing dust suppression methods that would reduce the probability of becoming contaminated and, therefore, reduce the need and extent of decontamination. However, some type of decontamination will always be required on site.

OSHA requires that proper PPE be worn when operating steam or pressure washing equipment. A rain suit, boots, hard hat, and a face shield are recommended. All personnel must be kept out of the path of steam or water spray.

5.7.6 Wastewater

Liquid wastewater from decontamination will be containerized and analyzed using a PID as described in **Section 5.8**.

5.7.7 Documentation

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination should include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination observations
- Weather conditions
- IDW handling

Personnel decontamination is not anticipated due to the nature of the planned soil sample collection activities. It is anticipated that field sampling members will don appropriate personal protective equipment (PPE) during surface soil sampling activities. Level D PPE is anticipated during this investigation, which includes hard hat, safety glasses, steel-toed boots, ear protection, and work gloves and/or chemical-resistant gloves.

5.8 INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) is expected to include soil, decontamination fluids, and PPE. In general, soil will be containerized and properly disposed of on the base, as long as the analytical results demonstrate the waste is nonhazardous by applying the “20 Times Rule” (i.e., none of the total analytical results exceed the corresponding Toxicity Characteristic Leaching Procedure [TCLP] limit by more than 20 times). Decontamination fluids will be field-screened visually and with a PID. Decontamination fluids containing no evidence of contaminants will be discharged either to the ground or to the sanitary sewer system. PPE will be disposed of on the base as a solid waste. If IDW storage is required, storage locations will be identified by the 27 SOCES, Asset Management Flight personnel.

5.9 FORMER AGE DISPATCH FACILITY SPILLS SITE (SS-C501)

5.9.1 Sampling Objectives and Rationale (SS-C501)

The general sampling objectives at SS-C501 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels. At SS-C501, subsurface soil samples will be collected in the vicinity of the former location of two diesel fuel spills (60 gallons each). Because the entire site is paved, surface soil is not considered a potential exposure pathway, and ecological receptors will not be considered for screening purposes at SS-C501.

5.9.2 Sampling Locations, Frequencies and Analysis (SS-C501)

The following site-specific activities will be completed at SS-C501 to meet the FSP objectives. COPCs for this site are based on its past use as a dispatch facility where fuel spills reportedly occurred and a variety of chemicals were used. The analyte list for SS-C501 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, VOCs, SVOCs, RCRA metals, and PCBs. Planned soil sample locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for SS-C501 in **Table 5-1**. Sample locations are shown on **Figures 5-1a** and **5-1b**.

5.9.2.1 Subsurface Soil Sampling (SS-C501)

Eleven planned subsurface soil borings will be completed at SS-C501 in order to satisfy the objectives of this investigation. Three additional soil borings (TBD borings) will be completed at SS-C501 based on data collected (PID readings and visual observations) from the first 11 planned borings. These three additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at SS-C501.

At both the northern and southern spill locations, five subsurface soil borings will be completed within the limits of each spill area. The two subsurface soil borings in the center of the spill areas will be completed to a depth of approximately 15 feet bgs while the other eight borings will be completed to approximately 10 feet bgs. One additional subsurface soil boring will be completed directly between the two spill areas, and will be completed to approximately 10 feet bgs. Subsurface soil samples at SS-C501 will be collected on 5-foot intervals beginning directly below the asphalt pavement.

5.10 FORMER GAS STATION SITE (ST-C502)

5.10.1 Sampling Objectives (ST-C502)

The general sampling objectives at ST-C502 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels, and to determine if other COPCs are present in subsurface soil at concentrations above screening levels at the

previously identified potential source areas and other potential source areas not previously investigated. At ST-C502, subsurface soil samples will be collected in the vicinity of the former location of the pump islands, the UST excavation area, and the vehicle service station area formerly containing two hydraulic lifts. Because the majority of the site is paved, surface soil is not considered a potential exposure pathway, and ecological receptors will not be considered for screening purposes at ST-C502. There is a small grassed landscaped area present to the northwest of Building 368 that was added to the site following the closing of the gas station and removal of USTs. The grassed landscaped area is elevated above the concrete curb and asphalt pavement, indicating that this area has been reworked and is likely fill material.

5.10.2 Sampling Locations, Frequencies, and Analysis (ST-C502)

The following site-specific activities will be completed at ST-C502 to meet the FSP objectives. COPCs for this site are based on its past use as a gas station, where a variety of chemicals were used. The analyte list for the UST excavation area and the pump islands at ST-C502 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, BTEX+naphthalene, site-related SVOCs, and lead. The analyte list for the vehicle service station area at ST-C502 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, VOCs, SVOCs, RCRA metals, and PCBs. Planned soil sample locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for ST-C502 in **Table 5-2**. Planned soil sampling locations are shown on **Figures 5-2a** and **5-2b**.

5.10.2.1 Subsurface Soil Sampling (ST-C502)

Thirteen planned subsurface soil borings will be completed at ST-C502 in order to satisfy the objectives of this investigation. Three additional soil borings (TBD borings) will be completed at ST-C502 based on data collected (PID readings and visual observations) from the first 13 planned borings. These three additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at ST-C502.

At the former pump islands area, seven soil borings will be completed within and adjacent to the former location of the two pump islands containing the fuel dispensers. Soil boring CA502-SB11 will be completed at the same location as previous soil boring CAFB-FAC0368-10. Results of the 1995 USGS investigation indicated that a release previously occurred at this location. Soil boring CA502-SB11 will be completed in order to confirm the vertical extent of contamination in this area (previously detected at approximately 30 feet bgs). This boring will be advanced to approximately 40 feet bgs. Based on the previous maximum concentration of TPH-GRO identified at 24 to 25 feet bgs, the additional soil borings at the pump island area will extend to approximately 30 feet bgs. Soil samples at the former pump island area will be collected on 5-foot intervals from directly below the asphalt pavement.

At the former UST excavation area, four soil borings will be completed within the limits of the former UST excavation, to depths of approximately 30 feet bgs. Although the bases of the three USTs at this site were 12 feet bgs, borings will be sampled on 5-foot intervals beginning at 1 foot bgs in order to ascertain the condition of the backfill placed within the excavation.

In the former vehicle service area, two soil borings will be advanced to depths of approximately 15 feet bgs in the approximate location of the former northeastern service bay containing a hydraulic lift. Based on the current configuration of the Cannon Federal Credit Union building, it is assumed that the location of the former southwestern service bay containing a hydraulic lift is within the building; therefore, it will not be investigated. Soil samples at the former vehicle service area will be collected on 5-foot intervals beginning directly below the asphalt pavement.

5.11 BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)

5.11.1 Sampling Objectives and Rationale (ST-C503)

The general sampling objectives at ST-C503 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels. At ST-C503, subsurface soil samples will be collected within the limits of the previous UST removal excavation. Based on the fact that the primary source of contamination at this site was previously detected at approximately 7 feet bgs (from a leaking UST as described in **Section 4.2**), and the UST excavation was backfilled with clean soil and the ground surface reworked following the UST removal, it is assumed that any potential surface soil contamination has been removed. Therefore, surface soil is not is not considered a likely exposure pathway and ecological receptors will not be considered for screening purposes at ST-C503.

5.11.2 Sampling Locations, Frequencies and Analysis (ST-C503)

The following site-specific activities will be completed at ST-C503 to meet the FSP objectives. COPCs for this site are based on the former presence of a diesel fuel UST used to power a generator. The analyte list for ST-C503 includes the following: TPH-DRO, TPH-ORO, BTEX+naphthalene, and site-related SVOCs. Planned soil sampling locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for ST-C503 in **Table 5-3**. Planned soil sampling locations are shown on **Figures 5-3a** and **5-3b**.

5.11.2.1 Subsurface Soil Sampling (ST-C503)

Seven planned subsurface soil borings will be completed at ST-C503 in order to satisfy the objectives of this investigation. Two additional soil borings (TBD borings) will be completed at ST-C503 based on data collected (PID readings and visual observations) from the first seven planned borings. These two additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at ST-C503.

The seven subsurface soil borings will be completed within the limits of the former UST excavation to depths of approximately 25 feet bgs. Soil boring CA503-SB03 will be completed at the same location as former soil sample location CAFB-FAC0600-03 to confirm the vertical extent of contamination in this area (previously detected from approximately 10 to 21 feet bgs). Soil boring CA503-SB05 will be completed at the same location as former soil sample location

CAFB-FAC0600-05 to confirm the vertical extent of contamination in this area (previously detected from approximately 10 to 21 feet bgs). Soil boring CA503-SB07 will be advanced between 10 and 25 feet bgs at the same location as soil sample location SES-UST-EX in order to quantify previously detected contamination in the area (previously detected from 11 feet bgs). The reported depth to the base of the UST was 7 feet bgs and the bottom of the excavation was 9 feet bgs. In order to ascertain the condition of the backfill placed within the excavation, borings will be sampled on 5-foot intervals beginning at the ground surface.

5.12 HOSPITAL ABANDONED UST SITE (ST-C504)

5.12.1 UST Location (ST-C504)

Prior to laying out sample locations at this site, the exact location of the abandoned UST will be determined. A reliable location for the UST has not been determined due to inconsistencies between previously constructed site maps and aerial photos (both historical and current). If Cannon AFB utility locating personnel cannot sufficiently locate the abandoned UST, then geo-magnetic methods will be employed in an attempt to accurately determine the abandoned UST's location. It is anticipated that a subcontracted locating service will perform the work using a Noggin PLUS Smart Cart system with 250 MHz antenna, or equivalent. Proposed sample locations will be adjusted based on the actual location of the abandoned UST.

5.12.2 Sampling Objectives (ST-C504)

The general sampling objectives at ST-C504 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soils at concentrations above screening levels. At ST-C504, subsurface soil samples will be collected within the vicinity of the abandoned UST. This site is used for industrial purposes and contains cooling towers, a paved access road, four concrete pads and three pad-mounted transformers. Vegetation is sparse on the grassed area. Because the primary source of contamination at this site was located approximately 18 feet bgs (from a leaking UST as described in **Section 4.4**), and based on current land use, surface soil is not considered a likely exposure pathway and ecological receptors are not considered for screening purposes.

5.12.3 Sampling Locations, Frequencies and Analysis (ST-C504)

The following site-specific activities will be completed at ST-C504 to meet the FSP objectives. COPCs for this site are based on the presence of a UST previously containing diesel fuel used to power a generator. The analyte list for ST-C504 includes the following: TPH-DRO, TPH-ORO, BTEX+naphthalene, and site-related SVOCs. Planned soil sample locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for ST-C504 in **Table 5-4**. Planned soil sampling locations are shown on **Figures 5-4a** and **5-4b**.

5.12.3.1 Subsurface Soil Sampling (ST-C504)

Eleven planned subsurface soil borings will be completed at ST-C504 in order to satisfy the objectives of this investigation. Three additional subsurface soil borings (TBD borings) will be completed at ST-C504 based on data collected (PID readings and visual observations) from the first 11 planned borings. These three additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at ST-C504.

At ST-C504, results of the 1995 USGS investigation indicated that the most contaminated area identified at this site was at CAFB-FAC1400-03. Planned soil boring CA504-SB01 will be completed at the former location of CAFB-FAC1400-03 in order to confirm the vertical extent of contamination in this area (previously detected from 18 to 75 feet bgs). This boring will be advanced to approximately 85 feet bgs. Three planned soil borings will be completed to the northwest, northeast, and southeast of previous soil boring CAFB-FAC1400-03. These three borings will be sampled to approximately 50 feet bgs (based on the previous maximum concentration of TPH-DRO identified from 49.5 to 50.5 feet bgs at CAFB-FAC1400-03). The final seven planned soil borings will be completed at step out locations to the northeast and southeast, and around the southwest end of the abandoned UST. These seven planned soil borings will be completed to approximately 25 feet bgs to ensure vertical delineation below the base of the abandoned UST (base at approximately 18 feet bgs). Subsurface soil samples at ST-C504 will be collected on 5-foot intervals beginning at either the ground surface or directly below the asphalt/concrete pavement.

5.13 FLIGHTLINE GENERATOR UNDERGROUND STORAGE TANKS SITE (ST-C505)

5.13.1 Sampling Objectives (ST-C505)

The general sampling objectives at ST-C505 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels. At ST-C505, subsurface soil samples will be collected within and outside the approximate limits of the previous UST removal excavation. The presence of fill versus natural material will be examined in the field to help better define the horizontal limits of the former UST excavation at this site. Soil borings may be moved slightly in the field based on the actual limits of the UST excavation at ST-C505.

Based on the fact that the primary source of contamination at this site was previously detected at approximately 9 feet bgs (from a leaking UST as described in **Section 4.5**), and the UST excavation was backfilled with clean soil and the ground surface reworked following the UST removal, it is assumed that any potential surface soil contamination has been removed. Therefore, surface soil is not is not considered a likely exposure pathway and ecological receptors will not be considered for screening purposes at ST-C505.

5.13.2 Sampling Locations, Frequencies and Analysis (ST-C505)

The following site-specific activities will be completed at ST-C505 to meet the FSP objectives. COPCs for this site are based on the former presence of a diesel fuel UST used to power a generator. The analyte list for ST-C505 includes the following: TPH-DRO, TPH-ORO, BTEX+naphthalene, and site-related VOCs. Planned soil sampling locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for ST-C505 in **Table 5-5**. Planned soil sampling locations are shown on **Figures 5-5a** and **5-5b**.

5.13.2.1 Subsurface Soil Sampling (ST-C505)

Ten planned subsurface soil borings will be completed at ST-C505 in order to satisfy the objectives of this investigation. Two additional soil borings (TBD borings) will be completed at ST-C505 based on data collected (PID readings and visual observations) from the first 10 planned borings. These two additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at ST-C505.

At ST-C505, seven planned subsurface soil borings will be completed within the limits of the previous UST excavation. Based on the results of the 1995 USGS investigation, the most contaminated areas identified at this site were at previous soil borings CAFB-FAC3060-03 and CAFB-FAC3060-02. Soil borings CA505-SB03 and CA505-SB01 will be completed at the same locations as former soil sample locations CAFB-FAC3060-02 and CAFB-FAC3060-03, respectively. These two borings and CA505-SB02 will be completed to a depth of 30 feet bgs to confirm the vertical extent of contamination in this area (previously detected from approximately 10 to 21 feet bgs). Four other subsurface soil boings will be completed near the corners of the former UST excavation, and will be completed to a depth of 25 feet bgs. Although the reported depth to the base of the UST and bottom of the excavation were both 9 feet bgs, soil samples collected from inside the former UST excavation limits will be collected on 5-foot intervals beginning at ground surface in order to ascertain the condition of the backfill placed within the excavation.

Outside the former UST excavation, three subsurface soil borings will be completed to a depth of 25 feet bgs to help define the horizontal extent of potential contamination. Subsurface soil samples collected outside the former UST excavation limits will be collected on 5-foot intervals beginning at the ground surface.

5.14 FORMER POL YARD REFUELING AREA SITE (SS-C507)

5.14.1 Sampling Objectives (SS-C507)

The general sampling objective at SS-C507 is to determine if COPCs are present in surface and subsurface soil at concentrations above screening levels at potential source areas at the site. Potential sources of contamination at this site include former fuel dispensers, tank filling areas, aboveground pipes, and surface spills. At the location of the two surface spills that were

previously excavated and backfilled, the presence of fill versus natural material will be examined in the field to better define the horizontal and vertical limits of the surface spill excavations. Based on the presence of large unpaved and grassed areas on the north and west parts of the site, surface soil is considered a potential exposure pathway, and preliminary screening for ecological receptors will be conducted.

5.14.2 Sampling Locations, Frequencies and Analysis (SS-C507)

The following site-specific activities will be completed to meet the FSP objectives. COPCs for this site are based on its past use as a POL yard refueling area and the results of a previous investigation that identified a PCB at one location (URS 2009). The analyte list for SS-C507 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, BTEX+naphthalene, site-related SVOCs, PCBs, and lead. Planned soil sample locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for SS-C507 in **Table 5-6**. Planned soil sampling locations are shown on **Figures 5-6a** and **5-6b**.

5.14.2.1 Surface Soil Sampling (SS-C507)

Because the potential sources of contamination at this site include former fuel dispensers, tank filling areas, aboveground pipes, and surface spills, it is possible that surface soil contamination may exist at several locations at this site. Surface samples will be taken at unpaved locations where the potential source was above ground. A total of 40 planned and eight additional (TBD) surface soil samples will be collected at SS-C507. Surface soil sampling locations are provided in **Table 5-6**.

5.14.2.2 Subsurface Soil Sampling (SS-C507)

Sixty-three planned subsurface soil borings will be completed at SS-C507 in order to satisfy the objectives of this investigation. Eight additional soil borings (TBD borings) will be completed at SS-C507 based on data collected (PID readings and visual observations) from the first 63 planned borings. These eight additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at SS-C507.

Depths and number of borings per potential source area were determined based on whether possible releases would have been likely to be above ground or underground, contained or uncontained, and relatively large or relatively small. Additional details concerning subsurface soil sampling at this site are included in the technical rationale provided in **Table 5-6**. The number of soil borings at each potential source area is listed below:

- Previous 400-gallon JP-8 fuel spill and excavation location to the west and south of Building 392 – three borings (SB01-03)
- Area west of the north JP-4/JP-8/MOGAS unloading ports - two borings (SB38 and 39)
- Fuel unloading ports (west-central part of site) – four borings (one per port) (SB04-07)

- Former pump house (Building 392) and associated JP-4/JP-8 fuel lines in the former canopy area – two borings (SB08 and 09)
- Fuel unloading area storm drains – two borings (one per drain) (SB10 and 11)
- Former OWS vault – two borings (SB12 and 13)
- Diesel fuel line canopy area and aboveground diesel fuel lines and elbows – four borings (SB14 and 49–51)
- Former diesel fuel pump island and underground diesel fuel lines – five borings (SB15, 16, and 46–48)
- Diesel fuel unloading ports (398 and 399) – two borings (one per port) (SB17 and 18)
- Previous JP-8 fuel spill to the north of the former canopy north of Building 390 – three borings (SB20, 21, and 52)
- Former pump house (Building 390) and associated JP-4/JP-8 fuel lines in the former canopy area – four borings (SB22–25)
- Underground JP-4/JP-8/MOGAS vault – one boring (SB26)
- Former JP-4/JP-8 pump islands and adjacent paved area – eight borings (two per pump island and one per side) (SB27–30 and 53–56)
- OWS vault and drum storage area – three borings (SB32–34)
- Former MOGAS unloading and dispensing area – five borings (SB35 and 57–60)
- Areas where runoff pools (e.g., breaks in curbs, low-lying areas downstream of potential source areas) – seven borings (SB19, 31, 36, 37, and 61–63)
- Underground JP-4/JP-8/MOGAS lines between Buildings 392 and 390 – four borings (SB40–43)
- Underground OWS elbows in west part of site – two borings (SB44 and 45)

Subsurface soil samples at SS-C507 will be collected on 5-foot intervals beginning at either 0.5 feet bgs or directly below the asphalt/concrete pavement.

5.15 SURFACE DISPOSAL AREA SITE (SD-C508)

5.15.1 Sampling Objectives (SD-C508)

The general sampling objectives at SD-C508 are to further define the horizontal and vertical extent of potential surface and subsurface soil contamination at the previously identified surface disposal area, to determine if other COPCs are present in surface and subsurface soil at concentrations above screening levels at the previously identified disposal area, and to determine if COPCs exist in surface or subsurface soil at concentrations above screening levels within the expanded site boundary not previously investigated. Because this area is generally unused,

vegetated land, surface soil is considered a potential exposure pathway, and preliminary screening for ecological receptors will be conducted.

5.15.2 Sampling Locations, Frequencies and Analysis (SD-C508)

The following site-specific activities will be completed to meet the FSP objectives. COPCs for this site are based on its inferred past use as a surface disposal area for various debris and burned material. The analyte list for SD-C508 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, VOCs, SVOCs, pesticides, RCRA metals, PCBs, explosives, and dioxins/furans. Planned soil sampling locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for SD-C508 in **Table 5-7**. Planned soil sampling locations are shown on **Figures 5-7a** and **5-7b**. Anticipated sample depth intervals for each boring are shown on **Table 5-7**.

5.15.2.1 Surface Soil Sampling (SD-C508)

Because the potential source of contamination at this site is debris on or near the surface of the ground, a surface soil sample will be taken at each boring location. Nine planned and two additional (TBD) surface soil samples will be collected at SD-C508. Surface soil sampling locations are provided in **Table 5-7**.

5.15.2.2 Subsurface Soil Sampling (SD-C508)

Nine soil borings will be completed at SD-C508 to satisfy the objectives of this investigation. Two additional soil borings (TBD borings) will be completed at SD-C508 based on data collected (PID readings and visual observations) from the first nine planned borings. These two additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at SD-C508.

One soil boring will be completed directly within the previously identified visible surface debris. This soil boring will be completed to approximately 20 feet bgs. Four other soil borings will be completed within the expanded site boundary not previously investigated, specifically within the mounded area with visibly different vegetation at the surface (describe in **Section 4.7**). These four borings will be completed to approximately 15 feet bgs. Four final soil boings will be completed outside the mounded area, but within the expanded site boundary. These four soil borings will be completed to approximately 10 feet bgs. Subsurface soil samples at SD-C508 will be collected on 5-foot intervals beginning at 0.5 feet bgs.

5.16 WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)

5.16.1 Sampling Objectives (TA/AS-C129)

The overall sampling objective at TA/AS-C129 is to determine if COPCs are present at concentrations above screening levels in the previously uninvestigated leach field area. Because the potential contamination at this site is from an underground source (the perforated pipes are

buried approximately 2.5 feet bgs), surface soil is not considered a potential exposure pathway and ecological receptors are not considered for screening purposes.

5.16.2 Sampling Locations, Frequencies and Analysis (TA/AS-C129)

The following site-specific activities will be completed to meet FSP objectives. COPCs for this site are based on its past use as a leach field connected to an OWS where waste oil and a variety of other chemicals may have been disposed. The analyte list for TA/AS-C129 includes the following: TPH-DRO, TPH-GRO, TPH-ORO, VOCs, SVOCs, RCRA metals, PCBs, and pesticides. Planned soil sample locations, identification numbers, depths, location coordinates, analytical parameters, and technical rationale for each soil sample location are provided for TA/AS-C129 in **Table 5-8**. Planned soil sampling locations are shown on **Figures 5-8a** and **5-8b**.

5.16.2.1 Surface Soil Sampling (TA/AS-C129)

Surface soil samples will be collected in the area covered by dried soil, and in the area containing metal debris and dried paint to assess the potential impacts to soils from the various types of waste dumped in these areas. Two surface soil samples will be collected in these areas. Surface soil sampling locations are provided in **Table 5-8**.

5.16.2.2 Subsurface Soil Sampling (TA/AS-C129)

Six planned subsurface soil borings will be completed at the former leach field, including one boring at the intersection of the drain pipe and the leach field (i.e., distribution box), in order to satisfy the objectives of the investigation. Additionally, one boring will be completed at the former cleanout/pipe to leach field, and one boring will be completed at the center of the drain pipe between the former location of the OWS and the leach field. Shallow borings (0 to 5 feet bgs) will also be advanced in the area covered by dried soil and in the area containing metal debris and dried paint. Two additional soil borings (TBD borings) will be completed at TA/AS-C129 based on data collected (PID readings and visual observations) from the first five planned borings. These two additional borings will be used to help further define the horizontal and vertical extent of subsurface contamination at TA/AS-C129.

Soil borings advanced at this site will be completed to approximately 15 feet bgs. Subsurface soil samples at TA/AS-C129 will be collected on 5-foot intervals beginning at the ground surface.

TABLE 5-1
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER AGE DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	VOCs[5]	SVOCs[6]	RCRA Metals[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA501-SB01	1-5	1236498.948	847068.969	X	X	X	X	X	X	X			Boring will be advanced on the north corner of the north diesel fuel spill area.
	5-10			X	X	X	X	X	X	X		X	
CA501-SB02	1-5	1236447.195	847022.305	X	X	X	X	X	X	X			Boring will be advanced on the west corner of the north diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
CA501-SB03	1-5	1236454.590	847065.820	X	X	X	X	X	X	X	X		Boring will be advanced in the center of the north diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA501-SB04	1-5	1236458.969	847110.366	X	X	X	X	X	X	X			Boring will be advanced on the east corner of the north diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
CA501-SB05	1-5	1236409.667	847058.708	X	X	X	X	X	X	X			Boring will be advanced on the south corner of the north diesel fuel spill area.
	5-10			X	X	X	X	X	X	X		X	
CA501-SB06	1-5	1236390.298	847002.840	X	X	X	X	X	X	X			Boring will be advanced in the center of the site, between the two fuel spill areas.
	5-10			X	X	X	X	X	X	X		X	
CA501-SB07	1-5	1236371.638	846945.002	X	X	X	X	X	X	X			Boring will be advanced on the north corner of the south diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
CA501-SB08	1-5	1236320.295	846893.792	X	X	X	X	X	X	X			Boring will be advanced on the west corner of the south diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
CA501-SB09	1-5	1236326.005	846939.860	X	X	X	X	X	X	X	X		Boring will be advanced in the center of the south diesel fuel spill area.
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
CA501-SB10	1-5	1236331.600	846982.943	X	X	X	X	X	X	X			Boring will be advanced on the east corner of the south diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			
CA501-SB11	1-5	1236280.915	846933.763	X	X	X	X	X	X	X			Boring will be advanced on the south corner of the south diesel fuel spill area.
	5-10			X	X	X	X	X	X	X			

TABLE 5-1
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER AGE DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]	Analytical Parameters									Technical Rationale
			TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	VOCs[5]	SVOCs[6]	RCRA Metals[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA501-SB12	1-5	To be determined	X	X	X	X	X	X	X	X		Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10		X	X	X	X	X	X	X			
	10-15		X	X	X	X	X	X	X			
CA501-SB13	1-5		X	X	X	X	X	X	X		X	
	5-10		X	X	X	X	X	X	X			
	10-15		X	X	X	X	X	X	X			
CA501-SB14	1-5		X	X	X	X	X	X	X			
	5-10		X	X	X	X	X	X	X			
	10-15		X	X	X	X	X	X	X			
		Totals	**33**	**33**	**33**	**33**	**33**	**33**	**33**	**4**	**4**	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-GRO analysis via USEPA Method 8015C

[4]TPH-ORO analysis via USEPA Method 8015C

[5]VOCs analysis via USEPA Method 8260B

[6]SVOCs analysis via USEPA Method 8270D

[7]Metals analysis via USEPA Method 6020A and USEPA Method 7471B (Mercury)

[8]PCBs analysis via USEPA Method 8082A

[9]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

[10]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface

MS/MSD = matrix spike/matrix spike duplicate

PCB = polychlorinated biphenyl

RCRA = Resource Conservation and Recovery Act

SVOC = semivolatile organic compound

TPH-DRO = total petroleum hydrocarbons-diesel range organics

TPH-GRO = total petroleum hydrocarbons-gasoline range organics

TPH-ORO = total petroleum hydrocarbons-oil range organics

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

TABLE 5-2
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters												Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX+Naphthalene[5]	VOCs[6]	Site-Related SVOCs[7]	SVOCs[8]	Lead[9]	RCRA Metals[10]	PCBs[11]	Field Duplicate Samples[12]	MS/MSD Samples[13]	
CA502-SB01	1-5	1237662.658	846524.522	X	X	X	X		X		X	~~X~~	~~X~~			Boring will be advanced in the north quadrant of the previously excavated UST pit (approximately 13 feet south of the north corner of the previously excavated UST pit) to determine if contamination is present from potential UST leaks.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~			
	25-30			X	X	X	X		X		X	~~X~~	~~X~~		X	
CA502-SB02	1-5	1237650.332	846537.105	X	X	X	X		X		X	~~X~~	~~X~~			Boring will be advanced in the east quadrant of the previously excavated UST pit (approximately 13 feet west of the east corner of the previously excavated UST pit) to determine if contamination is present from potential UST leaks.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~			
	25-30			X	X	X	X		X		X	~~X~~	~~X~~		X	
CA502-SB03	1-5	1237637.748	846524.779	X	X	X	X		X		X	~~X~~	~~X~~			Boring will be advanced in the south quadrant of the previously excavated UST pit (approximately 13 feet north of the south corner of the previously excavated UST pit) to determine if contamination is present from potential UST leaks.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~			
	25-30			X	X	X	X		X		X	~~X~~	~~X~~		X	
CA502-SB04	1-5	1237650.075	846512.195	X	X	X	X		X		X	~~X~~	~~X~~			Boring will be advanced in the west quadrant of the previously excavated UST pit (approximately 13 feet east of the west corner of the previously excavated UST pit) to determine if contamination is present from potential UST leaks.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~			
	25-30			X	X	X	X		X		X	~~X~~	~~X~~		X	
CA502-SB05	0-5	1237733.460	846519.618	X	X	X	X		X		X	~~X~~	~~X~~	X		Boring will be advanced on the northeast end of the northwest pump island (at the approximate location of the former fuel dispenser) to determine if contamination is present from potential leaking underground piping or potential surface spills.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~			
	25-30			X	X	X	X		X		X	~~X~~	~~X~~		X	

TABLE 5-2
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters												Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX+Naphthalene[5]	VOCs[6]	Site-Related SVOCs[7]	SVOCs[8]	Lead[9]	RCRA Metals[10]	PCBs[11]	Field Duplicate Samples[12]	MS/MSD Samples[13]	
CA502-SB06	1-5	1237728.478	846508.404	X	X	X	X		X		X	~~X~~	~~X~~			Boring will be advanced approximately 5 feet northwest of the northwest pump island to determine if contamination is present from potential surface spills.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~			
	25-30			X	X	X	X		X		X	~~X~~	~~X~~		X	
CA502-SB07	1-5	1237718.577	846505.194	X	X	X	X		X		X	~~X~~	~~X~~	X		Boring will be advanced on the southwest end of the northwest pump island (at the approximate location of the former fuel dispenser) to determine if contamination is present from potential leaking underground piping or potential surface spills.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~			
	25-30			X	X	X	X		X		X	~~X~~	~~X~~			
CA502-SB08	1-5	1237720.429	846518.221	X	X	X	X		X		X	~~X~~	~~X~~			Boring will be advanced approximately 8 feet southeast of the northwest pump island to determine if contamination is present from potential surface spills.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~			
	25-30			X	X	X	X		X		X	~~X~~	~~X~~			
CA502-SB09	1-5	1237701.813	846522.319	X	X	X	X		X		X	~~X~~	~~X~~			Boring will be advanced on the southwest end of the southeast pump island (at the approximate location of the former fuel dispenser) to determine if contamination is present from potential leaking underground piping or potential surface spills.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~	X		
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~	X		
	25-30			X	X	X	X		X		X	~~X~~	~~X~~			
CA502-SB10	1-5	1237704.465	846536.664	X	X	X	X		X		X	~~X~~	~~X~~			Boring will be advanced approximately 8 feet southeast of the southeast pump island to determine if contamination is present from potential surface spills.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~			
	25-30			X	X	X	X		X		X	~~X~~	~~X~~			

TABLE 5-2
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters												Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX+Naphthalene[5]	VOCs[6]	Site-Related SVOCs[7]	SVOCs[8]	Lead[9]	RCRA Metals[10]	PCBs[11]	Field Duplicate Samples[12]	MS/MSD Samples[13]	
CA502-SB11	0-5	1237716.992	846536.552	X	X	X	X		X		X	~~X~~	~~X~~			Boring will be advanced at the previous location of CAFB-FAC0368-10 (located in the primary source of contamination - on the northeast end of the southeastern pump island) in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-GRO (1,000 mg/kg) at 24-25 feet bgs.
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~	X		
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~	X		
	25-30			X	X	X	X		X		X	~~X~~	~~X~~			
	30-35			X	X	X	X		X		X	~~X~~	~~X~~			
	35-40			X	X	X	X		X		X	~~X~~	~~X~~			
CA502-SB12	1-5	1237713.652	846579.557	X	X	X		X		X		X	X	X		Boring will be advanced within the vicinity of the formerly present northeastern hydraulic lift in order to determine if contamination is present due to potential leaking hydraulic fuel lines, tanks or potential petroleum hydrocarbon surface spills.
	5-10			X	X	X		X		X		X	X			
	10-15			X	X	X		X		X		X	X			
CA502-SB13	1-5	1237705.838	846588.537	X	X	X		X		X		X	X			
	5-10			X	X	X		X		X		X	X			
	10-15			X	X	X		X		X		X	X		X	
CA502-SB14	1-5	To be determined		X	X	X	X		X		X	~~X~~	~~X~~	X		Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~		X	
CA502-SB15	1-5	To be determined		X	X	X	X		X		X	~~X~~	~~X~~		X	Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~	X		
CA502-SB16	1-5	To be determined		X	X	X	X		X		X	~~X~~	~~X~~			Boring location to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X		X		X	~~X~~	~~X~~			
	10-15			X	X	X	X		X		X	~~X~~	~~X~~			
	15-20			X	X	X	X		X		X	~~X~~	~~X~~			
	20-25			X	X	X	X		X		X	~~X~~	~~X~~			
			Totals	**87**	**87**	**87**	**81**	**6**	**81**	**6**	**81**	**6**	**6**	**9**	**9**	

TABLE 5-2
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER GAS STATION SITE (ST-C502)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]	Analytical Parameters												Technical Rationale
			TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX+Naphthalene[5]	VOCs[6]	Site-Related SVOCs[7]	SVOCs[8]	Lead[9]	RCRA Metals[10]	PCBs[11]	Field Duplicate Samples[12]	MS/MSD Samples[13]	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-GRO analysis via USEPA Method 8015C

[4]TPH-ORO analysis via USEPA Method 8015C

[5]BTEX+naphthalene analysis via USEPA Method 8260B

[6]VOCs analysis via USEPA Method 8260B

[7]Site-related SVOCs analysis via USEPA Method 8270D

[8]SVOCs analysis via USEPA Method 8270D

[9]Lead analysis via USEPA Method 6020A

[10]Metals analysis via USEPA Method 6020A and USEPA Method 7471B (Mercury)

[11]PCBs analysis via USEPA Method 8082A

[12]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

[13]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface

mg/kg = milligrams per kilogram

MS/MSD = matrix spike/matrix spike duplicate

SVOC = semivolatile organic compound

TPH-DRO = total petroleum hydrocarbons-diesel range organics

TPH-GRO = total petroleum hydrocarbons-gasoline range organics

TPH-ORO = total petroleum hydrocarbons-oil range organics

USEPA = United States Environmental Protection Agency

UST = underground storage tank

VOC = volatile organic compound

TABLE 5-3
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	SiteRelated SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA503-SB01	0-5	1235819.371	845220.667	X	X	X	X			Boring will be advanced in the center of the north quadrant of the previously excavated UST pit to determine if contamination is present from previous leaking UST.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA503-SB02	0-5	1235810.863	845212.870	X	X	X	X			Boring will be advanced in the center of the west quadrant of the previously excavated UST pit to determine if contamination is present from previous leaking UST.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA503-SB03	0-5	1235811.868	845227.384	X	X	X	X			Boring will be advanced at previous sample location CAFB-FAC0600-03 in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-DRO (3,500 mg/kg) at 14-16 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X	X		
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA503-SB04	0-5	1235812.390	845235.075	X	X	X	X			Boring will be advanced in the east corner of the previously excavated UST pit in order to determine if contamination is present at this location (and to assist in delineating any contamination present at CA503-SB03).
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA503-SB05	0-5	1235807.27	845219.06	X	X	X	X			Boring will be advanced at previous sample location CAFB-FAC0600-05 in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-DRO (820 mg/kg) at 10-12 feet bgs.
	5-10			X	X	X	X	X		
	10-15			X	X	X	X	X		
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA503-SB06	0-5	1235803.540	845219.918	X	X	X	X			Boring will be advanced in the center of the south quadrant of the previously excavated UST pit to determine if contamination is present from previous leaking UST.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	

TABLE 5-3
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	SiteRelated SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA503-SB07	10-15	1235805.05	845226.5	X	X	X	X	X		Boring will be advanced at the location of SES-UST-EX in order to quantify the previously detected contamination at this location. Previously, TPH detected at 1,370 mg/kg at 11 feet bgs.
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA503-SB08	0-5	To be determined		X	X	X	X		X	Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA503-SB09	0-5	To be determined		X	X	X	X			Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X			
	10-15			X	X	X	X	X		
	15-20			X	X	X	X			
	20-25			X	X	X	X			
			Totals	**43**	**43**	**43**	**43**	**5**	**5**	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-ORO analysis via USEPA Method 8015C

[4]BTEX + naphthalene analysis via USEPA Method 8260B

[5]Site-related SVOCs analysis via USEPA Method 8270D

[6]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

[7]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface

mg/kg = milligrams per kilogram

MS/MSD = matrix spike/matrix spike duplicate

SVOC = semivolatile organic compound

TPH-DRO = total petroleum hydrocarbons-diesel range organics

TPH-GRO = total petroleum hydrocarbons-gasoline range organics

TPH-ORO = total petroleum hydrocarbons-oil range organics

USEPA = United States Environmental Protection Agency

UST = underground storage tank

VOC = volatile organic compound

TABLE 5-4
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA504-SB01	0-5	1238826.411	844711.958	X	X	X	X			Boring will be advanced at the former location of CAFB-FAC1400-03 (located near the primary source of contamination - approximately 10 feet north of the center of the UST) in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-DRO (11,000 mg/kg) at 49.5-50.5 feet bgs. Concentrations of TPH-DRO previously detected to 75.0 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X	X		
	25-30			X	X	X	X			
	30-35			X	X	X	X			
	35-40			X	X	X	X			
	40-45			X	X	X	X			
	45-50			X	X	X	X	X		
	50-55			X	X	X	X			
	55-60			X	X	X	X			
	60-65			X	X	X	X	X		
	65-70			X	X	X	X			
	70-75			X	X	X	X			
	75-80			X	X	X	X	X		
	80-85			X	X	X	X			
CA504-SB02	0-5	1238833.919	844725.561	X	X	X	X			Boring will be advanced near the northeastern end of the UST in order to further define the vertical extent of contamination at this location. Adjacent soil boring CAFB-FAC1400-04 had detections of TPH-DRO (2,500 mg/kg) at 22.0 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X	X		
	25-30			X	X	X	X			
	30-35			X	X	X	X			
	35-40			X	X	X	X			
	40-45			X	X	X	X			
	45-50			X	X	X	X			

TABLE 5-4
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA504-SB03	0-5	1238812.773	844716.847	X	X	X	X			Boring will be advanced approximately 6 feet to the southeast of the center of the UST in order to further define the vertical extent of contamination at this location. Adjacent soil boring CAFB-FAC1400-02 had detections of TPH-DRO (6,200 mg/kg) at 20.0 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X	X		
	25-30			X	X	X	X			
	30-35			X	X	X	X			
	35-40			X	X	X	X	X		
	40-45			X	X	X	X			
	45-50			X	X	X	X			
CA504-SB04	1-5	1238833.944	844706.581	X	X	X	X			Boring will be advanced at the former location of CAFB-FAC1400-09 (approximately 8 feet northeast and 11 feet northwest of the center of the UST) in order to further define the vertical extent of contamination at this location. Maximum previously detected concentration of TPH-DRO (890 mg/kg) at 25-26 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
	25-30			X	X	X	X	X		
	30-35			X	X	X	X			
	35-40			X	X	X	X			
	40-45			X	X	X	X			
	45-50			X	X	X	X		X	
CA504-SB05	1-5	1238805.116	844722.614	X	X	X	X			Boring will be advanced approximately 16 feet to the southeast of the center of the UST in order to further define the horizontal extent of contamination to the southeast.
	5-10			X	X	X	X			
	10-15			X	X	X	X		X	
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	

TABLE 5-4
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA504-SB06	1-5	1238820.126	844724.676	X	X	X	X	X		Boring will be advanced southeast of the northeastern end of the UST in order to further define the horizontal extent of known contamination near the northeast end of the UST.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB07	1-5	1238839.785	844733.631	X	X	X	X		X	Boring will be advanced approximately 13 feet northeast of the northeast end of the UST in order to further define the horizontal extent of known contamination between the northeast end of the UST and previous soil boring CAFB-FAC1400-08 (previously nondetect).
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB08	0-5	1238813.282	844699.084	X	X	X	X		X	Borings will be advanced near the southwestern end of the UST in order to determine if contamination is present in this area (previously interpreted as unimpacted).
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB09	1-5	1238802.392	844697.022	X	X	X	X		X	
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB10	0-5	1238804.902	844708.038	X	X	X	X		X	
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			

TABLE 5-4
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA504-SB11	1-5	1238795.628	844689.323	X	X	X	X			Borings will be advanced near the southwestern end of the UST in order to determine if contamination is present in this area (previously interpreted as unimpacted).
	5-10			X	X	X	X		X	
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA504-SB12	0-5	To be determined		X	X	X	X	X		Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB13	0-5			X	X	X	X		X	
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA504-SB14	0-5			X	X	X	X			
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
			Totals	**97**	**97**	**97**	**97**	**10**	**10**	

TABLE 5-4
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]	Analytical Parameters						Technical Rationale
			TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-ORO analysis via USEPA Method 8015C

[4]BTEX + naphthalene analysis via USEPA Method 8260B

[5]Site-related SVOCs analysis via USEPA Method 8270D

[6]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

[7]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface

mg/kg = milligrams per kilogram

MS/MSD = matrix spike/matrix spike duplicate

RCRA = Resource Conservation and Recovery Act

SVOC = semivolatile organic compound

TPH-DRO = total petroleum hydrocarbons-diesel range organics

TPH-ORO = total petroleum hydrocarbons-oil range organics

USEPA = United States Environmental Protection Agency

UST = underground storage tank

VOC = volatile organic compound

TABLE 5-5
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA505-SB01	0-5	1239206.862	850901.345	X	X	X	X	X		Boring will be advanced at previous sample location CAFB-FAC3060-03 (located in the primary source area - on the northeast side of the approximate UST excavation) in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-DRO (5,300 mg/kg) at 9-11 feet bgs.
	5-10			X	X	X	X	X		
	10-15			X	X	X	X	X		
	15-20			X	X	X	X			
	20-25			X	X	X	X			
	25-30			X	X	X	X			
CA505-SB02	0-5	1239203.332	850896.899	X	X	X	X	X		Boring will be advanced in the center of the approximate UST excavation in order to further define the horizontal extent of contamination between the two areas of known contamination.
	5-10			X	X	X	X	X		
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
	25-30			X	X	X	X			
CA505-SB03	0-5	1239198.967	850891.773	X	X	X	X			Boring will be advanced at previous sample location CAFB-FAC3060-02 (located on the southwest side of the approximate UST excavation) in order to quantify the previously detected contamination at this location. Maximum previously detected concentration of TPH-DRO (1,300 mg/kg) at 9-11 feet bgs.
	5-10			X	X	X	X			
	10-15			X	X	X	X	X		
	15-20			X	X	X	X			
	20-25			X	X	X	X			
	25-30			X	X	X	X			
CA505-SB04	0-5	1239210.978	850897.247	X	X	X	X		X	Boring will be advanced in the north corner of the approximate UST excavation in order to further define the horizontal and vertical extent of known contamination near CAFB-FAC3060-03.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA505-SB05	0-5	1239202.764	850888.729	X	X	X	X			Boring will be advanced in the west corner of the approximate UST excavation in order to further define the horizontal and vertical extent of known contamination near CAFB-FAC3060-02.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	

TABLE 5-5
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters						Technical Rationale
				TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA505-SB06	0-5	1239195.716	850896.050	X	X	X	X			Boring will be advanced in the south corner of the approximate UST excavation in order to further define the horizontal and vertical extent of known contamination near CAFB-FAC3060-02.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA505-SB07	0-5	1239204.021	850904.657	X	X	X	X			Boring will be advanced in the east corner of the approximate UST excavation in order to further define the horizontal and vertical extent of known contamination near CAFB-FAC3060-03.
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X		X	
CA505-SB08	0-5	1239210.308	850890.937	X	X	X	X			Borings will be advanced in order to further define the horizontal and vertical extent of potential contamination outside the UST excavation.
	5-10			X	X	X	X			
	10-15			X	X	X	X		X	
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA505-SB09	0-5	1239210.843	850904.266	X	X	X	X			
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			
CA505-SB10	0-5	1239197.370	850902.384	X	X	X	X		X	
	5-10			X	X	X	X			
	10-15			X	X	X	X			
	15-20			X	X	X	X			
	20-25			X	X	X	X			

TABLE 5-5
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FLIGHTLINE GENERATOR UST SITE (ST-C505)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]	Analytical Parameters						Technical Rationale
			TPH-DRO[2]	TPH-ORO[3]	BTEX + Naphthalene[4]	Site-Related SVOCs[5]	Field Duplicate Samples[6]	MS/MSD Samples[7]	
CA505-SB11	0-5	To be determined	X	X	X	X			Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10		X	X	X	X			
	10-15		X	X	X	X	X		
	15-20		X	X	X	X			
	20-25		X	X	X	X			
CA505-SB12	0-5		X	X	X	X		X	
	5-10		X	X	X	X			
	10-15		X	X	X	X			
	15-20		X	X	X	X			
	20-25		X	X	X	X			
		Totals	**63**	**63**	**63**	**63**	**7**	**7**	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-ORO analysis via USEPA Method 8015C

[4]BTEX + naphthalene analysis via USEPA Method 8260B

[5]Site-related SVOCs analysis via USEPA Method 8270D

[6]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

[7]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, Californa.

bgs = below ground surface
mg/kg = milligrams per kilogram
MS/MSD = matrix spike/matrix spike duplicate
SVOC = semivolatile organic compound
TPH-DRO = total petroleum hydrocarbons-diesel range organics
TPH-ORO = total petroleum hydrocarbons-oil range organics
USEPA = United States Environmental Protection Agency
UST = underground storage tank
VOC = volatile organic compound

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS01	0-0.5	1239270.938	847748.733	X	X	X	X	X	X	X			Borings will be advanced at unpaved locations within the central part of the possible spill and excavation site (west and south of former pumphouse (Building 392) to determine if contamination is present in this area.
CA507-SB01	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS02	0-0.5	1239224.095	847752.463	X	X	X	X	X	X	X			
CA507-SB02	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
CA507-SS03	0-0.5	1239164.876	847750.996	X	X	X	X	X	X	X			
CA507-SS03	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS04	0-0.5	1239407.946	847791.334	X	X	X	X	X	X	X	X		Borings will be advanced at unpaved locations adjacent to fuel unloading ports to determine if contamination is present due to potential surface spills at these locations.
CA507-SS04	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS05	0-0.5	1239344.349	847791.342	X	X	X	X	X	X	X			
CA507-SS05	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS06	0-0.5	1239206.208	847791.977	X	X	X	X	X	X	X			
CA507-SS06	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS07	0-0.5	1239153.947	847790.784	X	X	X	X	X	X	X			Borings will be advanced at unpaved locations adjacent to fuel unloading ports to determine if contamination is present due to potential surface spills at these locations.
CA507-SS07	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS08	0-0.5	1239288.341	847792.399	X	X	X	X	X	X	X			Boring will be advanced to the north of the former location of Building 392, in the area formerly containing aboveground fuel lines, to determine if contamination is present in this area.
CA507-SS08	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS09	0-0.5	1239270.930	847797.460	X	X	X	X	X	X	X			Boring will be advanced in the area formerly occupied by Building 392 to determine if contamination is present in this area.
CA507-SS09	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SB10	1-5	1239379.193	847809.921	X	X	X	X	X	X	X			Borings will be located adjacent to storm drains under the grates in the concrete trench in the fuel unloading area on the west side of the site to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB11	1-5	1239179.853	847809.589	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS12	0-0.5	1239276.571	847851.895	X	X	X	X	X	X	X			Borings will be advanced on both ends of the area formerly occupied by an OWS within a concrete vault to determine if contamination is present in this area.
CA507-SB12	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SS13	0-0.5	1239253.817	847852.134	X	X	X	X	X	X	X			Borings will be advanced on both ends of the area formerly occupied by an OWS within a concrete vault to determine if contamination is present in this area.
CA507-SB13	0-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SS14	0-0.5	1239376.390	848074.957	X	X	X	X	X	X	X			Boring will be advanced in the area formerly containing aboveground diesel fuel lines (on the northeast part of the site) to determine if contamination is present in this area.
CA507-SB14	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SB15	1-5	1239376.390	848027.026	X	X	X	X	X	X	X			Borings will be advanced in paved areas near the ends of the former diesel pump island to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SB16	1-5	1239348.217	848012.174	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SB17	1-5	1239323.775	848046.505	X	X	X	X	X	X	X			Borings will be advanced in paved areas adjacent to the former diesel fuel unloading ports (398 and 399) to determine if contamination is present at these locations.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB18	1-5	1239270.773	848067.555	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS19	0-0.5	1239331.202	847980.726	X	X	X	X	X	X	X			Boring will be advanced in the unpaved area adjacent to a break in the concrete curb to the west of the diesel fuel pump island to determine if contamination is present in this area.
CA507-SB19	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
CA507-SS20	0-0.5	1239301.409	848095.815	X	X	X	X	X	X	X			Borings will be advanced within the approximate location of the previous 400-gallon JP-8 spill and excavation on the east part of the site and north of former Building 390, to determine if contamination is present in this area.
CA507-SB20	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS21	0-0.5	1239281.442	848094.934	X	X	X	X	X	X	X			
CA507-SB21	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS22	0-0.5	1239266.807	848095.354	X	X	X	X	X	X	X	X		Borings will be advanced in the area formerly occupied by aboveground fuel lines in the vicinity of the former pumphouse (Building 390) to determine if contamination is present in this area.
CA507-SB22	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS23	0-0.5	1239241.133	848096.836	X	X	X	X	X	X	X			Borings will be advanced in the area formerly occupied by aboveground fuel lines in the vicinity of the former pumphouse (Building 390) to determine if contamination is present in this area.
CA507-SB23	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS24	0-0.5	1239264.174	848130.424	X	X	X	X	X	X	X	X		Borings will be advanced in the area formerly occupied by aboveground fuel lines in the vicinity of the former pumphouse (Building 390) to determine if contamination is present in this area.
CA507-SB24	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS25	0-0.5	1239226.329	848095.825	X	X	X	X	X	X	X			Boring will be advanced in the center of the area formerly occupied by the pumphouse (Building 390) to determine if contamination is present in this area.
CA507-SB25	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS26	0-0.5	1239286.292	847974.296	X	X	X	X	X	X	X			Boring will be advanced adjacent to an underground vault constructed at the low point in the JP-4/JP-8/MOGAS lines to determine if contamination is present in this area.
CA507-SB26	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SB27	1-5	1239211.998	848026.333	X	X	X	X	X	X	X			Borings will be advanced in paved areas near the ends of the former JP-4/JP-8 pump islands to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB28	1-5	1239215.959	848061.431	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SB29	1-5	1239187.666	848011.473	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB30	1-5	1239187.666	848045.155	X	X	X	X	X	X	X			Borings will be advanced in paved areas near the ends of the former JP-4/JP-8 pump islands to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X		X	
CA507-SS31	0-0.5	1239211.490	847973.858	X	X	X	X	X	X	X			Boring will be advanced at the end of the concrete drainage swale to the west of the JP-4/JP-8 pump islands to determine if contamination is present in this area.
CA507-SB31	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS32	0-0.5	1239179.097	848078.400	X	X	X	X	X	X	X		X	Borings will be advanced on both ends of the concrete OWS vault to determine if contamination is present in this area.
CA507-SB32	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SS33	0-0.5	1239154.585	848078.400	X	X	X	X	X	X	X		X	Borings will be advanced on both ends of the concrete OWS vault to determine if contamination is present in this area.
CA507-SB33	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SS34	0-0.5	1239165.347	848107.707	X	X	X	X	X	X	X			Boring will be advanced to the east of the 55 gallon drum containment area (in the vicinity of an underground MOGAS line) to determine if contamination is present in this area.
CA507-SB34	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
CA507-SS35	0-0.5	1239093.834	848103.406	X	X	X	X	X	X	X			Boring will be advanced in an unpaved area at the former MOGAS unloading and dispensing area to determine if contamination is present in this area (potential surface spill area).
CA507-SB35	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X			
CA507-SS36	0-0.5	1239101.725	847940.234	X	X	X	X	X	X	X			Boring will be advanced at the end of the concrete drainage trench on the south part of the site to determine if contamination from runoff is present in this area.
CA507-SB36	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
CA507-SS37	0-0.5	1239095.988	848033.386	X	X	X	X	X	X	X			Boring will be advanced at a break in the curb to the west of the former MOGAS unloading and dispensing area to determine if contamination from runoff is present in this area.
CA507-SB37	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
CA507-SS38	0-0.5	1239384.971	847749.958	X	X	X	X	X	X	X			Borings will be advanced at equally spaced locations to the west of the JP-4/JP-8/MOGAS unloading ports (northwest part of the site) to determine if surface spills occurred in this area.
CA507-SB38	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
CA507-SS39	0-0.5	1239329.62	847751.094	X	X	X	X	X	X	X			
CA507-SB39	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SB40	5-10	1239285.58	847828.987	X	X	X	X	X	X	X	X		Borings will be advanced adjacent to the multiple underground fuel lines that run from Building 392 to Building 390 (central part of the site).
	10-15			X	X	X	X	X	X	X			
CA507-SB41	5-10	1239288.079	847894.552	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB42	5-10	1239288.357	847949.961	X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X			
CA507-SB43	5-10	1239278.019	848032.848	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB44	5-10	1239368.714	847853.203	X	X	X	X	X	X	X		X	Boring will be advanced adjacent to the underground OWS elbows (west part of the site).
	10-15			X	X	X	X	X	X	X			
CA507-SB45	5-10	1239175.823	847850.435	X	X	X	X	X	X	X		X	
	10-15			X	X	X	X	X	X	X			
CA507-SB46	5-10	1239378.437	848044.477	X	X	X	X	X	X	X		X	Boring will be advanced adjacent to an underground diesel fuel line that runs from the former diesel fuel unloading port to the dispensers and diesel fuel line canopy (northeast part of the site). (May be adjusted based on utility locate.)
	10-15			X	X	X	X	X	X	X			
CA507-SB47	5-10	1239348.017	848044.283	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB48	1-5	1239327.642	848002.317	X	X	X	X	X	X	X			Boring will be advanced on the southwest corner of the concrete pad underneath the former diesel fuel island (east-central part of the site).
	5-10			X	X	X	X	X	X	X		X	
CA507-SS49	0-0.5	1239376.512	848121.52	X	X	X	X	X	X	X			Borings will be advanced at former elbow locations in the above-ground diesel fuel lines (east-central part of the site) to determine if surface spills occurred in this area. Boring CA507-SS/SB-50 will also be used to determine if contamination is present to the east of the previous 400-gallon JP-8 spill and excavation located north of Building 390.
CA507-SB49	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS50	0-0.5	1239290.974	848121.512	X	X	X	X	X	X	X			
CA507-SB50	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS51	0-0.5	1239290.974	848140.583	X	X	X	X	X	X	X			Borings will be advanced at former elbow locations in the aboveground diesel fuel lines (east-central part of the site) to determine if surface spills occurred in this area. Boring CA507-SS/SB-50 will also be used to determine if contamination is present to the east of the previous 400-gallon JP-8 spill and excavation located north of Building 390.
CA507-SB51	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS52	0-0.5	1239291.432	848081.844	X	X	X	X	X	X	X			Boring will be advanced to the west of the previous 400-gallon JP-8 spill and excavation located north of Building 390 to determine if contamination is present in this area.
CA507-SB52	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SB53	1-5	1239243.073	848032.956	X	X	X	X	X	X	X			Borings will be advanced at paved and unpaved locations adjacent to the concrete pad underneath the former JP-4/JP-8 pump islands to determine if contamination is present due to potential surface spills at these locations (southeast part of the site).
	5-10			X	X	X	X	X	X	X			
CA507-SB54	1-5	1239204.948	847999.035	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X		X	
CA507-SB55	1-5	1239167.392	848033.261	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
CA507-SS56	0-0.5	1239210.117	848083.001	X	X	X	X	X	X	X			
CA507-SB56	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
CA507-SS57	0-0.5	1239104.723	848094.68	X	X	X	X	X	X	X			Borings will be advanced at equally spaced locations around the former MOGAS unloading and dispensing area.
CA507-SB57	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
CA507-SS58	0-0.5	1239083.14	848089.147	X	X	X	X	X	X	X			
CA507-SB58	1-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
CA507-SS59	0-0.5	1239086.108	848110.874	X	X	X	X	X	X	X			
CA507-SB59	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
CA507-SS60	0-0.5	1239105.398	848115.598	X	X	X	X	X	X	X			Borings will be advanced at equally spaced locations around the former MOGAS unloading and dispensing area.
CA507-SB60	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters									Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS61	0-0.5	1239138.666	847924.552	X	X	X	X	X	X	X			Boring will be advanced north of the concrete drainage trench on the south part of the site.
CA507-SB61	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X		X	
CA507-SS62	0-0.5	1239054.269	848034.947	X	X	X	X	X	X	X			Borings will be advanced at the discolored low points where surface runoff may have pooled.
CA507-SB62	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X		X	
CA507-SS63	0-0.5	1239042.143	847991.517	X	X	X	X	X	X	X			
CA507-SB63	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X		X	
CA507-SS64	0-0.5	To be determined		X	X	X	X	X	X	X	X		Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
CA507-SB64	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS65	0-0.5			X	X	X	X	X	X	X			
CA507-SB65	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS66	0-0.5			X	X	X	X	X	X	X			
CA507-SB66	0.5-5			X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS67	0-0.5			X	X	X	X	X	X	X		X	
CA507-SB67	0.5-5			X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			
CA507-SS68	0-0.5			X	X	X	X	X	X	X			
CA507-SB68	0.5-5			X	X	X	X	X	X	X		X	
	5-10			X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X			

TABLE 5-6
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
FORMER POL YARD REFUELING AREA SITE (SS-C507)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]	Analytical Parameters									Technical Rationale
			TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	BTEX + Naphthalene[5]	Site-Related SVOCs[6]	Lead[7]	PCBs[8]	Field Duplicate Samples[9]	MS/MSD Samples[10]	
CA507-SS69	0-0.5	To be determined	X	X	X	X	X	X	X			Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
CA507-SB69	0.5-5		X	X	X	X	X	X	X			
	5-10		X	X	X	X	X	X	X			
	10-15		X	X	X	X	X	X	X		X	
CA507-SS70	0-0.5		X	X	X	X	X	X	X			
CA507-SB70	0.5-5		X	X	X	X	X	X	X			
	5-10		X	X	X	X	X	X	X			
CA507-SS71	0-0.5		X	X	X	X	X	X	X			
CA507-SB71	0.5-5		X	X	X	X	X	X	X			
	5-10		X	X	X	X	X	X	X			
		Totals	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**24**	**24**	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.

[2]TPH-DRO analysis via USEPA Method 8015C

[3]TPH-GRO analysis via USEPA Method 8015C

[4]TPH-ORO analysis via USEPA Method 8015C

[5]BTEX + naphthalene analysis via USEPA Method 8260B

[6]Site-related SVOCs analysis via USEPA Method 8270D

[7]Lead analysis via USEPA Method 6020A.

[8]PCBs analysis via USEPA Method 8082A

[9]Field duplicate samples will be collected at a rate of 10 percent (1 per 10 samples collected) for laboratory analysis.

[10]MS/MSD samples will be collected at a rate of 10 percent (1 per 10 samples collected) for laboratory analysis.

Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface
EPA = Environmental Protection Agency
JP = jet propellant
MOGAS = motor gasoline
MS/MSD = matrix spike/matrix spike duplicate
OWS = oil/water separator
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SVOC = semivolatile organic compound
TPH-DRO = total petroleum hydrocarbons-diesel range organics
TPH-GRO = total petroleum hydrocarbons-gasoline range organics
TPH-ORO = total petroleum hydrocarbons-oil range organics
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

TABLE 5-7
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
SURFACE DISPOSAL AREA (SD-C508)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates[1] (Northing, Easting)[2]		Analytical Parameters												Technical Rationale
				TPH-DRO[3]	TPH-GRO[4]	TPH-ORO[5]	VOCs[6]	SVOCs[7]	Pesticides[8]	RCRA Metals[9]	PCBs[10]	Explosives[11]	Dioxins/Furans[12]	Field Duplicate Samples[13]	MS/MSD Samples[14]	
CA508-SS01	0-0.5	1228507.228	851294.596	X	X	X	X	X	X	X	X	X	X	X		Boring will be advanced in the area of visible burned surface debris (on the southwest part of the site) to determine if contamination is present in this area.
CA508-SB01	0.5-5			X	X	X	X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X	X	X			
CA508-SS02	0-0.5	1228620.071	851326.052	X	X	X	X	X	X	X	X	X	X			Boring will be advanced near the middle of the northern part of the site to determine if contamination is present in this area.
CA508-SB02	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X		X	
CA508-SS03	0-0.5	1228568.421	851372.417	X	X	X	X	X	X	X	X	X	X	X		Boring will be advanced near the middle of the eastern part of the site to determine if contamination is present in this area.
CA508-SB03	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X			
CA508-SS04	0-0.5	1228552.155	851273.669	X	X	X	X	X	X	X	X	X	X			Boring will be advanced near the middle of the western part of the site to determine if contamination is present in this area.
CA508-SB04	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X			
CA508-SS05	0-0.5	1228490.066	851350.786	X	X	X	X	X	X	X	X	X	X	X		Boring will be advanced near the middle of the southeastern quarter of the site to determine if contamination is present in this area.
CA508-SB05	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X			

TABLE 5-7
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
SURFACE DISPOSAL AREA (SD-C508)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates[1] (Northing, Easting)[2]		Analytical Parameters												Technical Rationale
				TPH-DRO[3]	TPH-GRO[4]	TPH-ORO[5]	VOCs[6]	SVOCs[7]	Pesticides[8]	RCRA Metals[9]	PCBs[10]	Explosives[11]	Dioxins/Furans[12]	Field Duplicate Samples[13]	MS/MSD Samples[14]	
CA508-SS06	0-0.5	1228664.916	851322.587	X	X	X	X	X	X	X	X	X	X			Borings will be advanced approximately 20 feet outside the perimeter of the mounded area with sparse vegetation to determine if contamination extends outside of the mounded area.
CA508-SB06	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X		X	
CA508-SS07	0-0.5	1228570.901	851234.753	X	X	X	X	X	X	X	X	X	X			
CA508-SB07	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
CA508-SS08	0-0.5	1228530.525	851398.286	X	X	X	X	X	X	X	X	X	X			
CA508-SB08	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X		X	
CA508-SS09	0-0.5	1228459.083	851267.988	X	X	X	X	X	X	X	X	X	X			
CA508-SB09	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X		X	
CA508-SS10	0-0.5	To be determined		X	X	X	X	X	X	X	X	X	X			Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
CA508-SB10	0.5-5			X	X	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X		X	
CA508-SS11	0-0.5			X	X	X	X	X	X	X	X	X	X			
CA508-SB11	0.5-5			X	X	X	X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X	X	X			
			Totals	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**5**	**5**	

TABLE 5-7
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
SURFACE DISPOSAL AREA (SD-C508)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates[1] (Northing, Easting)[2]	Analytical Parameters												Technical Rationale
			TPH-DRO[3]	TPH-GRO[4]	TPH-ORO[5]	VOCs[6]	SVOCs[7]	Pesticides[8]	RCRA Metals[9]	PCBs[10]	Explosives[11]	Dioxins/Furans[12]	Field Duplicate Samples[13]	MS/MSD Samples[14]	

Notes:
[1]Boring locations may be adjusted based on visible surface debris observed during field activities.
[2]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.
[3]TPH-DRO analysis via USEPA Method 8015C
[4]TPH-GRO analysis via USEPA Method 8015C
[5]TPH-ORO analysis via USEPA Method 8015C
[6]VOCs analysis via USEPA Method 8260B
[7]SVOCs analysis via USEPA Method 8270D
[8]Pesticides analysis via Method 8081B
[9]Metals analysis via USEPA Method 6020A and USEPA Method 7471B (Mercury)
[10]PCBs analysis via USEPA Method 8082A
[11]Explosives analysis via USEPA Method 8330
[12]Dioxins/furans analysis via USEPA Method 8290
[13]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.
[14]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.
Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface
MS/MSD = matrix spike/matrix spike duplicate
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SVOC = semivolatile organic compound
TPH-DRO = total petroleum hydrocarbons-diesel range organics
TPH-GRO = total petroleum hydrocarbons-gasoline range organics
TPH-ORO = total petroleum hydrocarbons-oil range organics
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

TABLE 5-8
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters										Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	VOCs[5]	SVOCs[6]	Pesticides[7]	RCRA Metals[8]	PCBs[9]	Field Duplicate Samples[10]	MS/MSD Samples[11]	
CA129-SB01	0-5	1238544.526	849438.747	X	X	X	X	X	X	X	X			Boring will be advanced in the northern part of the leach field to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X		X	
CA129-SB02	0-5	1238556.616	849454.608	X	X	X	X	X	X	X	X			
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X		X	
CA129-SB03	0-5	1238539.115	849456.368	X	X	X	X	X	X	X	X	X		Boring will be advanced near the center of the leach field to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
	20-25			X	X	X	X	X	X	X	X		X	
CA129-SB04	0-5	1238511.501	849457.072	X	X	X	X	X	X	X	X	X		Boring will be advanced in the south corners of the leach field to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
CA129-SB05	0-5	1238533.662	849483.994	X	X	X	X	X	X	X	X	X		
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
CA129-SB06	0-5	1238554.72	849443.36	X	X	X	X	X	X	X	X			Boring will be advanced near the intersection of the drain pipe and the leach field (i.e., distribution box) to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X	X	X		
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
CA129-SB07	0-5	1235891.47	849413.23	X	X	X	X	X	X	X	X			Boring will be completed near the center of the drain pipe between the former location of the ~~OWS~~leach field and the cleanout to determine if the drain pipe leaked.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X		X	

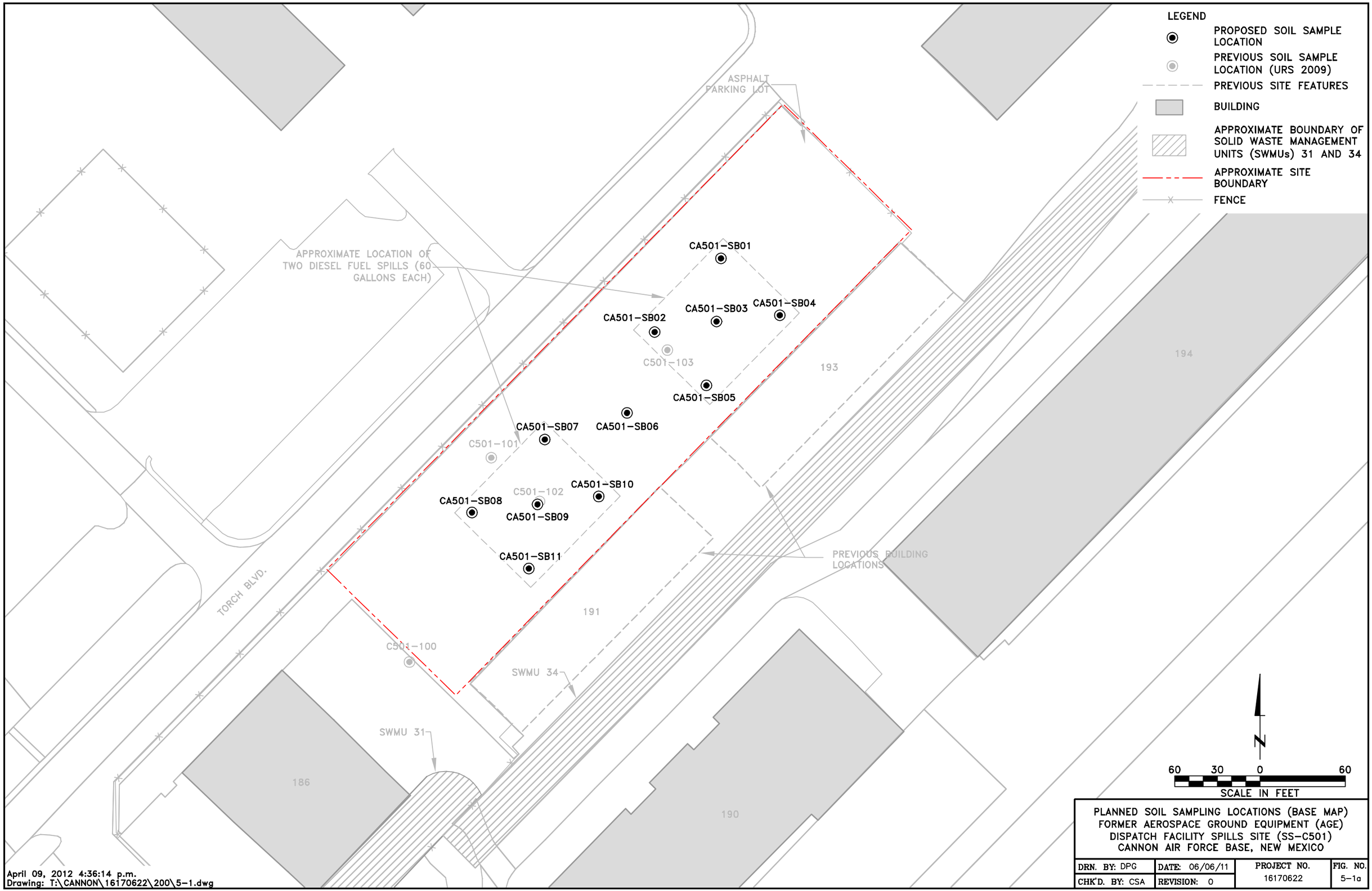
TABLE 5-8
SUMMARY OF PLANNED SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AFB, NEW MEXICO

Sample Location Identification	Approximate Sample Depth Interval (feet bgs)	Sample Coordinates (Northing, Easting)[1]		Analytical Parameters										Technical Rationale
				TPH-DRO[2]	TPH-GRO[3]	TPH-ORO[4]	VOCs[5]	SVOCs[6]	Pesticides[7]	RCRA Metals[8]	PCBs[9]	Field Duplicate Samples[10]	MS/MSD Samples[11]	
CA129-SB08	0-5	1238628.03	849382.88	X	X	X	X	X	X	X	X			Boring will be completed near the former location of the cleanout to determine if contamination is present in this area.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
CA129-SS09	0-5	1238571.72	849432.15	X	X	X	X	X	X	X	X			Surface soil samples collected to assess the potential impacts to soils from various types of waste dumped in these areas.
CA129-SS10	0-5	1238562.06	849445.04	X	X	X	X	X	X	X	X			
CA129-SB11	0-5	To be determined		X	X	X	X	X	X	X	X	X		Boring locations to be determined based on the results of field screening at the above locations.
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X			
CA129-SB12	0-5	To be determined		X	X	X	X	X	X	X	X			Boring locations to be determined based on the results of field screening at the above locations (i.e., borings will be placed in areas likely to have been affected by contamination).
	5-10			X	X	X	X	X	X	X	X			
	10-15			X	X	X	X	X	X	X	X			
	15-20			X	X	X	X	X	X	X	X		X	
			Totals	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**5**	**5**	

Notes:

[1]Horizontal coordinates are in New Mexico East State Plane, North American Datum of 1983.
[2]TPH-DRO analysis via USEPA Method 8015C
[3]TPH-GRO analysis via USEPA Method 8015C
[4]TPH-ORO analysis via USEPA Method 8015C
[5]VOCs analysis via USEPA Method 8260B
[6]SVOCs analysis via USEPA Method 8270D
[7]Pesticides analysis via Method 8081B
[8]Metals analysis via USEPA Method 6020A and USEPA Method 7471B (Mercury)
[9]PCBs analysis via USEPA Method 8082A
[10]Field duplicate samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.
[11]MS/MSD samples will be collected at a rate of 10% (1 per 10 samples collected) for laboratory analysis.
Laboratory analysis to be completed by EMAX Laboratories, Torrance, California

bgs = below ground surface
MS/MSD = matrix spike/matrix spike duplicate
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SVOC = semivolatile organic compound
TPH-DRO = total petroleum hydrocarbons-diesel range organics
TPH-GRO = total petroleum hydrocarbons-gasoline range organics
TPH-ORO = total petroleum hydrocarbons-oil range organics
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
FORMER AEROSPACE GROUND EQUIPMENT (AGE)
DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AIR FORCE BASE, NEW MEXICO

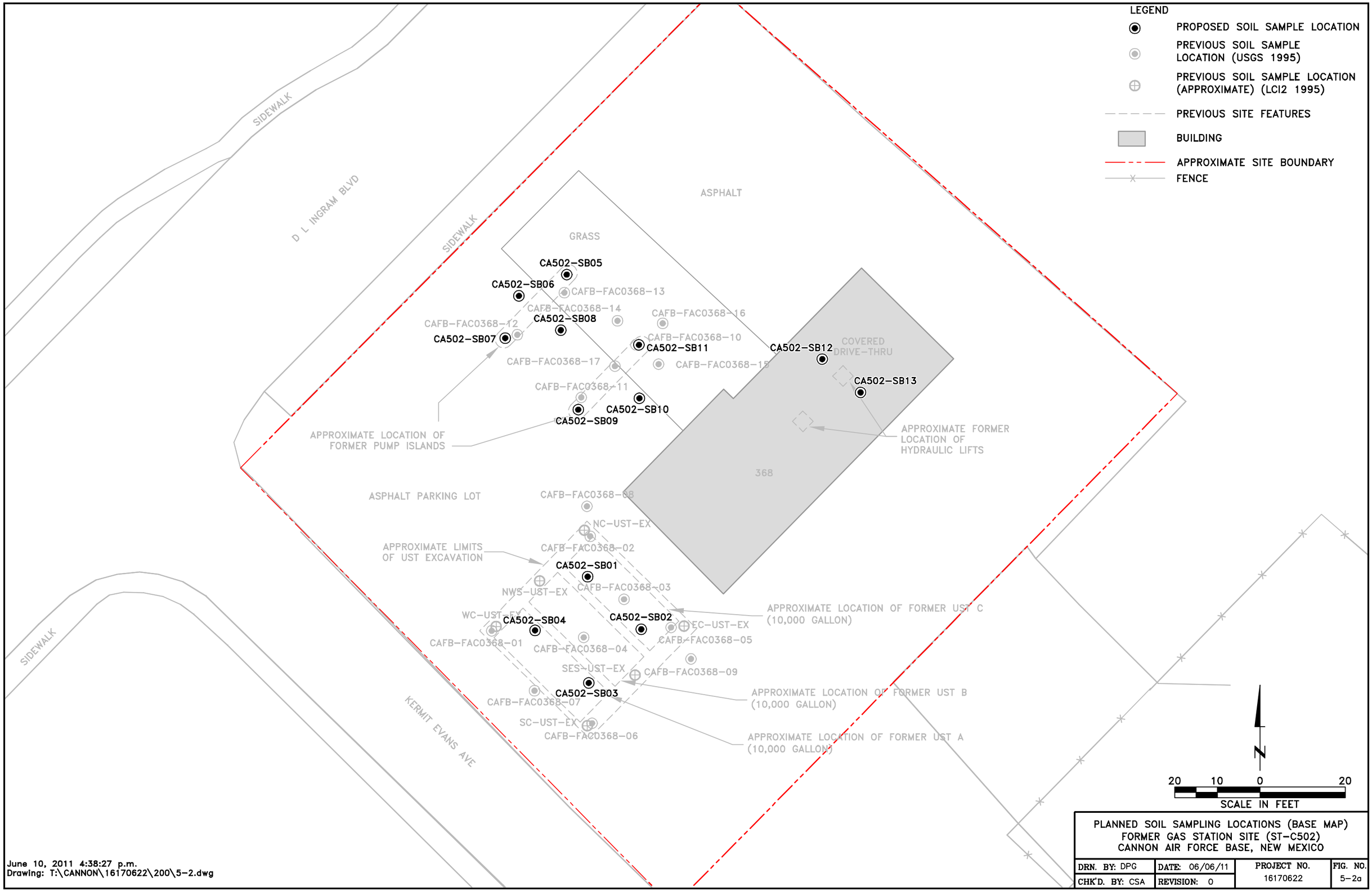
DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-1a
CHK'D. BY: CSA	REVISION: 0		

April 09, 2012 4:36:14 p.m.
Drawing: T:\CANNON\16170622\200\5-1.dwg

PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
FORMER AEROSPACE GROUND EQUIPMENT (AGE)
DISPATCH FACILITY SPILLS SITE (SS-C501)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-1b
CHK'D. BY: CSA	REVISION: 0		

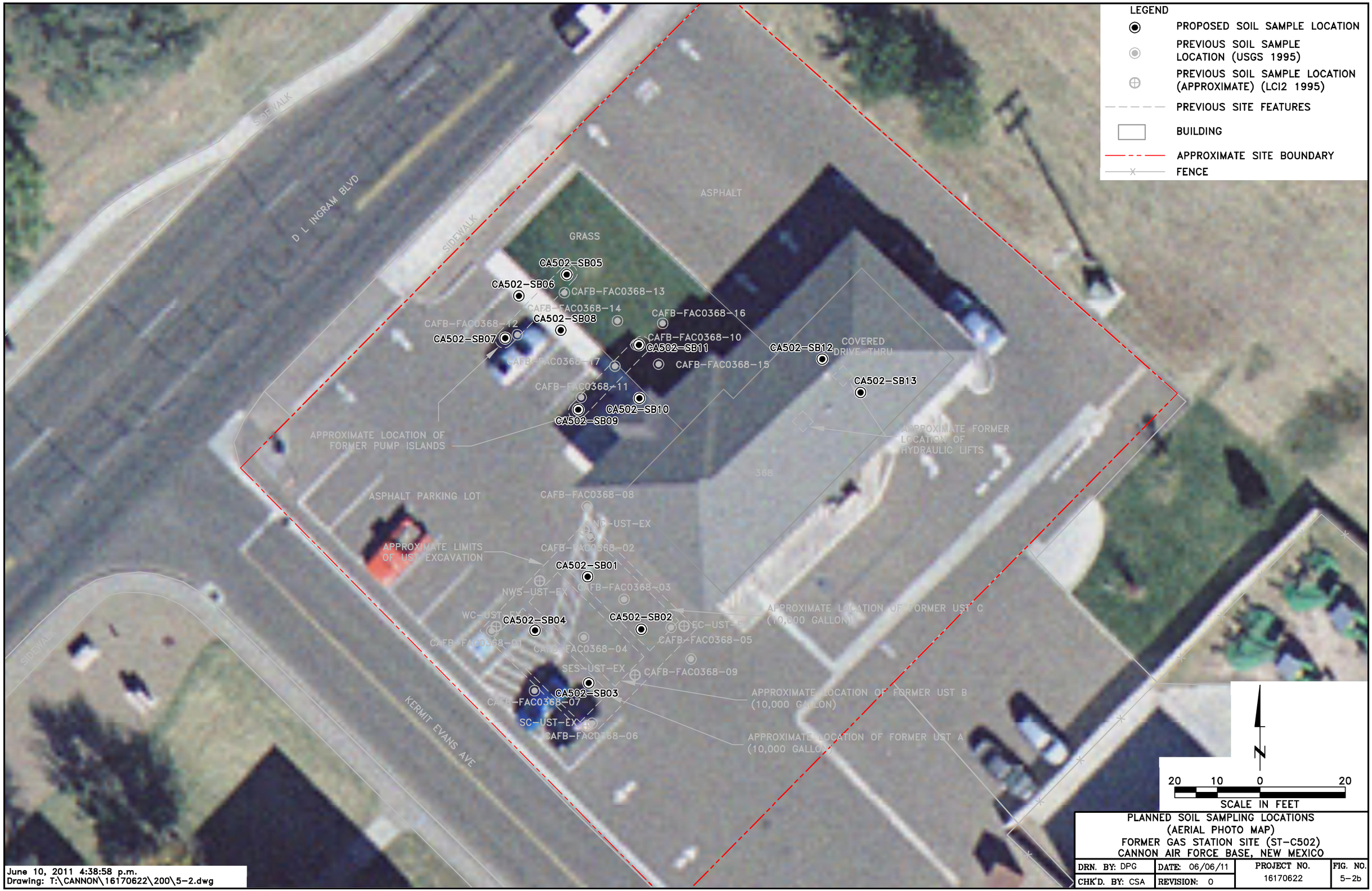
April 09, 2012 4:36:37 p.m.
Drawing: T:\CANNON\16170622\200\5-1.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
FORMER GAS STATION SITE (ST-C502)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-2a
CHK'D. BY: CSA	REVISION: 0		

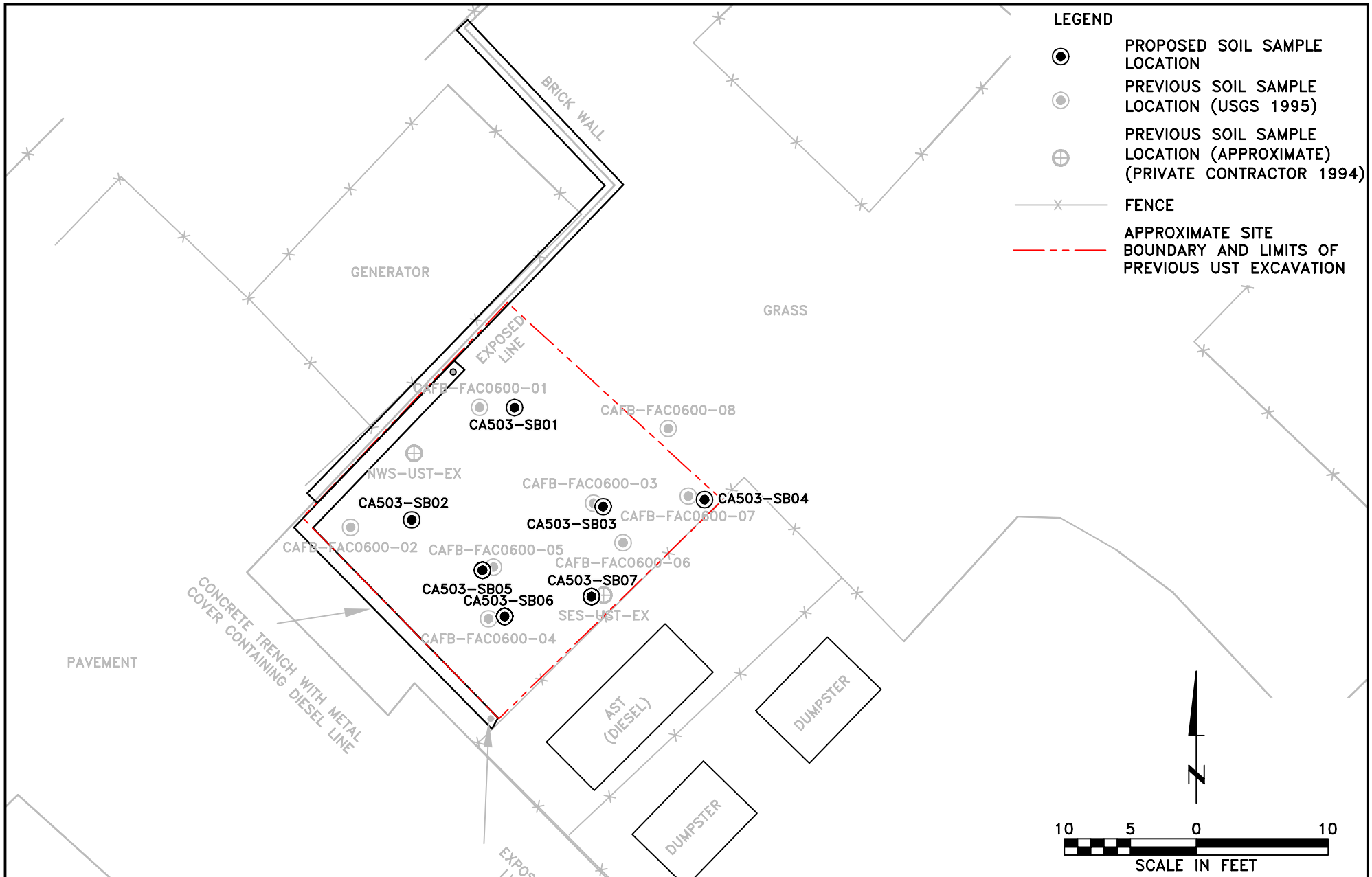
June 10, 2011 4:38:27 p.m.
Drawing: T:\CANNON\16170622\200\5-2.dwg



PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
FORMER GAS STATION SITE (ST-C502)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-2b
CHK'D. BY: CSA	REVISION: 0		

June 10, 2011 4:38:58 p.m.
Drawing: T:\CANNON\16170622\200\5-2.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AIR FORCE BASE, NEW MEXICO

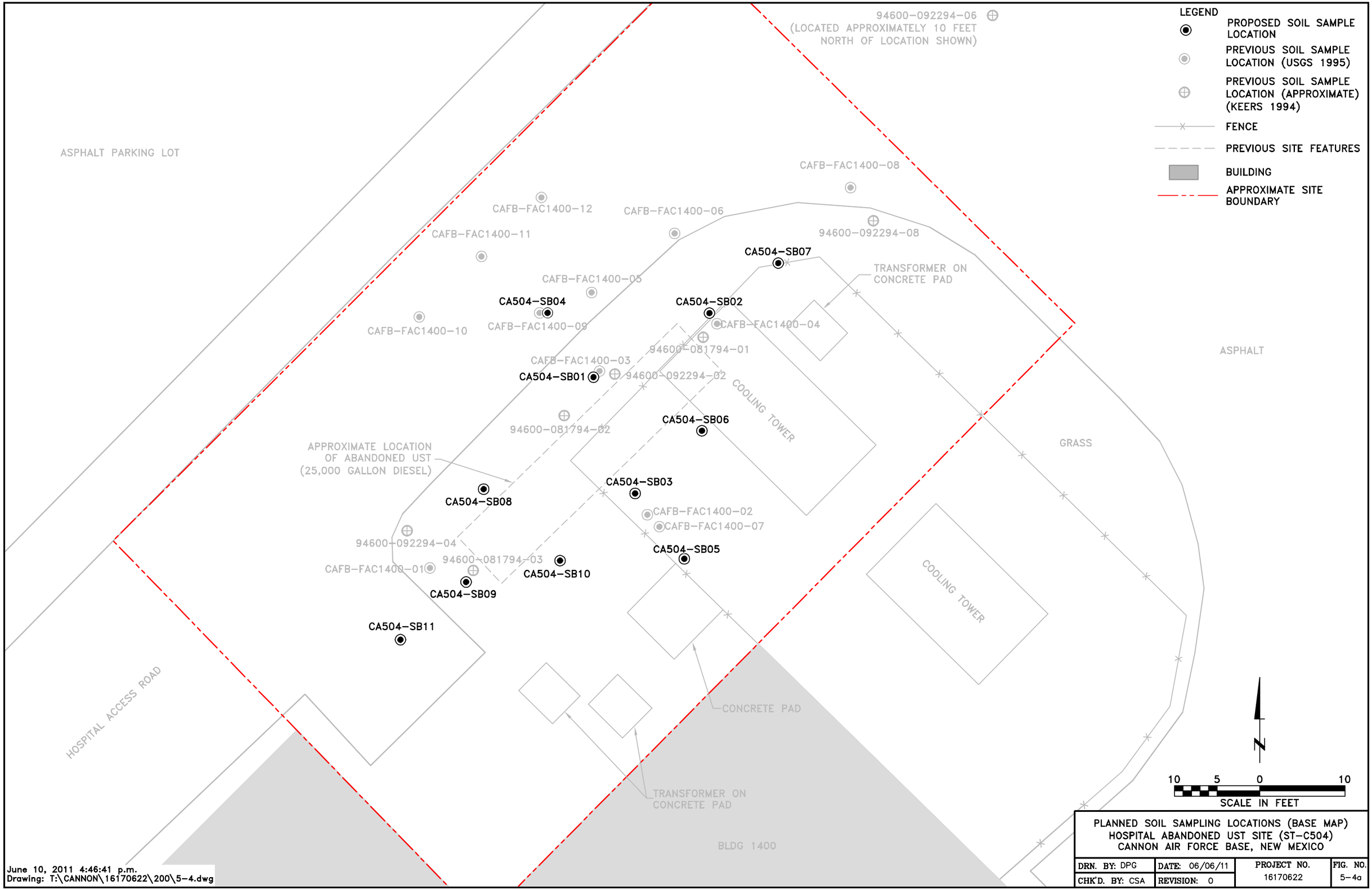
DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-3a
CHK'D. BY: CSA	REVISION: 0		

April 09, 2012 4:42:00 p.m.
Drawing: T:\CANNON\16170622\200\5-3.dwg

PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP
BASE SUPPORT/OPERATIONS GENERATOR FORMER UST SITE (ST-C503)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-3b

April 09, 2012 4:42:23 p.m.
Drawing: T:\CANNON\16170622\200\5-3.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AIR FORCE BASE, NEW MEXICO

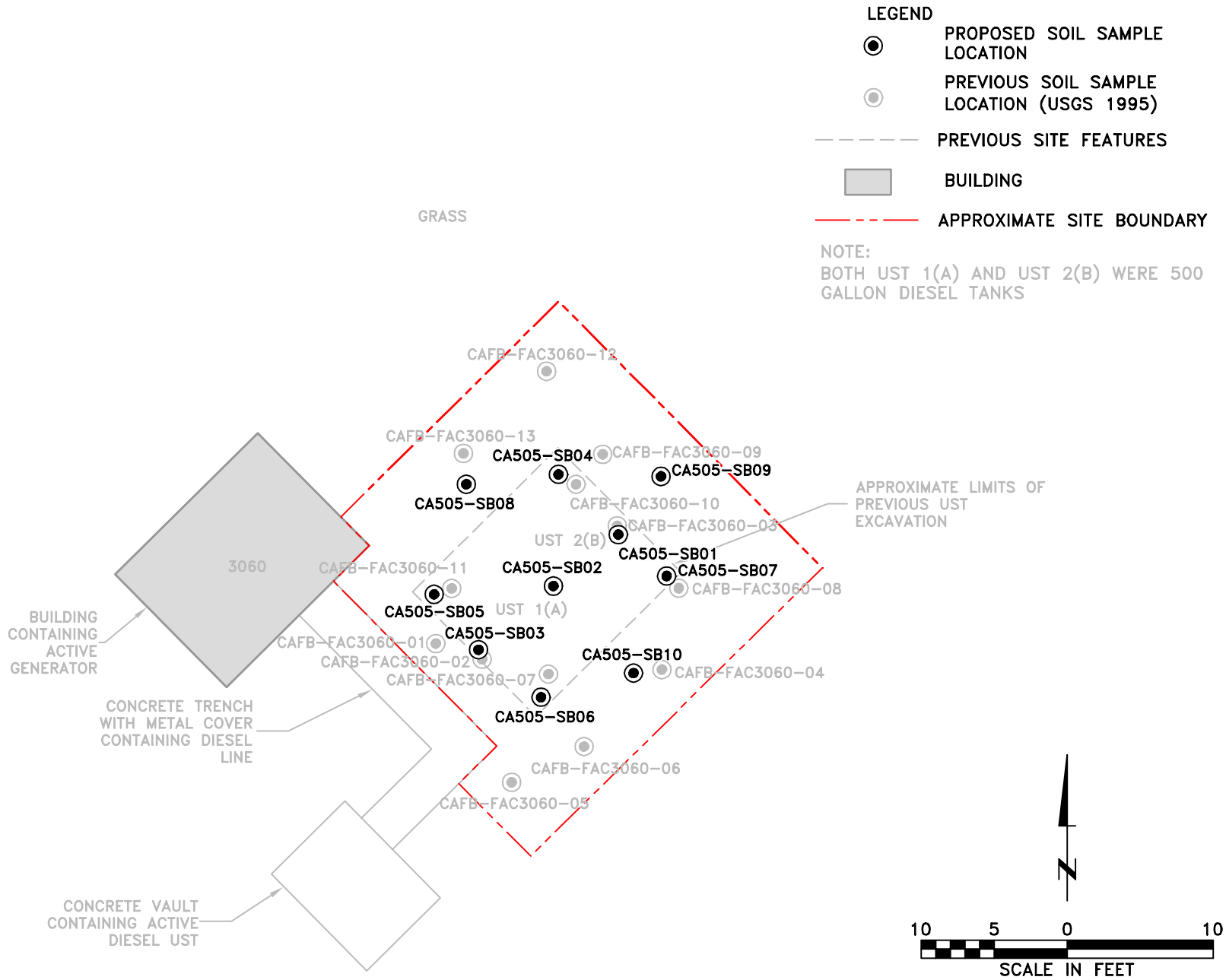
DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-4a

June 10, 2011 4:46:41 p.m.
Drawing: T:\CANNON\16170622\200\5-4.dwg

PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
HOSPITAL ABANDONED UST SITE (ST-C504)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-4b

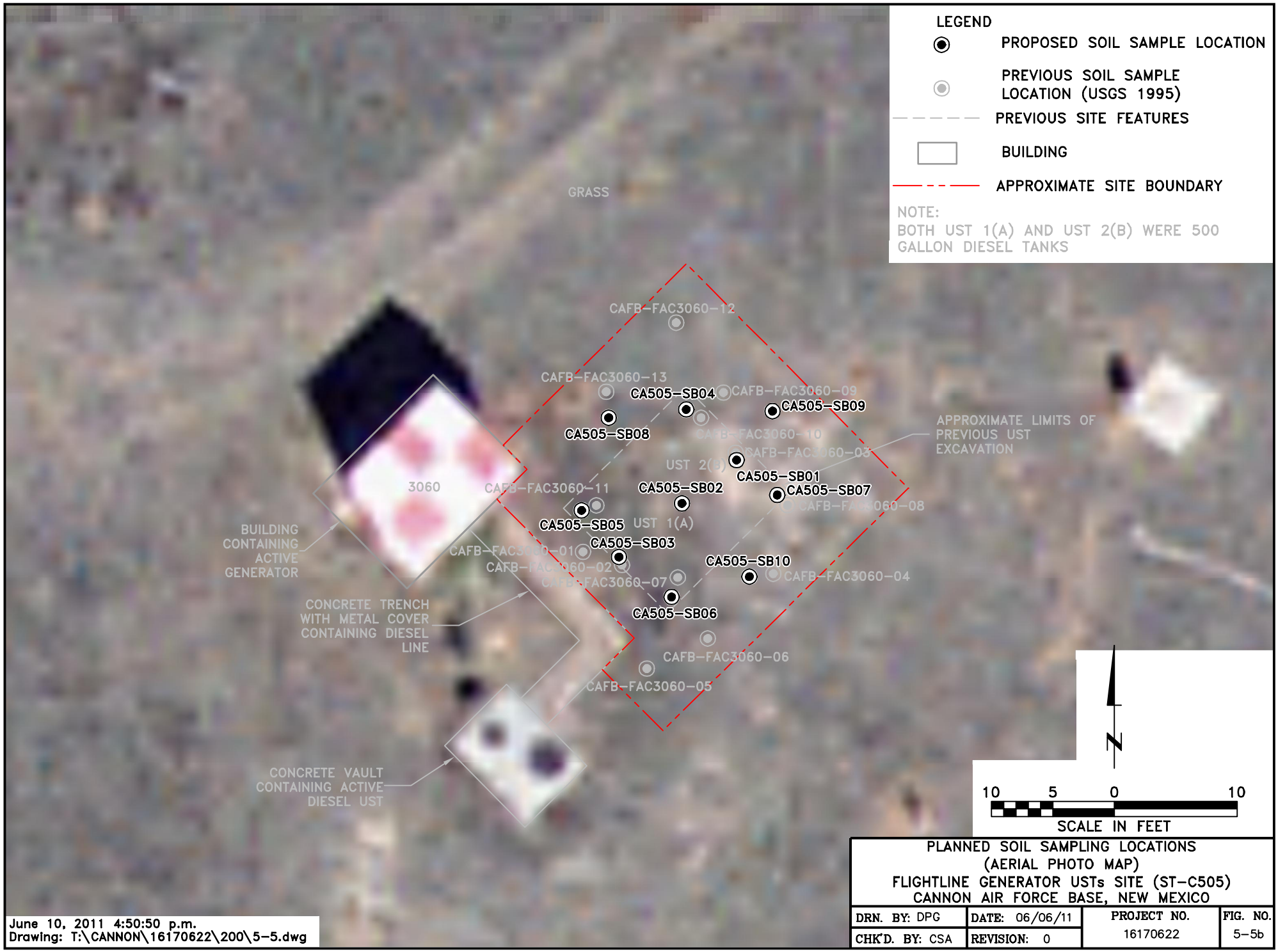
June 10, 2011 4:47:04 p.m.
Drawing: T:\CANNON\16170622\200\5-4.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
FLIGHTLINE GENERATOR USTs SITE (ST-C505)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-5a
CHK'D. BY: CSA	REVISION: 0		

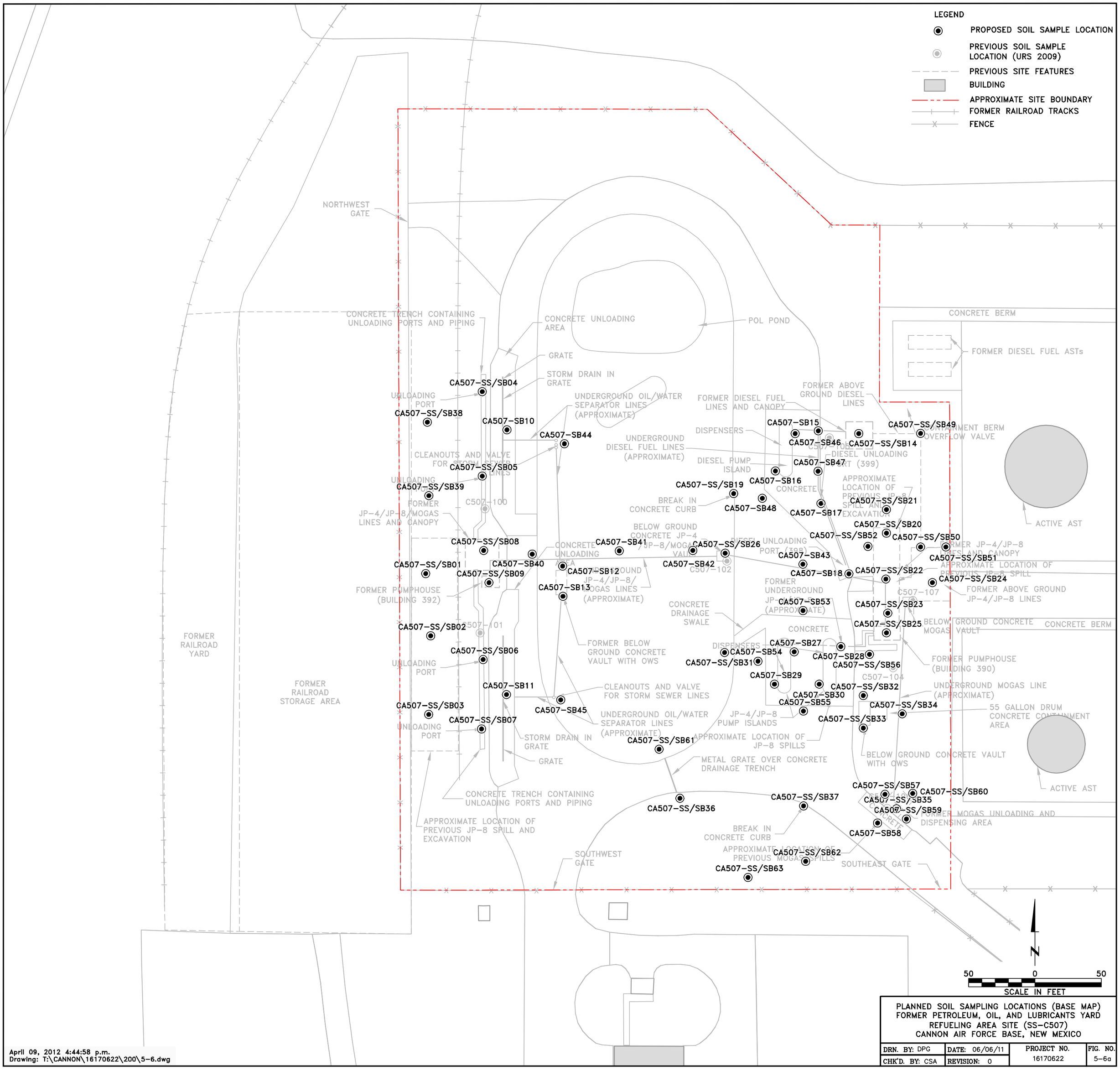
June 10, 2011 4:50:28 p.m.
Drawing: T:\CANNON\16170622\200\5-5.dwg



PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
FLIGHTLINE GENERATOR USTs SITE (ST-C505)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-5b
CHK'D. BY: CSA	REVISION: 0		

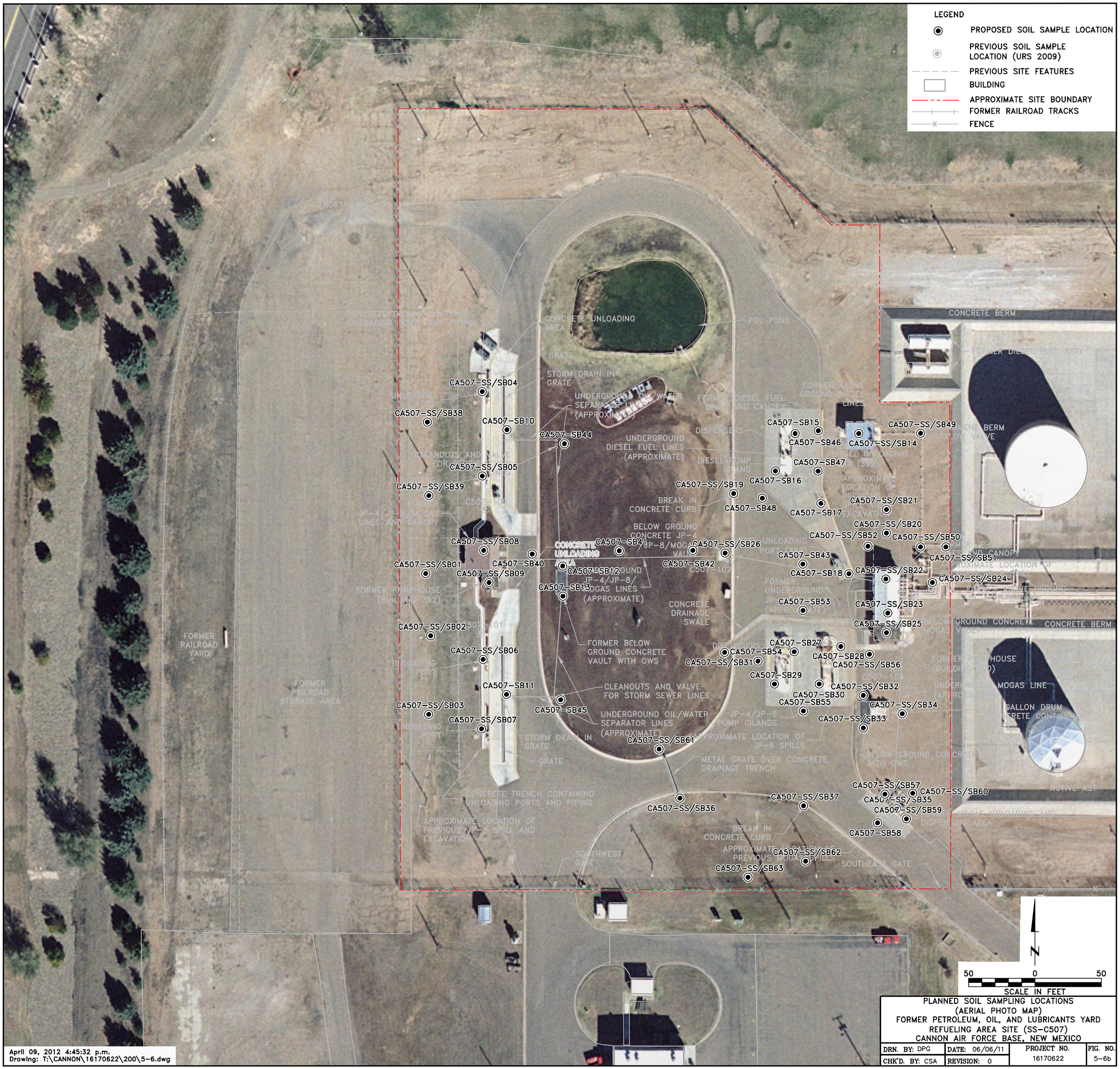
June 10, 2011 4:50:50 p.m.
Drawing: T:\CANNON\16170622\200\5-5.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
FORMER PETROLEUM, OIL, AND LUBRICANTS YARD
REFUELING AREA SITE (SS-C507)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-6a

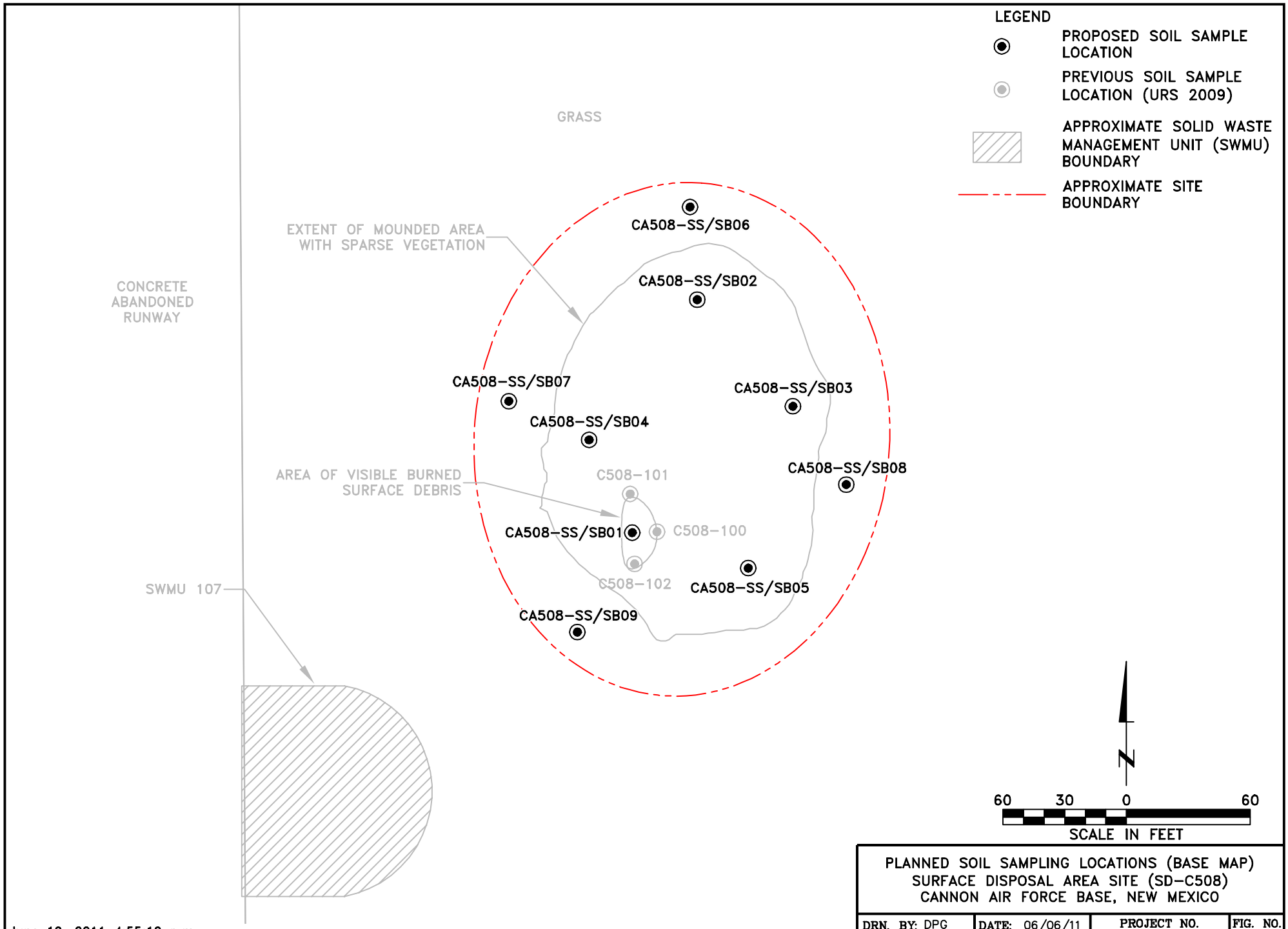
April 09, 2012 4:44:58 p.m.
Drawing: T:\CANNON\16170622\200\5-6.dwg



PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
FORMER PETROLEUM, OIL, AND LUBRICANTS YARD
REFUELING AREA SITE (SS-C507)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-6b

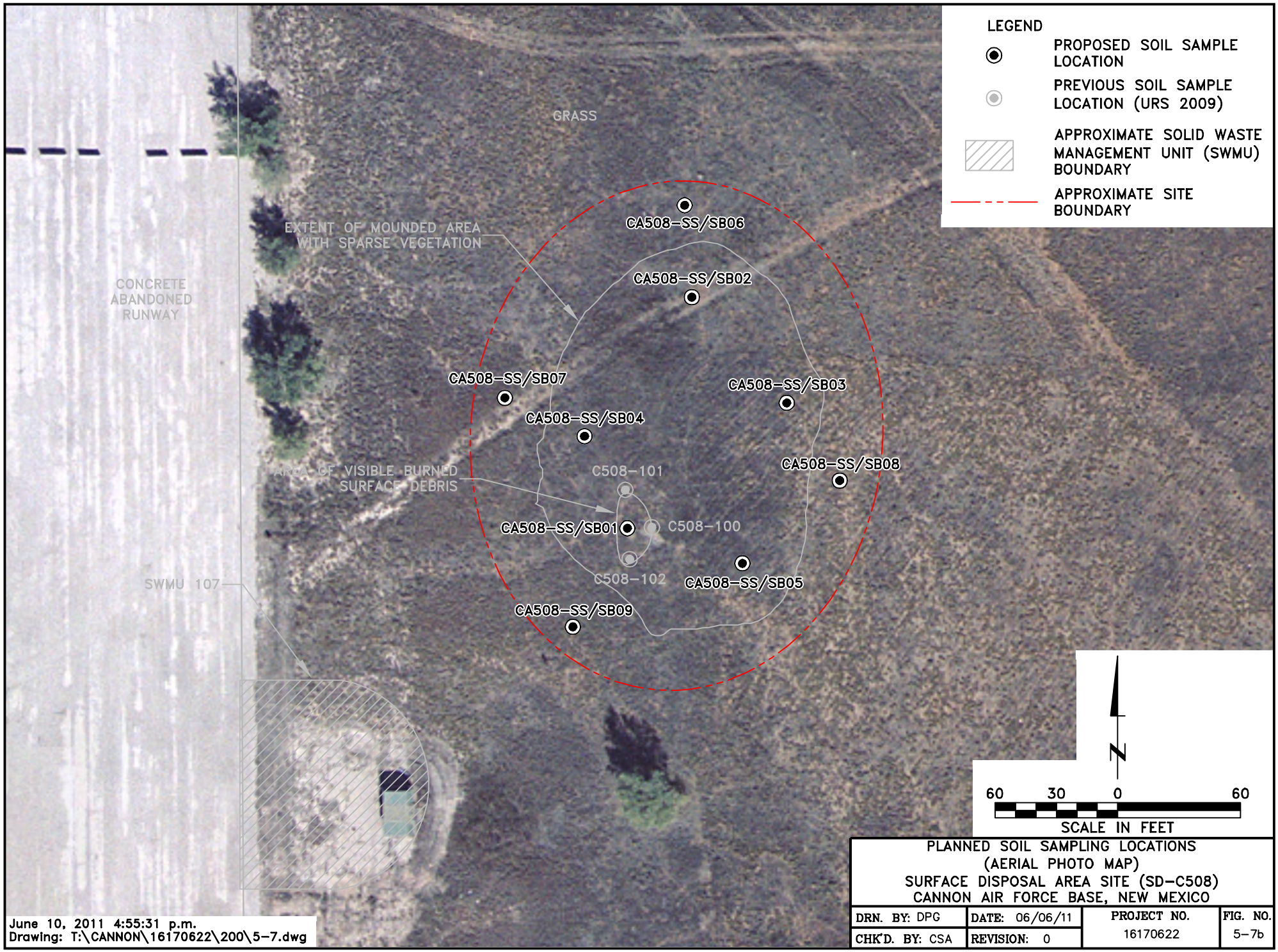
April 09, 2012 4:45:32 p.m.
Drawing: T:\CANNON\16170622\200\5-6.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO. 16170622	FIG. NO. 5-7a
CHK'D. BY: CSA	REVISION: 0		

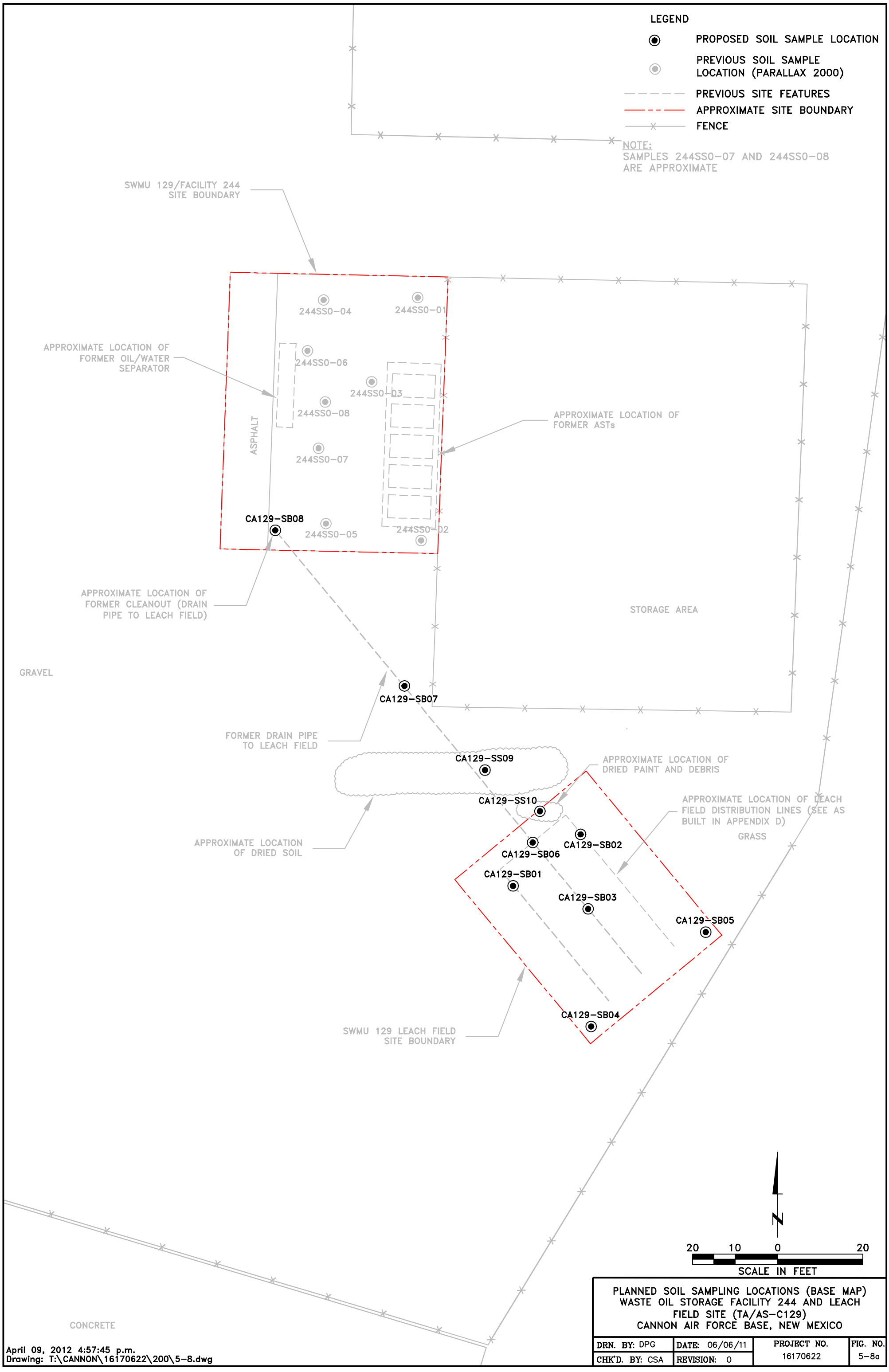
June 10, 2011 4:55:10 p.m.
Drawing: T:\CANNON\16170622\200\5-7.dwg



PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
SURFACE DISPOSAL AREA SITE (SD-C508)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-7b

June 10, 2011 4:55:31 p.m.
Drawing: T:\CANNON\16170622\200\5-7.dwg



PLANNED SOIL SAMPLING LOCATIONS (BASE MAP)
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-8a

PLANNED SOIL SAMPLING LOCATIONS
(AERIAL PHOTO MAP)
WASTE OIL STORAGE FACILITY 244 AND LEACH FIELD SITE (TA/AS-C129)
CANNON AIR FORCE BASE, NEW MEXICO

DRN. BY: DPG	DATE: 06/06/11	PROJECT NO.	FIG. NO.
CHK'D. BY: CSA	REVISION: 0	16170622	5-8b

This section presents the project documentation and reporting for the SI at eight sites project.

6.1 PROJECT MONITORING

The SI at eight sites project will be monitored continuously through a variety of mechanisms. URS will maintain open lines of communication with AFCEE and Cannon AFB to report progress and to quickly and accurately respond to items requiring clarification. URS will prepare monthly CPSMRs (AFCEE CDRL B005) to evaluate the overall progress of the project, along with any existing or potential problem areas. The monthly CPSMR will include a current project schedule (i.e., PPC [AFCEE CDRL B002]) that will be updated monthly to include actual document review times and field sampling event durations. The CPSMR will also provide field sampling progress during periods of on-going field sampling activities. The CPSMRs may be supplemented with periodic photographic documentation to help document the project's current field sampling status. The CPSMRs will also identify all testing and other QC activities that occurred during the reporting period, along with the QC test results. Examples include sample collection and CoC forms, laboratory test reports, survey data, and disposal records.

Monthly CPSMRs, with attachments, will provide a complete record of all activities completed during the SI at eight sites and will be sufficiently detailed to re-create each sampling, analytical testing, and monitoring event. The CPSMRs will be submitted monthly to AFCEE and Cannon AFB. Project execution documentation provided in the monthly CPSMRs may be used in a future site closure report.

Monthly FMERs (AFCEE CDRL C001) will be completed to correlate the status of expensed funds and man hours against the progress of the work completed and the negotiated budget.

6.2 FIELD FORM MANAGEMENT

All field forms completed during SI field activities will be submitted, via fax or as an email attachment, to the URS Omaha Office for detail checking to ensure all required information has been collected during site activities.

All field forms will be maintained in a central project file located in the URS Omaha Office and will be accessible to all project employees. Electronic scanned copies of all field forms will be maintained in the electronic project file.

6.3 SI AT EIGHT SITES REPORT

The SI Report or RCRA Facility Investigation Report (for TA/AS-C129) will include an Executive Summary, current and previous sampling results for the eight sites, a human health and ecological risk screen (where applicable), revised preliminary SCEMs, conclusions, and recommendations. At a minimum, this technical report will also include the following:

- Copies of all permits obtained to complete the work (e.g., dig permit) (AFCEE CDRL A015)

- Analytical data report package
- Field generated paperwork (i.e., SCFS and boring logs)
- Photographic documentation (AFCEE CDRL B005)
- Computer-aided design and drafting (CADD) drawings
- Draft, draft final, and final versions

In addition, this technical report will include all necessary digital files that are compatible with the existing Cannon AFB Geobase System, and will be suitable for submitting to NMED.

6.4 PROJECT FILE

The Project File for the SI at eight sites project will be maintained at the URS Omaha Office. Information or documents within the project file may be submitted to AFCEE or Cannon AFB upon request. The project file will contain, but not be limited to the following:

- All project-related proposals and SOWs
- Award documents
- Emails with government entities
- Phone call logs or meeting minutes
- Correspondence
- Presentation materials
- Site visit notes
- Site background information for each of the eight sites
- Monthly status and cost reports (i.e., CPSMRs)
- Monthly expenditure reports (i.e., FMER)
- Project schedule (i.e., PPC)
- Other written information pertaining to the execution of the task order
- Documents (draft, draft final, and final)
- Data files
- Environmental Resources Program Information Management Systems (ERPIMS) packages
- Complete populated database
- Comment resolution forms
- Sign-in sheets

Air Force Center for Engineering and the Environment (AFCEE). 2010. Statement of Work for Investigation of Oil Water Separators to Determine Defense Environmental Restoration Account Eligibility at Various Installations. June.

Efroymson, R.A., M.E. Will, G.W. Suter and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory. ES/ER/TN-85/R3. November.

Freeze, R.A. and J.A. Cherry. 1979. Groundwater. Prentice-Hall, Inc. Englewood Cliffs, NJ.

Gutentag, Edwin D., F.J. Heimes, N.C. Krothe, R.R. Luckey, and J.B. Weeks. 1984. Geohydrology of the High Plains Aquifer in Parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. USGS Professional Paper 1400-B.

Harza Engineering Company (Harza). 1997. Decision Document, JP-4 Fuel Spill. AOC B/IRP No. 22-18. Cannon AFB. January.

Lee Wan Associates, Inc. (Lee Wan). 1990. RCRA Facility Investigation Work Plan, Field Sampling Plan, and Program Management Plan. Alexandria, Virginia. June.

Los Alamos National Laboratory (LANL). 2010. Ecological Screening Levels (ESLs) in the LANL ECORISK Database, Version 2.5. October.

LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM. http://lanl.gov/environment/cleanup/ecorisk.shtml.

New Mexico Environmental Department (NMED). 2004. Letter from Mr. Glen von Gonten, Cannon AFB Project Leader, NMED, to Colonel Yates, Commander, 27th Fighter Wing. 12 January.

NMED. 2006. NMED TPH Screening Guidelines. October.

NMED. 2012. NMED Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation. February.

Office of the Deputy Under Secretary of Defense. 2009. Defense Environmental Restoration Program Manual, Draft. June.

Parallax, Inc. 2000. Closeout Report/Contamination Assessment, SWMU 129-Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, Final. July.

Radian Corp. 1986. Installation Restoration Program, Phase II – Confirmation/Qualification, Stage I. Cannon AFB. September.

Sposito, G. and A.L. Page. 1984. Cycling of Metal Ions in the Soil Environment. Metal Ions in Biological Systems, Volume 18. Circulation of Metals in the Environment. H. Sigel, ed. Marcel Dekker, Inc., New York.

Technical Cooperation Program (TTCP). 2009. Environmental Fate and Effects of Energetic Materials. The Technical Cooperation Program. http://www.em-guidelines.org/ecot.htm.

URS Group, Inc. (URS). 2005a. Work Plan. Includes: Quality Assurance Project Plan and Site Safety and Health Plan. Supplemental Assessment of Areas of Concern A, B, & C. Cannon AFB, New Mexico. Final Report. December.

URS. 2005b. Supplemental Assessment of Areas of Concern A, B, & C. Cannon AFB, New Mexico. Final. February.

URS. 2009. Final Evaluation Report. Cannon Air Force Base. Air Force Compliance Clean-up Site, Identification and Evaluation of DERA Eligibility for AFCEE, Multiple Locations. Prepared for the United States Army Corps of Engineers, Tulsa District. August.

United States Air Force. 2010. Air Force Environmental Restoration Programming Matrix. 20 April.

United States Environmental Protection Agency (USEPA). 1991. Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals). Interim. Office of Emergency and Remedial Response. Publication No. 9285.7-01B. December.

USEPA. 1994. Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. Office of Solid Waste and Emergency Response. Washington, D.C. July.

USEPA. 1999. Interim Final Lead-Based Paint Guidelines for Disposal of Department of Defense Residential Real Property – A Field Guide. December.

USEPA. 2001. USEPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review. Final. OSWER 9240.1-34. EPA 540-R-00-006. June.

USEPA. 2003. Ecological Screening Levels (ESLs) USEPA Region 5, RCRA. http://epa.gov/region05/waste/cars/pdfs/ecological-screening-levels-200308.pdf.

USEPA. 2004. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. Final. OSWER 9240.1-45. EPA 540-R-04-004. October.

USEPA. 2005-2007. Ecological Soil Screening Levels (ESSLs) Guidance Documents. OSWER Directive 9285.7. http://www.epa.gov/ecotox/ecossl/.

USEPA. 2010. Ecological Soil Screening Levels. October.United States Geological Survey (USGS). 1984. Professional Paper 1270. Element Concentrations in Soil and Other Surficial Materials in the Conterminous United States. By H.T. Shacklette and J.G. Borengen.

USGS. 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico. Volume I.

William Matotan and Associates. 1985. Water Well Master Plan Survey. Prepared for Department of the Air Force, Cannon Air Force Base, New Mexico.

Woodward-Clyde (W-C). 1991. Field Sampling Plan. Remedial Investigation. Phase I (18 SWMUs). Cannon AFB; Clovis, New Mexico.

W-C. 1995a. Appendix II SWMUs RCRA Facility Investigation. Final Report.

W-C. 1995b. Appendix III SWMUs RCRA Facility Investigation. Final Report.

W-C. 1997. Naturally Occurring Concentrations of Inorganics and Background Concentrations of Pesticides at Cannon Air Force Base, New Mexico. Final Report. September.

UNIFORM FEDERAL POLICY
QUALITY ASSURANCE PROJECT PLAN

SITE INVESTIGATION AT EIGHT SITES

CANNON AIR FORCE BASE

April 2012

Contract No. FA8903-08-D-8783
Task Order 0169

Prepared for:

Air Force Special
Operations Command

27th Special
Operations Wing

Under Contract to

Air Force Center for Engineering and the Environment

Prepared by:

URS

12120 Shamrock Plaza, Ste 300
Omaha, NE 68154

16170622

THIS PAGE INTENTIONALLY BLANK

TABLE OF CONTENTS

Introduction....1

Section 1 QAPP Worksheet #1 – Title and Approval Page....1-1

Section 2 QAPP Worksheet #2 – QAPP Identifying Information....2-1

Section 3 QAPP Worksheet #3 – Distribution List....3-1

Section 4 QAPP Worksheet #4 – Project Personnel Sign-Off Sheet....4-1

Section 5 QAPP Worksheet #5 – Project Organizational Chart....5-1

Section 6 QAPP Worksheet #6 – Communication Pathways....6-1

Section 7 QAPP Worksheet #7 – Personnel Responsibilities and Qualifications Table....7-1

Section 8 QAPP Worksheet #8 – Special Personnel Training Requirements Table....8-1

Section 9 QAPP Worksheet #9 – Project Scoping Session Participants Worksheet....9-1

Section 10 QAPP Worksheet #10 – Problem Definition....10-1

Section 11 QAPP Worksheet #11 – Project Quality Objectives/Systematic Planning Process Statements....11-1

Section 12 QAPP Worksheet #12 – Measurement Performance Criteria Table....12-1

Section 13 QAPP Worksheet #13 – Secondary Data Criteria and Limitations Table....13-1

Section 14 QAPP Worksheet #14 – Summary of Project Tasks....14-1

Section 15 QAPP Worksheet #15 – Reference Limits and Evaluation Table....15-1

Section 16 QAPP Worksheet #16 – Project Schedule / Timeline Table....16-1

Section 17 QAPP Worksheet #17 – Sampling Design and Rationale....17-1

Section 18 QAPP Worksheet #18 -- Sampling Locations and Methods/SOP Requirements Table....18-1

Section 19 QAPP Worksheet #19 – Analytical SOP Requirements Table....19-1

TABLE OF CONTENTS

Section 20 QAPP Worksheet #20 – Field Quality Control Sample Summary Table 20-1

Section 21 QAPP Worksheet #21 – Project Sampling SOP References Tables 21-1

Section 22 QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing, and Inspection Table 22-1

Section 23 QAPP Worksheet #23 – Analytical SOP References Table 23-1

Section 24 QAPP Worksheet #24 – Analytical Instrument Calibration Table 24-1

Section 25 QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table 25-1

Section 26 QAPP Worksheet #26 – Sample Handling System 26-1

Section 27 QAPP Worksheet #27 – Sample Custody Requirements Table 27-1

Section 28 QAPP Worksheet #28 – QC Samples Table 28-1

Section 29 QAPP Worksheet #29 – Project Documents and Records Table 29-1

Section 30 QAPP Worksheet #30 – Analytical Services Table 30-1

Section 31 QAPP Worksheet #31 – Planned Project Assessments Table 31-2

Section 32 QAPP Worksheet #32 – Assessment Findings and Corrective Action Responses 32-1

Section 33 QAPP Worksheet #33 – QA Management Reports Table 33-1

Section 34 QAPP Worksheet #34 – Verification (Step 1) Process Table 34-1

Section 35 QAPP Worksheet #35 – Validation (Steps IIa and IIb) Process Table 35-1

Section 36 QAPP Worksheet #36 – Validation (Steps IIa and IIb) Summary Table 36-1

Section 37 QAPP Worksheet #37 – Usability Assessment 37-1

Section 38 References 38-1

TABLE OF CONTENTS

List of Attachments

Attachment A Laboratory Standard Operating Procedures

Attachment B Laboratory Certifications

List of Tables

Table 12-1 Accuracy and Precision Criteria for VOC Analysis

Table 12-2 Accuracy and Precision Criteria for SVOC Analysis

Table 12-3 Accuracy and Precision Criteria for Organochlorine Pesticides Analysis

Table 12-4 Accuracy and Precision Criteria for PCB Analysis

Table 12-5 Accuracy and Precision Criteria for TPH-DRO, TPH-ORO and TPH-GRO Analysis

Table 12-6 Accuracy and Precision Criteria for Metals Analysis

Table 12-7 Accuracy and Precision Criteria for Dioxins/Furans Analysis

Table 12-8 Accuracy and Precision Criteria for Explosives

Table 12-9 Surrogate Compound Accuracy Criteria

Table 12-10 Calibration and QC Procedures for USEPA Methods SW8260B and SW8270D

Table 12-11 Calibration and QC Procedures for USEPA Methods SW8015C, SW8081B, SW8082A and SW8330A

Table 12-12 Calibration and QC Procedures for USEPA Methods SW6020A and SW7471B

Table 12-13 Calibration and QC Procedures for USEPA Method SW8290

TABLE OF CONTENTS

Acronyms and Abbreviations

°C	degrees Celsius
%D	percent difference
%R	percent recovery
AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
AST	Aboveground Storage Tank
BTEX	benzene, toluene, ethylbenzene, toluene and xylenes
bgs	below ground surface
BRA	Baseline Risk Assessment
B.S.	Bachelor of Science
CA	Corrective Action
CAC	corrective action complete
CAS	Chemical Abstracts Service
CAS	Columbia Analytical Services
CCB	continuing calibration blank
CCC	calibration check compounds
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CD	compact disc
CFR	Code of Federal Regulations
CIH	certified industrial hygienist
COC	chain of custody
COD	coefficient of determination
COPC	chemical of potential concern
CPR	cardiopulmonary resuscitation
CCV	continuing calibration verification
CVAA	cold vapor atomic absorption
DFTPP	decafluorotriphenylphosphine
DL	detection limit
DoD	Department of Defense
DQI	Data Quality Indicator

TABLE OF CONTENTS

DQO	data quality objective
DRO	diesel range organic
E	external
EDL	estimated detection limit
ELAP	Environmental Laboratory Accreditation Program
EMAX	EMAX Laboratories, Inc.
ERA	Ecological Risk Assessment
ESL	Ecological Screening Level
ESSL	Ecological Soil Screening Level
ERPIMS	Environmental Resources Program Information Management Systems
FS	Feasibility Study
GC	gas chromatography
GPS	global positioning system
GRO	gasoline range organics
g	gram
HRGC/HRMS	high resolution gas chromatography/high resolution mass spectrometry
I	internal
ICAL	initial calibration
ICP	inductively coupled plasma
ICP-AE	inductively coupled plasma – atomic emission
ICS	interference check sample
ICV	internal calibration verification
IDL	instrument detection limit
IS	internal standard
J	estimated
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
MB	method blank
mg/kg	milligrams per kilogram
MS	matrix spike
MSD	matrix spike duplicate
MD	matrix duplicate

TABLE OF CONTENTS

N/A	not applicable
NAD	North American Datum
NMED	New Mexico Environment Department
No	number
ORO	oil range organics
oz	ounce
P & P	Policies and Procedures
PAWP	Project Activities Work Plan
PCB	polychlorinated biphenyl
PDS	post digestion spike
PFTBA	perfluorotributylamine
PG	Professional Geologist
pH	hydrion ion exponent
PID	photoionization detector
PM	Project Manager
POL	petroleum, oil, and lubricants
ppm	parts per million
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
r	correlation coefficient
R	rejected
RCRA	Resource Conservation and Recovery Act
RF	response factor
RPD	relative percent difference
RSD	relative standard deviation
RSL	regional screening level
RT	retention time
SAP	Sampling and Analysis Plan
SCFS	sample collection field sheet
SOP	standard operating procedure
SB	subsurface soil
SSL	soil screening level

TABLE OF CONTENTS

SVOC	semivolatile organic compound
TBD	to be determined
TPH	total petroleum hydrocarbon
U	nondetect
UFP-QAPP	Uniform Federal Policy–Quality Assurance Project Plan
UJ	estimated nondetect
URS	URS Group, Inc.
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
UTL	upper tolerance limit
Ver	version
VOC	volatile organic compound

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY BLANK

INTRODUCTION

This Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) has been prepared in support of the Site Investigation (SI) at eight sites at Cannon Air Force Base (AFB), New Mexico. The eight sites include SS-C501, ST-C502, ST-C503, ST-C504, ST-C505, SS-C507, SD-C508, and TA/AS-C129 (SWMU 129). It provides completed worksheets prepared in accordance with Part 1 of the UFP-QAPP (the UFP-QAPP Manual).

This compilation of worksheets is intended to meet the requirements of the Sampling and Analysis Plan (SAP) and the Quality Assurance Project Plan (QAPP) and supplements the Project Activities Work Plan (PAWP). Each worksheet addresses specific requirements of the UFP-QAPP. The ultimate success of an environmental program or project depends on the quality of the environmental data that is collected and used in decision-making, and this depends significantly on the adequacy of the QAPP and its effective implementation.

The Former AGE Dispatch Facility Spills (SS-C501) site includes the area northeast of Building 186 where at least two diesel fuel spills (up to 60 gallons each) have historically occurred. The area has recently been repaved with asphalt.

The Former Gas Station underground storage tanks (USTs) (ST-C502) site formerly contained three 10,000-gallon gasoline USTs. In July 1995, the gasoline pump islands were added to the scope of the field investigation at this site. The USTs were removed in January 1995. Currently, the area includes the Cannon Federal Credit Union building and parking lot. An actual date of release cannot be determined; however, it is believed to have occurred during the service life of the tanks (USGS 1995).

The Base Support/Operations Generator Former UST (ST-C503) site formerly contained a 500-gallon diesel UST associated with an emergency generator located to the south of Building 600. The base of the tank was approximately seven feet below ground surface (bgs). The UST and some contaminated soil were removed in October 1994. The former UST was located between an aboveground storage tank (AST) and a brick wall that surrounds a generator and cooling towers (USGS 1995).

The Hospital Abandoned UST (ST-C504) site includes an abandoned 25,000-gallon diesel UST associated with an emergency generator at the Cannon AFB Hospital, Building 1400. The tank is constructed of steel, and its base is approximately 18 feet bgs (USGS 1995).

The Flightline Generator USTs (ST-C505) site formerly contained two 500-gallon diesel USTs associated with the emergency generator at Building 3060. The USTs were removed in December 1994 and January 1995.

INTRODUCTION

The petroleum, oil, and lubricants (POL) Yard Refueling Area (SS-C507) site includes historical spills associated with refueling stations, pumps, ASTs and piping at the POL Yard, which was closed in June/July 2009.

A surface disposal area (SD-C508) site identified in 2009 includes an area containing a variety of debris (some burned), including an ammunition can lid, metal slag, and mechanical parts. The surface disposal area is located east of the former north-south runway and north of SWMU 107.

The TA/AS-C129 site is located within SWMU 129. Facility 244 was originally built in 1991 to store waste petroleum products generated during routine maintenance of aircraft and service vehicles. The facility was used infrequently due to design and operational problems. Historically, lubricating oils, hydraulic fluids, and solvents were reportedly stored in tanks at this site. Fuels were reportedly never stored at this site (Parallax, Inc. [Parallax] 2000).

Additional site descriptions, site background and information about previous investigations are presented in Section 4 of the SI for eight sites PAWP (URS 2011).

QAPP Worksheet #1 (UFP-QAPP Manual Section 2.1) -- Title and Approval Page

Site Investigation at Eight Sites
Document Title

Air Force Center for Engineering and the Environment
Lead Organization

Tony Sedlacek, URS
Preparer's Name and Organizational Affiliation

12120 Shamrock Plaza, Suite 300 Omaha, NE 68154 (402-334-8181),
tony_sedlacek@urscorp.com
Preparer's Address, Telephone Number, and E-mail Address

4/20/2011
Preparation Date (Month/Day/Year)

Investigative Organization's Project Manager: Corey Anderson, URS Project Manager
Printed Name/Title

Signature/Date

Investigative Organization's Project QA Officer: Juan Szymanski, URS Quality Assurance Officer
Printed Name/Title

Signature/Date

Lead Organization's Project Manager: Eliud Burgos, AFCEE Project Manager
Printed Name/Title

Signature/Date

Primary Laboratory QA Manager: Kenette Pimentel / EMAX QA Manager
Printed Name/Title

Signature/Date

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) -- QAPP Identifying Information

Site Number/Code: SS-C501, ST-502, ST-C503, ST-C504, ST-C505, SS-C507, SD-C508 and TA/AS-C129 (SWMU 129)

Operable Unit: Not applicable (N/A)

Contractor Name: URS Group, Inc. (URS)

Contractor Number: FA8903-08-D-8783

Contract Title: Site Investigation at Eight Sites

Work Assignment Number: Task Order 0169

1. Identify guidance used to prepare Quality Assurance Project Plan (QAPP):

   Uniform Federal Policy for Quality Assurance Project Plans
   Department of Defense Quality Systems Manual, Version 4.2

2. Identify regulatory program:

   Resource Conservation and Recovery Act (RCRA) Hazardous Waste Permit 72124454) (No. NM7572124454)

3. Identify approval entity:

   Air Force Center for Engineering and the Environment (AFCEE)

4. This is a project-specific QAPP.

5. List dates of scoping sessions that were held:

   The project scoping session was completed during a site visit on April 19 and 20, 2011.

6. List dates and titles of QAPP documents written for previous site work, if applicable:

   Final Evaluation Report. Cannon AFB. Air Force Compliance Clean-up Site, Identification and Evaluation of Defense Environmental Restoration Account (DERA) Eligibility for AFCEE, Multiple Locations. August, 2009

   USGS. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico. Volume I. 1995

   Final Closeout Report/Contamination Assessment, SWMU 129-Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, Final. July, 2000

7. List organizational partners (stakeholders) and connection with lead organization:

   NMED – regulator

8. List data users:

   AFCEE, NMED, Cannon AFB and URS

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below:

   Not applicable

QAPP Worksheet #3 (UFP-QAPP Manual Section 2.3.1) -- Distribution List

QAPP Recipients	Title	Organization / Address	Telephone Number	E-mail Address	Document Control Number
Eliud Burgos	AFCEE Project Manager	AFCEE (EX) ATTN: Eliud Burgos 2261 Hughes Avenue, Suite 155 Lackland, TX 78236-9854	(210) 395-8626	Eliud.Burgos@us.af.mil	COPY 1
John Kieling	New Mexico Environment Department Program Manager	NMED – Hazardous Waste Bureau 2905 Rodeo Park Dr. East, Building 1 Santa Fe, NM 87505-6303	(505) 476-6000	To be determined (TBD)	COPY 2
Matthew Higginbotham	Cannon AFB Remedial Project Manager	27 SOCES/CEAN, 506 North DL Ingram Blvd Cannon AFB, New Mexico 88103-5003	(575)748-1092	Matthew.Higginbotham@cannon.af.mil	COPY 3
Kenette Pimentel	QA Manager	EMAX Laboratories, Inc. 1835 West 205th St Torrance, CA 90501	(301) 618-8889	Kpimentel@emaxlabs.com	COPY 4
Stephen Jacobson	URS Field Team Leader	URS 12120 Shamrock Plaza, Suite (STE) 300 Omaha, NE 68154	(402) 952-2544	stephen.jacobson@urs.com	COPY 5

QAPP Worksheet #4 (UFP-QAPP Manual Section 2.3.2) -- Project Personnel Sign-Off Sheet

Organization: Air Force Center for Engineering and the Environment

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
Eliud Burgos	AFCEE PM	(210) 395-8626		

Organization: Cannon Air Force Base

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
Matthew Higginbotham	Cannon AFB Remedial PM	(575) 784-1092		

Organization: URS

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
Corey Anderson	Project Manager	(402) 952-2551		
Tony Sedlacek	Project Chemist	(402) 952-2532		
Stephen Jacobson	URS Field Team Leader	(402) 952-2544		
Dennis Day	Health and Safety Officer	(402) 952-2525		

Organization: EMAX Laboratories, Inc. (EMAX)

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
Molly Nguyen	Project Manager	(310) 618-8889		
Kenette Pimentel	QA Manager	(310) 618-8889		

QAPP Worksheet #5 (UFP-QAPP Manual Section 2.4.1) -- Project Organizational Chart

See Figure 2-1 of the Site Investigation at eight sites PAWP

QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) -- Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Point of contact with AFCEE	AFCEE PM	Eliud Burgos	(210) 395-8626	Eliud Burgos is the liaison to Cannon AFB and URS.
Point of contact with Cannon AFB	Cannon AFB Remedial Project Manager	Matthew Higginbotham	(575) 784-1092	Matthew Higginbotham is the liaison to URS for technical matters. Will be notified by Corey Anderson if analytical data irregularities are observed or problems with analytical data are encountered.
Manage all URS Project Phases	URS Project Manager (PM)	Corey Anderson	(402) 952-2551	Corey Anderson is the URS point of contact to AFCEE.
QAPP Changes in the Field	URS Field Team Leader	Stephen Jacobson	(402) 952-2544	Notify Corey Anderson immediately by phone of changes to QAPP made in the field and the reason.
Reporting Lab Data Quality Issues	EMAX QA Manager	Kenette Pimentel	(310) 618-8889	All quality assurance/quality control (QA/QC) issues with project field samples will be reported by Kinette Pimentel to Tony Sedlacek immediately via email. Tony Sedlacek will communicate data quality issues to Corey Anderson.
Analytical Corrective Actions	URS Chemist	Tony Sedlacek	(402) 952-2532	The need for corrective action for analytical issues will be determined by Tony Sedlacek.
Release of Analytical Data	URS Chemist	Tony Sedlacek	(402) 952-2532	No analytical data can be released until an acceptable data package has been received, validation is completed, and Tony Sedlacek has approved the release.
QAPP Amendments	AFCEE PM	Eliud Burgos	(210) 395-8626	Any major changes to the QAPP must be approved by Eliud Burgos before they can be implemented.

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) -- Personnel Responsibilities and Qualifications Table

Name	Title	Organization	Responsibilities	Education and Experience Qualifications
Eliud Burgos	AFCEE PM	AFCEE	Oversees administrative aspects of project	TBD
Matthew Higginbotham	Remedial PM	Cannon AFB	Oversees project - communications and review activities with URS	TBD
Corey Anderson	URS PM	URS	Manages project – coordinates with lead agency	Professional Geologist (PG), Bachelor of Science (B.S.), Environmental Geololgy, 14 year's experience .
Tony Sedlacek	URS Project Chemist	URS	Analytical laboratory oversight	B.S. Chemistry, 6 years exp.
Stephen Jacobson	URS Field Team Leader	URS	Supervises and performs field sampling and coordinates on site field activities	PG, B.S. Geology, 9 years exp.
Dennis Day	Health and Safety Officer	URS	Oversees Health and Safety for field activities	CIH >15 years exp.
Molly Nguyen	Laboratory Project Manager	EMAX	Manages analytical laboratory	B.S. Chemistry, 10 years exp.
Kenette Pimentel	Laboratory QA Manager	EMAX	Performs lab QA oversight	B.S. Chemical Engineering, 25 years exp.

QAPP Worksheet #8 (UFP-QAPP Manual Section 2.4.4) -- Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates[1]
Field geology and sampling	Health and Safety Training/Refresher per 29 Code of Federal Regulation (CFR) 1910.120 Tailgate meeting to discuss sampling plan and procedures	URS	March 2012 Start of fieldwork	Field Team Leader and Project Field Team Project Field Team just prior to the start of field activities	Field Team Leader and Project Field Team, URS	URS, Omaha Office Certificates available on request Field Logbook Daily Safety Forms
	First Aid Training/Cardiopulmonary resuscitation (CPR)	Omaha First Aid Training	Various	Field Team Leader and Project Field Team	Field Team Leader and Project Field Team, URS	URS, Omaha office Certificates available on request

[1] If training records and/or certificates are on file elsewhere, document their location in this column. If training records and/or certificates do not exist or are not available, then this should be noted. A record of the tailgate meeting will be made in the Field Log Book.

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) -- Project Scoping Session Participants Sheet

Project Name: Site Investigation at 8 Sites **Projected Date(s) of Sampling:** Spring and Summer 2012 **Project Manager:** Corey Anderson	**Site Name:** SS-C501, ST-502, ST-C503, ST-C504, ST-C505, SS-C507, SD-C508, and TA/AS-C129 (SWMU 129) **Site Location:** Cannon AFB
Date of Session: The project scoping session was completed during a site visit on April 19 and 20, 2011. **Scoping Session Purpose:** The purpose of the scoping session was to conduct site walkovers, to determine site boundaries, to gather historical site information and to refine the project scope. Detailed site plans were obtained, when possible, to assist in identifying source areas and choosing areas for soil sampling. Additional scoping session details are summarized in the April 2011 site visit notes presented in Appendix D of the PAWP.	

QAPP Worksheet #10 (UFP-QAPP Manual Section 2.5.2) -- Problem Definition

Problem Definition:

Additional analytical data is required to further define the horizontal and vertical extent of known chemicals of potential concern (COPCs) and to determine the presence or absence of various COPCs at the eight sites where potential soil contamination was previously identified.

The investigative approach at the eight sites is designed to provide soil data of sufficient quality and quantity to evaluate whether a release has occurred that could pose a risk to human health or the environment and to evaluate the need for further evaluation, such as collection of additional data, completion of a Baseline Risk Assessment (BRA), or completion of a Feasibility Study (FS).

Project Description:

The primary objective of this project is to complete a Site Investigation that will include collection of surface and subsurface soil samples that will be used to provide the information necessary to further define the horizontal and vertical extent of known COPCs and to determine the presence or absence of chemical contamination, which may pose an unacceptable risk to human health or the environment at these eight sites.

Project Decision Condition:

The soils investigation decision process is designed to identify appropriate actions for each of the eight sites based on three recommendations: corrective action complete (CAC) without controls, CAC with controls, or further investigation and evaluation. Site-specific recommendations for the selection of an appropriate action will depend on whether COPCs are detected in soils at each site, at levels that may pose an unacceptable risk to human health or the environment. The recommendations will be made on the following basis:

- If the horizontal and vertical extent of contamination has been defined and no threat to human health exists based on comparison of maximum concentrations (excluding metals/pesticides below background and field/laboratory contaminants) to NMED residential soil screening levels (SSLs) (NMED 2012) or United States Environmental Protection Agency (USEPA) Residential Regional Screening Levels (RSLs) (USEPA 2011), and no potential threat to the environment is apparent, then CAC without

QAPP Worksheet #10 (UFP-QAPP Manual Section 2.5.2) -- Problem Definition

controls will be recommended. Note: Maximum concentrations will be compared to USEPA RSLs if NMED SSLs are unavailable.

- If one or more COPCs exceed residential SSLs, but not other relevant SSLs, and the horizontal and vertical extent of contamination has been defined, and no potential threat to the environment is apparent, then CAC with controls will be recommended.
- If there is a potential significant threat to human health based on the presence of COPCs with concentrations exceeding NMED SSLs or USEPA RSLs, further investigation will be recommended for the site. Further investigation may include additional field investigation and/or a BRA.

Preliminary ecological screening levels for any detected COPCs will also be used to determine whether further investigation at two of the sites (SS-C507 and SD-C508) is necessary, since these sites are considered potential habitat for ecological receptors. Ecological screening levels will be selected from the following sources in order of priority:

1) USEPA (2005-2007) Ecological Soil Screening Levels (ESSLs); the lowest of plant, soil invertebrate, bird and mammal ESSLs;
2) The lower of:
   a. Technical Cooperation Program – Energetic Material (TTCP);
   b. Los Alamos National Laboratory Ecological Screening Levels (ESLs) (LANL 2011)
3) USEPA Region 5 ESLs (USEA 2003);
4) Other published literature (for example, Efroymson et al 1997).

Due to the small size and developed nature of six of the eight sites, these six sites do not support suitable habitat for ecologically sensitive species and, therefore, do not support suitable habitat for ecological receptors.

All detected analytes will be compared to screening levels presented in Worksheet #15.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) -- Project Quality Objectives/Systematic Planning Process Statements

Who will use the data?

Data will be used by AFCEE, URS and Cannon AFB to evaluate the need for further evaluation, CAC with controls, or CAC without controls at the eight sites.

What will the data be used for?

The data should result in sufficient information to determine the need for further evaluation, such as collection of additional data, completion of BRA, or possible completion of FS.

What types of data are needed?

Discrete surface and subsurface soil samples will be collected continuously using direct push technology from each site and analyzed for selected COPCs. COPCs will be selected from the following: total petroleum hydrocarbon–diesel range organics (TPH-DRO); TPH-gasoline range organics (GRO); TPH-oil range organics (ORO); volatile organic compounds (VOCs); benzene, toluene, ethylbenzene, and xylene (BTEX)+naphthalene; semivolatile organic compounds (SVOCs); site-related SVOCs; pesticides; RCRA metals; lead; polychlorinated biphenyls (PCBs); dioxins/furans; and explosives. Soil samples from each site will be analyzed for the COPCs considered likely to be present based on the site's background.

Planned soil sampling locations, depths, analytical parameters, and technical rationale for each soil boring are provided for each site in Tables 5-1 through 5-8 of the PAWP. Final soil sampling depths will be based on previous sampling results, field observations (e.g., color and odor), and headspace analysis. The sampling efforts described here are discussed in greater detail in **Worksheet #17**.

Also, soil lithological data will be collected to characterize site stratigraphy. Sampling locations and site boundaries will also be surveyed using global positioning system (GPS) survey methods. Horizontal coordinates will be surveyed using the North American

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) -- Project Quality Objectives/Systematic Planning Process Statements

Datum of 1983 (NAD83). Each sample location will be photographed and the appropriate field documentation will be completed.
How much data are needed? Samples that will be collected at each site are presented in Tables 5-1 through 5-8 of the PAWP.
How good does the data need to be? Laboratory analytical data (generated by a Department of Defense [DoD] Environmental Laboratory Accreditation Program [ELAP] accredited laboratories using USEPA test methods) will be used to determine the presence or absence of various COPCs and define horizontal and vertical extent of known COPCs at the eight sites. Investigative samples will be duplicated in the field at a rate of 10 percent and analyzed by EMAX to assess field and laboratory precision.
When will data be collected? Data are anticipated to be collected in the spring and summer of 2012.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-10 and do not replace the appropriate DoD QSM Version (Ver) 4.2 Appendix F Table F-4.			
Analytical Group	Volatile Organic Compounds				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8260B / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-1 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-10 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-4.			
Analytical Group	Semivolatile Organic Compounds				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8270D / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-2 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-11 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-2.			
Analytical Group	Organochlorine Pesticides				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8081B / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-3 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-11 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-2.			
Analytical Group	Polychlorinated Biphenyls				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8082A / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-4 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-11 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-2.			
Analytical Group	TPH-DRO/TPH-ORO/TPH-GRO				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8015C / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-5 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-11 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-2.			
Analytical Group	Explosives				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8330A / N/A	Precision – Lab	RPD < 30%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Tables 12-8 and 12-9	LCS/LCSD, surrogate and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-12 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-7.			
Analytical Group	Metals				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 6020A and 7471B / N/A	Precision – Lab	RPD < 20%	Matrix duplicate (MD) and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field and Laboratory (matrix) Duplicates	S&A
		Accuracy/Bias	See Table 12-6	LCS and MS recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) -- Measurement Performance Criteria Table

Matrix	Soil	Data review criteria are listed in Table 12-13 and do not replace the appropriate DoD QSM Ver 4.2 Appendix F Table F-6.			
Analytical Group	Dioxins/Furans				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See PAWP	USEPA SW-846 8290 / N/A	Precision – Lab	RPD < 20%	MS/MSD and/or LCS/LCSD	S&A
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field duplicates	S&A
		Accuracy/Bias	See Table 12-7	LCS/LCSD and MS/MSD recoveries	A
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
		Sensitivity	Detected	Laboratory Fortified Blank at 3X DL	A
		Completeness	Greater than 95% laboratory analysis	Data Completeness Check	S&A

[1] Reference number from QAPP Worksheet #21
[2] Reference number from QAPP Worksheet #23

TABLE 12-1
ACCURACY AND PRECISION CRITERIA FOR VOC ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
1,1,1,2-Tetrachloroethane	75-125	30
1,1,1-Trichloroethane	70-135	30
1,1,2,2-Tetrachloroethane	55-130	30
1,1,2-Trichloroethane	60-125	30
1,1-Dichloroethane	75-125	30
1,1-Dichloroethene	65-135	30
1,1-Dichloropropene	70-135	30
1,2,3-Trichlorobenzene	60-135	30
1,2,3-Trichloropropane	65-130	30
1,2,4-Trichlorobenzene	65-130	30
1,2,4-Trimethylbenzene	65-135	30
1,2-Dibromo-3-chloropropane	40-135	30
1,2-Dibromoethane	70-125	30
1,2-Dichlorobenzene	75-120	30
1,2-Dichloroethane	70-135	30
1,2-Dichloropropane	70-120	30
1,3,5-Trimethylbenzene	65-135	30
1,3-Dichlorobenzene	70-125	30
1,3-Dichloropropane	75-125	30
1,4-Dichlorobenzene	70-125	30
2,2-Dichloropropane	65-135	30
2-Butanone	30-160	30
2-Chlorotoluene	70-130	30
2-Hexanone	45-145	30
4-Chlorotoluene	75-125	30
4-Methyl-2-pentanone	45-145	30
Acetone	20-160	30
Benzene	75-125	30
Bromobenzene	65-120	30
Bromochloromethane	70-125	30
Bromodichloromethane	70-130	30
Bromoform	55-135	30
Bromomethane	30-160	30
Carbon disulfide	45-160	30
Carbon tetrachloride	65-135	30
Chlorobenzene	75-125	30
Chlorodibromomethane	65-130	30
Chloroethane	40-155	30
Chloroform	70-125	30
Chloromethane	50-130	30
cis-1,2-Dichloroethene	65-125	30
cis-1,3-Dichloropropene	70-125	30
Dibromomethane	75-130	30
Dichlorodifluoromethane	35-135	30
Ethylbenzene	75-125	30
Hexachlorobutadiene	55-140	30
Isopropylbenzene	75-130	30

TABLE 12-1
ACCURACY AND PRECISION CRITERIA FOR VOC ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
m,p-Xylene	80-125	30
Methylene chloride	55-140	30
Naphthalene	40-125	30
n-Butylbenzene	65-140	30
n-Propylbenzene	65-135	30
o-Xylene	75-125	30
p-Isopropyltoluene	75-135	30
sec-Butylbenzene	65-130	30
Styrene	75-125	30
tert-Butylbenzene	65-130	30
Tetrachloroethene	65-140	30
Toluene	70-125	30
trans-1,2-Dichloroethene	65-135	30
trans-1,3-Dichloropropene	65-125	30
Trichloroethene	75-125	30
Trichlorofluoromethane	25-185	30
Vinyl chloride	60-125	30

Notes:

Accuracy evaluation criteria are from Table G-5 and precision evaluation criteria are from Table F-4 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

VOC = Volatile Organic Compond

TABLE 12-2
ACCURACY AND PRECISION CRITERIA FOR SVOC ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
1,2,4-Trichlorobenzene	45-110	30
1,2-Dichlorobenzene	45-100	30
1,3-Dichlorobenzene	40-100	30
1,4-Dichlorobenzene	35-105	30
2,4,5-Trichlorophenol	50-110	30
2,4,6-Trichlorophenol	45-110	30
2,4-Dichlorophenol	45-110	30
2,4-Dimethylphenol	30-105	30
2,4-Dinitrophenol	15-130	30
2,4-Dinitrotoluene	50-115	30
2,6-Dinitrotoluene	50-110	30
2-Chloronaphthalene	45-105	30
2-Chlorophenol	45-105	30
2-Methylnaphthalene	45-105	30
2-Methylphenol	40-105	30
2-Nitroaniline	45-120	30
2-Nitrophenol	40-110	30
4-Nitrophenol	15-140	30
3 & 4-Methylphenol	40-105	30
3-Nitroaniline	25-110	30
4,6-Dinitro-2-methylphenol	30-135	30
4-Bromophenyl-phenyl ether	45-115	30
4-Chloro-3-methylphenol	45-115	30
4-Chlorophenyl-phenyl ether	45-110	30
4-Nitroaniline	35-115	30
Acenaphthene	45-110	30
Acenaphthylene	45-105	30
Anthracene	55-105	30
Benzo(a)anthracene	50-110	30
Benzo(a)pyrene	50-110	30
Benzo(b)fluoranthene	45-115	30
Benzo(g,h,i)perylene	40-125	30
Benzo(k)fluoranthene	45-125	30
Benzyl alcohol	20-125	30
Bis(2-chloroethoxy)methane	45-110	30
Bis(2-chloroethyl)ether	40-105	30
Bis(2-chloroisopropyl)ether	20-115	30
Bis(2-ethylhexyl)phthalate	45-125	30
Butylbenzylphthalate	50-125	30
Carbazole	45-115	30
Chrysene	55-110	30
Di-n-butylphthalate	55-110	30
Di-n-octylphthalate	40-130	30
Dibenz(a,h)anthracene	40-125	30
Dibenzofuran	50-105	30
Diethylphthalate	50-115	30
Dimethylphthalate	50-110	30

TABLE 12-2
ACCURACY AND PRECISION CRITERIA FOR SVOC ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
Fluoranthene	55-115	30
Fluorene	50-110	30
Hexachlorobenzene	45-120	30
Hexachlorobutadiene	40-115	30
Hexachloroethane	35-110	30
Indeno(1,2,3-cd)pyrene	40-120	30
Isophorone	45-110	30
N-Nitroso-di-n-propylamine	40-115	30
N-Nitrosodimethylamine	20-115	30
N-Nitrosodiphenylamine	50-115	30
Naphthalene	40-105	30
Nitrobenzene	40-115	30
Pentachlorophenol	25-120	30
Phenanthrene	50-110	30
Phenol	40-100	30
Pyrene	45-125	30

Notes:

Accuracy evaluation criteria are from Table G-7 and precision evaluation criteria are from Table F-4 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

SVOC = Semi-volatile organic compound

TABLE 12-3
ACCURACY AND PRECISION CRITERIA FOR ORGANOCHLORINE PESTICIDE ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
4,4'-DDD	30-135	30
4,4'-DDE	70-125	30
4,4'-DDT	45-140	30
Aldrin	45-140	30
alpha-BHC	60-125	30
alpha-Chlordane	65-120	30
beta-BHC	60-125	30
delta-BHC	55-130	30
Dieldrin	65-125	30
Endosulfan I	15-135	30
Endosulfan II	35-140	30
Endosulfan sulfate	60-135	30
Endrin	60-135	30
Endrin aldehyde	35-145	30
Endrin ketone	65-135	30
gamma-BHC	60-125	30
gamma-Chlordane	65-125	30
Heptachlor	50-140	30
Heptachlor epoxide	65-130	30
Methoxychlor	55-145	30

Notes:
Accuracy evaluation criteria are from Table G-15 and precision evaluation criteria are from Table F-2 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

BHC = Hexachlorocyclohexane

DDD = Dichlorodiphenyldichloroethane

DDE = Dichlorodiphenyldichloroethylene

DDT = Dichlorodiphenyltrichloroethane

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

TABLE 12-4
ACCURACY AND PRECISION CRITERIA FOR PCB ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
Aroclor 1016	40-140	30
Aroclor 1260	60-130	30

Notes:

Accuracy evaluation criteria are from Table G-17 and precision evaluation criteria are from Table F-2 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

TABLE 12-5
ACCURACY AND PRECISION CRITERIA FOR TPH-DRO, TPH-ORO AND TPH-GRO ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
TPH-DRO	60-150	30
TPH-ORO	50-150	30
TPH-GRO	50-150	30

Notes:

Accuracy evaluation criteria are from EMAX in-house limits and precision evaluation criteria are from Table F-2 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics

TPH-GRO = Total Petroleum Hydrocarbons - Gasoline Range Organics

TPH-ORO = Total Petroleum Hydrocarbons - Oil Range Organics

TABLE 12-6
ACCURACY AND PRECISION CRITERIA FOR METALS ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Spiking Compound	Accuracy (%R)	Precision (RPD)
	Soil	Soil
Arsenic	80-120	20
Barium	80-120	20
Cadmium	80-120	20
Chromium	80-120	20
Lead	80-120	20
Mercury	80-120	20
Selenium	80-120	20
Silver	75-120	20

Notes:

Accuracy evaluation criteria are from Table G-19 and precision evaluation criteria are from Tables F-7 and F-8 of the DoD QSM, Version 4.2.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

RPD = relative percent difference

TABLE 12-7
ACCURACY AND PRECISION FOR DIOXINS/FURANS ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

	Accuracy (%R)	Precision (RPD)
Spiking Compound	**Soil**	**Soil**
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	75-117	20
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	72-118	20
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	58-120	20
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	67-121	20
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	62-122	20
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	74-119	20
1,2,3,4,6,7,8,9-Heptachlorodibenzo-p-dioxin (OCDD)	62-137	20
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	79-120	20
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	73-112	20
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	61-131	20
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	75-126	20
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	48-123	20
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	68-111	20
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	62-121	20
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	66-112	20
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	69-135	20
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	64-135	20

Notes:
to Columbia Analytical Services (CAS) of Houston.
Accuracy and precision evaluation criteria are CAS in-house limits.
The accuracy and precision values are applicable to MS/MSD and LCS/LCSD samples.
%R = Percent recovery
LCS/LCSD = Laboratory control sample/Laboratoy control sample duplicate
MS/MSD = Matrix spike/matrix spike duplicate
RPD = Relative percent difference

TABLE 12-8
ACCURACY AND PRECISION FOR EXPLOSIVES ANALYSIS
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

	Accuracy (%R)	Precision (RPD)
Spiking Compound	**Soil**	**Soil**
1,3,5-Trinitrobenzene	75-125	30
1,3-Dinitrobenzene	80-125	30
2,4,6-Trinitrotoluene	55-140	30
2,4-Dinitrotoluene	80-125	30
2,6-Dinitrotoluene	80-120	30
2-Amino,4,6-Dinitrotoluene	80-125	30
2-Nitrotoluene	80-125	30
3-Nitrotoluene	75-120	30
4-Amino-2,6-Dinitrotoluene	80-125	30
4-Nitrotoluene	75-125	30
HMX	75-125	30
Nitrobenzene	75-125	30
RDX	70-135	30
Tetryl	10-150	30

Notes:
The accuracy and precision values are applicable to MS/MSD and LCS/LCSD samples.
%R = Percent recovery
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
LCS/LCSD = Laboratory control sample/Laboratoy control sample duplicate
MS/MSD = Matrix spike/matrix spike duplicate
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine
RPD = Relative percent difference

TABLE 12-9
SURROGATE COMPOUND ACCURACY CRITERIA
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

Analysis	Spiking Compound	Accuracy (%R) Soil
Volatile Organic Compounds	4-Bromofluorobenzene	85-120
	Toluene-d_8	85-115
Semivolatile Organic Compounds	2,4,6-Tribromophenol	35-125
	2-Fluorobiphenyl	45-105
	2-Fluorophenol	35-105
	Nitrobenzene-d_5	35-100
	Phenol-d_6	40-100
	Terphenyl -d_{14}	30-125
Diesel Range Organics / Oil Range Organics	Bromobenzene	50-150
	Hexacosane	50-150
Gasoline Range Organics	Bromofluorobenzene	50-150
	1,1,1-Trifluorotoluene	50-150
Organochlorine Pesticides	Tetrachloro-m-xylene	70-125
	Decachlorobiphenyl	55-130
Polychlorinated Biphenyls	Decachlorobiphenyl	60-125
Explosives	3,4-Dinitrotoluene	70-130

Notes:
Accuracy evaluation criteria for VOCs, SVOCs, PCBs and Pesticides are from Table G-3 of the DoD QSM, Version 4.2 and accuracy evaluation criteria for GRO, DRO, ORO and Explosives are EMAX in-house control limits.

%R = percent recovery

AFB = Air Force Base

DoD QSM = Department of Defense Quality Systems Manual

PCBs = Polychlorinated Biphenyls

SVOCs = semivolatile organic compounds

UFP-QAPP = Uniform Federal Policy - Quality Assurance Project Plan

VOCs = volatile organic compounds

TABLE 12-10
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8260B AND SW8270D

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
LOD determination and verification	At initial set-up and verified quarterly. If multiple instruments are used, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Apply **R**-flag to data without a valid LOD
LOQ establishment and verification	At initial setup and quarterly: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If LOQ is not set at the lowest calibration standard, must be verified with each batch. If multiple instruments are used, the LOQ must be verified on each.	The LOQ must meet the control limits of the LCS found in QAPP **Tables 12-1** and **12-2**.	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the LCS control limits in QAPP **Tables 12-1** and **12-2**.	Apply **R**-flag to data without a valid LOQ
Holding time	Every sample	Soil VOCs: 48 hours until frozen by laboratory (< -7°C), 14 days to analysis. Soil SVOCs: 14 days to extract, 40 days to analysis.	Contact URS as to additional measures to be taken.	VOCs and SVOCs: Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.
Sample temperature	Every cooler	4 ± 2 °C	Contact URS as to additional measures to be taken.	VOCs and SVOCs: Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to nondetects. VOCs and SVOCs: Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to nondetects.
Mass Tuning	VOCs and SVOCs: Prior to initial calibration and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Apply **R**-flag to data without a valid tune.

TABLE 12-10
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8260B AND SW8270D

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Breakdown check (DDT Method 8270C only)	At the beginning of each 12-hour period, prior to analysis of samples	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat breakdown check	Apply **R**-flag to data analyzed if DDT degradation is not met.
Minimum five point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis	1. Average response factor (RF) for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform and 1,1-dichloroethane. SVOCs ≥ 0.050 2. RSD for RFs for CCCs: VOCs and SVOCs ≤ 30% and one option below: Option 1: RSD for each analyte ≤ 15% Option 2: linear least squares regression r ≥ 0.995 Option 3: non-linear regression: coefficient of determination (COD) r^2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat ICAL	Apply **R**-flag to data without a valid ICAL
Second source calibration verification (ICV)	Once after each ICAL	All project analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.

TABLE 12-10
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8260B AND SW8270D

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Continuing calibration verification (CCV)	Daily before sample analysis and every 12 hours of sampling time.	1. Average RF for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform and 1,1-dichloroethane. SVOCs ≥ 0.050 2. % Difference/Drift for all target compounds and surrogates: VOCs and SVOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration.	Correct problem then repeat CCV. If that fails, then repeat initial calibration and reanalyze all samples since last successful calibration verification	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.
Method blank	One per preparatory batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Apply **U**-flag to analytes detected in field samples < 5X blank contamination (< 10X for common laboratory contaminants).
LCS containing all analytes to be reported, including surrogates.	One per preparatory batch	QC acceptance criteria specified in QAPP **Tables 12-1 and 12-2**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30% or 1/2 the lower limit): Apply **J**-flag to detects and **R**-flag to nondetects.
Internal standards verification	Every field sample, standard and QC sample.	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.

TABLE 12-10
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8260B AND SW8270D

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Surrogate spike	All field and QC samples	QC acceptance criteria specified in QAPP **Table 12-8**.	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to nondetects.
Matrix spike/matrix spike duplicate (MS/MSD)	One per preparatory batch per matrix	QC acceptance criteria specified in QAPP **Tables 12-1 and 12-2**.	Examine the project-specific DQOs. Contact URS as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects and **UJ**-flag to nondetects if acceptance criteria are not met. No qualification if concentration is > 4X the spiking amount.
Field Duplicate	One per 10 field samples	If both the parent and duplicate values are > 5X the LOQ, then 30% RPD for aqueous samples and 50% RPD for soil samples. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	N/A	Apply **J**-flag to detects and **UJ**-flag to nondetects
Professional Judgment	As determined by URS Chemist	Common laboratory contaminants detected at levels > 2X the LOQ.	N/A	Apply **U**-flag to analytes detected in field samples.

Notes:

Data evaluation criteria are from Table F-4 of the DoD QSM, Version 4.2. Industry standard was used when flagging criteria was not specified in the DoD QSM, Version 4.2.

TABLE 12-11
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8015C, SW8081B, SW8082A AND SW8330A
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
LOD determination and verification	At initial set-up and verified quarterly. If multiple instruments are used, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Apply **R**-flag to data without a valid LOD
LOQ establishment and verification	At initial setup: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If LOQ is not set at the lowest calibration standard, must be verified with each batch. If multiple instruments are used, the LOQ must be verified on each.	The LOQ must meet the control limits of the LCS found in QAPP **Tables 12-3, 12-4, 12-5** and **12-8**.	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the LCS control limits in QAPP **Tables 12-3, 12-4, 12-5** and **12-8**.	Apply **R**-flag to data without a valid LOQ
Holding time	Every sample	GRO Soil samples: 48 hours until frozen by laboratory (< -7°C), 14 days to analysis. DRO, ORO, Pesticides, PCB and Explosives Soil samples: 14 days to extract, 40 days to analysis.	Contact URS as to additional measures to be taken.	GRO samples: Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria. DRO, ORO, Pesticides, PCB and Explosives soil samples: Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.

TABLE 12-11
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8015C, SW8081B, SW8082A AND SW8330A
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Sample temperature	Every cooler	4 ± 2 °C	Contact URS as to additional measures to be taken.	Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to nondetects. Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to nondetects.
Breakdown Check (Endrin / DDT Method 8081 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 15% for both DDT and Endrin.	Correct problem then repeat breakdown check.	Apply R-flag to data analyzed if Endrin / DDT degradation is not met.
Minimum five point ICAL for all analytes (DRO/ORO/GRO/Pesticides/PCBs/ Explosives)	ICAL prior to sample analysis	One of the options below: Option 1: RSD for each analyte ≤ 20% Option 2: linear least squares regression r ≥ 0.995 Option 3: non-linear regression: COD r^2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration	Apply **R**-flag to data without a valid ICAL
Second source calibration verification (ICV) (DRO/ORO/GRO/Pesticides/PCBs)	Immediately following ICAL.	All project analytes within established retention time windows. All project analytes within ± 20% of expected value from the ICAL.	Correct problem, then rerun ICV. If that fails, repeat ICAL.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.
Explosives		All project analytes within ± 15% of expected value from the ICAL.		

TABLE 12-11
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8015C, SW8081B, SW8082A AND SW8330A
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Continuing calibration verification (CCV) (DRO/ORO/GRO/Pesticides/PCBs)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes within established retention time windows. All project analytes within ± 20% of expected value from the ICAL.	Correct problem then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and R-flag to nondetects.
Explosives		All project analytes within ± 15% of expected value from the ICAL.		
Method blank	One per preparatory batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Apply **U**-flag to analytes detected in field samples < 5X blank contamination.
LCS containing all analytes to be reported, including surrogates.	One per preparatory batch	QC acceptance criteria specified in QAPP **Tables 12-3, 12-4, 12-5** and **12-8**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30% or 1/2 the lower limit): Apply **J**-flag to detects and **R**-flag to nondetects.
Surrogate spike	All field and QC samples	QC acceptance criteria specified in QAPP **Table 12-9**.	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to nondetects.
Confirmation of positive results (second column or second detector)	All positive results must be confirmed (with the exception of Method 8015).	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	Use project-specific reporting requirements if available; otherwise, use method reporting requirements; otherwise, report the result from the primary column.	Apply **J**-flag if RPD >40%. Apply **U**-flag if primary result not confirmed.

TABLE 12-11
CALIBRATION AND QC PROCEDURES FOR
USEPA METHODS SW8015C, SW8081B, SW8082A AND SW8330A
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Matrix spike/matrix spike duplicate (MS/MSD)	One per preparatory batch per matrix	QC acceptance criteria specified in QAPP **Tables 12-3, 12-4, 12-5** and **12-8**.	Examine the project-specific DQOs. Contact URS as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data. No qualification if concentration is > 4X the spiking amount.
Field Duplicate	One per 10 field samples	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil samples and 30% RPD for aqueous samples. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	N/A	Apply **J**-flag to detects and **UJ**-flag to nondetects

Notes:
Data evaluation criteria are from Table F-2 of the DoD QSM, Version 4.2. Industry standard was used when flagging criteria was not specified in the DoD QSM, Version 4.2.

TABLE 12-12
CALIBRATION AND QC PROCEDURES FOR
USEPA METHOD SW6020A AND SW7471B
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
LOD determination and verification	At initial set-up and verified quarterly. If multiple instruments are used, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Apply **R**-flag to data without a valid LOD
LOQ establishment and verification	At initial setup: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If LOQ is not set at the lowest calibration standard, must be verified with each batch. If multiple instruments are used, the LOQ must be verified on each.	The LOQ must meet the control limits of the LCS found in QAPP **Table 12-6**.	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the LCS control limits in QAPP **Table 12-6.**	Apply **R**-flag to data without a valid LOQ
Instrument detection limit (IDL) study	At initial set-up	IDLs shall be ≤ LOD.		Apply **R**-flag to data without a valid IDL.
Holding time	Every sample	Metals: 6 months (mercury 28 days)	Contact URS as to additional measures to be taken.	Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.
Sample temperature	Every cooler	None (mercury 4 ± 2 °C)	Contact URS as to additional measures to be taken.	Mercury samples arriving at temperatures > 6 °C, apply **J**-flag to detects and **UJ**-flag to nondetects.
Tuning	Prior to ICAL	Mass calibration ≤ 0.1 amu from the true value; Resolution < 0.9 amu full width at 10% peak height; For stability, RSD ≤ 5% for at least four replicate analyses.	Corect problem, then repeat ICAL.	Apply **R**-flag to data without a valid ICAL.

TABLE 12-12
CALIBRATION AND QC PROCEDURES FOR USEPA METHOD SW6020A AND SW7471B
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Initial calibration for all analytes (ICAL) **ICP: minimum of two standards and a blank** **CVAA: minimum 5 standards and a blank**	Daily ICAL prior to sample analysis	$r \geq 0.995$	Correct problem then repeat initial calibration	Apply **R**-flag to data without a valid ICAL
Second source calibration verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analyte(s) within ± 10% of true value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat initial calibration.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.
Continuing calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence.	ICP: All analytes within ± 10% of true value. CVAA: within ± 20% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.
Method blanks	One per preparatory batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Apply **U**-flag to analytes detected in field samples < 5X blank contamination.
Calibration blanks	Before beginnin a sample run, after 10 samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. If required, reprep and reanalyze calibration blank and all samples following the last acceptable calibration blank mus tbe reanalyzed.	Apply **U**-flag to analytes detected in field samples < 5X blank contamination.
LCS containing all analytes to be reported.	One per preparatory batch	QC acceptance criteria specified in QAPP **Table 12-6**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<40%): Apply **J**-flag to detects and **R**-flag to nondetects.

TABLE 12-12
CALIBRATION AND QC PROCEDURES FOR USEPA METHOD SW6020A AND SW7471B
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Matrix spike (MS)	One per preparatory batch per matrix	QC acceptance criteria specified in QAPP **Table 12-6**.	Examine the project-specific DQOs. If the matrix spike falls outside criteria, additional quality control tests are required to evaluate matrix effects.	For the lead in the parent sample. High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<40%): Apply **J**-flag to detects and **R**-flag to nondetects. No qualification if native concentration is > 4X the spiking amount.
Matrix duplicate (MD)	One per preparatory batch per matrix.	RPD < 20% (sample and sample duplicate)	Examine the project-specific DQOs. Contact URS as to additional measures to be taken.	Data shall be evaluated to determine the source of difference. Apply **J**-flag to detects if acceptance criteria are not met.
Interference check solutions (ICS) (ICP only)	At the beginning of an analytical run and every 12 hours	ICS-A: Absolute value of concentration for all non-spiked analytes <LOD (unless they are a verified trace impurity from one of the spiked analytes) ICS-AB: Within ± 20% of true value	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects.
Dilution Test (ICP only)	One per preparatory batch	Five-fold dilution must agree within ± 10% of the original measurement	Perform post digestion spike addition	If the metal(s) outside criteria in parent sample were detected at levels > 50x the LOQ and the PDS fails. Apply **J**-flag to detects in parent sample.
Post-digestion spike (PDS) addition (ICP only)	When dilution test fails or analyte concentration in all samples < 50x LOD	Recovery within 75-125%	None	For the specific analyte(s) in the parent sample. Apply **J**-flag to detects.
Internal standards (IS)	Every sample.	IS intensity within 30-120% of intensity of the IS in the ICAL.	Reanalyze sample at 5-fold dilution with addition of appropriate amounts of internal standards.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects.
Field Duplicate	One per 10 field samples	If both the parent and duplicate values are > 5X the LOQ, then 50% RPD for soil samples. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	N/A	Apply **J**-flag to detects and **UJ**-flag to nondetects

Notes:
Data verification criteria are from Tables F-7 and F-8 of the DoD QSM, Version 4.2. Industry standard was used when flagging criteria was not specified in the DoD QSM, Version 4.2.

TABLE 12-13
CALIBRATION AND QC PROCEDURES FOR
USEPA METHOD SW8290
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
LOD determination and verification	At initial set-up and verified quarterly. If multiple instruments are used, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Apply **R**-flag to data without a valid LOD
LOQ establishment and verification	At initial setup and quarterly: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If LOQ is not set at the lowest calibration standard, must be verified with each batch. If multiple instruments are used, the LOQ must be verified on each.	The LOQ must meet the control limits of the LCS found in QAPP **Table 12-7**.	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the LCS control limits in QAPP **Table 12-7**.	Apply **R**-flag to data without a valid LOQ
Holding time	Every sample	Soil : 30 days to extract, 45 days to analysis.	Contact URS as to additional measures to be taken.	Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.
Sample temperature	Every cooler	4 ± 2 °C	Contact URS as to additional measures to be taken.	Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to nondetects. Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to nondetects.
Initial calibration (ICAL) for all analytes	ICAL prior to sample analysis, as needed by the failure of calibration verification standard, and when a new lot is used as standard source for HRCC-3, sample fortification or recovery solutions.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and S/N ratio ≥ 10 for all target analyte ions; RSD ≤ 20% for the response factors (RF) for all 17 unlabeled standards and RSD ≤ 20% for the RFs for the 9 labeled IS.	Correct problem then repeat initial calibration. Calibration may not be forced through origin.	Apply **R**-flag to data without a valid ICAL

TABLE 12-13
CALIBRATION AND QC PROCEDURES FOR
USEPA METHOD SW8290
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Continuing calibration verification (CCV)	At the beginning of each 12 hour period, and at the end of the anlaytical sequence.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and For unlabeled standards, RF within ± 20% D of RF established in ICAL; For labeled standards, RF within ± 30% D of RF established in ICAL.	Correct problem, repeat calibration verification standard. If that fails, then repeat ICAL and reanalyze all samples analyzed since the last successful CCV. End-of-run CCV: If the RF for unlabeled standards ≤ 25% RPD and the RF for labeled standards ≤ 35% RPD (relative to the RF established in the ICAL), the mean RF from the two daily CCVs must be used for quantitation of impacted samples instead of the ICAL mean RF value. If the starting and ending CCV RFs differ more than > 25% RPD for unlabeled compounds or 35% RPD for labeled compounds, the sample may be quantitated against a new initial calibration if it is analyzed within two hours. Otherwise reanalyze samples with positive detections if necessary.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.
Method blank	One per preparatory batch, run after calibration standards and before samples.	Use project-specific criteria, if available. Otherwise, no analytes detected ≥ LOD for the analyte or ≥ 5% of the associated regulatory limit for the analyte or ≥ 5% of the sample result for the analyte, whichever is greater, per method.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Apply **U**-flag to analytes detected in field samples < 5X blank contamination.
LCS (or fortified field blank)	One per preparatory batch	QC acceptance criteria specified in QAPP **Table 12-7**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30% or 1/2 the lower limit): Apply **J**-flag to detects and **R**-flag to nondetects.
Sample duplicate	One per preparatory batch	RPD ≤ 25% (between sample and sample duplicate), per method	Examine the project-specific DQOs. Contacnt URS as to additional measures to be taken.	Apply **J**-flag to detects and **UJ**-flag to nondetects

TABLE 12-13
CALIBRATION AND QC PROCEDURES FOR
USEPA METHOD SW8290
SITE INVESTIGATION AT 8 SITES
CANNON AFB, NEW MEXICO

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	URS Flagging Criteria
Internal standards	Every field sample, standard and QC sample.	%R recovery for each IS in the original sample (prior to dilutions) must be within 40-135% per method.	Correct problem, then reprep and reanalyze the sample(s) with failed IS.	Apply **J**-flag to detects and **UJ**-flag to nondetects
Matrix spike/matrix spike duplicate (MS/MSD)	One per preparatory batch per matrix	QC acceptance criteria specified in QAPP **Table 12-7**.	Examine the project-specific DQOs. Contact URS as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects and **UJ**-flag to nondetects if acceptance criteria are not met. No qualification if concentration is > 4X the spiking amount.
Field Duplicate	One per 10 field samples	If both the parent and duplicate values are > 5X the LOQ, then 30% RPD for aqueous samples and 50% RPD for soil samples. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	N/A	Apply **J**-flag to detects and **UJ**-flag to nondetects

Notes:

Data evaluation criteria are from Table F-6 of the DoD QSM, Version 4.2. Industry standard was used when flagging criteria was not specified in the DoD QSM, Version 4.2.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) -- Secondary Data Criteria and Limitations Table

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Report that includes the descriptions, finding and results of previous investigations completed at sites SS-C501, SS-C507 and SD-C508	Final Evaluation Report. Cannon AFB. Air Force Compliance Clean-up Site, Identification and Evaluation of Defense Environmental Restoration Account (DERA) Eligibility for AFCEE, Multiple Locations. August, 2009	URS, analytical results from soil borings, boring logs.	Utilize analytical results of previous investigations at sites SS-C501, SS-C507 and SD-C508 to determine sample quantities, locations and initial depths.	None
Report that includes the descriptions, finding and results of previous investigations completed at sites ST-C502, ST-C503, ST-C504 and ST-C505	USGS. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico. Volume I. 1995	USGS, analytical results from soil borings	Utilize analytical results of previous investigations at sites ST-C502, ST-C503, ST-C504 and ST-C505 to determine sample quantities, locations and initial depths.	None
Report that includes the descriptions, finding and results of previous investigations completed at site TA/AS-C129.	Final Closeout Report/Contamination Assessment, SWMU 129-Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, Final. July, 2000	Parallax, Inc. analytical results from soil borings	Utilize analytical results of previous investigations at site TA/AS-C129 to determine sample quantities, locations and initial depths.	None

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) -- Summary of Project Tasks

Project Tasks:

1. Discrete surface and subsurface soil samples will be collected from the eight sites. Discussion of the sampling approach and sampling design and rationale is provided in **Worksheet #17**.

2. Samples will be collected using the URS PAWP.

Analysis Tasks:

1. EMAX will analyze all surface and subsurface soil samples for TPH-DRO, TPH-GRO, TPH-ORO, VOCs, BTEX+naphthalene, SVOCs, site-related SVOCs, pesticides, metals, lead, PCBs and explosives using USEPA SW-846 Methods 8015C, 8260B, 8270D, 8081B, 6020A/7471B, 8082A and 8330A.

2. EMAX will subcontract analysis of all surface and subsurface soil samples for dioxins/furans to Columbia Analytical Services (CAS) – Houston. Dioxins/Furans will be analyzed using USEPA SW-846 Method 8290.

Quality Control Tasks:

1. Matrix spike/matrix spike duplicates (MS/MSD) will be collected at an approximate frequency of 10 percent.

2. Investigative samples will be duplicated in the field at a rate of 10 percent to assess field and laboratory precision.

Secondary Data:

Previously collected information will be used. See **Worksheet #13**.

Data Management Tasks:

Data will be placed in the Environmental Resources Program Information Management System (ERPIMS) database after data review has been performed and data qualifiers have been added. The data in the ERPIMS database will also be submitted to AFCEE in the form of an ERPIMS data submittal.

Documentation and Records:

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) -- Summary of Project Tasks

1. All samples collected will have coordinate locations documented, locations photographed, records of each sample collected in field logbooks, and all field measurements documented in field logbooks.

Documentation and Records continued:

2. Sample collection field sheets (SCFS) will be completed for each investigative sample. Sample identification (ID), sample depth, sample parameters, QA/QC information soil lithologic data, and data collected will be recorded on the SCFS.
3. Chain of Custody (COC) forms and airbills will be prepared and retained for each sample shipment.
4. Copies of the finalized documents, photpgraphs, and technical project documents (including but not limited to the UFP-QAPP, Site Safety and Health Plan [SSHP] and PAWP) will be retained in a central project file for a minimum of 10 years. Other project-related files, such as contract documents, employee benefits, and other information will be retained in accordance with URS policy as stated in URS Policies and Procedures (P & P) Number 070.040JDE.

Data Packages:

EMAX and CAS-Houston will complete analytical Level IV data packages in accordance with the DoD QSM. EMAX and CAS-Houston will provide ERPIMS lab submission files.

Assessment/Audit Tasks:

Field Sample Collection and Documentation Audits: A field audit will be completed at the beginning of the investigation. A laboratory audit of EMAX will be completed if the proficiency evaluation samples do not pass evaluation criteria. Proficiency evaluation samples will be purchased from a certified vendor. Proficiency evaluation samples will be collected in sample containers supplied by the laboratory and submitted blind to the laboratory and analyzed for the project analytical parameters.

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) -- Summary of Project Tasks

Data Review Tasks:

1. EMAX and CAS-Houston will verify that all data are complete for samples received. All data package deliverable requirements will be met. Data will be 100% reviewed by URS using the analytical data summary package. Also, the criteria listed in **Tables 12-1** through **Tables 12-9,** in accordance with DoD QSM Version 4.2 will be utilized. A data review report will be produced by URS for each sample delivery group.

2. Reviewed data and all related field logbooks/notes/records will be reviewed to assess total measurement error and determine overall usability of the data for project purposes. Data limitations will be determined and data will be compared to Project Quality Objectives. Corrective action will be initiated as necessary. Final data are placed in an ERPIMS database, with any necessary qualifiers and tables.

3. Comparison of laboratory proficiency evaluation sample results to proficiency evaluation evaluation criteria.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
1,1,1,2-Tetrachloroethane	630-20-6	2.91E+01	SSL	1.00+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1,1-Trichloroethane	71-55-6	1.56E+04	SSL	2.60E+02	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1,2,2-Tetrachloroethane	79-34-5	8.02E+00	SSL	1.27E-01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1,2-Trichloroethane	79-00-5	2.81E+00	SSL	2.86E+01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1-Dichloroethane	75-34-3	6.45E+01	SSL	2.10E+02	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1-Dichloroethene	75-35-4	4.49E+02	SSL	1.10E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,1-Dichloropropene	563-58-6	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2,3-Trichlorobenzene	87-61-6	4.90E+01	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2,3-Trichloropropane	96-18-4	4.97E-02	SSL	3.36E+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2,4-Trichlorobenzene	120-82-1	7.30E+01	SSL	2.70E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2,4-Trimethylbenzene	95-63-6	6.20E+01	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2-Dibromo-3-chloropropane	96-12-8	1.86E+00	SSL	3.50E-02	USEPA Region 5 ESLs	1.00E-02	2.00E-03	5.00E-03	1.00E-02
1,2-Dibromoethane	106-93-4	5.88E-01	SSL	1.23E+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2-Dichlorobenzene	95-50-1	2.31E+03	SSL	9.20E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2-Dichloroethane	107-06-2	7.89E+00	SSL	8.50E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,2-Dichloropropane	78-87-5	1.52E+01	SSL	3.27E+01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,3,5-Trimethylbenzene	108-67-8	7.80E+02	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,3-Dichlorobenzene	541-73-1	-	-	7.30E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
1,3-Dichloropropane	142-28-9	1.60E+03	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
1,4-Dichlorobenzene	106-46-7	3.17E+01	SSL	8.80E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
2,2-Dichloropropane	594-20-7	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
2-Butanone	78-93-3	3.71E+04	SSL	3.60E+02	LANL 2011	1.00E-02	5.00E-03	5.00E-03	1.00E-02
2-Chlorotoluene	95-49-8	1.56E+03	SSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
2-Hexanone	591-78-6	2.10E+02	RSL	3.60E-01	LANL 2011	2.00E-02	5.00E-03	1.00E-02	2.00E-02
4-Chlorotoluene	106-43-4	1.60E+03	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
4-Methyl-2-pentanone	108-10-1	5.82E+03	SSL	9.80E+00	LANL 2011	2.00E-02	5.00E-03	1.00E-02	2.00E-02
Acetone	67-64-1	6.66E+04	SSL	1.20E+00	LANL 2011	1.00E-02	5.00E-03	5.00E-03	1.00E-02
Benzene	71-43-2	1.54E+01	SSL	2.40E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Bromobenzene	108-86-1	3.00E+02	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Bromochloromethane	74-97-5	1.60E+02	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Bromodichloromethane	75-27-4	5.41E+00	SSL	5.40E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Bromoform	75-25-2	6.20E+01	RSL	1.59E+01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Bromomethane	74-83-9	1.65E+01	SSL	2.35E-01	USEPA Region 5 ESLs	1.00E-02	2.00E-03	5.00E-03	1.00E-02
Carbon disulfide	75-15-0	1.53E+03	SSL	8.20E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Carbon tetrachloride	56-23-5	1.08E+01	SSL	2.98E+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Chlorobenzene	108-90-7	3.76E+02	SSL	2.40E+00	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Chlorodibromomethane	124-48-1	1.21E+01	SSL	2.05E+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
Chloroethane	75-00-3	2.98E+04	SSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Chloroform	67-66-3	5.86E+00	SSL	8.00E+00	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Chloromethane	74-87-3	2.75E+02	SSL	1.04E+01	USEPA Region 5 ESLs	1.00E-02	2.00E-03	3.00E-03	1.00E-02
cis-1,2-Dichloroethene	156-59-2	1.56E+02	SSL	2.30E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
cis-1,3-Dichloropropene	10061-01-5	-	-	3.98E-01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Dibromomethane	74-95-3	2.50E+01	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Dichlorodifluoromethane	75-71-8	1.68E+02	SSL	3.95E+01	USEPA Region 5 ESLs	1.00E-02	2.00E-03	3.00E-03	1.00E-02
Ethylbenzene	100-41-4	6.84E+01	SSL	5.16E+00	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Hexachlorobutadiene	87-68-3	6.20E+00	RSL	3.98E-02	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Isopropylbenzene	98-82-8	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
m,p-Xylene	136777-61-2	7.74E+02	SSL	1.40E+00	LANL 2011	1.00E-02	2.00E-03	5.00E-03	1.00E-02
Methylene chloride	75-09-2	4.09E+02	SSL	2.60E+00	LANL 2011	1.00E-02	2.00E-03	5.00E-03	1.00E-02
Naphthalene	91-20-3	4.30E+01	SSL	2.90E+01	USEPA ESSLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
n-Butylbenzene	104-51-8	3.90E+03	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
n-Propylbenzene	103-65-1	3.40E+03	RSL	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
o-Xylene	95-47-6	8.98E+02	SSL	1.40E+00	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
p-Isopropyltoluene	99-87-6	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
sec-Butylbenzene	135-98-8	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Styrene	100-42-5	7.28E+03	SSL	1.20E+00	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
tert-Butylbenzene	98-06-6	-	-	-	-	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Tetrachloroethene	127-18-4	7.02E+00	SSL	1.80E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Toluene	108-88-3	5.27E+03	SSL	2.30E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
trans-1,2-Dichloroethene	156-60-5	2.70E+02	SSL	2.30E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
trans-1,3-Dichloropropene	10061-02-6	-	-	3.98E-01	USEPA Region 5 ESLs	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Trichloroethene	79-01-6	8.77E+00	SSL	4.20E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Trichlorofluoromethane	75-69-4	1.41E+03	SSL	5.20E+01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03
Vinyl chloride	75-01-4	7.28E-01	SSL	1.20E-01	LANL 2011	5.00E-03	2.00E-03	3.00E-03	5.00E-03

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.

[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method

Undetermined values display a dash in the associated cell.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
ESLs = United States Environmental Protection Agency, Region 5, Resource Conservation and Recovery Act Ecological Screening Levels, 2003
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM.
LOD = limit of detection
LOQ = limit of quantitation
RSL = United States Environmental Protection Agency Regional Screening Levels, May 2011
SSLs = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.
USEPA = United States Environmental Protection Agency
USEPA. 2007. Ecological Soil Screening Levels (ESSLs) Guidance Documents. OSWER Directive

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Semivolatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
1,2,4-Trichlorobenzene	120-82-1	7.30E+01	SSL	2.70E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
1,2-Dichlorobenzene	95-50-1	2.31E+03	SSL	9.20E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
1,3-Dichlorobenzene	541-73-1	-	-	7.30E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
1,4-Dichlorobenzene	106-46-7	3.17E+01	SSL	8.80E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,4,5-Trichlorophenol	95-95-4	6.11E+03	SSL	1.41E+01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,4,6-Trichlorophenol	88-06-2	6.11E+01	SSL	9.94E+00	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,4-Dichlorophenol	120-83-2	1.83E+02	SSL	8.75E+00	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,4-Dimethylphenol	105-67-9	1.22E+03	SSL	1.00E+01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,4-Dinitrophenol	51-28-5	1.22E+02	SSL	6.09E-02	USEPA Region 5 ESLs	6.60E-01	1.67E-01	3.30E-01	6.60E-01
2,4-Dinitrotoluene	121-14-2	1.57E+01	SSL	2.50E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2,6-Dinitrotoluene	606-20-2	6.11E+01	SSL	1.80E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2-Chloronaphthalene	91-58-7	6.26E+03	SSL	1.22E-02	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2-Chlorophenol	95-57-8	3.91E+02	SSL	3.90E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2-Methylnaphthalene	91-57-6	3.10E+02	RSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
2-Methylphenol	95-48-7	3.10E+03	RSL	6.70E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2-Nitroaniline	88-74-4	6.10E+02	RSL	5.40E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
2-Nitrophenol	88-75-5	-	-	1.60E+00	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
4-Nitrophenol	100-02-7	-	-	5.12E+00	USEPA Region 5 ESLs	6.60E-01	1.67E-01	1.67E-01	6.60E-01
3 & 4-Methylphenol	106-44-5	3.10E+02	RSL	6.90E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Semivolatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
3-Nitroaniline	99-09-2	-	-	2.19E+01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
4,6-Dinitro-2-methylphenol	534-52-1	4.89E+00	SSL	-	-	6.60E-01	1.67E-01	3.30E-01	6.60E-01
4-Bromophenyl-phenyl ether	101-55-3	-	-	-	-	3.30E-01	1.67E-01	1.67E-01	3.30E-01
4-Chloro-3-methylphenol	59-50-7	6.10E+03	RSL	7.95E+00	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
4-Chlorophenyl-phenyl ether	7005-72-3	-	-	-	-	3.30E-01	1.67E-01	1.67E-01	3.30E-01
4-Nitroaniline	100-01-6	2.40E+01	RSL	2.19E+01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Acenaphthene	83-32-9	3.44E+03	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Acenaphthylene	208-96-8	-	-	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Anthracene	120-12-7	1.72E+04	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Benzo(a)anthracene	56-55-3	1.48E+00	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Benzo(a)pyrene	50-32-8	1.48E-01	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Benzo(b)fluoranthene	205-99-2	1.48E+00	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Benzo(g,h,i)perylene	191-24-2	-	-	1.10E+00	USEPA ESSLs	USEPA ESSLs	2.50E-03	5.00E-03	1.00E-02
Benzo(k)fluoranthene	207-08-9	1.48E+01	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Benzyl alcohol	100-51-6	6.10E+03	RSL	1.20E+02	LANL 2011	1.30E+01	3.30E-01	6.60E-01	1.30E+01
Bis(2-chloroethoxy)methane	111-91-1	1.80E+02	RSL	3.02E-01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Bis(2-chloroethyl)ether	111-44-4	2.68E+00	SSL	-	-	3.30E-01	1.67E-01	1.67E-01	3.30E-01

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Semivolatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
Bis(2-chloroisopropyl)ether	108-60-1	9.15E+01	SSL	-	-	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Bis(2-ethylhexyl)phthalate	117-81-7	3.47E+02	SSL	2.00E-02	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Butylbenzylphthalate	85-68-7	2.60E+02	RSL	9.00E+01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Carbazole	86-74-8	-	-	8.00E+01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Chrysene	218-01-9	1.48E+02	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Di-n-butylphthalate	84-74-2	6.11E+03	SSL	1.10E-02	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Di-n-octylphthalate	117-84-0	-	-	1.10E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Dibenz(a,h)anthracene	53-70-3	1.48E-01	SSL	1.10E+00	USEPA ESSLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Dibenzofuran	132-64-9	7.80E+01	RSL	6.10E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Diethylphthalate	84-66-2	4.89E+04	SSL	1.00E+02	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Dimethylphthalate	131-11-3	6.11E+05	SSL	1.00E+01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Fluoranthene	206-44-0	2.29E+03	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Fluorene	86-73-7	2.29E+03	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Hexachlorobenzene	118-74-1	3.04E+00	SSL	7.90E-02	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Hexachlorobutadiene	87-68-3	6.20E+00	RSL	3.98E-02	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Hexachloroethane	67-72-1	4.28E+01	SSL	5.96E-01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Indeno(1,2,3-cd)pyrene	193-39-5	1.48E+00	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Isophorone	78-59-1	5.12E+03	SSL	1.39E+02	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Semivolatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
N-Nitroso-di-n-propylamine	621-64-7	6.90E-02	RSL	-	-	3.30E-01	1.67E-01	1.67E-01	3.30E-01
N-Nitrosodimethylamine	62-75-9	2.26E-02	SSL	3.20E-04	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
N-Nitrosodiphenylamine	86-30-6	9.93E+02	SSL	5.45E-01	USEPA Region 5 ESLs	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Naphthalene	91-20-3	4.30E+01	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Nitrobenzene	98-95-3	5.35E+01	SSL	2.20E+00	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Pentachlorophenol	87-86-5	8.94E+00	SSL	3.60E-01	USEPA ESSLs	6.60E-01	1.75E-01	3.30E-01	6.60E-01
Phenanthrene	85-01-8	1.83E+03	SSL	2.90E+01	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02
Phenol	108-95-2	1.83E+04	SSL	7.90E-01	LANL 2011	3.30E-01	1.67E-01	1.67E-01	3.30E-01
Pyrene	129-00-0	1.72E+03	SSL	1.10E+00	USEPA ESSLs	1.00E-02	2.50E-03	5.00E-03	1.00E-02

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
Shaded values indicate DLs exceed Screening Levels.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
ESLs = United States Environmental Protection Agency, Region 5, Resource Conservation and Recovery Act Ecological Screening Levels, 2003
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmentla Services Division, Los Alamos, NM.
LOD = limit of detection
LOQ = limit of quantitation
RSL = United States Environmental Protection Agency Regional Screening Levels, May 2011
SSL = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.USEPA. 2007. Ecological Soil Screening Levels (ESSLs) Guidance Documents. OSWER Directive

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Organochlorine Pesticides
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
4,4'-DDD	72-54-8	2.03E+01	SSL	2.10E-02	USEPA ESSLs	4.0E-03	1.20E-03	2.40E-03	4.0E-03
4,4'-DDE	72-55-9	1.43E+01	SSL	2.10E-02	USEPA ESSLs	4.0E-03	1.20E-03	2.40E-03	4.0E-03
4,4'-DDT	50-29-3	1.72E+01	SSL	2.10E-02	USEPA ESSLs	4.0E-03	1.20E-03	2.40E-03	4.0E-03
Aldrin	309-00-2	2.84E-01	SSL	3.70E-02	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
alpha-BHC	319-84-6	7.72E-01	SSL	5.80E+01	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
alpha-Chlordane	5103-71-9	-	-	2.70E-01	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
beta-BHC	319-85-7	2.70E+00	SSL	2.70E-01	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
delta-BHC	319-86-8	-	-	9.94E+00	USEPA Region 5 ESLs	2.0E-03	6.00E-04	1.20E-03	2.0E-03
Dieldrin	60-57-1	3.04E-01	SSL	4.90E-03	USEPA ESSLs	4.0E-03	1.20E-03	2.40E-03	4.0E-03
Endosulfan I	959-98-8	-	-	6.40E-01	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
Endosulfan II	33213-65-9	-	-	6.40E-01	LANL 2011	4.0E-03	1.20E-03	2.40E-03	4.0E-03
Endosulfan sulfate	1031-07-8	-	-	3.58E-02	USEPA Region 5 ESLs	4.0E-03	1.50E-03	3.0E-03	4.0E-03
Endrin	72-20-8	1.83E+01	SSL	1.40E-03	LANL 2011	4.0E-03	1.20E-03	2.40E-03	4.0E-03
Endrin aldehyde	7421-93-4	-	-	1.05E-02	USEPA Region 5 ESLs	4.0E-03	1.20E-03	2.40E-03	4.0E-03
Endrin ketone	53494-70-5	-	-	-	-	4.0E-03	1.20E-03	2.40E-03	4.0E-03
gamma-BHC	58-89-9	5.17E+00	SSL	9.40E-03	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
gamma-Chlordane	5103-74-2	-	-	2.20E+00	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03
Heptachlor	76-44-8	1.08E+00	SSL	5.90E-02	LANL 2011	2.0E-03	6.00E-04	1.20E-03	2.0E-03

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Organochlorine Pesticides
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
Heptachlor epoxide	1024-57-3	5.30E-02	RSL	1.52E-01	USEPA Region 5 ESLs	2.0E-03	6.00E-04	1.20E-03	2.0E-03
Methoxychlor	72-43-5	3.10E+02	RSL	5.00E+00	LANL 2011	2.0E-02	4.00E-03	8.0E-03	2.0E-02

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
ESLs = United States Environmental Protection Agency, Region 5, Resource Conservation and Recovery Act Ecological Screening Levels, 2003
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NMLOD = limit of detection
LOQ = limit of quantitation
RSL = United States Environmental Protection Agency Regional Screening Levels, May 2011SSLs = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.
USEPA. 2007. Ecological Soil Screening Levels (ESSLs) Guidance Documents. OSWER Directive

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Polychlorinated biphenyls
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
PCB-1016	12674-11-2	3.93E+00	SSL	1.00E+00	LANL 2011	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1221	11104-28-2	1.49E+00	SSL	-	-	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1232	11141-16-5	1.49E+00	SSL	-	-	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1242	53469-21-9	2.22E+00	SSL	4.10E-02	LANL 2011	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1248	12672-29-6	2.22E+00	SSL	7.20E-03	LANL 2011	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1254	11097-69-1	1.12E+00	SSL	4.10E-02	LANL 2011	5.00E-02	2.00E-02	3.30E-02	5.00E-02
PCB-1260	11096-82-5	2.22E+00	SSL	1.40E-01	LANL 2011	5.00E-02	2.00E-02	3.30E-02	5.00E-02

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
Shaded values indicate DLs exceed Screening Levels.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM
LOD = limit of detection
LOQ = limit of quantitation
SSL = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: TPH-DRO/TPH-ORO/TPH-GRO
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
Diesel Range Organics	68334-30-5	1.00E+03	NMED	-	-	1.00E+01	2.50E+00	5.00E+00	1.00E+01
Oil Range Organics	N/A	1.00E+03	NMED	-	-	2.00E+01	5.00E+00	1.00E+01	2.00E+01
Gasoline Range Organics	8006-61-9	1.00E+03	NMED	-	-	1.00E+00	3.50E-02	5.00E-01	1.00E+00

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method
NMED: New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Investigations and Remediation, February 2012

mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
LOD = limit of detection
LOQ = limit of quantitation
NMED = New Mexico Environment Department

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: RCRA Metals
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
Arsenic	7440-38-2	3.90E+00	SSL	1.80E+01	USEPA ESSLs	5.00E-01	5.00E-02	1.00E-01	5.00E-01
Barium	7440-39-3	1.56E+04	SSL	3.30E+02	USEPA ESSLs	5.00E-01	7.20E-02	1.00E-01	5.00E-01
Cadmium	7440-43-9	7.03E+01	SSL	3.60E-01	USEPA ESSLs	5.00E-01	5.70E-02	1.00E-01	5.00E-01
Chromium	7440-47-3	1.17E+05	SSL	2.60E+01	USEPA ESSLs	5.00E-01	5.00E-02	1.00E-01	5.00E-01
Lead	7439-92-1	4.00E+02	SSL	1.10E+01	USEPA ESSLs	5.00E-01	5.00E-02	1.00E-01	5.00E-01
Mercury	7439-97-6	1.56E+01	SSL	1.30E-02	LANL 2011	1.00E-01	3.30E-02	3.30E-02	1.00E-01
Selenium	7782-49-2	3.91E+02	SSL	5.20E-01	USEPA ESSLs	5.00E-01	5.00E-02	1.00E-01	5.00E-01
Silver	7440-22-4	3.91E+02	SSL	4.20E+00	USEPA ESSLs	5.00E-01	5.00E-02	1.00E-01	5.00E-01

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM
LOD = limit of detection
LOQ = limit of quantitation
RSL = United States Environmental Protection Agency Regional Screening Levels, May 2011
SSL = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.
USEPA. 2007. Ecological Soil Screening Levels (ESSLs) Guidance Documents. OSWER Directive

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Dioxins/Furans
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							EDLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	4.50E-05	SSL	2.90E-07	LANL 2011	1.00E-06	5.88E-08	1.00E-07	1.00E-06
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4	-	-	-	-	2.50E-06	4.82E-08	2.5E-07	2.50E-06
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	57653-85-7	-	-	-	-	2.5E-06	4.66E-08	2.5E-07	2.5E-06
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	39227-28-6	-	-	-	-	2.5E-06	4.25E-08	2.5E-07	2.5E-06
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	19408-74-3	-	-	-	-	2.5E-06	4.47E08	2.5E-07	2.5E-06
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	35822-46-9	-	-	-	-	2.5E-06	4.79E-08	7.5E-07	2.5E-06
1,2,3,4,6,7,8,9-Heptachlorodibenzo-p-dioxin (OCDD)	3268-87-9	-	-	-	-	5.0E-06	6.95E-08	1.50E-06	5.0E-06
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9	4.50E-04	SSL	-	-	1.00E-06	5.62E-08	1.00E-07	1.00E-06
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6	-	-	-	-	2.5E-06	3.96E-08	2.5E-07	2.5E-06

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Dioxins/Furans
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							EDLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4	-	-	-	-	2.5E-06	3.88E-08	2.5E-07	2.5E-06
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	72918-21-9	-	-	-	-	2.5E-06	3.35E-08	2.5E-07	2.5E-06
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	70648-26-9	-	-	-	-	2.5E-06	4.18E-08	2.5E-07	2.5E-06
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9	-	-	-	-	2.5E-06	3.40E-08	2.5E-07	2.5E-06
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5	-	-	-	-	2.5E-06	3.67E-08	2.5E-07	2.5E-06
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4	-	-	-	-	2.5E-06	3.77E-08	2.5E-07	2.5E-06
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7	-	-	-	-	2.5E-06	5.00E-08	2.5E-07	2.5E-06
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-0	-	-	-	-	5.00E-06	6.44E-08	5.00E-07	5.00E-06

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service
DL = detection limit
EDL = estimated detection limit
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM
LOD = limit of detection
LOQ = limit of quantitation
SSL = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) -- Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Explosives
Concentration Level: Low

Analyte	CAS Number	Residential Human Health Project Action Limit[1] (mg/kg)	Residential Human Health Project Action Limit Reference	Ecological Project Action Limit (mg/kg)	Ecological Project Action Limit Reference	Soil Project Quantitation Limit Goal (mg/kg)	Achievable Laboratory Limits[2]		
							Soil		
							DLs (mg/kg)	LODs (mg/kg)	LOQs (mg/kg)
1,3,5-Trinitrobenzene	99-35-4	2.20E+03	RSL	6.60E+00	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
1,3-Dinitrobenzene	99-65-0	6.10E+00	RSL	7.30E-02	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
2,4,6-Trinitrotoluene	118-96-7	3.91E+01	SSL	6.40E+00	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
2,4-Dinitrotoluene	121-14-2	1.57E+01	SSL	2.50E+00	LANL 2011	2.00E-01	5.50E-02	1.00E-01	2.00E-01
2,6-Dinitrotoluene	606-20-2	6.11E+01	SSL	1.80E+00	LANL 2011	2.00E-01	5.60E-02	1.00E-01	2.00E-01
2-Amino-4,6-Dinitrotoluene	35572-78-2	1.50E+02	RSL	1.00E+01	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
2-Nitrotoluene	88-72-2	2.91E+01	SSL	9.90E+00	LANL 2011	2.00E-01	7.60E-02	1.00E-01	2.00E-01
3-Nitrotoluene	99-08-4	7.82E+00	SSL	1.20E+01	LANL 2011	2.00E-01	9.50E-02	1.00E-01	2.00E-01
4-Amino-2,6-Dinitrotoluene	19406-51-0	1.50E+02	RSL	3.60E+00	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
4-Nitrotoluene	99-99-0	2.44E+02	SSL	2.20E+01	LANL 2011	2.00E-01	9.90E-02	1.00E-01	2.00E-01
HMX	2691-41-0	3.91E+03	SSL	1.70E+01	TTCP 2009	2.00E-01	5.00E-02	1.00E-01	2.00E-01
Nitrobenzene	98-95-3	5.35E+01	SSL	2.20E+00	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
RDX	121-82-4	5.82E+01	SSL	7.50E+00	LANL 2011	2.00E-01	5.00E-02	1.00E-01	2.00E-01
Tetryl	479-45-8	2.44E+02	SSL	9.90E-01	LANL 2011	2.00E-01	5.70E-02	1.00E-01	2.00E-01

[1]If results exceed residential screening levels, then Cannon AFB reserves the right to compare existing concentrations to industrial soil screening levels.
[2] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Undetermined values display a dash in the associated cell.
mg/kg = milligram per kilogram
AFB = Air Force Base
CAS = Chemical Abstracts Service

DL = detection limit
LANL. 2011. Ecorisk Database, Release 3.0 October. Los Alamos National Laboratory, Environmental Programs Directorate, Waste and Environmental Services Division, Los Alamos, NM.
LOD = limit of detection
LOQ = limit of quantitation
RSL = United States Environmental Protection Agency Regional Screening Levels, May 2011
SSL = New Mexico Environment Department Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program, Risk Assessment Guidance for Site Investigations and Remediation, Soil Screening Levels, Appendix A, Februray 2012.
TTCP. 2009. Environmental Fate and Effects of Energetic Materials. The Technical Cooperation Program. Available at: http://www.em-guidelines.org/ecot.htm.

QAPP Worksheet #16 (UFP-QAPP Manual Section 2.8.2) -- Project Schedule / Timeline Table

See Figure 1-7 of the Site Investigation at Eight Sites PAWP.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Sampling Approach:

Surface and subsurface soil samples will be collected to further define the horizontal and vertical extent of known contamination and to determine the presence or absence of chemical contamination, which may pose an unacceptable risk to human health or the environment at these eight sites. Results from this investigation will be included in the Site Investigation for Eight Sites Report.

The analytical data will be screened against NMED residential soil SSL (NMED 2012) or USEPA residential RSLs (USEPA 2011) and Cannon AFB background levels (W-C 1997) presented in Worksheet #15. Ecological screening levels will be selected from the following sources in order of priority:

1) USEPA (2005-2007) Ecological Soil Screening Levels (ESSLs); the lowest of plant, soil invertebrate, bird and mammal ESSLs;
2) The lower of:
   a. Technical Cooperation Program – Energetic Material (TTCP);
   b. Los Alamos National Laboratory Ecological Screening Levels (ESLs) (LANL 2011)
3) USEPA Region 5 ESLs (USEA 2003);
4) Other published literature (for example, Efroymson et al 1997).

Sampling Design and Rationale

The sampling design has been created to further define the horizontal and vertical extent of potential surface and/or subsurface soil contamination above screening levels and to determine if other COPCs are present in surface and/or subsurface soil at concentrations above screenings levels.

The planned surface and subsurface soil sampling locations, location coordinates, analytical parameters, and QA/QC sample locations are provided in Tables 5-1 through 5-8 of the PAWP. Planned surface and subsurface soil sampling locations are shown on Figures 5-1a through 5-8b of the PAWP. Soil samples will be collected from various depths and were identifed using previous sampling results.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Former AGE Dispatch Facility Spills Site (SS-C501)

The general sampling objectives at SS-C501 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels.

Samples will be analyzed for TPH-DRO, TPH-ORO and TPH-GRO (USEPA Method 8015C), VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270D), RCRA metals (USEPA Methods 6020A/7471B), and PCBs (USEPA Method 8082A). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for SS-C501 in Table 5-1 of the PAWP. Sample locations are shown on Figures 5-1a and 5-1b of the PAWP.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Former Gas Station Site (ST-C502)

The general sampling objectives at ST-C502 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels at the previously identified potential source areas and other potential source areas not previously investigated.

Samples will be analyzed for TPH-DRO, TPH-ORO, and TPH-GRO (USEPA Method 8015C), VOCs or BTEX+naphthalene (USEPA Method 8260B), SVOCs or site-related SVOCs (USEPA Method 8270D) and RCRA metals or lead (USEPA Methods 6020A/7471B). Samples may also be analyzed for PCBs (USEPA Method 8082A). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for ST-C502 in Table 5-2 of the PAWP. Planned soil sampling locations are shown on Figures 5-2a and 5-2b of the PAWP.

Base Support/Operations Generator Former UST Site (ST-C503)

The general sampling objectives at ST-C503 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels.

Samples will be analyzed for TPH-DRO, TPH-ORO (USEPA Method 8015C), BTEX+naphthalene (USEPA Method 8260B), site-related SVOCs (USEPA Method 8270D). Note: Site-related SVOCs will consist of 2-Methyl naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. The site-related SVOC analyte list is derived from Table 3 of the NMED TPH Screening Guidelines (NMED 2006). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for ST-C503 in Table 5-3 of the PAWP. Planned soil sampling locations are shown on Figures 5-3a and 5-3b of the PAWP.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Hospital Abandoned UST Site (ST-C504)

The general sampling objectives at ST-C504 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels.

Samples will be analyzed for TPH-DRO, TPH-ORO (USEPA Method 8015C), BTEX+naphthalene (USEPA Method 8260B), site-related SVOCs (USEPA Method 8270D). Note: Site-related SVOCs will consist of 2-Methyl naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. The site-related SVOC analyte list is derived from Table 3 of the NMED TPH Screening Guidelines (NMED 2006). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for ST-C504 in Table 5-4 of the PAWP. Planned soil sampling locations are shown on Figures 5-4a and 5-4b of the PAWP.

Flightline Generator USTs Site (ST-C505)

The general sampling objectives at ST-C505 are to further define the horizontal and vertical extent of potential subsurface soil contamination above screening levels and to determine if other COPCs are present in subsurface soil at concentrations above screening levels.

Samples will be analyzed for TPH-DRO, TPH-ORO (USEPA Method 8015C), BTEX+naphthalene (USEPA Method 8260B), site-related SVOCs (USEPA Method 8270D). Note: Site-related SVOCs will consist of 2-Methyl naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. The site-related SVOC analyte list is derived from Table 3 of the NMED TPH Screening Guidelines (NMED 2006). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for ST-C505 in Table 5-5 of the PAWP. Planned soil sampling locations are shown on Figures 5-5a and 5-5b of the PAWP.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Former POL Yard Refueling Area Site (SS-C507)

The general sampling objective at SS-C507 is to determine if COPCs are present at concentrations above screening levels at potential source areas at the site.

Samples will be analyzed for TPH-DRO, TPH-ORO, TPH-GRO (USEPA Method 8015C), BTEX+naphthalene (USEPA Method 8260B), site-related (USEPA Method 8270D), PCBs (USEPA Method 8082A) and lead (USEPA Methods 6020A). Note: Site-related SVOCs will consist of 2-Methyl naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. The site-related SVOC analyte list is derived from Table 3 of the NMED TPH Screening Guidelines (NMED 2006). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for SS-C507 in Table 5-6 of the PAWP. Planned soil sampling locations are shown on Figures 5-6a and 5-6b of the PAWP.

Surface Disposal Area Site (SD-C508)

The general sampling objectives at SD-C508 are to further define the horizontal and vertical extent of potential surface and subsurface soil contamination at the previously identified surface disposal area, to determine if other COPCs are present in surface and subsurface soil at concentrations above screening levels at the previously identified disposal area, and to determine if COPCs exist in surface and subsurface soil at concentrations above screening levels within the expanded site boundary not previously investigated.

Samples will be analyzed for TPH-DRO, TPH-ORO, TPH-GRO (USEPA Method 8015C), VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270D), PCBs (USEPA Method 8082A), RCRA metals (USEPA Methods 6020A/7471B), organochlorine pesticides USEPA Method 8081B), dioxins/furans (USEPA Method 8290) and explosives (USEPA Method 8330A). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for SD-C508 in Table 5-7 of the PAWP. Planned soil sampling locations are shown on Figures 5-7a and 5-7b of the PAWP. Anticipated sample depth intervals for each boring are shown on Table 5-7 of the PAWP.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) -- Sampling Design and Rationale

Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129)

The overall sampling objective at TA/AS-C129 is to determine if COPCs are present at concentrations above screening levels in the previously uninvestigated leach field area.

Samples will be analyzed for TPH-DRO, TPH-ORO, TPH-GRO (USEPA Method 8015C), VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270D), PCBs (USEPA Method 8082A), RCRA metals (USEPA Methods 6020A/7471B), and organochlorine pesticides USEPA Method 8081B). The analyte lists are presented in Worksheet #15. Planned soil sample locations, identification numbers, depths, and location coordinates, for each soil sample location are provided for TA/AS-C129 in Table 5-8 of the PAWP. Planned soil sampling locations are shown on Figures 5-8a and 5-8b of the PAWP.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) -- Sampling Locations and Methods Requirements Table

Sampling Location	Matrix	Depth (feet)	Analytical Group	Concentration Level	Number of Samples	Sampling Reference[1]	Rationale for Sampling Location
CA501-SBXX-XXX	Soil	1-15	VOCs, SVOCs, TPH-DRO, TPH-ORO, TPH-GRO, PCBs, RCRA Metals	Low to nondetect	33 samples 4 duplicates	See PAWP	See Worksheet #17
CA502-SBXX-XXX	Soil	0-40	VOCs or BTEX+ naphthalene, SVOCs or site-related SVOCs, TPH-DRO, TPH-ORO, TPH-GRO, RCRA Metals or Lead, PCBs (at select locations)	Low to nondetect	87 samples 9 duplicates	See PAWP	See Worksheet #17
CA503-SBXX-XXX	Soil	0-25	BTEX+naphthalene, site-related SVOCs, TPH-DRO, TPH-ORO	Low to nondetect	42 samples 5 duplicates	See PAWP	See Worksheet #17
CA504-SBXX-XXX	Soil	1-85	BTEX+naphthalene, site-related SVOCs, TPH-DRO, TPH-ORO	Low to nondetect	97 samples 10 duplicates	See PAWP	See Worksheet #17
CA505-SBXX-XXX	Soil	0-30	BTEX+naphthalene, site-related SVOCs, TPH-DRO, TPH-ORO	Low to nondetect	63 samples 7 duplicates	See PAWP	See Worksheet #17
CA507-SBXX-XXX	Soil	1-20	BTEX+naphthalene, site-related SVOCs, TPH-DRO, TPH-ORO, TPH-GRO, PCBs, Lead	Low to nondetect	239 samples 24 duplicates	See PAWP	See Worksheet #17

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) -- Sampling Locations and Methods Requirements Table

Sampling Location	Matrix	Depth (feet)	Analytical Group	Concentration Level	Number of Samples	Sampling Reference[1]	Rationale for Sampling Location
CA508-SBXX-XXX	Soil	0-20	VOCs, SVOCs, TPH-DRO, TPH-ORO, TPH-GRO, Pesticides, PCBs, RCRA Metals, Dioxins/Furans, Explosives	Low to nondetect	41 samples 5 duplicates	See PAWP	See Worksheet #17
CA129-SBXX-XXX	Soil	0-25	VOCs, SVOCs, TPH-DRO, TPH-ORO, TPH-GRO, Pesticides, PCBs, RCRA Metals	Low to nondetect	43 samples 5 duplicates	See PAWP	See Worksheet #17

Note: Specific information for sample locations, sample depths and analytical parameters is presented in Tables 5-1 through 5-8 in the Work Plan.

[1] Detailed sampling procedures are provided in Section 5 of the PAWP.

XX = Sample location identification
XXX = Sample depth identification

QAPP Worksheet #19 (UFP-QAPP Manual Section 3.1.1) -- Analytical Requirements Table

Matrix	Analytical Group	Concentration Level	Preparation and Analytical Method Reference	Sample Volume	Containers	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation, analysis)
Soil	VOCs or BTEX+naphthalene	Low	USEPA 8260B	5 grams	3 x 40 mL	4°C ± 2°C, two vials reagent water with sodium bisulfate, one vial methanol	48 hours until frozen by laboratory (< -7°C), 14 days to analysis
Soil	SVOCs or site-related SVOCs	Low	USEPA 8270D	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis
Soil	TPH-DRO	Low	USEPA 8015C	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis
Soil	TPH-ORO	Low	USEPA 8015C	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis
Soil	TPH-GRO	Low	USEPA 8015C	5 grams	3 x 40 mL	4°C ± 2°C, two vials reagent water with sodium bisulfate, one vial methanol	48 hours until frozen by laboratory (< -7°C), 14 days to analysis
Soil	Pesticides	Low	USEPA 8081B	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis
Soil	PCBs	Low	USEPA 8082A	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis
Soil	RCRA Metals	Low	USEPA 3050B and 6020A	8 oz	1 x 8 oz glass jar	None	6 months, 28 days mercury
Soil	Lead	Low	USEPA 3050B and 6020A	8 oz	1 x 8 oz glass jar	None	6 months
Soil	Dioxins/Furans	Low	USEPA 8290	8 oz	1 x 8 oz glass jar	4° C, in the dark	30 days to extraction, 45 days to analysis
Soil	Explosives	Low	USEPA 8330A	8 oz	1 x 8 oz glass jar	4° C	14 days to extract, 40 days to analysis

oz = ounce
USEPA = United States Environmental Protection Agency

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) -- Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Conc. Level	Preparation and Analytical SOP[1]	No. of Investigative Samples[2]	No. of Field Duplicate Samples	No. of MS/ MSD	Total No. of Samples[3]
Former AGE Dispatch Facility Spills (SS-C501)	Soil	VOCs	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	SVOCs	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	TPH-DRO	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	TPH-ORO	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	TPH-GRO	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	PCBs	Low to nondetect	N/A	33	4	4	37
Former AGE Dispatch Facility Spills (SS-C501)	Soil	RCRA Metals	Low to nondetect	N/A	33	4	4	37
Former Gas Station (ST-C502)	Soil	VOCs or BTEX+naphthalene	Low to nondetect	N/A	87	9	9	96
Former Gas Station (ST-C502)	Soil	SVOCs or Site-Related SVOCs	Low to nondetect	N/A	87	9	9	96
Former Gas Station (ST-C502)	Soil	TPH-DRO	Low to nondetect	N/A	87	9	9	96

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) -- Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Conc. Level	Preparation and Analytical SOP[1]	No. of Investigative Samples[2]	No. of Field Duplicate Samples	No. of MS/ MSD	Total No. of Samples[3]
Former Gas Station (ST-C502)	Soil	TPH-ORO	Low to nondetect	N/A	87	9	9	96
Former Gas Station (ST-C502)	Soil	TPH-GRO	Low to nondetect	N/A	87	9	9	96
Former Gas Station (ST-C502)	Soil	RCRA Metals or Lead	Low to nondetect	N/A	87	9	9	96
Former Gas Station (ST-C502)	Soil	PCBs	Low to nondetect	N/A	6	1	1	7
Base Support/ Operations Generator Former UST (ST-C503)	Soil	BTEX+naphathalene	Low to nondetect	N/A	42	5	5	47
Base Support/Operations Generator Former UST (ST-C503)	Soil	Site-Related SVOCs	Low to nondetect	N/A	42	5	5	47
Base Support/Operations Generator Former UST (ST-C503)	Soil	TPH-DRO	Low to nondetect	N/A	42	5	5	47
Base Support/Operations Generator Former UST (ST-C503)	Soil	TPH-ORO	Low to nondetect	N/A	42	5	5	47
Hospital Abandoned UST (ST-C504)	Soil	BTEX+naphathalene	Low to nondetect	N/A	97	10	10	107
Hospital Abandoned UST (ST-C504)	Soil	Site-Related SVOCs	Low to nondetect	N/A	97	10	10	107

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) -- Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Conc. Level	Preparation and Analytical SOP[1]	No. of Investigative Samples[2]	No. of Field Duplicate Samples	No. of MS/ MSD	Total No. of Samples[3]
Hospital Abandoned UST (ST-C504)	Soil	TPH-DRO	Low to nondetect	N/A	97	10	10	107
Hospital Abandoned UST (ST-C504)	Soil	TPH-ORO	Low to nondetect	N/A	97	10	10	107
Flightline Generator USTs (ST-C505)	Soil	BTEX+naphathalene	Low to nondetect	N/A	63	7	7	70
Flightline Generator USTs (ST-C505)	Soil	Site-Related SVOCs	Low to nondetect	N/A	63	7	7	70
Flightline Generator USTs (ST-C505)	Soil	TPH-DRO	Low to nondetect	N/A	63	7	7	70
Flightline Generator USTs (ST-C505)	Soil	TPH-ORO	Low to nondetect	N/A	63	7	7	70
POL Yard Refueling Area (SS-C507)	Soil	BTEX+naphathalene	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	Site-Related SVOCs	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	TPH-DRO	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	TPH-ORO	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	TPH-GRO	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	PCBs	Low to nondetect	N/A	239	24	24	263
POL Yard Refueling Area (SS-C507)	Soil	Lead	Low to nondetect	N/A	239	24	24	263

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) -- Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Conc. Level	Preparation and Analytical SOP[1]	No. of Investigative Samples[2]	No. of Field Duplicate Samples	No. of MS/ MSD	Total No. of Samples[3]
Surface disposal area (SD-C508)	Soil	VOCs	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	SVOCs	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	TPH-DRO	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	TPH-ORO	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	TPH-GRO	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	PCBs	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	RCRA Metals	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	Pesticides	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	Dioxins/Furans	Low to nondetect	N/A	41	5	5	46
Surface disposal area (SD-C508)	Soil	Explosives	Low to nondetect	N/A	41	5	5	46
TA/AS-C129 (SWMU 129)	Soil	VOCs	Low to nondetect	N/A	43	5	5	48

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) -- Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Conc. Level	Preparation and Analytical SOP[1]	No. of Investigative Samples[2]	No. of Field Duplicate Samples	No. of MS/ MSD	Total No. of Samples[3]
TA/AS-C129 (SWMU 129)	Soil	SVOCs	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	TPH-DRO	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	TPH-ORO	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	TPH-GRO	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	PCBs	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	Pesticides	Low to nondetect	N/A	43	5	5	48
TA/AS-C129 (SWMU 129)	Soil	RCRA Metals	Low to nondetect	N/A	43	5	5	48

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).
[2] If samples will be collected at different depths at the same location, count each discrete sampling depth as a separate sampling location or station.
[3] MS/MSD samples are not included in the total number of samples.
SOP = Standard operating procedure

All laboratory SOPs were removed from this document at the request of NMED.

QAPP Worksheet #21 (UFP-QAPP Manual Section 3.1.2) -- Project Sampling SOP References Table

See PAWP.

Reference Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
See PAWP	N/A	N/A	N/A	N/A	N/A

All reference to sampling SOPs were removed from this document at the request of NMED. Detailed sampling procedures are provided in Section 5 of the PAWP.

QAPP Worksheet #22 (UFP-QAPP Manual Section 3.1.2.4) -- Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maint. Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person
Photoionization detector (PID)	Calibrated to 100 ppm using 100 ppm isobutylene	Clean unit weekly	Check response with marking pen	Observe pump and PID response	Daily	Within 3%	Clean lamp	Field personnel

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) -- Analytical SOP References Table

Laboratory SOPs are located in Attachment A

SOP Reference Number [1]	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
N/A	N/A	N/A	N/A	N/A	N/A	N/A

All laboratory SOPs were removed from this document at the request of NMED.

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
ICP-MS (Method 6020A)	Establish instrument detection limits (IDLs)	At initial set-up and after significant change in instrument type, personnel, test method, or sample matrix.	IDL shall be ≤ LOD.	NA	NA	N/A
ICP-MS (Method 6020A)	Calibrate using multi-point standard calibration	Daily prior to analysis of sample	Correlation coefficient ≥ 0.995	Correct problem then repeat initial calibration	Analyst or certified instrument technician	N/A
ICP-MS (Method 6020A)	Establish linear dynamic range	Once every six months.	The calculated value should be within ± 10% of the true value	NA	Analyst or certified instrument technician	N/A
ICP-MS (Method 6020A)	Run interference check solution	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes. ICS-AB: Within ± 20% of its true value	Correct problem then repeat the calibration process, reanalyze all samples	Analyst or certified instrument technician	N/A
ICP-MS (Method 6020A)	Second source calibration verification (ICV)	Once after each ICAL, prior to beginning a sample run.	± 10% of its true value	Correct problem then repeat the calibration process	Analyst or certified instrument technician	N/A
ICP-MS (Method 6020A)	Continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	± 10% of its true value	Terminate analysis; recalibrate and reanalyze the samples	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
ICP-MS (Method 6020A)	Continuing calibration blank (CCB)	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Terminate analysis; recalibrate and reanalyze the samples	Analyst or certified instrument technician	N/A
CVAA (Method 7471B)	Initial Calibration (ICAL) for all analytes. Minimum 5 standards and a calibration blank	Daily ICAL prior to analyzing samples	Correlation coefficient is ≥ 0.995	Correct problem then repeat the calibration process	Analyst or certified instrument technician	N/A
CVAA (Method 7471B)	Second source calibration verification (ICV)	Once after 5-point standard calibration, prior to sample run	± 10% of its true value	Correct problem then repeat the calibration process	Analyst or certified instrument technician	N/A
CVAA (Method 7471B)	Continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	± 20% of its true value	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
CVAA (Method 7471B)	Calibration blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Reprep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst or certified instrument technician	N/A
GC-MS (Methods 8260B/8270D)	MS tuning check	Prior to ICAL and at the beginning of each 12-hour period	The manufacture's specifications for DFTPP, PFTBA, or other specified compound shall be used. Mass assignments should be within ± 0.1 mass units of target values.	Retune instrument and verify. Rerun affected samples.	Analyst or certified instrument technician	N/A
GC-MS (Method 8270D)	Breakdown check (8270D only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤20% for DDT. No visible peak tailing for Benzidine or Pentachlorophenol and should not exceed a tailing factor of 2.	Correct problem then repeat performacen check.	Analyst certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
GC-MS (Methods 8260B/8270D)	Minimum five-point initial calibration (ICAL) for all analytes.	Prior to sample analysis	Average response factor (RF) for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1- dichloroethane. PAHs ≥ 0.050. RSD for RFs for CCCs: VOCs and PAHs ≤ 30% and one option below: RSD for each analyte ≤ 15% or least square regression ≥ 0.995	Correct problem then repeat ICAL	Analyst or certified instrument technician	N/A
GC-MS (Methods 8260B/8270D)	Second source calibration verification	After ICAL All analytes within ± 20% of expected value	Correct problem and verify second source standard.	Rerun second source verification. If that fail, correct problem and repeat initial calibration	Analyst or certified instrument technician	N/A
GC-MS (Methods 8260B/8270D)	RT window position for each analyte and surrogate	Once per ICAL	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
GC-MS (Methods 8260B/8270D)	Relative RT (RRT)	With each sample	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then reanalyze all samples analyzed since the last RT check; If that fails then rerun ICAL and samples.	Analyst or certified instrument technician	N/A
GC-MS (Methods 8260B/8270D)	CCV	Daily, before sample analysis and every 12 hours of analysis time.	Average RF for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2- tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1- dichloroethane. SVOCs ≥ 0.050 %Difference (%D)/Drift for all target compounds and surrogates: VOCs and PAHs ≤ 20%D	Correct problem, rerun CCV. Reanalyze all samples since last successful calibration verification. If that fails, repeat initial calibration.	Analyst or certified instrument technician	N/A
GC-MS (Methods 8260B/8270D)	Internal Standards (IS)	Every field sample, standard, and QC sample.	RT ± 30 seconds from RT of the midpoint standard in the ICAL; EICP area within -50% to + 100% of ICAL midpoint standard	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed during failure is mandatory.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
GC-FID (Methods 8015C/8015C)	Minimum five point ICAL for all analytes (DRO/ORO/GRO)	ICAL prior to sample analysis	One of the options below: Option 1: RSD for each analyte $\leq$ 20% Option 2: linear least squares regression r $\geq$ 0.995 Option 3: non-linear regression: COD $r^2 \geq 0.99$ (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration	Analyst or certified instrument technician	N/A
GC-FID (Methods 8015C/8015C)	Second source calibration verification (ICV) (DRO/ORO/GRO)	Immediately following ICAL.	All project analytes within established retention time windows. All project analytes within $\pm$ 20% of expected value from the ICAL.	Correct problem, then rerun ICV. If that fails, repeat ICAL.	Analyst or certified instrument technician	N/A
GC-FID (Methods 8015C/8015C)	Continuing calibration verification (CCV) (DRO/ORO/GRO)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes within established retention time windows. All project analytes within $\pm$ 20% of expected value from the ICAL.	Correct problem then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
GC-ECD (Methods 8081B/8082A)	Minimum five point ICAL for all analytes (DRO/ORO/GRO)	ICAL prior to sample analysis	One of the options below: Option 1: RSD for each analyte $\leq$ 20% Option 2: linear least squares regression r $\geq$ 0.995 Option 3: non-linear regression: COD $r^2 \geq 0.99$ (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration	Analyst or certified instrument technician	N/A
GC-ECD (Methods 8081B/8082A)	Second source calibration verification (ICV) (DRO/ORO/GRO)	Immediately following ICAL.	All project analytes within established retention time windows. All project analytes within $\pm$ 20% of expected value from the ICAL.	Correct problem, then rerun ICV. If that fails, repeat ICAL.	Analyst or certified instrument technician	N/A
GC-ECD (Methods 8081B/8082A)	Continuing calibration verification (CCV) (DRO/ORO/GRO)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes within established retention time windows. All project analytes within $\pm$ 20% of expected value from the ICAL.	Correct problem then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
HPLC	Initial multipoint calibration for all analytes (minimum five standards) (ICAL)	Initial calibration prior to sample analysis	*Option 1*: RSD for each analyte ≤ 20% *Option 2* Linear least squares regression r > 0.995 *Option 3:* Non-linear regression: coefficient of determination r_2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration.	Analyst or certified instrument technician	N/A
HPLC	Second-source Calibration verification	Once per ICAL	All analytes within ± 15% of expected value.	Correct problem, then rerun second source. If that fails, repeat ICAL.	Analyst or certified instrument technician	N/A
HPLC	Retention time window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical shift	Position shall be set using the midpoint standard of the initial calibration curve or the value in the CCV run at the beginning of the analytical shift.	N/A	Analyst or certified instrument technician	N/A
HPLC	Retention time window verified for each analyte	Each calibration verification standard	Analyte within established window	Correct problem then reanalyze all samples analyzed since the last retention time check. If they fail, redo ICAL and reset retention time window.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
HPLC	Calibration verification Initial ICV and continuing CCV	ICV: Daily, before sample analysis CCV: After every 10 field samples and at the end of the analysis sequence	All analytes within ± 15% of expected value from the ICAL.	ICV: Correct problem then rerun ICV. If that fails, repeat initial calibration. CCV: Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification.	Analyst or certified instrument technician	N/A
HRGC/HRMS (Method 8290)	Initial calibration (ICAL) for all analytes	ICAL prior to sample analysis, as needed by the failure of calibration verification standard, and when a new lot is used as standard source for HRCC-3, sample fortification or recovery solutions.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and S/N ratio $\geq$ 10 for all target analyte ions; RSD $\leq$ 20% for the response factors (RF) for all 17 unlabeled standards and RSD $\leq$ 20% for the RFs for the 9 labeled IS.	Correct problem then repeat initial calibration. Calibration may not be forced through origin.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
HRGC/HRMS (Method 8290)	Continuing calibration verification (CCV)	At the beginning of each 12 hour period, and at the end of the anlaytical sequence.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and For unlabeled standards, RF within ± 20% D of RF established in ICAL; For labeled standards, RF within ± 30% D of RF established in ICAL.	Correct problem, repeat calibration verification standard. If that fails, then repeat ICAL and reanalyze all samples analyzed since the last successful CCV. End-of-run CCV: If the RF for unlabeled standards ≤ 25% RPD and the RF for labeled standards ≤ 35% RPD (relative to the RF established in the ICAL), the mean RF	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
HRGC/HRMS (Method 8290)	Continuing calibration verification (CCV) (Continued)	At the beginning of each 12 hour period, and at the end of the anlaytical sequence.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and For unlabeled standards, RF within ± 20% D of RF established in ICAL; For labeled standards, RF within ± 30% D of RF established in ICAL.	from the two daily CCVs must be used for quantitation of impacted samples instead of the ICAL mean RF value. If the starting and ending CCV RFs differ more than > 25% RPD for unlabeled compounds or 35% RPD for labeled compounds, the sample may be quantitated against a new initial calibration if it is analyzed within two hours. Otherwise reanalyze samples with positive detections if necessary.	Analyst or certified instrument technician	N/A

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP[1]
HRGC/HRMS (Method 8290)	Internal standards	Every field sample, standard and QC sample.	%R recovery for each IS in the original sample (prior to dilutions) must be within 40-135% per method.	%R recovery for each IS in the original sample (prior to dilutions) must be within 40-135% per method.	Analyst or certified instrument technician	N/A

[1] The Analytical SOP References table is found on Worksheet #23.

QAPP Worksheet #25 (UFP-QAPP Manual Section 3.2.3) -- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP[1]
ICP-MS	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
CVAA	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
GC-MS	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
GC-ECD	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
GC-FID	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
HPLC	Maintenance specified in lab Equipment Maintenance SOP	N/A	N/A	N/A	N/A	N/A	Analyst	N/A
HRGC/HRMS	N/A	N/A	N/A	N/A	N/A	N/A	Analyst	N/A

QAPP Worksheet #26 (UFP-QAPP Manual Appendix A) -- Sample Handling System

Sample Collection, Packaging, and Shipment

Sample Collection (Personnel/Organization): Project Field Team, URS

Sample Packaging (Personnel/Organization): Project Field Team, URS

Coordination of Shipment (Personnel/Organization): Project Field Team, URS

Type of Shipment/Carrier: Overnight/FedEx

Sample Receipt and Analysis

Sample Receipt (Personnel/Organization): TBD by Molly Nguyen/EMAX

Sample Custody and Storage (Personnel/Organization): TBD by Molly Nguyen/EMAX

Sample Preparation (Personnel/Organization): TBD by Molly Nguyen/EMAX

Sample Determinative Analysis (Personnel/Organization): TBD by Molly Nguyen/EMAX

Sample Archiving

Field Sample Storage (No. of days from sample collection): 30 days

Sample Extract/Digestate Storage (No. of days from extraction/digestion): 90 days

Biological Sample Storage (No. of days from sample collection): N/A

Sample Disposal

Personnel/Organization: TBD by Molly Nguyen/EMAX

Number of Days from Analysis: 30 days

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) – Sample Custody Requirements Table

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

See PAWP

Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal):

See the following SOPs

N/A

Sample Identification Procedures:

See PAWP

Chain of Custody Procedures:

See PAWP

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	VOCs
Analytical Method Reference	USEPA SW-846 Method 8260B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-1	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-10
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-1	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-10

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	VOCs
Analytical Method Reference	USEPA SW-846 Method 8260B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-10

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	SVOCs
Analytical Method Reference	USEPA SW-846 Method 8270D

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-2	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-10
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-2	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-10

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	SVOCs
Analytical Method Reference	USEPA SW-846 Method 8270D

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-10

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	TPH-DRO,TPH-ORO,TPH-GRO
Analytical Method Reference	USEPA SW-846 Method 8015C

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-5	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-5	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	TPH-DRO,TPH-ORO,TPH-GRO
Analytical Method Reference	USEPA SW-846 Method 8015C

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	Organochlorine Pesticides
Analytical Method Reference	USEPA SW-846 Method 8081B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-3	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-3	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	Organochlorine Pesticides
Analytical Method Reference	USEPA SW-846 Method 8081B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	PCBs
Analytical Method Reference	USEPA SW-846 Method 8082A

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-4	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-4	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	PCBs
Analytical Method Reference	USEPA SW-846 Method 8082A

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	Explosives
Analytical Method Reference	USEPA SW-846 Method 8330A

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-8	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-8	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	Explosives
Analytical Method Reference	USEPA SW-846 Method 8330A

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	In all samples	See Table 12-9	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Laboratory QA Manager	Accuracy/Bias	See Table 12-11

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	RCRA Metals
Analytical Method Reference	USEPA SW-846 Method 6020A / 7471B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Re-extract or re-analyze samples associated with the MB except when the sample analysis resulted in a nondetect.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS)	One per preparation/analytical batch	See Table 12-6	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-12
Matrix Spike (MS)	One per preparation/analytical batch	See Table 12-6	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-12

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	RCRA Metals
Analytical Method Reference	USEPA SW-846 Method 6020A / 7471B

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Sample duplicate	One sample duplicate per preparatory batch per matrix	See Table 12-6	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-12

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Soil
Analytical Group	Dioxins/Furans
Analytical Method Reference	USEPA SW-846 Method 8290

QC Sample	Frequency/Number	Method QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparatory batch, run after calibration standards and before samples.	Use project-specific criteria, if available. Otherwise, no analytes detected ≥ LOD for the analyte or ≥ 5% of the associated regulatory limit for the analyte or ≥ 5% of the sample result for the analyte, whichever is greater, per method.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Laboratory QA Manager	Accuracy/Bias	No target compounds ≥ LOQ
Laboratory Control Sample (LCS) or fortified field blank)	One per preparation/analytical batch	See Table 12-7	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory QA Manager	Precision/Accuracy	See Table 12-13
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation/analytical batch	See Table 12-7	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Laboratory QA Manager	Precision/Accuracy	See Table 12-13

QAPP Worksheet #29 (UFP-QAPP Manual Section 3.5.1) -- Project Documents and Records Table

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field Logbook	Sample Receipt, Custody, and Tracking Records	Sample Receipt, Custody, and Tracking Records	Data Validation Reports	
Chain of Custody Records	Corrective Action Forms	Standard Traceability Logs	Corrective Action Forms	
Air Bills	Reported Field Sample Results	Sample Prep Logs		
Custody Seals	Sample Disposal Records	Equipment Maintenance, Testing, and Inspection Logs		
Corrective Action Forms		Corrective Action Forms		
		Reported Field Sample Results		
		Reported Results for Standards, QC Checks, and QC Samples		
		Data Package Completeness Checklist		
		Sample Disposal Records		
		Extraction/Cleanup-up Records		
		Raw Data (stored on disk CD-R)		

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) -- Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ID Number	Analytical SOP	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)
Soil	VOCs	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX Laboratories, Inc. 1835 West 205th St Torrance, CA 90501 Attn: Molly Nguyen (310) 618-8889
Soil	SVOCs	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	TPH-DRO/TPH-ORO	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	TPH-GRO	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	Organochlorine Pesticides	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	PCBs	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	RCRA Metals	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX
Soil	Explosives	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	EMAX

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) -- Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ID Number	Analytical SOP	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)
Soil	Dioxins/Furans	Low	CAAXXX-SBXX-XXX	N/A	21 days for full data package	Columbia Analytical Services – Houston 19408 Park Row Dr.; Suite 320 Houston, TX 77084 Note: EMAX will be contact for Columbia Analytical Services

All laboratory SOPs were removed from this document at the request of NMED.

QAPP Worksheet #31 (UFP-QAPP Manual Section 4.1.1) -- Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Review Field Logbooks and Chain of Custody forms	As work progresses	Internal	URS	Corey Anderson and/or Tony Sedlacek, URS	Stephen Jacobson, Field Team Leader, URS	Stephen Jacobson, Field Team Leader, URS	Stephen Jacobson, Field Team Leader, URS

QAPP Worksheet #32 (UFP-QAPP Manual Section 4.1.2) -- Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Review Field Logbooks and Chain of Custody forms	Marked up copy of document	Corey Anderson, PM, URS	Within 24 hours of finding deficiency	Review of corrected documentation	Stephen Jacobson, Field Team Leader, URS	24 hours after notification

QAPP Worksheet #33 (UFP QAPP Manual Section 4.2) -- QA Management Reports Table

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Site Investigation at Eight Sites Report	One report after all field data collected.	TBD	Corey Anderson, PM, URS	Eliud Burgos, AFCEE John Kieling, NMED Matthew Higginbotham,Cannon AFB

QAPP Worksheet #34 (UFP-QAPP Manual Section 5.2.1) -- Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Chain of custody and shipping forms	Chain of custody (COC) forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the COC should be initialed by the reviewer, a copy of the COC retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	I	Stephen Jacobson, Field Team Leader, URS
Laboratory Sample Receipt Reports	Laboratory report listing all samples received condition of receipt and analyses requested. Signed copy of COC included.	I	Tony Sedlacek, URS
Field Logbooks	Field logbooks will be reviewed internally and placed in the project file.	I	Corey Anderson, URS
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	I	Kenette Pimentel, EMAX
	All received data packages will be verified externally according to the data validation procedures specified in Worksheet #35.	E	Tony Sedlacek, URS

QAPP Worksheet #35 (UFP-QAPP Manual Section 5.2.2) -- Validation (Steps IIa and IIb) Process Table

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	PAWP	Ensure that all sampling procedures were followed	Tony Sedlacek, URS
IIb	Documentation of QC Sample Results	Establish that all required QC samples were analyzed and met evaluation criteria.	Tony Sedlacek, URS
IIb	Project Quantitation Limits	Verify that sample results met the quantitation limits specified in the QAPP	Tony Sedlacek, URS

QAPP Worksheet #36 (UFP-QAPP Manual Section 5.2.2) -- Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa	Soil	VOCs, SVOCs, TPH-DRO,TPH-ORO, TPH-GRO, Organochlorine Pesticides, PCBs, RCRA Metals, Dioxins/Furans, Explosives	Low	DoD QSM Version 4.2	Tony Sedlacek, URS
IIa	Soil	VOCs, SVOCs, TPH-DRO,TPH-ORO, TPH-GRO, Organochlorine Pesticides, PCBs, RCRA Metals, Dioxins/Furans, Explosives	Low	QAPP Worksheets 12, 15 and 24. QAPP Tables 12-1 through 12-13	Tony Sedlacek, URS

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) -- Usability Assessment

The Data Usability Assessment will be performed by URS personnel. Corey Anderson, URS PM, will be responsible for information in the Usability Assessment. He will also be responsible for assigning task work to the individual task members who will be supporting the Data Usability Assessment. Note that the Data Usability Assessment will be conducted on reviewed data. After the Data Usability Assessment has been performed, data deemed appropriate for decision-making purposes will be used to determine the extent of contamination of the eight sites. The results of the Data Usability Assessment will be presented in the Site Investigation of Eight Sites Report. The following items will be assessed and conclusions drawn based on their results.

Precision – Results of field duplicates will be presented separately in tabular format for the sample pair. For the field duplicate pair, the results will be assessed as stated in Tables 12-10 through 12-13. MS/MSD RPDs are calculated by the laboratory and those with RPDs outside the criteria established in Tables 12-1 through 12-8 will be listed in tabular form in the Site Investigation of Eight Sites Report. A discussion will follow summarizing the results of the laboratory precision. Any conclusions about the precision of the analyses will be drawn and any limitations on the use of the data will be described.

Accuracy/Bias Contamination – Results for all laboratory method blanks will be evaluated and analytes detected in these blanks will be listed in tabular form in the data review report. Laboratory data will be qualified based on the criteria listed in Tables 12-10 through 12-13. A discussion will follow summarizing the results of the laboratory accuracy/bias. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be described.

Overall Accuracy/Bias – Results for all LCS, surrogate and MS/MSD recoveries that are outside evaluation criteria will be presented in tabular format in the Site Investigation of Eight Sites Report. The results will be checked versus those listed in Tables 12-1 through 12-9. A discussion will follow summarizing the overall accuracy/bias. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be described.

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) -- Usability Assessment

Sensitivity – Results for the sensitivity check standard will be provided by the laboratory for all analyses. The results for each analyte will be checked against the performance criteria presented on Worksheet #12 and cross checked against the quantitation limits presented on Worksheet #15. Results for analytes that exceed criteria will be identified on the tables. A discussion will follow summarizing the results of the laboratory sensitivity. Any conclusions about the sensitivity of the analyses will be drawn and any limitations on the use of the data will be described.

Representativeness – A measure of representativeness will be provided by assessing if the proper analytical procedures, appropriate methods, holding times and field duplicate procedures were followed. Any conclusions about the representativeness of the analyses will be drawn and any limitations on the use of the data will be described.

Comparability – The results will be compared to any previous sampling results (if available). Comparability is also achieved by using standard sampling and analysis procedures that can be reproduced.

Completeness – A completeness check will be performed on all data generated by the laboratory. Completeness criteria are presented on Worksheet #12. Completeness will be calculated as the number of data points for each analyte that is deemed useable (not rejected) divided by the total number of data points for each analyte. A discussion will follow summarizing the results of the calculation of data completeness. Any conclusions about the completeness of the data will be drawn and any limitations on the use of the data will be described.

Graphics – Figures will be constructed showing each sampling location.

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) -- Usability Assessment

Reconciliation – Each of the measurement performance criteria listed in Worksheet #12 will be examined to determine if the objective was met. Each analysis will be evaluated separately in terms of the major impacts observed from the data review, data quality indicators and measurement performance criteria assessments. Based on the results of these assessments, the quality of the data will be determined. Usability of the data will be based on the quality assessment. After establishing the usability of the data, it will be determined if the DQO was met and if project action limits were met. The final report will include a summary of all points that comprised the reconciliation of each objective. Any conclusions or limitations on the usability of any of the data will be described.

REFERENCES

Intergovernmental Data Quality Task Force. 2005. Uniform Federal Policy for Quality Assurance Project Plans. March.

Los Alamos National Laboratory (LANL). 2011. Exorisk Database Release. Los Alamos Natinoal Laboratory, Environmental Programs Directorate Waste and Environmental Services Division, Los Alamos, NM. October

New Mexico Environment Department (NMED). 2006. TPH Screening Guidelines. October.

NMED. 2012. Risk Assessment Guidance for Investigations and Remediation, Volume 1. February.

Parallax, Inc. 2000. Closeout Report/Contamination Assessment, SWMU 129-Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, Final. July.

The Technical Cooperation Program (TTCP). 2009. Environmental Fate and Effects of Energetic Materials. Available at http://www.em-guidelines.org/ecot.htm.

URS Group, Inc. 2009. Final Evaluation Report. Cannon Air Force Base. Air Force Compliance Clean-up Site, Identification and Evaluation of DERA Eligibility for AFCEE, Multiple Locations. Prepared for the United States Army Corps of Engineers, Tulsa District. August.

U. S. Department of Defense, Environmental Data Quality Workgroup. 2010. Quality Systems Manual (QSM) for Environmental Laboratories, Version 4.2. October.

United States Environmental Protection Agency (USEPA). 2003. Region 5 RCRA, Ecological Screening Levels, August.

USEPA. 2007. Ecological Soil Screening Levels, August.

USEPA. 2011. Regional Screening Levels. November.

United States Geological Survey (USGS). 1995. Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico. Volume I.

Woodward-Clyde (W-C). 1997. "Naturally Occurring Concentrations of Inorganics and Background Concentrations of Pesticides at Cannon Air Force Base, New Mexico." Final Report. September.

REFERENCES

THIS PAGE INTENTIONALLY BLANK

ATTACHMENT A
LABORATORY STANDARD OPERATING PROCEDURES

((Included electronically as PDF only))

THIS PAGE INTENTIONALLY BLANK

STANDARD OPERATING PROCEDURE

ACID DIGESTION, TOTAL METALS FOR SOLIDS

SOP No.:	EMAX-3050	Revision No.	4	Date:	24-Aug-10
Prepared By:	Mary Jane Mendoza			Date:	08-24-10
Approved By:	Kenette Pimentel QA Manager			Date:	08.24.10
Approved By:	Caspar Pang Laboratory Director			Date:	08-24-10.

Control Number: 3050-04-

1.0 SCOPE AND APPLICATION

1.1. This method describes the acid digestion for soils, sludge, sediments and other related substances that are solid in nature, in preparation for metals analysis by ICP analytical technique. This SOP adopts the same acid strength as SW846 Method 3050B. A comparative study of this modified procedure vis-à-vis the reference method show better recoveries for some elements particularly antimony.

2.0 SUMMARY OF METHOD

2.1. Metal analytes are acid digested from a pre-measured sample. Hydrochloric acid is added to the sample and heated to initialize digestion. Nitric acid is added to the digestate and is further oxidized with 30% peroxide. Hydrochloric acid is again added to complete acid digestion.

2.2. **Interferences**

2.2.1. Sludge samples can contain diverse matrix types, which may present analytical challenge.

2.2.2. Samples having high concentrations may cause memory effect on the digestion vessels. Treating the vessels with 1:1 v/v of HCL and HNO3 will decontaminate the digestion vessels.

3.0 DETECTION LIMITS

3.1. Refer to applicable analytical procedure

4.0 DYNAMIC RANGE

4.1. Refer to applicable analytical procedure.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Holding Time**

5.1.1. All samples shall be digested within 180 days from sampling date.

5.2. **Preservation**

5.2.1. All samples shall be stored at the condition specified by the project.

6.0 ASSOCIATED SOP

6.1. EMAX-QC04 Balance Calibration

6.2.	EMAX-QC06	Calibration of Micropipettes
6.3.	EMAX-QC07	Glassware Cleaning
6.4.	EMAX-SM04	Analytical and QC Labeling
6.5.	EMAX-6010	ICP Emission Spectrometric Method for Trace Metal Analyses

7.0 SAFETY

7.1. Read the MSDS of all chemicals listed in this SOP.

7.2. All reagents, standards and samples shall be treated as potential hazard. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves, shall be worn at all times when performing this procedure.

7.3. All wastes generated during digestion, i.e., filter papers, paper towels, etc., and/or any solid material contaminated with acid, shall be placed in the wastes containers under the fume hoods. These wastes shall be labeled acidic wastes and shall be given to the waste management unit for proper disposal. NO ACIDIC WASTE SHALL BE DISPOSED IN THE TRASH CAN.

7.4. All acidic rinsate (pH ≤ 2) shall be labeled acidic water and shall be given to the waste management unit for proper disposal. NO ACID WASTE SHALL BE DISPOSED IN THE SINK.

7.5. If for any reason, acid and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with copious amount of tap water. If irritations or any other discomfort related to the incident persist, inform your supervisor immediately, so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS & REAGENTS

8.1. **Instruments & Supplies**

Balance	Sartorius LC 620 S or equivalent
Spatula	Stainless steel or equivalent
Digestion vessel	50-mL, 100-mL digestion vessel
Pipet	1-mL, 0.100-mL
Digestion block	Aluminum blocks or equivalent
Thermometer	Range 0 – 110°C
Watch Glass	Killdee Conical Watch glass or equivalent
Filter	Whatman #41 or equivalent
Digestate Container	125-mL Polyethylene bottle, Graduated

8.2. **Chemicals & Reagents**

Reagent water	ASTM Type II Water
Nitric Acid	NX0407-2 EM Science or equivalent
Hydrochloric Acid	HX0607-2 EM Science or equivalent
Hydrogen Peroxide	VW3690-5 VWR or equivalent

9.0 STANDARD

9.1. ICP Matrix Spike and Laboratory Control Solution

ICP MATRIX SPIKE AND LCS STANDARD 1	
PARAMETER	CONCENTRATION (mg/L)
Arsenic Barium Beryllium Cadmium Chromium Cobalt Copper Lead Manganese Nickel Selenium Silver Thallium Vanadium Zinc	100
Aluminum Iron	1000

ICP MATRIX SPIKE AND LCS STANDARD 2	
PARAMETER	CONCENTRATION (mg/L)
Antimony	500
Bismuth Boron Molybdenum Strontium Tin Titanium	100

ICP MATRIX SPIKE AND LCS STANDARD 3	
PARAMETER	CONCENTRATION (mg/L)
Calcium Magnesium Potassium Sodium	5000

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Sample Handling

10.1.1.1. Based from the work order, determine the samples to form a preparative batch (not to exceed 20 field samples). Withdraw the sample(s) from the sample control room designated for metals analysis (passing # 10 sieve) and bring them to the weighing area. Allow the samples to equilibrate at room temperature.

Note: Sample homogeneity is crucial in metals analysis. If no sample was designated for metals analysis, and it is apparent that sample particles contain > #10 sieve, inform the Supervisor for further instruction.

10.1.1.2. Take digestion vessels and label each one corresponding to the samples withdrawn. Take four more vessels and label them as preparation blank, LCS, matrix spike and matrix spike duplicate.

10.1.1.3. Check project sub-sampling requirement. If multi-incremental sub-sampling (MIS) is required, refer to EMAX-SM01, section 5.13.2 for details. Otherwise follow the steps described in EMAX-SM01, section 5.13.1.

10.1.1.4. Scoop 1-2-g sub-sample and transfer into a properly labeled digestion vessel. Record the weight to the nearest 0.01-g.

10.1.2. Pre-heating the Digestion Block

10.1.2.1. Place a digestion vessel with reagent water and a temperature monitoring thermometer on the digestion block.

10.1.2.2. Turn the digestion block on and set the thermostat to ~95°C or to a predetermined

temperature to obtain approximately 95°C once the digestion vessel is covered with a watch glass.

10.1.2.3. When the temperature reading is about 95°C ± 5°C, the digestion block is now ready for digestion.

10.1.3. Standard Addition.

10.1.3.1. Call for a witness for standard addition. Have the witness verify the setting of the micropippet and the expiration dates of the spike standards.

10.1.3.2. Add 0.5-ml of ICP Spike 1 and 2 and 1.0-mL of ICP spike 3 (Sec. 9.1) to LCS and matrix spike samples.

10.1.4. Acid Digestion

10.1.4.1. Add 10-mL of regent water and 5-ml of concentrated HCL[1] into each vessel, swirl the vessel to mix the acid and the sample. Add same amount of acid into a clean and empty vessel and designate it as blank. Insert the vessels in the digestion block(s). Cap the vessels with conical watch glass.

10.1.4.2. Check the temperature of the digestion block (95°C ± 5°C), adjust if necessary. If temperature happens to be ≥ 100°C, adjust the thermostat and wait until temperature falls within 95°C ± 5°C. Record the temperature reading in the digestion log.

10.1.4.3. Place the digestion vessels on the digestion block and reflux for 15 minutes without boiling.

10.1.4.4. Transfer the vessels into unheated digestion block and allow the vessels to cool down for at least 5 minutes. Lift the watch glass and add 10-mL of concentrated HNO_3. Place the watch glass back before working on the next vessel.

10.1.4.5. Return the vessels to the digestion block and reflux for another 15 minutes.

10.1.4.6. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes. Lift the water glass and add 10-mL 1:1 HNO3. Place the water glass back before working on the next vessel.

10.1.4.7. Return the vessels to the digestion block and reflux for another 15 minutes.

10.1.4.8. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes.

10.1.4.9. Add 2-mL of reagent water. Then add 3-mL of 30% hydrogen peroxide (H_2O_2) to each vessel, swirling each one of them after every addition to initiate peroxide reaction. Continue to add H_2O_2 until the amount added reaches 10-mL.

10.1.4.10. Return the vessels to the heated digestion block. Care must be taken to ensure that losses do not occur due to excessive effervescence.

10.1.4.11. Continue to reflux the mixture at 95°C ± 5°C for 15 minutes. Remove the digestion vessels from the digestion block.

10.1.4.12. Lift the watch glass, add 5-mL of concentrated HCl. Swirl the vessel until added

[1] Addition of 5-ml HCl is a modification from Method 3050B to enhance recovery of antimony. Refer to Appendix 2 for the comparative study done on ICP.

reagents are properly mixed with the solution. Place the watch glass before working on the next vessel. Return the vessels into the heated digestion block. Reflux for additional 15 minutes. Subsequently, remove the digestion vessels from the digestion block and allow the vessels to cool down and dilute to 100-mL final volume with reagent water.

10.1.4.13. Let the digestate settle and centrifuge or filter with Whatman #41 (see 10.1.5) if necessary otherwise digestates are now ready for analysis.

10.1.5. Digestate Filtration

10.1.5.1. Place Whatman #41 filter paper into each funnel resting on holders. Rinse the filter papers with reagent water.

10.1.5.2. Place a pre-labeled digestate container under each funnel making sure that the labels are visible.

10.1.5.3. Check the labels to make sure that they agree. Pour the digestate into the filter.

10.1.5.4. Filter and collect the digestates in the labeled container. The digestates are now ready for analysis.

10.2. **Instrument Parameters**

10.2.1. Take a digestion vessel filled halfway with tap water and insert a thermometer to serve as a temperature monitoring vessel. Place the temperature monitoring vessel on the digestion block together with the samples being digested. Check the temperature reading from time to time to ensure that it delivers heat at about 95°C ± 5°C.

10.3. **Calibration**

10.3.1. Balance calibration shall be carried out as described by EMAX-QC04.

10.3.2. Thermometer calibration shall be carried out as described by EMAX-QC05.

10.3.3. Pipette calibration shall be carried out as described by EMAX-QC06.

10.3.4. Check acid dispenser monthly using a class “A” graduated cylinder for accuracy prior to acid digestion. Adjust the dispenser stopper if necessary. Document the dispenser calibration on the digestion log.

10.3.5. **Volumetric Containers Calibration**

10.3.5.1. Perform calibration of digestion vessels per lot.

10.3.5.2. Randomly select 3 vessels from the lot.

10.3.5.3. Using a calibrated balance, tare off digestate vessel.

10.3.5.4. Fill the vessel to the 50-mL mark with reagent water and record the weight.

10.3.5.5. Fill the vessel to the 100-mL mark with reagent water and record the weight.

10.3.5.6. Repeat steps 10.3.3.2 to 10.3.3.4 on the other two vessels.

10.3.5.7. Take the temperature reading of the reagent water used. Get the density of reagent water corresponding to the reagent water at that temperature.

10.3.5.8. Calculate the actual volumes measured for each of the digestion vessel using Eq.-10.6.1.

10.3.5.9. Calculate the average volume measured from the three vessels using Eq-10.6.2.

10.3.5.10. Calculate the standard deviation using Eq-10.6.3.

10.3.5.11. Acceptance criteria shall be ± 2% of the expected value. All measurements must fall into the acceptance criteria, otherwise reject the lot.

10.4. **Analysis**

10.4.1. For ICP analytical technique refer to EMAX-6010 or EMAX-6010C.

10.5. **Data Reduction**

10.5.1. Refer to analytical procedures.

10.6. **Calculations**

10.6.1. Calculate for actual volume measured as indicated by the graduation of the vessel.

$$V = \frac{W}{D} \qquad \text{Eq-10.6.1}$$

where:

V	=	Actual volume measure
W	=	Weight of reagent water
D	=	Density of reagent water at the measured temperature

10.6.2. Calculate for average volume measured for each vessel.

$$V_{ave} = \frac{\sum V}{n} \qquad \text{Eq-10.6.2}$$

where:

ΣV	=	Summation of volume calculated from each trial
n	=	Number of measurements
V_{ave} =	=	Average volume measured

10.6.3. Calculate the Standard Deviation.

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}} \qquad \text{Eq-10.6.3}$$

where:

SD	=	Standard Deviation
$\overline{x}$	=	Mean
x_i	=	Result at i^{th} measurement
n	=	Number of measurements

10.7. **Report Generation**

10.7.1. Refer to analytical method

10.8. **Data Review**

10.8.1. Refer to analytical method

10.9. **Preventive Maintenance**

10.9.1. The digestion area in general shall be maintained clean at all times to prevent contamination

11.0 QUALITY CONTROL

11.1. The maximum number of original field samples in an analytical batch shall be 20 unless otherwise specified by the project.

11.2. Matrix spike samples shall be taken from a specified matrix spike field sample. In the absence of a specified matrix spike field sample, the analyst performing the extraction shall choose from any of the samples within the analytical batch.

11.3. A method blank, LCS, MS and MSD shall be prepared in every analytical batch, unless otherwise specified by the project. They shall be subjected to the same process that the field samples undergo as described in section 10.

11.4. In the event that there is insufficiency of sample to be used for MS/MSD, LCS duplicate shall be prepared to demonstrate precision.

11.5. All labwares to be used in the sample preparation shall be properly treated as specified in EMAX-QC07.

11.6. All reagents shall undergo quality control acceptance prior to its use.

11.7. Every lot of digestion vessels shall be checked for accuracy prior to its use. Record the verification in the Digestion Vessel QC Log (see Appendix 3).

11.8. Demonstration of proficiency is required prior to performing this procedure.

12.0 CORRECTIVE ACTION

12.1. Corrective action for each Quality Control procedure is summarized in Appendix 1 of the analytical method.

12.2. A non-conformance report (NCR) shall be filled out and attached to the analysis folder whenever the following circumstances occur. Corrective action shall be undertaken as advised below:

12.2.1. For insufficiency of sample(s), inform the Supervisor immediately for further advice.

12.2.2. Insufficient preservation of sample. If sample pH is ≥ 2, and no special instruction is provided by the analysis folder, inform your supervisor immediately for further action.

12.2.3. Breakage of sample container. Identify the sample and check for sample spare. If a spare is found replace the broken sample, if not inform your supervisor immediately for further action.

12.2.4. Sample overflow due to excessive effervescence. Identify the sample and check for sample spare. If a spare is found re-digest the sample, if none inform your supervisor immediately for further action.

12.2.5. Breakage of digestate container or sample was spilled prior to dilution to final volume. Identify the digestate. If it is a method blank or LCS, re-digest the whole analytical batch. If it is a sample, re-digest the sample with a method blank and LCS. If re-extraction is not possible, inform your supervisor for further action.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped in the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to the WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. Collect all waste generated, i.e. acidic rinsate, filter papers, etc. , into properly labeled waste containers and properly turn them over to the waste disposal unit.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch is a group of samples that are prepared and/or analyzed at the same time using the same reagent lot.

15.1.1.1. **Preparation batch** is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.2. **Analytical batch** is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.4. Matrix – is a component or form of a sample.

15.1.5. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.6. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.7. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.8. Reagent Water – is purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.9. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.10. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.11. Sample Duplicate – is a second sample aliquot of any sample (preferably the MS sample) to check matrix homogeneity and precision of method in a given matrix.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria specified in this SOP shall be applied to all projects when performing acid digestion of soil, sludge, and sediment samples for metals analysis. In the instance where there is a project or program specific requirement, the requirements given in the project shall take precedence over this SOP.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. USEPA SW846, Method 3050B

16.2. EMAX Quality Systems Manual, as updated

17.0 APPENDICES

17.1. Figures

17.1.1.	Figure 1	Acid Digestion Flow Diagram

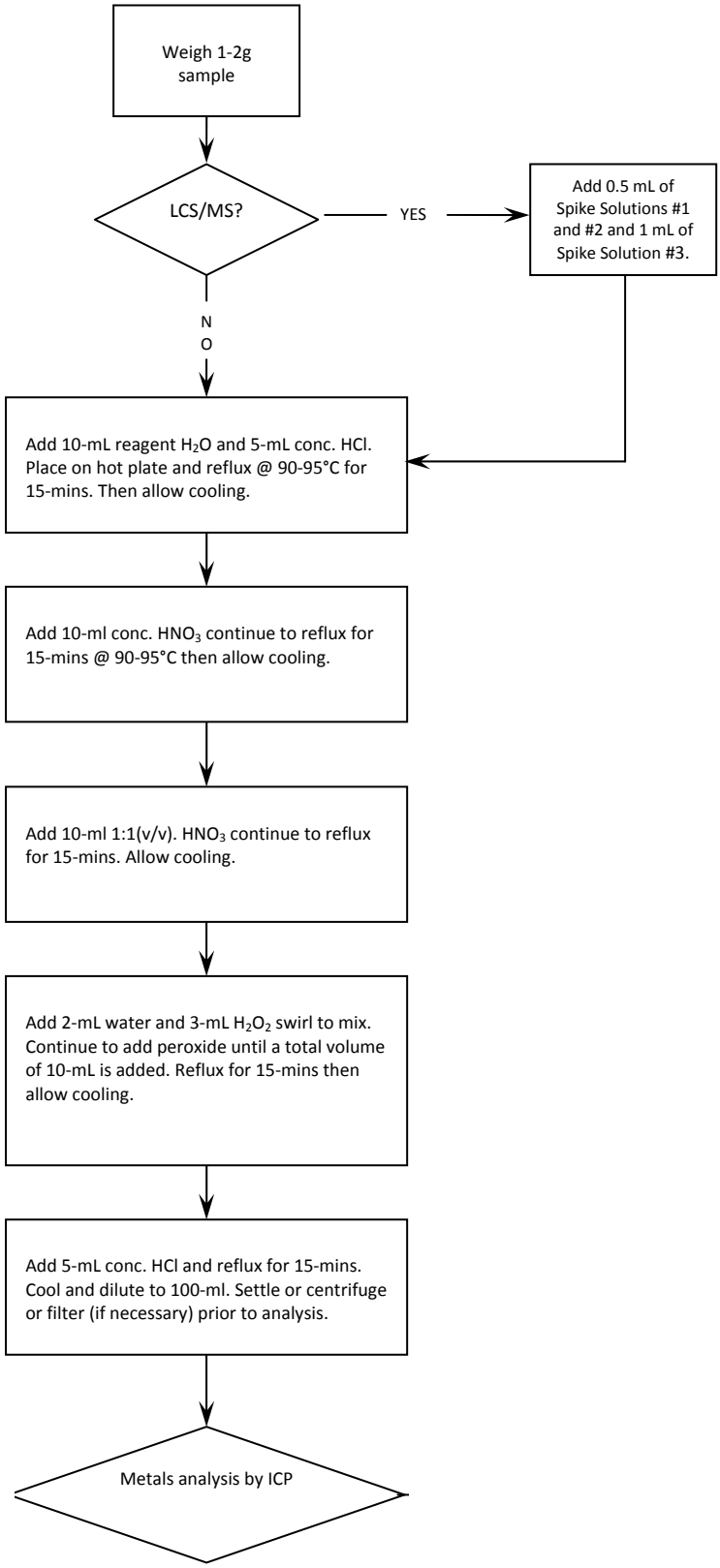
17.2. Appendices

17.2.1.	Appendix 1	Demonstration of Capability
17.2.2.	Appendix 2	Comparative Study of Modified 3050B

17.3. Forms

17.3.1.	3050FS	Digestion Log
17.3.2.	3050FC	Volumetric Containers Calibration Log

FIGURE 1: ACID DIGESTION FLOW DIAGRAM



APPENDIX 1: **DEMONSTRATION OF CAPABILITY**

ANALYTICAL METHOD: SW 6010C
PREPARATION BATCH: IPE017S
ANALYTICAL BATCH: D8E007

Preparation Date: 5/6/2010
Extracted by: M. Mendoza
Analytical Run Date: 5/7/2010
Analyzed by: T. Hoang

	Concentration (mg/Kg)				True Value (mg/Kg)	Ave. Conc. (mg/Kg)	Ave. Rec. (%)	Std. Dev.	RPD (%)	ACCEPTANCE LIMITS (% Rec)	Evaluation
	ID8E007025 IPE017SL	ID8E007026 IPE017SC	ID8E007028 IPE017SY	ID8E007045 IPE017SX							
Aluminum	528	515	512	515	500	518	104	7.141	1.4	80 - 120	PASSED
Antimony	271	263	267	266	250	267	107	3.304	1.2	80 - 120	PASSED
Arsenic	52.1	50.2	51.6	51.8	50	51.4	103	0.842	1.6	80 - 120	PASSED
Barium	51.2	49.8	50	50.1	50	50.3	101	0.629	1.3	80 - 120	PASSED
Beryllium	51.1	50	49.6	49.4	50	50	100	0.759	1.5	80 - 120	PASSED
Boron	49.4	47.9	48.9	49.3	50	48.9	98	0.685	1.4	80 - 120	PASSED
Cadmium	52.9	51.4	51.9	52.1	50	52.1	104	0.624	1.2	80 - 120	PASSED
Calcium	5400	5250	5410	5490	5000	5390	108	100.1	1.9	80 - 120	PASSED
Chromium	53.4	51.6	52.9	53.4	50	52.8	106	0.85	1.6	80 - 120	PASSED
Cobalt	51.7	50.3	50.8	51.4	50	51.1	102	0.624	1.2	80 - 120	PASSED
Copper	52.4	50.5	52.6	53.6	50	52.3	105	1.295	2.5	80 - 120	PASSED
Iron	524	507	517	519	500	517	103	7.136	1.4	80 - 120	PASSED
Lead	51.2	49.7	50	50.3	50	50.3	101	0.648	1.3	80 - 120	PASSED
Magnesium	5020	4970	4890	4830	5000	4930	99	84.21	1.7	80 - 120	PASSED
Manganese	49.8	48.7	48.3	47.9	50	48.7	97	0.818	1.7	80 - 120	PASSED
Molybdenum	55.7	54.1	54.3	54.5	50	54.7	109	0.719	1.3	80 - 120	PASSED
Nickel	54.6	53.1	53.7	54.2	50	53.9	108	0.648	1.2	80 - 120	PASSED
Potassium	5160	5040	5170	5230	5000	5150	103	79.58	1.5	80 - 120	PASSED
Selenium	50.8	49.1	50.6	51	50	50.4	101	0.866	1.7	80 - 120	PASSED
Silver	51.2	49.6	50.8	51.6	50	50.8	102	0.864	1.7	80 - 120	PASSED
Sodium	5250	5130	5250	5320	5000	5240	105	78.9	1.5	80 - 120	PASSED
Strontium	48.2	46.7	48.3	49.2	50	48.1	96	1.036	2.2	80 - 120	PASSED
Thallium	54.2	52.6	52.6	52.6	50	53	106	0.8	1.5	80 - 120	PASSED
Tin	55.2	53.6	53.6	53.4	50	54	108	0.839	1.6	80 - 120	PASSED
Titanium	52.3	51.2	51.1	50.8	50	51.4	103	0.656	1.3	80 - 120	PASSED
Vanadium	52.4	50.7	51.7	52	50	51.7	103	0.726	1.4	80 - 120	PASSED
Zinc	57.5	55.5	56	56.4	50	56.4	113	0.85	1.5	80 - 120	PASSED

APPENDIX 2: **COMPARATIVE STUDY OF MODIFIED 3050B**

ANALYTICAL METHOD: SW 6010C
PREPARATION BATCH: IPG052S - Modified Method 3050B
IPG053S - Reference Method 3050B
ANALYTICAL BATCH: D8G025
QC STANDARD: 09G281-02

Preparation Date: 7/27/2010
Extracted by: M. Mendoza
Analytical Run Date: 7/28/2010
Analyzed by: T. Hoang

COMPOUND	TRUE VALUES (mg/Kg)	ACCEPTANCE LIMITS (mg/Kg)	RECOVERY LIMITS (%)	REFERENCE METHOD 3050B				MODIFIED METHOD 3050B			
				Concentration (mg/Kg)		Recovery		Concentration (mg/Kg)		Recovery	
				D8G025063 G281-02	D8G025064 G281-02D	D8G025063 G281-02	D8G025064 G281-02D	D8G025054 G281-02	D8G025055 G281-02D	D8G025054 G281-02	D8G025055 G281-02D
Aluminum	7320	4940 - 16400	67.5 - 224	13900	13800	190%	189%	12600	12600	172%	172%
Antimony	110	11.0 - 121	10.0 - 110	22.4	20.4	20%	19%	71.5	76.7	65%	70%
Arsenic	84.2	42.8 - 92.7	50.8 - 110	67.5	68.1	80%	81%	70.1	71.7	83%	85%
Barium	247	186 - 318	75.3 - 129	246	248	100%	100%	266	261	108%	106%
Beryllium	49.0	29.0 - 53.9	59.2 - 110	39.7	39.4	81%	80%	43.8	42.5	89%	87%
Boron	130	61.8 - 149	47.5 - 115	99.8	99.8	77%	77%	108	105	83%	81%
Cadmium	76.5	48.7 - 84.4	63.7 - 110	70.6	71.6	92%	94%	77.5	76.8	101%	100%
Calcium	10200	7860 - 12900	77.1 - 126	10400	11500	102%	113%	11200	11200	110%	110%
Chromium	116	74.8 - 140	64.5 - 121	108	108	93%	93%	117	119	101%	103%
Cobalt	64.6	47.2 - 79.7	73.1 - 123	64.5	64.2	100%	99%	70	69	108%	107%
Copper	143	99.7 - 166	69.7 - 116	134	135	94%	94%	143	144	100%	101%
Iron	23300	11500 - 36200	49.4 - 155	25400	24700	109%	106%	25500	25700	109%	110%
Lead	82.0	41.9 - 90.2	51.1 - 110	62.5	63.6	76%	78%	66.4	66.2	81%	81%
Magnesium	7400	5300 - 9060	71.6 - 122	7080	7140	96%	96%	7330	7330	99%	99%
Manganese	475	428 - 724	90.1 - 152	566	581	119%	122%	618	597	130%	126%
Molybdenum	66.1	36.0 - 72.7	54.5 - 110	55.4	53.9	84%	82%	63.5	62.8	96%	95%
Nickel	144	88.8 - 158	61.7 - 110	129	131	90%	91%	142	141	99%	98%
Potassium	3740	2360 - 4990	63.1 - 133	4080	3970	109%	106%	4110	3920	110%	105%
Selenium	189	97.2 - 208	51.4 - 110	151	155	80%	82%	157	162	83%	86%
Silver	40.6	21.2 - 44.6	52.2 - 110	33.3	34.7	82%	85%	35.3	35.9	87%	88%
Sodium	200	31.4 - 324	15.7 - 162	223	214	112%	107%	199	202	100%	101%
Strontium	135	88.1 - 162	65.3 - 120	121	118	90%	87%	128	125	95%	93%
Thallium	127	73.2 - 144	57.6 - 113	108	114	85%	90%	116	110	91%	87%
Tin	250	39.5 - 275	15.8 - 110	72.1	73.5	29%	29%	85.3	86	34%	34%
Titanium	609	426 - 792	70.0 - 130	725	731	119%	120%	765	746	126%	122%
Vanadium	61.8	55.6 - 123	90.0 - 199	97.4	95.8	158%	155%	99.6	99.3	161%	161%
Zinc	208	145 - 270	69.7 - 130	227	228	109%	110%	258	244	124%	117%

** Note: Modified 3050B procedure is specified in EMAX-3050 Rev. 4*

3050FS: **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

DIGESTION LOG *for* ICP

Page 1

Sample Prep ID	Lab Sample ID	Sample Amount (g | ml)	pH	Extract Volume (ml)
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				

Book#: EIP-092

Batch:

Matrix:

SOP #	Rev.#
☐ EMAX-3005	
☐ EMAX-3010	
☐ EMAX-3050	
☐ EMAX-200.7	
☐ EMAX-	

	DATE	TIME	TEMP
START			°C
END			°C

Standards	ID	Amount Added (ml)
LCS -1		
LCS -2		
LCS -3		
MS		
Reagent	**Lot# / ID**	**Amount Added (ml)**
HNO_3		
HCl		
H_2O_2		
HNO3(1:1)		
Digestate Location		
Extract Location		

Comments:

Prepared By:

Standard Added By: Witnessed By:

Extract Rcvd By: Checked By:

Date endorsed to waste Disposal:

Accepted By:

3050FC: **VOLUMETRIC CONTAINERS CALIBRATION LOG**

EMAX LABORATORIES, INC.

VOLUMETRIC CONTAINER CALIBRATION

Page # 1

Book # QC-VC-001

Container Size _____ mL Lot#: _____

Cal. Points	Balance Readings (g)			
EV(ml)				
1				
2				
3				

Calibration Solution	DI WATER
Temperature(°C)	
Density	#N/A
Acceptance Criteria: Within (±)	2% of EV

Lot#: _____ Ref. No.: QC-VC-001-01-01

Cal. Points	Calculated Results (ml)			
EV				
1				
2				
3				
Average				
SD				
Criteria (±)				
Upper Limit				
Lower Limit				

Comments: @-ml EV:
@-ml EV:
@-ml EV:
@-ml EV:

Calibrated Date:
Checked by: Date:

Container Size _____ mL Lot#: _____

Cal. Points	Balance Readings (g)			
EV(ml)				
1				
2				
3				

Calibration Solution	DI WATER
Temperature(°C)	
Density	#N/A
Acceptance Criteria: Within (±)	2% of EV

Lot#: _____ Ref. No.: QC-VC-001-01-02

Cal. Points	Calculated Results (ml)			
EV				
1				
2				
3				
Average				
SD				
Criteria (±)				
Upper Limit				
Lower Limit				

Comments: @-ml EV:
@-ml EV:
@-ml EV:
@-ml EV:

Calibrated Date:
Checked by: Date:

Container Size _____ mL Lot#: _____

Cal. Points	Balance Readings (g)			
EV(ml)				
1				
2				
3				

Calibration Solution	DI WATER
Temperature(°C)	
Density	#N/A
Acceptance Criteria: Within (±)	2% of EV

Lot#: _____ Ref. No.: QC-VC-001-01-03

Cal. Points	Calculated Results (ml)			
EV				
1				
2				
3				
Average				
SD				
Criteria (±)				
Upper Limit				
Lower Limit				

Comments: @-ml EV:
@-ml EV:
@-ml EV:
@-ml EV:

Calibrated Date:
Checked by: Date:

TOC

STANDARD OPERATING PROCEDURE

EXTRACTION, PULSE SONICATION

SOP No.:	EMAX-3550	Revision No.	3	Effective Date:	03-Sep-10
Prepared By:	Marina Lyudmirskaya			Date:	09-03-10
Approved By:	Kenette Pimentel QA Manager			Date:	09.03.10
Approved By:	Caspar Pang Laboratory Director			Date:	09-03-10

Control Number: 3550-03-

1.0 SCOPE AND APPLICATION

1.1. This method describes the process of sample preparation, extraction, and concentration of solid samples prior to analysis. This process is applicable but not limited to soils; sediments, sludge, and other related substances that are solid in nature, requiring determination and quantification of semivolatile; pesticide; extractable hydrocarbons and other organic compounds of similar characteristic. This SOP is an adaptation of the USEPA SW846, Method 3550C.

2.0 SUMMARY OF METHOD

2.1.1. A measured amount of sample is solvent extracted, utilizing a pulse sonicator. The extract is concentrated to a volume required by the analytical method or subsequently exchanged to an appropriate solvent as prescribed by the analytical method.

2.1.2. **Interference**

2.1.2.1. Solvents, reagents, glassware, and other sample processing hardware may yield artifacts and/or interference to sample analysis. All these materials must be demonstrated to be free from interference under the conditions of the analysis by analyzing method blanks. Specific selection of reagents and purification of solvents by distillation in all-glass systems may be necessary. Refer to each method for specific guidance on quality control procedures and to EMAX-QC07 for guidance on the cleaning of glassware.

2.1.2.2. Interference co-extracted from the samples will vary considerably from source to source. If analysis of an extracted sample is prevented due to interferences, further clean-up of the sample extract may be necessary. Refer to Method 3600 for guidance on clean-up procedures.

2.1.2.3. Phthalate esters contaminate many types of products commonly found in the laboratory. Plastics, in particular, must be avoided because phthalates are commonly used as plasticizers and are easily extracted from plastic materials. Serious phthalate contamination may result at any time if consistent quality control is not practiced.

2.1.2.4. Soap residue (e.g. sodium dodecyl sulfate), which results in a basic pH on glassware surfaces, may cause degradation of certain analyte. Specifically, Aldrin, Heptachlor, and most organophosphorus pesticides will degrade in this situation. This problem is especially pronounced with glassware that may be difficult to rinse. These items should be hand-rinsed very carefully to avoid this problem.

3.0 DETECTION LIMITS

3.1. Refer to applicable analytical procedure.

4.0 DYNAMIC RANGE

4.1. Refer to applicable analytical procedure.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Holding Time**

5.1.1. All samples shall be extracted within 14 days from sampling date unless otherwise specified by the project.

5.1.2. All extracts shall be analyzed within 40 days from extraction.

5.2. **Preservation**

5.2.1. All samples and extracts shall be stored at $\leq$ 6°C.

6.0 ASSOCIATED SOPs

EMAX-QC02	Preparation of Analytical Standards
EMAX-QC04	Balance Calibration
EMAX-QC06	Calibration of Micropipettes
EMAX-QC07	Glassware Cleaning
EMAX-MCD	Moisture Content Determination
EMAX-SM04	Analytical and QC Sample Labeling
EMAX-3640	Clean-up, GPC

7.0 SAFETY

7.1. Read all MSDS for chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves at all times when performing this procedure. Perform all sample and standard handling in the fume hood.

7.3. Place all wastes generated during analytical process in the waste containers. Endorse these wastes to waste disposal section for proper disposal.

7.4. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. Instruments and Supplies

8.1.1. Standard Preparation

Balance	Sartorius
Syringe	1000 µL, gas tight, Hamilton
Volumetric Flask	10 ml, glass

8.1.2. Sample Handling

Particle size reduction	10 lb. Drop hammer and 4" ϕ steel cylinder
Sieve	No. 10 Standard Sieve
Pan	Glass, 18" x 24"
Scoop	Stainless Steel
Balance	Sartorius LC 6200 D or equivalent
Spatula	Stainless steel or equivalent
Beaker	300 ml, tall form, Kimax 14030-300 or equivalent
Vials	40 ml

8.1.3. Sample Extraction

Standard Addition	1 ml, 0.5 ml, .025 ml gas-tight syringe or equivalent
Extractor Probe ¾" & $^{1}/_{8}$"	Pulse Sonicator, 300 watts with pulsing capability
Filter	Whatman #41
Stemless funnel	75 mm, glass, Fisher 10-384B or equivalent

8.1.4. Extract Concentration

8.1.4.1. TurboVap Concentration Technique

Concentrator	TurboVap II or equivalent
Concentrator Tubes	200 ml Zymark tubes or equivalent
Pipettes	9 in, disposable glass
Volumetric Flask	1 ml, 10 ml
Graduated Cylinder	10 ml
Vials	2 ml, glass with Teflon faced septa; 20 ml, glass with Al or Teflon faced cap

Rubber Bulb	2 ml, latex

8.2. **Chemicals and Reagents**

Chemical/Reagent	Name	Source
Extraction solvent	Methylene Chloride	EM-DX0837-1 or equivalent
Exchange solvents	Hexane, Acetonitrile	EM-HX0297-1 or equivalent EM-AX0145-1 or equivalent
Drying reagent	Sodium Sulfate (baked at 400°C)	EM-SX0760E-3 or equivalent
Blank Soil	Organic free silica sand (baked at 400°C)	Ottawa Sand No. 30 or equivalent.

9.0 STANDARDS[1]

Analysis	Surrogate	Matrix Spike
Semivolatile	Spike amount – 0.4 ml	Spike amount – 0.2 ml
Semivolatile (SIM)	Spike amount – 0.1 ml	Spike amount – 0.05 ml
Chlorinated Pesticide	Spike amount – 1 ml	Spike amount – 1.0 ml
PCB	Spike amount – 1 ml	Spike amount - 0.5 ml
Polynuclear Aromatic Hydrocarbons By HPLC	Spike amount – 50 µL	Spike amount – 400 µL
Extractable TPH	Spike Amount – 1 ml	Spike Amount – 1 ml

10.0 PROCEDURES

10.1. Sample Preparation

10.1.1. Sample Handling

[1] For other methods, where this procedure is applicable, matrix spike and surrogate standards are listed in Section 9 of the specific analytical SOP.

10.1.1.1. Soil samples. Open the container and discard the top half-inch layer. Decant any water layer. Mix the sample thoroughly and discard any foreign objects, i.e., any vegetation, sticks, and rocks.

10.1.1.2. Concrete, mortar and other related samples. If sample amount is greater than 500 grams, use a clean aluminum pan to reduce the amount of sample by quartering. Return the excess sample that is in the sample container. Place the sample to be crushed in a clean 4" diameter steel mold. Position the 10-lb drop hammer vertically on top of the sample. Lift and drop the hammer until the sample is crushed to particles passing No. 10 standard sieve. Place the crushed sample in a clean and properly labeled sample container.

10.1.1.3. Perform moisture content determination as described in EMAX-MCD.

10.1.2. **Blank Soil Treatment**

10.1.2.1. Thoroughly wash the silica sand with methylene chloride.

10.1.2.2. Leave it open in a fume hood until the sand is air-dried.

10.1.2.3. Bake silica sand at 400 ^{o}C overnight and allow the sand to cool down.

10.1.2.4. Perform low level concentration extraction and have it analyzed for the intended use.

10.1.3. **Extraction - Low Level Concentration (< 20 mg/Kg)**

10.1.3.1. Weigh 30.0 g[2] of sample in a beaker and cover the beaker with aluminum foil before weighing the next sample. Use blank soil for Blank and LCS. Add sodium sulfate sufficient enough so that when mixed with the soil, the mixture shall have a free-flowing sandy texture.

10.1.3.2. Add matrix spike standard to matrix spike samples and LCS. Add surrogate standard to all samples to include blank, LCS and matrix spike samples. Refer to Section 9.0 for specific standard working solutions. Add about 80 ml of methylene chloride to each beaker.

10.1.3.3. Prepare the drying bed. Surface the stemless funnels with filter paper then pour anhydrous sodium sulfate to about 2/3 of the funnel. Rinse with methylene chloride and let it sit on properly labeled concentrator tube.

10.1.3.4. Fine-tune the pulse sonicator according to the manufacturer's operating manual to attain adequate extraction efficiency using ¾" probe. Make sure the probe is clean and rinsed with methylene chloride before using. Place the sonicator probe about 1/4 inch below the solvent. Turn on the sonicator and adjust the height of the probe so that the soil particles are free flowing with the solvent as the sonicator probe pulses without solvent spillage. Refer to 10.2.1 for pulse sonicator parameters.

10.1.3.5. Rinse the probe with methylene chloride into the beaker, and pour the extract into a drying bed.

10.1.3.6. Repeat the sonication process two times more, adding about 60 ml of fresh solvent each time. After the last extract has passed through the drying bed, rinse the beaker

[2] For TPH use 10-g unless otherwise specified by the project.

with methylene chloride wash bottle and combine the rinsate with the extract. Subsequently, rinse the drying bed with methylene chloride wash bottle. The extract is now ready for concentration.

10.1.4. **Extraction – Medium/High Concentration Levels (> 20 mg/Kg)**

10.1.4.1. Weigh 1.0 g of sample in a 40 ml vial. Wipe the rim of the each vial prior to capping them. Use blank soil for Blank and LCS.

10.1.4.2. Add matrix spike standard to matrix spike samples and LCS. Add surrogate standard to all samples to include blank, LCS and matrix spike samples. Refer to Section 9.0 for specific standard working solutions.

10.1.4.3. Add about 2 g of sodium sulfate and use a micro spatula for mixing. Pour about 20 ml of methylene chloride and stir the mixture with the spatula making sure that the soil and sodium sulfate is free flowing. Rinse the spatula with methylene chloride wash bottle.

10.1.4.4. Prepare the drying bed. Surface the stemless funnels with filter paper, containing about 5 g of anhydrous sodium sulfate. Rinse with methylene chloride and let it sit on properly labeled concentrator tube.

10.1.4.5. Sonicate the mixture for 2 minutes using $^{1}/_{8}$" probe. Rinse the probe with methylene chloride into the vial, and pour the extract into the drying bed.

10.1.4.6. Rinse the vial thoroughly. Subsequently, rinse the drying bed with methylene chloride wash bottle.

10.1.4.7. After all the rinsate has passed through the drying bed, the extract is now ready for concentration. Proceed to Section 10.1.6.

10.1.5. **Extraction – Wipe Samples**

10.1.5.1. Place a blank wipe in a 4-oz. sample jar with teflon-lined cap.

10.1.5.2. Note that samples received should be contained in a glass jar with Teflon-lined caps/septa. If not, record the sample condition as received in the extraction log and transfer the sample in a 4-oz. sample jar with Teflon-lined cap. Rinse the container with methylene chloride and pour the rinsate into the sample.

10.1.5.3. Add matrix spike standard to matrix spike samples and LCS. Add surrogate standard to all samples to include blank, LCS and matrix spike samples. Refer to Section 9.0 for specific standard working solutions.

10.1.5.4. Fill the sample container with methylene chloride until the wipe is completely submerged. Place the samples in the shaker. Turn on the shaker and shake for 1 hour.

10.1.5.5. Prepare the drying bed. Surface the stemless funnels with filter paper, and pour anhydrous sodium sulfate to about 2/3 of the funnel. Rinse with methylene chloride and let it sit on properly labeled concentrator tube.

10.1.5.6. Pour the extract into a drying bed. Rinse the sample thoroughly and pour the rinsate into the drying bed. Subsequently, rinse the drying bed with methylene chloride wash bottle.

10.1.5.7. After all the rinsate has passed through the drying bed, the extract is now ready for concentration. Proceed to 10.1.6.

10.1.6. **Concentrating Extracts**

10.1.6.1. Set the TurboVap concentrator as described in 10.2.2 and concentrate the extracts to ≤ final volume required in Table I. Refer to Table I for specific extract treatment. If solvent exchange is required, proceed to 10.1.6.2. If solvent exchange is not required, proceed to 10.1.6.3. If extract clean up is required, refer to specific clean-up SOP.

10.1.6.2. Using an appropriate solvent wash bottle, rinse the sides of the concentrator tube and swirl the tube to mix the concentrated extract with the exchange solvent. Add approximately 100 ml of exchange solvent and concentrate to ≤ final volume required in table.

10.1.6.3. Adjust the volume of the solvent according to Table I. Transfer the extract in a properly labeled and appropriate extract container.

Table 1: Specific Extract Treatment

Method	Exchange Solvent	Final Vol. (ml)	Extract Container
Semi volatile	none	2	4 ml screw cap vial with Teflon faced septa
Chlorinated Pesticides	Hexane	10	20 ml clear vial with Teflon lined cap
Polynuclear Aromatic Hydrocarbons	Acetonitrile	5	20 ml clear vial with Teflon lined cap
Extractable TPH	None	10	20 ml clear vial with Teflon lined cap

10.2. **Instrument Parameters**

10.2.1. Pulse Sonicator

Make	Duty Cycle	Intensity/Output Control	Timer (min)
Tekmar Sonic Disruptor	50%-70%	10	3
Braun-Sonic U	0.5	High	3
Branson Sonifier 450	50%-70%	10	3
Tekmar Ultrasonic Processor	Pulse on: 0.8 sec Pulse off: 0.5 sec	75%-85% 40% max. when using microtip	1 min:52 sec

10.2.2. Concentrator

10.2.2.1. TurboVap Concentrator

10.2.2.2. Set the water bath temperature at a maximum of 5°C less than the boiling point of the solvent in use, i.e., methylene chloride (BP = 40 °C). Temperature setting shall not exceed 35 °C.

10.2.2.3. Maintain the pressure of Nitrogen blowing down into the extracts at 11 psi.

10.3. **Calibration**

10.3.1. Calibrate pipettes used to dispense standards to ensure accuracy in standard addition as described in EMAX-QC06.

10.3.2. Check that the balance used for sample weighing was calibrated for the day, otherwise inform the supervisor.

10.4. **Analysis**

10.4.1. Refer to specific analytical SOP.

10.5. **Calculations**

10.5.1. Not applicable.

10.6. **Preventive Maintenance**

10.6.1. Maintain cleanliness in the extraction lab to minimize contamination uncertainties.

11.0 QUALITY CONTROL

11.1. The maximum number of original field samples in an analytical batch shall be 20 unless otherwise specified by the project.

11.2. Matrix spike samples shall be taken from a specified matrix spike field sample. In the absence of a specified matrix spike field sample, the analyst performing the extraction shall choose from any of the samples within the analytical batch.

11.3. A method blank, LCS, MS and sample duplicate shall be prepared in every analytical batch, unless otherwise specified by the project. They shall be subjected to the same process that the field samples undergo as described in Section 10.

11.4. In the event that there is insufficient amount of sample to be used for MS/MSD, LCS duplicate shall be prepared to demonstrate precision.

11.5. All labwares to be used in the sample preparation shall be properly treated as specified in EMAX-QC07.

11.6. All reagents and standards shall undergo quality control acceptance prior to its use.

12.0 CORRECTIVE ACTION

12.1. Whenever the following circumstances occur, corrective action shall be undertaken as advised below:

- Insufficient amount of sample. Check the COC and/or analytical folder for any special instruction. If none, complete the NCR and inform the supervisor immediately for further instruction.
- Breakage of sample container. Identify the sample and check for sample spare. If a spare is found, replace the broken sample. If not, inform your supervisor immediately for further action.
- Breakdown of apparatus. If the concentrator is broken (no power supply) in the middle of extraction, resolve the problem and continue to extract the samples. If the problem is beyond your means, inform your supervisor.

- Breakage of extract container or sample was spilled prior to dilution to final volume. Identify the extract. If it is a method blank or LCS, re-extract the whole analytical batch. If it is a sample, re-extract the sample with a method blank and LCS. If re-extraction is not possible, inform your supervisor for further action.

13.0 POLLUTION PREVENTION

13.1. Prevent indoor pollution by handling the solvents and extracts under the fume hoods.

13.2. Separate and properly identify all unused expired analytical standards prior to endorsing them to Waste Disposal Unit for proper disposal.

13.3. Keep extraction area clean to prevent contamination of sample.

14.0 WASTE MANAGEMENT

14.1. Collect all waste generated, i.e. extracted samples, filters, wipes, vials, etc. and properly turn them over to the waste disposal unit.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – A group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.1.1. **Preparation batch** – Composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.2. **Analytical batch –** Composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – A determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Lab Control Sample (LCS) – A target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.4. Matrix – A component or form of a sample.

15.1.5. Matrix Spike (MS) – A sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.6. Matrix Spike Duplicate (MSD) – A replicate of MS analyzed to monitor precision or recovery.

15.1.7. Method Blank – A target-analyte-free sample subjected to the entire sample preparation

and/or analytical to monitor contamination.

15.1.8. Reagent Water – Purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.9. Sample – A specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.10. Sample Duplicate – A second sample aliquot of any sample (preferably the MS sample) to check matrix homogeneity and precision of method in a given matrix.

15.1.11. Sub-sample – An aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing this analysis unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. USEPA SW846, Method 3550B

17.0 APPENDICES

17.1. Appendix

17.1.1. Appendix 1 Demonstration of Capability

17.2. Forms

17.2.1. 3550FS Extraction Log

Appendix 1: **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil / Hazardous Waste PT** **PT Study Closing Date: 3/4/2010**

Method: **SW 3550 C/SW 8270 D** **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
1	1,2,3,4-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
2	1,2,3,5-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
3	1,2,3-Trichlorobenzene	<330 ug/kg	<500	-	Acceptable
4	1,2,4,5-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
5	1,2,4-Trichlorobenzene	1000 ug/kg	1790	300-2070	Acceptable
6	1,2-Dichlorobenzene	<330 ug/kg	<300	-	Acceptable
7	1,3,5-Trichlorobenzene	<330 ug/kg	<500	-	Acceptable
8	1,3-Dichlorobenzene	<330 ug/kg	<300	-	Acceptable
9	1,4-Dichlorobenzene	1000 ug/kg	1920	300-2120	Acceptable
10	1-Chloronaphthalene	<330 ug/kg	<500	-	Acceptable
11	2,3,4,5-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
12	2,3,4,6-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
13	2,3,4-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
14	2,3,5,6-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
15	2,3,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
16	2,3,6-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
17	2,3-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
18	2,4,5-Trichlorophenol	1130 ug/kg	1900	300-2300	Acceptable
19	2,4,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
20	2,4,6-Trichlorophenol	958 ug/kg	1800	300-2240	Acceptable
21	2,4,6-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
22	2,4-Dibromophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
23	2,4-Dichlorophenol	962 ug/kg	1800	300-2260	Acceptable
24	2,4-Dichlorophenyl-3-methyl-4-nitrophenyle	<330 ug/kg	<500	-	Acceptable
25	2,4-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
26	2,4-Dimethylphenol	1080 ug/kg	3790	505-4170	Acceptable
27	2,4-Dinitrophenol	<660 ug/kg	<600	-	Acceptable
28	2,4-Dinitrotoluene	1240 ug/kg	1820	300-2570	Acceptable
29	2,5-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
30	2,6-Dichlorophenol	1160 ug/kg	2110	523-2330	Acceptable
31	2,6-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
32	2,6-Dinitrotoluene	<330 ug/kg	<300	-	Acceptable
33	2-Amino-1-methylbenzene	<330 ug/kg	<500	-	Acceptable
34	2-Chloronaphthalene	613 ug/kg	1120	200-1350	Acceptable
35	2-Chlorophenol	1190 ug/kg	2300	300-2870	Acceptable
36	2-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
37	2-Methyl-4,6-Dinitrophenol	<660 ug/kg	<600	-	Acceptable
38	2-Methylnaphthalene	961 ug/kg	1620	426-1780	Acceptable
39	2-Methylphenol	2470 ug/kg	5190	600-5710	Acceptable

Appendix 1 (cont.): **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil / Hazardous Waste PT** **PT Study Closing Date: 3/4/2010**

Method: **SW 3550 C/SW 8270 D** **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
40	2-Nitroaniline	<330 ug/kg	<500	-	Acceptable
41	2-Nitrophenol	1510 ug/kg	3630	600-3990	Acceptable
42	3,3'-Dichlorobenzidine	<330 ug/kg	<500	-	Acceptable
43	3,4,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
44	3,4-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
45	3,5-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
46	3-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
47	3-Nitroaniline	<330 ug/kg	<500	-	Acceptable
48	3-Nitrophenol	<330 ug/kg	<500	-	Acceptable
49	4-Bromophenyl-phenylether	2300 ug/kg	3040	836-3580	Acceptable
50	4-Chloro-3-methylphenol	<330 ug/kg	<300	-	Acceptable
51	4-Chloroaniline	655 ug/kg	815	0-1960	Acceptable
52	4-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
53	4-Chlorophenyl-phenylether	2370 ug/kg	3390	842-3930	Acceptable
54	4-Methylphenol (and/or 3-Methylphenol)	2400 ug/kg	4600	1200-5060	Acceptable
55	4-Nitroaniline	1200 ug/kg	1070	107-4210	Acceptable
56	4-Nitrophenol	1830 ug/kg	5500	600-6600	Acceptable
57	4-Nitrophenylphenylether	<330 ug/kg	<500	-	Acceptable
58	Acenaphthene	870 ug/kg	1420	200-1820	Acceptable
59	Acenaphthylene	863 ug/kg	1500	228-1930	Acceptable
60	Aniline	<660 ug/kg	<500	-	Acceptable
61	Anthracene	1380 ug/kg	1850	343-2420	Acceptable
62	Benzidine	<1300 ug/kg	<500	-	Acceptable
63	Benzo(a)anthracene	1240 ug/kg	1400	364-1890	Acceptable
64	Benzo(a)pyrene	1110 ug/kg	1340	319-1840	Acceptable
65	Benzo(b)fluoranthene	<330 ug/kg	<200	-	Acceptable
66	Benzo(g,h,i)perylene	<330 ug/kg	<200	-	Acceptable
67	Benzo(k)fluoranthene	1330 ug/kg	1760	444-2240	Acceptable
68	Benzoic acid	<1300 ug/kg	<500	-	Acceptable
69	Benzotrichloride	<330 ug/kg	<500	-	Acceptable
70	Benzyl alcohol	<330 ug/kg	<500	-	Acceptable
71	Benzyl chloride	<330 ug/kg	<500	-	Acceptable
72	Bis(2-chloroethoxy)methane	993 ug/kg	1710	300-2120	Acceptable
73	bis(2-Chloroethyl)ether	977 ug/kg	1840	229-2020	Acceptable
74	Bis(2-chloroisopropyl) ether	<330 ug/kg	<300	-	Acceptable
75	Bis(2-ethylhexyl)phthalate	1600 ug/kg	1690	300-2660	Acceptable
76	bis(2-methoxyethyl)phthalate	<330 ug/kg	<500	-	Acceptable
77	Butyl benzyl phthalate	1790 ug/kg	2130	446-2840	Acceptable
78	Carbazole	<330 ug/kg	<500	-	Acceptable

Appendix 1 (cont.): **DEMONSTRATION OF CAPABILITY**

PT # HW0110 Soil / Hazardous Waste PT **PT Study Closing Date: 3/4/2010**

Method: SW 3550 C/SW 8270 D **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
79	Chrysene	<330 ug/kg	<200	-	Acceptable
80	Diamylphthalate	<330 ug/kg	<500	-	Acceptable
81	Dibenzo(a,h)anthracene	1110 ug/kg	1260	200-1910	Acceptable
82	Dibenzofuran	1660 ug/kg	2520	648-2990	Acceptable
83	Dicyclohexylphthalate	<330 ug/kg	<500	-	Acceptable
84	Diethylphthalate	1200 ug/kg	1830	300-2420	Acceptable
85	Dimethylphthalate	1270 ug/kg	1970	300-2550	Acceptable
86	Di-n-butylphthalate	1530 ug/kg	1900	300-2730	Acceptable
87	Di-n-octylphthalate	1750 ug/kg	1950	300-2900	Acceptable
88	Dinonylphthalate	<330 ug/kg	<500	-	Acceptable
89	Fluoranthene	2000 ug/kg	2360	720-3040	Acceptable
90	Fluorene	1260 ug/kg	1820	349-2340	Acceptable
91	Hexachlorobenzene	<330 ug/kg	<300	-	Acceptable
92	Hexachlorobutadiene	1140 ug/kg	1900	300-2400	Acceptable
93	Hexachlorocyclohexane	<330 ug/kg	<500	-	Acceptable
94	Hexachlorocyclopentadiene	<330 ug/kg	<300	-	Acceptable
95	Hexachloroethane	895 ug/kg	1840	71.8-2050	Acceptable
96	Hexyl-2-ethylhexylphthalate	<330 ug/kg	<500	-	Acceptable
97	Indeno(1,2,3-cd)pyrene	<330 ug/kg	<200	-	Acceptable
98	Isophorone	814 ug/kg	1740	423-1920	Acceptable
99	Maleic anhydride	<330 ug/kg	<500	-	Acceptable
100	Naphthalene	1050 ug/kg	1830	218-2160	Acceptable
101	Nitrobenzene	1040 ug/kg	1920	300-2430	Acceptable
102	N-Nitrosodiethylamine	<330 ug/kg	<1500	-	Acceptable
103	N-Nitrosodimethylamine	653 ug/kg	1860	0-2040	Acceptable
104	N-Nitroso-di-n-propylamine	<330 ug/kg	<300	-	Acceptable
105	N-Nitrosodiphenylamine	1000 ug/kg	1700	422-1990	Acceptable
106	Pentachlorobenzene	<330 ug/kg	<500	-	Acceptable
107	Pentachlorohexane	<330 ug/kg	<500	-	Acceptable
108	Pentachlorophenol	2550 ug/kg	5790	600-6370	Acceptable
109	Phenanthrene	1360 ug/kg	1810	372-2330	Acceptable
110	Phenol	1930 ug/kg	3800	380-4280	Acceptable
111	Pyrene	1390 ug/kg	1720	497-2270	Acceptable
112	Pyridine	<1300 ug/kg	<500	-	Acceptable

Appendix 1 (cont.): **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil/Hazardous Waste Proficiency Testing** **PT Study Closing Date: Mar. 4, 2010**

Method: SW 3550 C / SW 8081 B Analyst: Enrico Santos

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aldrin	419	µg/Kg	412	130	-	562	Acceptable
2	alpha-BHC	428	µg/Kg	236	126	-	555	Acceptable
3	beta-BHC	156	µg/Kg	172	30.4	-	263	Acceptable
4	delta-BHC	307	µg/Kg	344	77.7	-	431	Acceptable
5	gamma-BHC (Lindane)	276	µg/Kg	299	84.6	-	412	Acceptable
6	alpha-Chlordane	200	µg/Kg	194	65.3	-	262	Acceptable
7	gamma-Chlordane	303	µg/Kg	331	139	-	428	Acceptable
8	DDD (4,4)	288	µg/Kg	324	118	-	464	Acceptable
9	DDE (4,4)	47.9	µg/Kg	57.6	11.1	-	96.4	Acceptable
10	DDT (4,4)	130	µg/Kg	181	44.4	-	276	Acceptable
11	Dieldrin	475	µg/Kg	483	190	-	653	Acceptable
12	Endosulfan I	329	µg/Kg	374	123	-	487	Acceptable
13	Endosulfan II	252	µg/Kg	265	76.1	-	361	Acceptable
14	Endosulfan Sulfate	105	µg/Kg	124	21.9	-	180	Acceptable
15	Endrin	155	µg/Kg	186	60.8	-	228	Acceptable
16	Endrin aldehyde	172	µg/Kg	371	37.1	-	409	Acceptable
17	Endrin Ketone	407	µg/Kg	459	121	-	634	Acceptable
18	Heptachlor	70.0	µg/Kg	86.4	22.9	-	118	Acceptable
19	Heptachlor Epoxide (beta)	56.2	µg/Kg	71.7	21.9	-	98.3	Acceptable
20	Methoxychlor	374	µg/Kg	392	43.4	-	601	Acceptable
21	Chlordane (total)	572	µg/Kg	652	140	-	926	Acceptable
22	Toxaphene (total)	783	µg/Kg	785	78.5	-	1130	Acceptable

Appendix 1 (cont.): **DEMONSTRATION OF CAPABILITY**

PT # WP0110 Water Pollution Proficiency Testing PT Study Closing Date: Feb. 18, 2010

Method: SW 3580 / SW 8082 A Analyst: Supakit Deesopha

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aroclor 1016	18.6	mg/Kg	30.1	4.83	-	42.0	Acceptable
4	Aroclor 1242	0	mg/Kg	0				Acceptable
6	Aroclor 1254	0	mg/Kg	0				Acceptable
7	Aroclor 1260	0	mg/Kg	0				Acceptable

PT # HW0110 Soil/Hazardous Waste Proficiency Testing PT Study Closing Date: Mar. 4, 2010

Method: SW 3550 C / SW 8081 B Analyst: Enrico Santos

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aroclor 1016	5.81	mg/kg	6.03	1.22	-	8.42	Acceptable
2	Aroclor 1221	<0.05	mg/kg	<0.2				Acceptable
3	Aroclor 1232	<0.05	mg/kg	<0.2				Acceptable
4	Aroclor 1242	<0.05	mg/kg	<0.2				Acceptable
5	Aroclor 1248	<0.05	mg/kg	<0.2				Acceptable
6	Aroclor 1254	<0.05	mg/kg	<0.2				Acceptable
7	Aroclor 1260	<0.05	mg/kg	<0.2				Acceptable
8	Total PCBs	5.81	mg/kg	6.03	1.22	-	8.42	Acceptable

3550FS: **EXTRACTION LOG**

EMAX LABORATORIES, INC.

Page 1

EXTRACTION LOG FOR TPH

SOP ☐ EMAX-3550 Rev. No.3 ☐ EMAX-3520 Rev. No.2 ☐ EMAX-LUFT E Rev. No.3 ☐ EMAX-3540 Rev. No.2 ☐ EMAX-3510Rev.No. 2 ☐ EMAX-AK102 Rev.No. 3

Matrix: Start Date: Time: End Date: Time: Book # EDS-050

PREPARATION BATCH * _____

Sample Prep ID	Lab Sample ID	Sonicator Number	Sample Amount (g | ml)	Extract Volume (ml)	Silica Gel Clean-up	Notes
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						

Standards	ID	Amount Added (ml)
Surrogate		
LCS/MS		

Reagent	Lot# / ID
CH_2Cl_2	
Na_2SO4	
HCl	
Silica Sand	
Silica Gel	

TUNING	
Sonicator #	Reading

Concentrator Water Bath Temp. (C)		
1		
2		
3		
4		
5		
6		

Comments: Test thermometer = T_1

Prepared By: Standard Added By:

Witnessed By: Checked By:

Extract Received by: Extract Location:

Disposal Date: Disposed By:

This page is checked during data review.

TOC

STANDARD OPERATING PROCEDURES

CLOSED SYSTEM PURGE AND TRAP

SOP No.:	EMAX-5035	Revision No.	2	Date:	14-May-09
Prepared By:	Souzan Greas			Date:	05-14-09
Approved By:	Kenette Pimentel QA Manager			Date:	05.14.09
Approved By:	Caspar Pang Laboratory Director			Date:	5/14/09

Control Number: **5035-02-**

1.0 SCOPE AND APPLICATION

1.1. This method describes a closed-system purge and trap process for the sample preparation and extraction for the analysis of volatile organics in a solid matrix. It applies to the gas chromatographic determination of volatile organics in sediment, soil, and waste. The low soil method (0.5 to 200 µg/kg) utilize a hermetically-sealed sample vial, the seal of which is never broken from the time of sampling to the time of sample preservation. Procedures are also included for preparing high concentration sample for purging by Method 5030C.

2.0 SUMMARY OF METHOD

2.1. Low Concentration Soil Samples (0.5-200 µg/Kg)

2.1.1. Samples collected in EnCore^{R} tube are preserved within 48 hours of sample collection by directly transferring its contents into a 40 ml vial containing sodium bisulfate as preservative, 5-ml of reagent water and a stir bar. Samples are extracted in a purge and trap closed system interfaced to a GC instrument equipped with a detector appropriate for the determinative method.

2.1.2. In the purge and trap closed, is equipped with an autosamper. The vial containing the sample is simultaneously analyzed and heated. A duplicate sample is prepared in case re-analysis is needed.

2.2. High Concentration Soil Sample and another Encore tube is extracted with 5-ml methanol in case sample dilution is necessary.

2.3. This method is an adaptation of SW846 Method 5035A.

2.4. **Interferences**

2.4.1. Impurities in the purge gas and organic compounds in the trap account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination by running method blanks. The use of non-polytetrafluoroethylene (non-PTFE) plastic coating, non-PTFE thread sealant, or flow controllers with rubber components in the purging device must be avoided. These compounds will result in interferences or false positives in the determinative step.

2.4.2. Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) during shipment or storage. A trip blank prepared from organic-free reagent water and carried through sampling and handling serves as a check on such contamination.

2.4.3. Contamination by carryover can occur whenever high-concentration and low-concentration samples are analyzed in sequence. Where practical, samples with unusually high concentrations of analytes should be followed by an analysis of organic-free reagent water to check for cross-contamination.

2.4.4. The volatile lab should be free of solvents and contamination. Special precautions must be taken to determine methylene chloride. The volatile area should be isolated from all atmospheric sources of methylene chloride, otherwise random background levels will result.

3.0 REPORTING LIMITS

3.1. Refer to specific analytical SOP.

4.0 DYNAMIC RANGE

4.1. 5.0 µg/kg to 200 µg/kg

5.0 PRESERVATION AND HOLDING TIME

5.1. Samples are preserved with sodium bisulfate or extracted with methanol within 48 hours from sampling date or as specified by the project.

5.2. Analyze preserved samples within 14 days from sampling or extracts within 14 days from extraction.

5.3. Preserved samples and extracts shall be stored at $\leq 6^{o}C$.

6.0 ASSOCIATED SOPs

6.1. All SOPs utilize purge and trap procedures for sample preparation are listed below:

6.1.1. EMAX-BTEXM Aromatic Volatile Volatiles by GC

6.1.2. EMAX-8015P Total Volatile Petroleum Hydrocarbons

6.1.3. EMAX-8260 Volatile Organics by GC/MS

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. All reagents, standards, and samples shall be treated as potential hazards. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves, shall be worn at all times when performing this procedure. All sample and standard handling shall be performed in the fume hood.

7.3. All wastes generated during the analytical process shall be placed in the wastes containers. These wastes shall be endorsed to the waste disposal section for proper disposal.

7.4. Water samples shall be neutralized to pH 7 ($\pm$ 2) prior to disposal.

7.5. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If an irritation persists, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS, AND SUPPLIES

8.1. Instruments and Supplies

8.1.1. Purge and Trap Autosampler : Archon

8.1.2. Trap: VOCARB 4000 (Supelco) or equivalent

8.1.3. Syringe: 5 ml, gas-tight with Luerlok tip

8.1.4. Microsyringe: 5, 10, 25, 50 µl (Hamilton 702N or equivalent)

8.1.5. Sparging Vessel: 40 ml vials with screw cap and Teflon-lined septum

8.1.6. Stir bars: Teflon lined

8.1.7. Archon Soil Method Program (If applicable to the method) : Internal Standard solution is added automatically by the instrument to the initial calibration standards containing all analytes of interest and surrogates, in the same fashion as used for the samples.

8.2. Chemicals and Reagents

8.2.1. Reagent Water: Organic free water, generated from active charcoal column.

8.2.2. Reagent Soil: Silica sand baked at 200°C overnight

8.2.3. Preservative: Sodium Bisulfate, Reagent grade

8.2.4. Extraction Solvent: Methanol, Ultrapure

9.0 STANDARDS

9.1. Preparation of standard is outlined in Section 9.0 of each analytical method.

9.2. Spiking Standard Solution

9.2.1. Refer to specific analytical method.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Decontamination of Reusable Labwares

10.1.1.1. Stir bars. Wash recycled stir bars with tap water until no solids are visible. Rinse with methanol and final rinse with copious amount of reagent water. Bake for a minimum of 2 hours at 120°C and allow cooling before reuse.

10.1.2. Purifying Reagent Soil

10.1.2.1. Fill a clean 1-L wide mouth glass jar with silica sand. Label the jar with the silica sand lot number for traceability purposes and bake it at 200 °C overnight.

10.1.2.2. Analyze a 5-g sample to verify that the reagent soil is organic free.

10.1.2.3. Sample result must be < RL for all target analytes, otherwise, the lot will be discarded.

10.1.2.4. Submit result to the QA Department.

10.1.3. Low Level Sample Preservation (<200µg/kg)

10.1.3.1. Remove EnCore tubes from freezer and let them warm up to room temperature. Line them up chronologically according to the sample IDs.

10.1.3.2. Label the vials and line them up in the same order as the EnCore tubes. Prepare one extra vial for preparation blank.

10.1.3.3. Add 1-g of sodium bisulfate, 5 ml of organics free water and a clean stirring bar to each of the vials. Re-cap the vial and gently mix the content.

10.1.3.4. List the samples into the preparation log on the same order as the samples are lined up.

10.1.3.5. Weigh the first vial and record the weight to the nearest 0.01-g as W_1. Open the Encore Tube envelope corresponding to the first vial and take-out one tube and re-seal the envelope.

10.1.3.6. Using the Encore tube sample extruder, remove the tube seal and quickly extrude the entire content of the EnCore tube into the vial and seal the vial with the screw cap. Record the weight to the nearest .01-g as W_2.

Note: Due to the nature of volatile compounds, minimum sample exposure must be observed during the sample transfer from the Encore tube to the vial.

10.1.3.7. Repeat the same procedures for the rest of the samples.

10.1.3.8. Duplicate the entire process suffixing the sample IDs with "R" to be used in case re-analysis is needed.

10.1.3.9. Extract another set of samples as described in 10.1.4 in case sample concentration(s) is >200 µg/kg. Prepare another preparation blank for each preparation batch.

10.1.4. Medium Level Samples (>200µg/kg)

10.1.4.1. Remove EnCore tubes from sample storage and let them warm up to room temperature. Line them up chronologically according to the sample IDs.

10.1.4.2. Label the vials and line them up in the same order as the EnCore tubes. Prepare one extra vial for extraction blank.

10.1.4.3. Add 5-ml of methanol containing 2.5 µg/ml of surrogate and matrix spikes to designated MS/MSD samples. Re-cap each vial after methanol addition.

10.1.4.4. List the samples into the extraction log on the same order as the samples are lined up.

10.1.4.5. Weigh the first vial and record the weight to the nearest 0.01-g as W_1. Open the EnCore Tube envelope corresponding to the first vial, and take-out one tube.

10.1.4.6. Using the EnCore tube sample extruder, remove the tube seal and quickly extrude the entire content of the EnCore tube into the vial and seal the vial. Record the weight to the nearest .01-g as W_2. Use 5-g of reagent soil for the extraction blank.

Note: Due to the nature of volatile compounds, minimum sample exposure must be observed during the sample transfer from the Encore tube to the vial.

10.1.4.7. Repeat the same procedures for the rest of the samples.

10.1.4.8. Store extracts at ≤ 6°C.

10.2. **Instrument Parameters**

10.2.1.	Purge Gas	:	Helium at 40 ml/min at 30 psi
10.2.2.	Desorb Time	:	4.0 ± 0.1 min.
10.2.3.	Purge Time	:	11.0 ± 0.1 min.
10.2.4.	Purge Temp.	:	40°C
10.2.5.	Desorb Temp.	:	220°C

10.2.6. Backflush Gas Flow: 20-60 ml/min.

10.3. **Calibration**

10.3.1. Refer to specific analytical method.

10.4. **Analysis**

10.4.1. Refer to specific analytical method.

10.5. **Data Reduction**

10.5.1. Refer to specific analytical method.

10.6. **Calculations**

10.6.1. Refer to specific analytical method.

10.7. **Report Generation**

10.7.1. Refer to specific analytical method.

10.8. **Data Review**

10.8.1. Refer to specific analytical method.

10.9. **Preventive Maintenance**

10.9.1. Instruments should receive routine preventive maintenance. Routine maintenance insures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction, consequently affecting results.

11.0 QUALITY CONTROL

11.1. Before processing any samples, the analyst must demonstrate through the analysis of reagent water blank that all glassware and reagents are free of interference.

11.2. The sequence of runs and quality control acceptance criteria are specified in the individual analytical methods. They include method blank, calibrations, lab control samples, and matrix spike/matrix spike duplicate.

12.0 CORRECTIVE ACTIONS

12.1. Since the performance of this method is always combined with an individual analytical method, the corrective actions are outlined in the specific methods.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped in the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to the WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to the WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. When the low concentration samples are strongly alkaline or highly calcareous in nature, the sodium bisulfate solution may not be strong enough to reduce the pH of the sample to below 2. Additional steps may be required to preserve the samples. Such steps include: addition of large amount of sodium bisulfate solution, storage of the samples at –10°C, or significantly reducing the maximum holding time for low concentration samples. Whichever steps are employed, they should be clearly described in the case narrative.

15.2. Soil samples that contain carbonate minerals may effervescence upon contact with the acidic preservative solution in low concentration sampling vial. Therefore, when samples are known or suspected to contain high levels of carbonate, sodium bisulfate should be replaced with organic free reagent water and samples should be analyzed within 48 hours of sampling.

15.3. **Application of EMAX QC Procedures**

15.3.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing purgeable volatile analyses. In instances where there is a project or program QAPP, the requirements given in the project shall take precedence over this SOP.

15.3.2. **Department of Defense (DoD) Projects**

15.3.2.1. When samples from DoD sponsored projects are analyzed for purgeable volatiles, the calibration, QC, corrective action, and data flagging requirements shall follow the specifics outlined in the DoD Quality Systems Manual for Environmental Laboratories, latest version. In the absence of a project QAPP or directive from the client project manager, DoD Quality Systems Manual latest version shall be applied.

16.0 REFERENCES

1.1. "Test Methods for Evaluating Solid Waste, Physical / Chemical Methods", EPA Publication SW-846 Update IV, Method 5035A.

1.2. EMAX Quality Systems Manual.

17.0 APPENDICES

17.1.	Table 1	Method Proficiency for Volatiles
17.2.	Appendix 1	Preservation Log for Volatiles
17.3.	Appendix 2	Extraction Log for Volatiles

METHOD PROFICIENCY

Unit: µg/kg
Sample Amount(g): 5
Sample Purge(ml): 5
Type of Sample: Encore

Date Analyzed: 04/30/09
Analyzed by: C. Mendoza

PARAMETER	VO03D38L RDB648	VO03D38C RDB649	VO03D39L RDB656	VO03D39C RDB657	TV (ug/kg)	Ave. Conc.	Ave. % Rec.	Std Dev.	RSD	QC Criteria	Comments
Acetone	187.54	191.45	174.90	178.69	200	183.14	92	7.662	4	40 - 160	Passed
Acrolein	181.46	189.98	171.92	173.74	200	179.27	90	8.247	5	50 - 150	Passed
Acrylonitrile	252.64	260.58	248.34	246.56	250	252.03	101	6.248	2	70 - 130	Passed
Benzene	51.35	51.94	49.59	52.09	50	51.24	102	1.144	2	70 - 130	Passed
Bromobenzene	49.97	53.20	54.23	52.85	50	52.56	105	1.824	3	70 - 130	Passed
Bromochloromethane	51.67	52.47	52.02	52.87	50	52.26	105	0.524	1	60 - 150	Passed
Bromodichloromethane	52.79	52.51	51.39	53.53	50	52.56	105	0.886	2	60 - 130	Passed
Bromoform	50.71	54.52	54.33	52.55	50	53.03	106	1.782	3	60 - 130	Passed
Bromomethane	48.46	50.99	44.82	44.72	50	47.25	94	3.041	6	40 - 160	Passed
tert-Butyl alcohol	238.13	253.76	253.20	249.46	250	248.64	99	7.260	3	70 - 160	Passed
2-Butanone (MEK)	194.60	203.41	195.39	187.35	200	195.18	98	6.570	3	50 - 160	Passed
n-Butylbenzene	53.62	55.67	54.09	53.14	50	54.13	108	1.099	2	50 - 150	Passed
sec-Butylbenzene	52.41	55.10	55.17	52.11	50	53.70	107	1.664	3	70 - 130	Passed
tert-Butylbenzene	50.00	53.43	54.57	50.92	50	52.23	104	2.128	4	70 - 130	Passed
Carbon disulfide	50.44	51.90	48.52	50.11	50	50.24	100	1.387	3	50 - 130	Passed
Carbon tetrachloride	52.23	52.39	50.27	52.57	50	51.86	104	1.071	2	50 - 130	Passed
Chlorobenzene	52.11	52.70	50.39	53.17	50	52.09	104	1.213	2	70 - 130	Passed
Chloroethane	48.37	52.88	45.16	44.42	50	47.71	95	3.852	8	60 - 150	Passed
Chloroform	51.33	53.33	51.87	51.78	50	52.08	104	0.869	2	70 - 130	Passed
1-Chlorohexane	52.57	52.58	49.92	52.49	50	51.89	104	1.316	3	70 - 130	Passed
Chloromethane	49.81	54.44	45.04	45.96	50	48.81	98	4.282	9	50 - 150	Passed
2-Chlorotoluene	52.34	54.06	55.06	52.31	50	53.44	107	1.354	3	70 - 130	Passed
4-Chlorotoluene	49.34	54.63	55.12	51.80	50	52.72	105	2.687	5	70 - 130	Passed
Dibromochloromethane	51.79	52.61	51.61	53.33	50	52.33	105	0.794	2	70 - 130	Passed
1,2-Dibromo-3-chloropropane	49.76	49.57	52.42	52.52	50	51.07	102	1.623	3	50 - 150	Passed
1,2-Dibromoethane	51.17	51.56	50.80	51.59	50	51.28	103	0.372	1	50 - 150	Passed
Dibromomethane	51.84	51.65	51.69	53.28	50	52.11	104	0.780	1	70 - 130	Passed
1,1-Dichloroethane	51.90	54.02	51.35	52.45	50	52.43	105	1.152	2	70 - 130	Passed
1,2-Dichloroethane	51.23	51.63	51.71	53.14	50	51.93	104	0.833	2	60 - 140	Passed
1,2-Dichlorobenzene	51.71	52.99	51.60	52.83	50	52.28	105	0.730	1	70 - 130	Passed
1,3-Dichlorobenzene	51.73	54.06	53.57	52.47	50	52.96	106	1.054	2	70 - 130	Passed
trans-1,4-Dichloro-2-Butene	49.44	53.37	51.81	50.75	50	51.34	103	1.666	3	60 - 140	Passed
1,4-Dichlorobenzene	52.08	53.21	52.52	52.73	50	52.64	105	0.467	1	70 - 130	Passed
Dichlorodifluoromethane	50.77	53.47	46.30	46.58	50	49.28	99	3.463	7	50 - 130	Passed
1,1-Dichloroethene	51.86	53.61	51.17	51.30	50	51.99	104	1.126	2	60 - 130	Passed
cis-1,2-Dichloroethene	52.35	54.74	52.08	52.76	50	52.98	106	1.205	2	70 - 130	Passed
trans-1,2-Dichloroethene	52.57	53.86	50.93	52.17	50	52.38	105	1.206	2	70 - 130	Passed
1,1-Dichloropropene	50.41	51.29	50.00	52.42	50	51.03	102	1.070	2	70 - 130	Passed
1,2-Dichloropropane	52.33	52.32	51.52	53.41	50	52.40	105	0.775	1	70 - 130	Passed
1,3-Dichloropropane	50.72	51.88	51.52	52.81	50	51.74	103	0.866	2	70 - 140	Passed
2,2-Dichloropropane	54.83	56.42	51.01	51.77	50	53.51	107	2.546	5	40 - 140	Passed
cis-1,3-Dichloropropene	52.47	52.75	51.23	53.64	50	52.52	105	0.998	2	60 - 130	Passed
trans-1,3-Dichloropropene	52.96	53.63	52.16	53.88	50	53.16	106	0.770	1	60 - 140	Passed
tert-Butyl ethyl ether (ETB	51.18	52.95	51.48	52.96	50	52.14	104	0.947	2	70 - 130	Passed
Ethyl Methacrylate	50.98	51.72	51.94	52.23	50	51.72	103	0.535	1	50 - 150	Passed
Ethylbenzene	52.75	53.33	52.20	52.67	50	52.74	105	0.461	1	70 - 130	Passed
2-Hexanone (MBK)	200.32	202.82	196.57	192.08	200	197.95	99	4.681	2	60 - 160	Passed
Hexachlorobutadiene	52.63	52.31	49.11	50.97	50	51.26	103	1.603	3	50 - 140	Passed
Iodomethane	51.81	53.99	50.43	51.44	50	51.92	104	1.500	3	40 - 150	Passed
Isopropyl ether (DIPE)	52.24	53.76	51.98	52.69	50	52.67	105	0.785	1	70 - 130	Passed
Isopropylbenzene	50.44	53.35	54.11	52.30	50	52.55	105	1.590	3	70 - 140	Passed
p-Isopropyltoluene	51.73	53.91	53.44	52.85	50	52.98	106	0.942	2	60 - 140	Passed
Methylene Chloride	47.32	49.29	47.13	47.39	50	47.78	96	1.009	2	70 - 130	Passed

PRESERVATION LOG FOR VOLATILES

SOP ☐ 5035 Revision No. 2 ☐ **Book # E02-026**

Start Date: **Time:** **End Date:** **Time:**

Lab Sample ID	W_1 (g)	W_f (g)	Notes

Standards / Reagents	ID / Lot#	Amount Added (mL)
$NaHSO_4 \cdot H_2O$		
Reagent Water		
Sand		
DISPENSER CALIBRATION		

W_1 = Weight of Vial+Stirrer+$NaHSO_4 \cdot H_2O$+Solvent

W_f = W_1+Sample

Comments: _____

Prepared By: _____

Checked By: _____

Samples Received By: _____

Sample Location _____

Disposed by: _____ Date:

EXTRACTION LOG FOR VOLATILES

SOP ☐ EMAX-5035 Rev. No.: 2 ☐ Book # E01-030

Start Date: Time: End Date: Time:

Lab Sample ID	w_1 (g)	w_f (g)	Notes

Standards / Reagents	ID / Lot#	Amount Added (ml)
Surrogate		
LCS/MS		
Sand		
Methanol/Surrogate		

W_1 - Weight of Vial+Solvent

W_f = Weight of Vial+Solvent+Sample

Comments: _____

Prepared By: _____

Standard Added By: _____

Witnessed By: _____

Checked By: _____

Extract Received By: _____

Extract Location: _____

Disposed By: _____ Date: _____

STANDARD OPERATING PROCEDURES

TRACE METALS BY ICP-MS

SOP No.:	EMAX-6020	Revision No.	6	Effective Date:	14-Feb-11
Prepared By:	Mary Jane Mendoza			Date:	02.14.11
Approved By:	Kenette Pimentel QA Manager			Date:	02.14.11
Approved By:	Caspar Pang Laboratory Director			Date:	02-14-11
				Control Number:	**6020-06**

1.0 SCOPE AND APPLICATION

1.1. This procedure is applicable for the determination of sub-µg/L concentrations of a large number of elements in drinking water, wastewater, groundwater, aqueous, extract, soil, sludge, and sediment samples using the Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) method. All matrices require proper sample preparation prior to analysis.

1.2. The elements and their corresponding isotopes are listed in Table 1.

1.3. This SOP is an adaptation of the SW846 Method 6020A.

2.0 SUMMARY OF METHOD

2.1. Metal analytes in water are acid digested from a pre-measured sample. Nitric acid and hydrochloric acid are added to the sample and heated without boiling until the volume is substantially reduced. The digestate is diluted back to its original sample volume using reagent water.

2.2. Metal analytes in soil are acid digested from a pre-measured sample. Nitric acid is added to the sample and heated to initialize digestion. It is further oxidized with 30% hydrogen peroxide and the acid used for final reflux is hydrochloric acid.

2.3. Digestates are introduced by pneumatic nebulization resulting aerosol into a high temperature argon plasma, where they are decomposed, atomized and ionized. The ions produced are extracted from the plasma via the sample and skimmer orifices in the interface region of the mass spectrometer. The extracted ions are guided by an off-axis Lens System to reduce background noise, passes through an Octopole Reaction System (ORS) where some ions require a simple reaction with H_2 or He to eliminate matrix interference prior to entering the Quadrupole Mass Filter (QMF). The QMF separates ions based on their mass-to-charge ratios and ions are counted by electron multiplier detector.

2.4. Quantitation is accomplished by comparing the response of a major ion relative to an internal standard using a calibration curve.

2.5. **Interference**

2.5.1. Isobaric Elemental Interference. Are caused by isotopes of different elements which form singly or doubly charge ions of the same nominal mass-to-charge ratio. The signal of an isotope of an interfering element is determined and subtracted from the analyte isotope signal.

2.5.2. Isobaric Polyatomic Ion Interference. Are caused by ions consisting of more than one atom which have the same nominal mass-to-charge ratio as the isotope of interest. To correct for isobaric polyatomic ion interferences, optimize the cell gas pressure on each analyte so that when the ORS employs simple reaction gases (H_2 and He) side reactions create new and unpredictable interferences. The ORS is equipped with notch filters and by using scanning voltages the created interferences are prevented from reaching the analyzer.

2.5.3. Physical Interference. Nebulization and transport processes can be affected if a matrix component causes a change in surface tension or viscosity. An internal standard can be used to correct physical interference if is carefully matched to the analyte so that the two elements are similarly affected by matrix changes. When the intensity level of the internal standard is less than 70% of the intensity of the first standard used during calibration, the sample must be diluted and re-analyzed.

2.5.4. Memory Interference. Contamination by carry-over can occur whenever high concentrations are analyzed in sequence with a low concentration sample. To reduce potential carry-over the rinse period between samples must be long enough to eliminate significant memory effect.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Established limits are shown in Table 5.

4.0 DYNAMIC RANGE

4.1. Linear Dynamic Range (LDR) is the concentration over which the instrument response remains linear.

4.2. Establish LDR of each analyte by determining the signal response from a minimum of three preferably five different concentration across the range. The upper limit should be within 10% (±10%) of the true value.

4.3. Verify the established LDR every six months or when there is a significant change in the instrument signal, whichever comes first.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. Expected sample condition when received in the lab:

- water samples in HDPE, preserved to pH <2 with HNO_3
- soil samples in glass jar or brass tubes

5.2. When water sample preservation is requested to be done in the lab, preserve the sample to pH <2 wit HNO_3 and observe at least 24 hours from the time preservative is added before sample digestion.

5.3. Store water samples in the same condition as received unless specified in the project requirement.

5.4. Store soil samples at ≤ 6°C.

5.5. **Holding Time**

5.5.1. Analyze all samples within 180 days from the collection date.

6.0 ASSOCIATED SOPs

6.1. EMAX-QA04 Method Detection Limit (MDL)

6.2. EMAX-QA08 Corrective Action

6.3. EMAX-QC01 Quality Control for Chemicals

6.4. EMAX-QC02 Analytical Standard Preparation

6.5. EMAX-QC06 Calibration of Micropipettes

6.6. EMAX-QC07 Glassware Cleaning

6.7. EMAX-SM04 Analytical and QC Labeling

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. Observe the following precautions during operation or maintenance of the instrument:

- Close the instruments hoods and panels prior to operation.
- Check the exhaust system for a positive extraction at the exhaust duct.
- Handle the solvents correctly.
- Check the drain vessels frequently.
- Make sure that the argon tank is chained.
- Wait for the instrument interface region to cool down prior to instrument maintenance.
- Observe all cautions and warnings stipulated in the Agilent 7500 ICP/MS Manuals.

7.3. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure. Observe all chemical hygiene procedures as mentioned in the Chemical Hygiene Plan.

7.4. Place all wastes generated during analytical process in a properly labeled satellite waste containers.

7.5. DO NOT DISPOSE ACIDIC WASTE IN THE TRASH CAN OR IN THE SINK.

7.6. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

8.1.1. ICP-MS: Agilent 7500CE Octopole Reaction System

8.1.2. Autosampler: CETAC ASX-520

8.1.3. Computer: IBM Compatible

8.1.4. RF Generator: Agilent RF Generators

8.1.5. Data Acquisition: Agilent Chemstation (G1834B)

8.1.6. Autosampler rack(s): 17 mm, 60 positions

8.1.7. Culture tubes: 17 mm, polypropylene

8.1.8. Volumetric Flask: 100 ml

8.1.9. Micropipets: 100 - 1000 µl

8.1.10. Pipet Tips: 100 - 1000 µl

8.1.11. Polyethylene bottles: 250, 500, 1000 ml

8.1.12. Liquid argon

8.1.13. Hydrogen, Compressed: Ultra-high purity

8.1.14. Helium, compressed: Ultra-high purity

8.1.15. Balance Sartorius LC 620 S or equivalent

8.1.16. Spatula Stainless steel or equivalent

8.1.17. Digestion vessel 50 ml, 100 ml snap seal

8.1.18. Pipette 1 ml, 0.100 ml, 5 ml

8.1.19. Digestion block Aluminum blocks or equivalent

8.1.20. Thermometer Range 0 - 110°C

8.1.21. Filter Whatman #41 or equivalent

8.1.22. Digestate Container 50 ml polyethylene vessel, 100 ml Corning snap seal or equivalent

8.1.23. Disposable watch glass

8.2. **Chemicals and Reagents**

8.2.1. DI water, ASTM Type II or equivalent

8.2.2. Nitric Acid, Trace high purity grade, concentrated

8.2.3. Hydrochloric acid, Trace high purity grade, concentrated

8.2.4. Hydrogen Peroxide, ACS grade (e.g., VW3690-5 from VWR) or equivalent

9.0 STANDARDS

9.1. **Tune Check Standard**

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
Tuning Solution	Agilent	Li, Y, Ce, Tl, Co	0.01	2% HNO_3
Tuning Check Standard	High Purity Standard	Co, In, Li, Tl	10	2% HNO_3

9.1.1. Prepare tuning check standard at concentration level suggested below.

STANDARD	Aliquot, (ml)	Final volume (ml)	Final Concentration (mg/L)
Intermediate tuning check standard	0.5	50	0.100

9.2. **Internal Standard (IS)**

9.2.1. Purchase stock internal standard as certified standard at concentration listed below or equivalent.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
IS	Agilent	Li6, Sc, Ge, Rh, In, Tb, Bi, Lu	100	10% HNO_3

9.3. **Calibration Standards**

9.3.1. Calibration Stock Standard

9.3.1.1. Purchase custom-made certified mixed stock standards as listed in the table below or equivalent.

STANDARD	SOURCE	ELEMENTS	CONC. (µg/ml)	MATRIX
SM-2208-001	High Purity	As, B, Se, Sr, Tl, Ti, V, Zn, Sb, Mo, Sn	10	2% HNO_3 and Trace HF Acid
SM-2208-002	High Purity	Ba, Be, Cd, Cr, Co, Cu, Pb, Li, Mn, Ni, Ag, U	10	2% HNO_3
SM-2208-003	High Purity	Al, Fe, K, Ca, Mg, Na	1000	4% HNO_3

9.3.2. Matrix Acid Blank (S0)

9.3.2.1 Prepare matrix acid solution by mixing 3% by volume nitric acid and 2% by volume hydrochloric acid in reagent water. Transfer into a clean HDPE bottle and identify the solution as S0.

9.3.2.2 Use this solution for standards or digestate dilutions.

9.3.3. Initial Calibration Standard

9.3.3.1 The initial calibration consists of a blank (S0) and three standards (S3, S4 and S5). Prepare the standards as suggested below. Refer to Table 3 for final concentrations for each analyte. Please note: More standard points may be added at the discretion of the analyst.

	SM-2208-001 (ml)	SM-2208-002 (ml)	SM-2208-003 (ml)	Final volume (ml)	Final Concentration (mg/L)
S1	0.025	0.025	0.025	50	0.005/0.5
S2	0.125	0.125	0.125		0.025/2.5
S4	0.250	0.250	0.250		0.05/5

9.3.4. Continuing Calibration Verification (CCV) Standard

9.3.4.1 Prepare CCV using the stock standards and S0 as suggested below. Refer to Table 3 for final concentrations for each analyte.

From Calibration Stock Standard	Aliquot (ml)	Final volume (ml)	CCV Final Concentration (mg/L)
SM-2208-001	0.125	50	0.025
SM-2208-002	0.125		0.025

From Calibration Stock Standard	Aliquot (ml)	Final volume (ml)	CCV Final Concentration (mg/L)
SM-2208-003	0.125		2.5

9.3.4.2 Prepare intermediate solution for Low Level CCV (LLCCV) using the stock standards and S0 as suggested below. Refer to Table 3 for final concentrations of each analyte.

	From Calibration Stock Standard	Aliquot (ml)	Final volume (ml)	LLCCV Final Concentration (mg/L)
MIX 7	SM-2208-001	1.0	10	1.0
	SM-2208-002	1.0		1.0
	SM-2208-003	1.0		100
Zn	Zn	0.5		10

9.4. **Secondary Source Standard**

9.4.1. Purchase secondary stock standard from a different source as certified standards or equivalent. Refer to list below.

SOURCE	STANDARD	ELEMENTS	CONC. (mg/L)	MATRIX
CPI	EMAX MIX 2	As, Ba, Be, B, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, Sr, Tl, Ti, V, Zn, Ag, Sb, Mo, Li, U, Sn	10	5% HNO_3 + Tr HF
	EMAX MIX 3	Al, Fe, Ca, Mg, K, Na	1000	5% HNO_3

9.4.2. Refer to EMAX-QC02 for detailed procedure of standard preparation and labeling.

9.5. **Initial Calibration Verification (ICV)**

9.5.1. Prepare ICV using the secondary stock standards and S0 as suggested below. Refer to Table 3 for final concentrations for each analyte.

From Stock Standard	Aliquot (ml)	Final Volume (ml)	ICV Final Concentration (mg/L)
EMAX MIX 2	0.150	50	0.030
EMAX MIX 3	0.150		3

9.6. **Interference Standards (ICSA/ICSAB)**

9.6.1. Purchase ICS stock standard as mix certified standards at concentration levels listed below.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
6020ICS-0A (ICSA)	Inorganic Ventures	Al, Ca, Fe, Mg, Na, P, K, S	1000	1.4% HNO_3
		C	2000	
		Cl	10000	
		Mo, Ti	20	

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
6020ICS-0A + EMAX MIX 2 (ICSAB)	6020ICS-0A	Al, Ca, Fe, Mg, Na, P, K, S	1000	1.4% HNO_3
		C	2000	
		Cl	10000	
		Mo, Ti	20	
	EMAX MIX 2	As, Ba, Be, B, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, Sr, Tl, Ti, V, Zn, Ag, Sb, Mo, Li, U, Sn	10	5% HNO_3 + Tr HF

9.6.2. Prepare Intermediate ICSA and ICSAB standards at concentration levels suggested below. Refer to Table 3 final concentrations.

Standard	Parent Standard	Aliquot (ml)	Final Volume (ml)	Final Concentration (mg/L)
Intermediate ICSA	6020ICS-0A	5	50	Varied
Intermediate ICSAB	6020ICS-0A	5	50	Varied
	EMAX MIX 2	0.10		

9.7. **LCS/MS Spike Standard**

9.7.1. Purchase LCS/MS standards as certified custom-mixed.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
EMAX MIX 2	CPI	B, Sr, As, Ba, Be, Ag, Cd, Cr, Co, Cu, Tl, Pb, Mn, Ni, Se, V, Zn, Ti, Sb, Mo, Li, U, Sn	10	5% HNO_3+ Tr HF
EMAX MIX 3		Al, Fe, Ca, Mg, K, Na	1000	5% HNO_3

9.8. **P/A Tuning Standard**

9.8.1. Using the calibration stock standard from 9.3.1, prepare a 50 µg/L and 100 µg/L mixed standard. These standards should also include 50 µg/L and 100 µg/L of internal standard, which can be prepared by using the internal standard stock from 9.2.1.

10.0 PROCEDURES

10.1. **Sample Preparation for Water Samples**

10.1.1. Based from the work order, determine the samples to form a preparative batch (not to exceed 20 samples per preparative batch). Withdraw the sample(s) from the sample control room and bring them to the preparation area. Allow the samples to equilibrate at room temperature.

10.1.2. Shake the sample container. Pour a small amount of sample into the sample cap and trickle just enough to wet the pH indicator strip. Compare the color of the wet strip to the indicator chart displayed in the pH indicator box. Record the pH in the digestion log. If the pH value is <2, proceed to 10.1.3. If the pH value is ≥2, check if special instruction is written on the analysis folder or in the COC. Otherwise, fill out an NCR and inform the supervisor immediately. DO NOT PROCEED WITH THE DIGESTION. WAIT FOR FURTHER INSTRUCTION.

10.1.3. Line up the samples chronologically under the hood. Check and record the lot number of the digestion vessels if it has been verified for accuracy. Take digestion vessels and label each one corresponding to the samples withdrawn and place them in front of each sample making sure that their labels agree. Take four more vessels and label them as preparation blank, LCS, matrix spike and matrix spike duplicate.

10.1.4. Mix the sample thoroughly to achieve homogeneity. Fill each digestion vessel up to the 50-ml mark. (The reduction of the volume is due to waste minimization).

10.1.5. Record the volume in the digestion log. Use reagent water for blank and LCS.

10.1.6. Take another digestion vessel; fill it with tap water to 50 ml mark. Put a thermometer inside and let it sit on the digestion block. Turn the thermostat to a pre-determined mark to deliver heat at 90°C - 95°C. Record the temperature reading in the digestion log.

10.1.7. Standard Addition

10.1.7.1. Call for a witness for standard addition. Have the witness verify the setting of the micropipette and the expiration dates of the spike standards.

10.1.7.2. Add 0.125 ml of each from EMAX MIX 2 and 3 (see Section 9.4.1) solutions to matrix spike samples and LCS.

10.1.8. Acid Digestion for Dissolved Metals

10.1.8.1. Add 0.5 ml of concentrated HNO_3 and 0.25 ml concentrated HCl to each of the digestion vessels.

10.1.8.2. Cap the digestion vessels with disposable watch glass.

10.1.8.3. Check that the temperature of the digestion block is 85°C, adjust if necessary. If temperature happens to be less than 85ºC, adjust the thermostat and wait until temperature falls at 85°C.

10.1.8.4. Place the digestion vessels on the digestion block and reduce volume of sample by continuous heating without boiling for two hours.

10.1.8.5. Reflux gently for another 15 minutes. Remove the digestion vessels from the digestion plate and allow the vessels to cool down.

10.1.8.6. Using a reagent water wash bottle, rinse the disposable watch glass collecting the rinsate on the same digestion vessel that it covered. Add 1.0 ml concentration HNO_3 and 0.25 ml concentration HCl for matrix matching.

10.1.8.7. Dilute the digestate with reagent water to the 50 ml mark of the digestion vessel. Seal the vessel and shake. If the digestate appears to be turbid, pass it through Whatman #41 filter and collect it in a new polyethylene container.

10.1.9. Acid Digestion for Total Recoverable Metals

10.1.9.1. Add 0.5 ml of concentrated HNO_3 and 0.25 ml concentrated HCl to each of the digestion vessels.

10.1.9.2. Cap the digestion vessels with disposable watch glass.

10.1.9.3. Check that the temperature of the digestion block is 85°C, adjust if necessary. If temperature happens to be less than 85°C, adjust the thermostat and wait until temperature falls at 85°C.

10.1.9.4. Place the digestion vessels on the digestion block and reduce volume of sample by continuous heating without boiling for two hours.

10.1.9.5. Reflux gently for another 15 minutes. Remove the digestion vessels from the digestion block and allow the vessels to cool down.

10.1.9.6. Using a reagent water wash bottle, rinse the disposable watch glass collecting the rinsate on the same digestion vessel that it covered. Add 1.0 ml concentration HNO_3 and 0.25 ml concentration HCl for matrix matching.

10.1.9.7. Dilute the digestate with reagent water to the 50 ml mark of the digestion vessel. Seal the vessel and shake. If the digestate appears to be turbid, pass it through Whatman #41 filter and collect it in a new polyethylene container.

10.2. **Sample Preparation for Soil Samples**

10.2.1. Sample Handling

10.2.1.1. Based from the work order, determine the samples to form a preparative batch (not to exceed 20 field samples). Withdraw the sample(s) from the sample control room designated for metals analysis (passing # 10 sieve) and bring them to the weighing area. Allow the samples to equilibrate at room temperature.

Note: Sample homogeneity is crucial in metals analysis. If no sample was designated for metals analysis, and it is apparent that sample particles contain > #10 sieve, inform the Supervisor for further instruction.

10.2.1.2. Take digestion vessels and label each one corresponding to the samples withdrawn. Take four more vessels and label them as preparation blank, LCS, matrix spike and matrix spike duplicate.

10.2.1.3. Check project sub-sampling requirement. If multi-incremental sub-sampling (MIS) is required, refer to EMAX-SM01, section 5.13.2 for details. Otherwise follow the steps described in EMAX-SM01, section 5.13.1.

10.2.1.4. Scoop 1-2 g sub-sample and transfer into a properly labeled digestion vessel. Record the weight to the nearest 0.01 g.

10.2.2. Pre-heating the Digestion Block

10.2.2.1. Place a digestion vessel with reagent water and a temperature monitoring thermometer on the digestion block.

10.2.2.2. Turn the digestion block on and set the thermostat to ~95°C or to a predetermined temperature to obtain approximately 95°C once the digestion vessel is covered with a watch glass.

10.2.2.3. When the temperature reading is about 95°C ± 5°C, the digestion block is now ready for digestion.

10.2.3. Standard Addition

10.2.3.1. Call for a witness for standard addition. Have the witness verify the setting of the micropipette and the expiration dates of the spike standards.

10.2.3.2. Add 2.5 ml of EMAX MIX 2 & 3 (Sec. 9.4.1) to LCS and matrix spike samples.

10.2.4. Acid Digestion

10.2.4.1. Add 10 ml of regent water and 5 ml of concentrated HCL[1] into each vessel, swirl the vessel to mix the acid and the sample. Add same amount of acid into a clean and empty vessel and designate it as blank. Insert the vessels in the digestion block(s). Cap the vessels with conical watch glass.

10.2.4.2. Check the temperature of the digestion block (95°C ± 5°C), adjust if necessary. If temperature happens to be ≥ 100°C, adjust the thermostat and wait until temperature falls within 95°C ± 5°C. Record the temperature reading in the digestion log.

10.2.4.3. Place the digestion vessels on the digestion block and reflux for 15 minutes without boiling.

10.2.4.4. Transfer the vessels into unheated digestion block and allow the vessels to cool down for at least 5 minutes. Lift the watch glass and add 10-mL of concentrated HNO_3. Place the watch glass back before working on the next vessel.

10.2.4.5. Return the vessels to the digestion block and reflux for another 15 minutes.

10.2.4.6. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes. Lift the water glass and add 10 ml 1:1 HNO3. Place the water glass back before working on the next vessel.

10.2.4.7. Return the vessels to the digestion block and reflux for another 15 minutes.

10.2.4.8. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes.

10.2.4.9. Add 2 ml of reagent water. Then add 3 ml of 30% hydrogen peroxide (H_2O_2) to each vessel, swirling each one of them after every addition to initiate peroxide reaction. Continue to add H_2O_2 until the amount added reaches 10 ml.

10.2.4.10. Return the vessels to the heated digestion block. Care must be taken to ensure that losses do not occur due to excessive effervescence.

10.2.4.11. Continue to reflux the mixture at 95°C ± 5°C for 15 minutes. Remove the digestion vessels from the digestion block and allow the vessel to cool down for at least 5 mins.

10.2.4.12. Lift the watch glass, add 5 ml of concentrated HCl. Swirl the vessel until added reagents are properly mixed with the solution. Place the watch glass before working on the next vessel. Return the vessels into the heated digestion block. Reflux for additional 15 minutes. Subsequently, remove the digestion vessels from the digestion block and allow the vessels to cool down and dilute to 100 ml final volume with reagent water.

10.2.4.13. Let the digestate settle and centrifuge or filter with Whatman #41 (see 10.1.5) if necessary otherwise digestates are now ready for analysis.

10.2.5. Digestate Filtration

10.2.5.1. Place Whatman #41 filter paper into each funnel resting on holders. Rinse the filter papers with reagent water.

10.2.5.2. Place a pre-labeled digestate container under each funnel making sure that the labels are visible.

[1] Addition of 5 ml HCl is a modification from Method 3050B to enhance recovery of antimony. Refer to Appendix 3 for the comparative study done on ICP-MS.

10.2.5.3. Check the labels to make sure that they agree. Pour the digestate into the filter.

10.2.5.4. Filter and collect the digestates in the labeled container. The digestates are now ready for analysis.

10.3. **Instrument Parameters**

10.3.1. Set instrument parameters as suggested below.

10.3.2. Plasma Condition

- RF Power: 1550 W
- RF Matching: 1.68 V
- Sample Depth: 8.0 mm
- Torch Height: -0.4 mm
- Torch Vertical: 0 mm
- Carrier Gas: 0.9 L/min
- Make-up Gas: 0.2 L/min Note: Total Carrier and Make-up gas not to exceed 1.1 L/min.
- Peristaltic pump: 0.1 rps
- Spray Chamber (S/C) Temp: 2°C

10.3.3. Ion Lenses

- Extract 1: 0 V
- Extract 2 : -130V
- Omega Bias-ce: -20 V
- Omega Lens-ce: -2 V
- Cell Entrance: -30 V
- QP Focus: 3 V
- Cell Exit: -30 V

10.3.4. Octopole Parameters

- Octopole RF: 190 V
- Octopole Bias: -9 V

10.3.5. Q-Pole Parameters

- AMU Gain: 127
- AMU Offset: 125
- Axis Gain: 0.9996
- Axis Offset: 0.04
- QP Bias: -3 V

10.3.6. Detector Parameters

- Discriminator: 8 mV
- Analog HV: 1630 V
- Pulse HV: 990 V

10.3.7. Reaction Cell

- H_2 Gas: 3.0 ml/min
- He Gas: 4 ml/min

10.3.8. Adjust the instrument parameters to optimize the instrument performance in conformance to the tuning requirement.

10.3.9. Print the most current instrument parameters and place in the appropriate binder for easy reference. Replaced instrument parameter set-up should be archived chronologically for future reference and historical record.

10.4. **Calibration**

10.4.1. Instrument Set-Up

10.4.1.1. Set up the ICP-MS with proper operating parameters. Refer to Section 10.3.

10.4.1.2. Ignite the plasma and allow the instrument to become thermally stable for at least 30 minutes.

10.4.1.3. Check the peristaltic pump to deliver a steady flow.

10.4.2. Tuning the Instrument

10.4.2.1. Tune the instrument according to Normal Mode, Hydrogen Mode and Helium Mode without the internal standard. Refer to Section 10.3 for parameters. On the ICP-MS main Menu, go to Instrument and click Tune and run the tuning solution without the internal standard. After about 60 seconds (making sure the solution is in the system) click start and evaluate the counts of the isotopes according to the table below.

Mode	Range		
Normal	Li6 ≥ 6400 counts	Y89 ≥ 16000 counts	Tl205 ≥ 9600 counts
Hydrogen	Ar/Ar78 < 10	Co59 ≥ 3000 counts	
Helium	V51/Co59 < 0.6	Co59 ≥ 7000 counts	ArCl-75 < 10 counts

10.4.2.2. If non-compliant, adjust parameters (e.g. Torch height, Torch vertical, Octopole Bias and QP Bias) and repeat the tune process until the required range is met.

10.4.2.3. Click Generate report for a full scan of the tune. Save all tune values to the current method.

10.4.3. Perform a P/A Factor Evaluation

10.4.3.1. Analyze the 50 µl P/A Tuning Standard.

10.4.3.2. Under "Tune," access "P/A Factor."

10.4.3.3. Select "Load masses from acquired method" and then select calcium "Ca" from the list of elements. Select "delete" to remove Ca from the P/A Factor analysis.

10.4.3.4. Select "run."

10.4.3.5. When complete accept the changes.

10.4.3.6. Print out P/A Factor and store the printout with the tuning data.

10.4.3.7. Accept the new P/A Factors.

10.4.3.8. Under "file" select "copy tune parameters" and copy the P/A Factors to both the H2 and He modes.

10.4.3.9. Save file as "norm.u".

10.4.4. Perform Tune Check

10.4.4.1. Analyze the intermediate tune check solution (9.1.1) using 4 replicates.

10.4.4.2. Evaluate the tune check so that the mass calibration differs no more than 0.1 AMU of the true value and the resolution to be less than 0.9 AMU full width.

10.4.5. Initial Calibration (ICAL)

10.4.5.1. Analyze a calibration blank (S0) and a multi-point calibration standard (Section 9.3.3.1).

10.4.5.2. Set the instrument rinse time to 90 seconds between each standard solution.

10.4.5.3. Refer to Appendix 1 for ICAL acceptance criteria and /or corrective action.

10.4.6. Initial Calibration Verification (ICV)/ Instrument Calibration Blank (ICB)

10.4.6.1. Analyze the ICV (Section 9.5.1) from a second source to verify the concentration of the ICAL.

10.4.6.2. Analyze a low-level ICV (LLICV) from the same source as the calibration standard to verify the lower limit of quantitation (RL).

10.4.6.3. Analyze an ICB after LLICV to demonstrate absence of instrument contamination.

10.4.6.4. Refer to Appendix 1 for ICV, LLICVand ICB acceptance criteria and /or corrective action.

10.4.7. Continuing Calibration Verification (CCV)/ Continuing Calibration Blank (CB)

10.4.7.1. Analyze CCV to check the validity of the ICAL every 10 samples and at the end of the analytical sequence.

10.4.7.2. Analyze low-level CCV (LLCCV) to check the system stability at low end of ICAL at the end of the analytical sequence.

10.4.7.3. Analyze a CCB every after LLCCV to demonstrate the absence of instrument contamination.

10.4.7.4. Refer to Appendix 1 for CCV, LLCCV and CCB acceptance criteria and/or corrective action.

10.4.8. ICSA and ICSAB

10.4.8.1. Analyze ICSA and ICSAB at the beginning of each analytical run and every 12 hours thereafter.

10.4.9. Establishing Instrument Detection Limit (IDL)

10.4.9.1. Analyze a minimum of seven consecutive method blanks.

10.4.9.2. Repeat the process within three non-consecutive days.

10.4.9.3. Calculate the standard deviation of each run.

10.4.9.4. The average of the standard deviation of the three runs determines the IDL for each analyte.

10.4.9.5. Establish IDL at least every 3 months.

10.4.10. Verifying Linear Dynamic Range (LDR)

10.4.10.1. Verify the LDR by preparing a standard at the upper limit of the LDR. Analyze and quantitate against the normal calibration curve. Percent recovery must be within ± 10% of expected value. If non-complaint re-establish LDR.

10.4.10.2. At a minimum perform LDR verification every six months.

10.5. **Analysis**

10.5.1. Analytical Sequence

10.5.1.1. From the main menu, go to Sequence and input the analytical sequence into the instrument using data acquisition software. Refer to Table 4.

10.5.1.2 Set QC limits on QC samples for easy verification while analytical samples are running.

10.5.1.3 Using the analytical sequence, arrange the standards and the digestates to be analyzed chronologically.

10.5.1.4 Transfer about 10 ml of its content into the autosampler tubes placing them on the autosampler rack in the same order as the analytical sequence. A dilution of x10 for soil samples is required due to the high acid content of the digestate.

10.5.1.5 Dilution Test sample is prepared at 5 times dilution. Seal the tube with Parafilm and invert the tube several times to ensure adequate mixing.

10.5.1.6 Prepare a Post Digestion Spike test sample. Using the un-spiked sample digestate (preferably the QC sample), add MS standard to maintain the same spike level as the MS sample digestate.

10.5.1.7 A 100 µg/L internal standard shall be spiked into each sample.

10.5.1.8 Set the prepared analytical samples into the auto-sampler and start the analytical run.

10.5.2. Sample Result Evaluation

10.5.2.1 Check QC parameters as soon as the data is available.

- Check the initial calibration verification (ICV, LLICV and ICB) against Appendix 1.
- Check MB, LCS against Appendix 1. Perform specified corrective action if necessary.
- Check the MS, duplicate sample, serial dilution and post digestion spike results. If matrix interference is indicated, dilute the sample and re-analyzed.
- Check intensity of internal standard on each sample.
- If any of the above checkpoints is non-compliant, perform the specified corrective action in /Appendix 1. If results indicate digestion problem, fill-up an

NCR and order re-digestion for the affected sample(s). If unresolved, consult the Supervisor for further action.

10.5.2.2 Check the sample rack to ensure that the Autosampler did not skip any sample.

10.5.2.3 Check concentration of target analytes. If the response exceeds LDR, dilute and reanalyze the sample at a concentration within the LDR.

10.5.2.4 Check other QC requirements like ICSA, ICSAB, CCV, LLCCV, CCB against Appendix 1.

10.6. **Calculations**

10.6.1. The computer software is designed to calculate the concentrations in the digestates, based on the assumption that the initial calibration is linear through the origin. Thus, for aqueous samples, the computer-produced results represent the concentration of the sample.

10.6.2. For water samples, if the initial sample taken was V_s, different from 50 mL, then calculate the concentration using the following equation:

$$C_s = C_i\left(\frac{V_e}{V_s}\right)DF \qquad \text{Eq-10.6.2}$$

where:

C_s	-	concentration in the sample, µg/L
C_i	-	concentration in the digestate, µg/L
V_s	-	volume of sample taken, mL
V_e	-	volume of digestate, mL
DF	-	dilution factor

10.6.3. For solids, use the following equation to calculate the concentration.

$$Cs = C_i\left(\frac{V_e}{W_s}\right)\left(\frac{100}{100 - \%H_2O}\right)DF \qquad \text{Eq-10.6.3}$$

Where:

C_s	–	concentration in the sample, µg/L
C_I	–	concentration in the digestate (computer generated), µg/L
W_s	–	sample amount taken, g
V_e	–	volume of digestate, mL
$\% H_2O$	–	percent moisture of the sample
DF	–	dilution factor

10.6.4. <u>Calculate the percent recovery (%R)</u>

$$\%\ Recovery = \frac{Cf - C}{Cs} * 100 \qquad \text{Eq-10.6.4}$$

where:

C_f	–	concentration found, µg/ L
C	–	concentration of sample, µg/L
C_s	–	concentration of spike, µg/L

10.6.5. Relative Percent Difference (%RPD)

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$ Eq-10.6.5

Where:

RPD = Relative Percent Difference

C_1 = Measured concentration of the first sample aliquot

C_2 = Measured concentration of the second sample aliquot

10.7. **Data Reduction**

10.7.1. Make a copy of the analytical run log and highlight the data to be reported.

10.7.2. Collate the reportable raw data separating the QC results from sample results.

10.7.3. Keep all other data generated with the analytical folder marked with "For record only" for traceability purpose.

10.8. **Report Generation**

10.8.1. Print the summary of the analytical run, perform a data transfer into a disk, and convert the instrument electronic output file into an ASCII file format.

10.8.2. Run the ICPCHK.exe program for calibration check.

10.8.3. Identify samples that need to be re-analyzed, if any, and report all samples that met the analytical requirements.

10.8.4. Generate the report using the following in-house reporting program:

Executable Files	Required Support Files	Output
WDBX[2].exe	Login File (requires network), project.pln, seq_name.sq, seq_name.ckv, seq_name.ckb, seq_name.csv, seq_name.qck, EXCLCMP.LST	Method.txt [this file integrates the login sample information and the analytical sample information]
IF1VX.exe	method.txt, method.met, method.crf, project.pln, project code.txt, qcell.txt	Sample Results (Form1)
IQCICP.exe	method.txt, method.crf, method.qc, project.pln, project code.txt, qcell.txt	QC Summary for LCS and MS (Form 3)
QCX.exe	method.txt, method.crf, method.qc, project.pln, qcell.txt	Summary for Dilution Test (Form 3)
LABCHRNX.exe	method.txt	Lab Chronicle

X[2] – latest program version

Executable Files	Required Support Files	Output
CN2.exe	Login File, method.txt, Form 1, Form 3	Case Narrative

10.7.4. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated and re-analyses.

- Sample Results
- LCS Summary
- MS Summary
- Duplicate Summary
- CCV Summary
- ICV Summary
- ICAL Summary

10.7.5. Generate the case narrative using CN2.exe.

10.7.6. Submit the analysis package for secondary review.

10.8. **Data Review**

10.8.1. Perform a 100% data review in accordance to EMAX-DM01 and the PSR.

- Review the ICPCHK.exe output file to ensure that it agrees with the instrument output. Check Project Specific Requirement (PSR) or Appendix 1 for acceptance criteria.
- Check frequency of calibration verification. Verify results to be within acceptance limits.
- Check of target analytes concentration to be within linear range.
- Verify interference check results to be within acceptance limits.

10.8.2. If any of the above checkpoints is non-compliant, re-analysis is required.

10.9. **Preventive Maintenance**

10.9.1. Instruments shall receive routine preventive maintenance that is properly recorded in the instrument-specific maintenance logs. The list of maintenance is summarized in Form 6020FM. The practice ensures optimum operating condition of the equipment thus reducing the possibility of frequent instrument malfunction.

11.0 QUALITY CONTROL

11.1. **Sample Preparation QC**

11.1.1. A preparative batch consists of 20 or fewer samples of the same matrix that are prepared for analysis simultaneously or sequentially, using the same lots of all reagents.

11.1.2. Every preparative batch shall have at least one method blank, one LCS and a set of MS/MSD unless otherwise specified by the project. These QC samples shall be digested together with the field samples.

11.1.3. All reagents shall be subjected to QC check prior to its use. Refer to EMAX-QC01 for details.

11.2. **Sample Analysis QC**

11.2.1. Perform a tune check before every analytical run, an initial calibration and initial calibration verification (ICV / LLICV). Obtain the ICV standard from a different source from that of the initial calibration and LLICV from the same source as the ICAL. Analyze an instrument calibration blank (ICB) after the LLICV. No further analysis shall be valid unless acceptance criteria are met.

11.2.2. Monitor the intensities of all internal standards for every analysis. Refer to Appendix 1 for acceptance criteria.

11.2.3. Verify inter-element and background correction factors with ICSA and ICSAB standards after ICB every 12 hours.

11.2.4. Verify calibration with continuing calibration verification (CCV) standard and continuing calibration blank (CCB) after every ten samples and at the end of the analytical run. Also verify LLCCV at the end of the analytical run.

11.2.5. Evaluate results of MS/MSD to document matrix interference.

11.2.6. Perform Post Digestion Spike whenever recoveries for MS/MSD failed.

11.2.7. Evaluate Dilution Test result if post digestion spike result failed to meet the acceptance criteria. Failure typically happens when analyte concentrations are high.

11.2.8. Refer to Appendix 1 for acceptance criteria.

11.3. **Method QC**

11.3.1. Establish a Method Detection Limit Study before the analytical procedure can be used.

11.3.2. Establish Method proficiency before the analytical procedure can be used.

11.3.3. Establish demonstration of proficiency for all analysts conducting this analysis.

11.3.4. Perform dynamic range study at least every six months or whenever there is a significant change in instrument response unless otherwise specified by the project.

12.0 CORRECTIVE ACTION

12.1. Quality control procedures and corresponding corrective actions are summarized in Appendix 1.

12.2. If tune is non-compliant, consider the following suggestions to correct the problem:

- Check the instrument settings and make sure that the instrument parameters are properly set up.
- Check argon gas flow.
- Perform auto tune or visual optimization
- If the problem persists, inform the Supervisor.

12.3. If correlation coefficient (R) of ICAL is non-compliant, consider the following suggestions to help you correct the problem:

- Check the calibration points for possible presence of out-lier. If out-lier is present, prepare a fresh standard and repeat the calibration.
- Check the connections and make sure that they are air-tight. Perform maintenance as needed.
  - Presence of bubbles is indicative of poor connection between the sipper and the nebulizer.
  - Poor precision to inability to light the plasma is a symptom of a poor drain tube connection
  - Poor precision and carry-over problems are indicative of a dirty spray chamber.
  - Relative increase in the sensitivity ratio of the higher: lower atomic number elements are indicative of stretched pump tubing. The sample flow rate decreases as the tubing stretches.
- Check the argon gas flow. Loss of signal is indicative of low or no argon gas flow.
- Poor precision and a gradual loss of signal is indicative of "salting-out" in the nebulizer and/or spray chamber due to samples with high dissolved or suspended solids. This problem will necessitate nebulizer and spray chamber cleaning.
- If the problem persists, inform the Supervisor.

12.4. If ICV is non-compliant, consider the following suggestions to help you correct the problem:

- If the RSD is high it is indicative that the carry-over might be present in the spray chamber.
- If result is bias high, prepare a fresh standards and repeat calibration.
- If the problem persists, inform the Supervisor.

12.5. If ICB/CCB is non-compliant, consider the following suggestions to correct the problem:

- Prepare a fresh calibration blank solution. Perform instrument rinsing and repeat the ICB/CCB prior to re-analysis of associated sample(s).
- Carry-over problem is indicative of dirty spray chamber, nebulizer and/or torch. Perform instrument maintenance and repeat the calibration.
- If the problem persists, inform the Supervisor.

12.6. If CCV or LLICV or LLCCV is non-compliant, consider the following suggestions to correct the problem:

- Check the connections prior to re-running the ICAL. Refer to Section 12.3.
- Prepare a new standard and repeat the ICAL.

12.7. If the intensity of the Internal Standard is non-compliant, consider the following suggestions to correct the problem:

- Check for drift occurrence by observing the internal standard intensities in the calibration blank.
- If drift has occurred, terminate the analysis, recalibrate, verify the new calibration and reanalyze the affected samples.
- If drift has not occurred, dilute affected samples five fold and reanalyze with the addition of appropriate amounts of internal standards.

12.8. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

- Rule-out instrument contamination by checking the CCBs. Refer to Section 12.5.

- Rule-out reagent contamination by testing each reagent as described in EMAX-QC01.
- Rule-out digestate vessel contamination by adding verified reagents heating the vessels prior to testing.
  - Common environmental contaminants – Ca, Si, Fe, Na, Mg, K, Tl, Cu, Mn, can be minimized by maintaining the lab clean.
- Other sources of contamination:
  - Sweat contains Ca, Mg, Pb, K, NH_4^+ , SO_4^{-2}, PO_4^{-3}, and Cd (for those who smoke).
  - Cosmetics can contain high concentrations of Al, Be, Ca, Cu, Cr, K, Fe, Mn, Ti, and Zn.
  - Some hair dyes contain $Pb(OAC)_2$.
  - Dandruff shampoo can contain significant levels of Se.
  - Eye make-up may contain Hg as a preservative.
  - Calamine lotion is almost pure ZnO.
  - Watches and jewelry contain an assortment of elements and should not be worn in the laboratory.
- Re-digest MB and the associated samples with reagents free of contamination or with newly opened reagents.
- If the problem persists, inform the Supervisor.

12.9. If LCS is non-compliant, consider the following suggestions to correct the problem:

- If result is bias-high, check the LCS standard by analyzing at the spike level.

  If the LCS check is within 80-120 % of the expected value, check the calibration of the micropipette use for spiking. Re-digest and re-analyze the LCS and the associated samples.

  If the LCS check is not within 80-120%, prepare a fresh LCS standard, re-digest and re-analyze LCS and the associated samples.
- Common Problems with Ag, As, Ba, Pb, and Cr, indicating stock standard degradation, are as follows:

  Low Silver (Ag) recovery is indicative of Chloride contamination causing AgCl precipitation

  Low Arsenic (As) recovery is indicative of loss during sample preparation as volatile oxides (AsO_3) or precipitation as $AsCl_3$

  Low Barium (Ba) recovery is indicative of SO_4or CrO_4 contamination. Barium will form precipitates with HF and H_2SO_4.

  High Lead (Pb) recovery is indicative of environmental contamination.

12.10. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.10.1. Corrective action needs the function of other department; e.g., the sample needs to be re-digested. Refer to EMAX-QA08 for details of completing an NCR.

12.10.2. Corrective action needs the assistance of the Project Manager; e.g., sample passed the holding time, insufficient amount of sample, etc.

12.10.3. Corrective action prescribed in the IQC Summary does not correct the problem.

12.11. For other problems encountered, inform the supervisor immediately for further instruction.

13.0 POLLUTION PREVENTION

13.1. Unused samples, digestates and instrument wastes are very acidic and are very corrosive. Endorse the wastes to the Waste Management Unit for proper treatment or disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process endorsed to WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

Preparation batch is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

Analytical batch is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – is defined as an instrument response per unit measure. It is an experimental value by measuring the response of an instrument per unit target analyte under the method specific condition. A determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.4. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.5. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.6. Matrix – is a physical state of a sample. Most of environmental samples are classified as water, soil or air.

15.1.7. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.8. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.9. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical procedure to monitor contamination.

15.1.10. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.11. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.12. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria specified in this SOP shall be applied to all projects when performing metals analysis. In the instance where there is a project or program specific requirement, the requirements given in the project shall take precedence over this SOP.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluating Solid Waste, Physical / Chemical Methods", EPA Publication SW-846 Update IV, Method 6020A.

16.2. Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry, Method 200.8 Rev. 5.4 EMMC Version.

16.3. USEPA SW846, Method 3050B.

16.4. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Tables**

17.1.1.	Table 1	ICP-MS Elements & Isotopes
17.1.2.	Table 2	Initial Calibration Standard Preparation Method
17.1.3.	Table 3	Calibration Standards Concentration and Reporting Limit
17.1.4.	Table 4	ICP-MS Analytical Sequence
17.1.5.	Table 5	MDL and Linear Range Concentration Levels

17.2. **Figures**

17.2.1. Figure 1 Typical Sample Report

17.2.2. Figure 2 Typical LCS/LCD Summary

17.2.3. Figure 3 Typical MS/MSD Summary

17.2.4. Figure 4 Typical Case Narrative

17.3. **Appendices**

17.3.1. Appendix 1 Summary of In-House Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.3.3. Appendix 3 Comparative Study of Modified 3050B

17.4. **Forms**

17.4.1. 6020FA Analytical Run Log

17.4.2. 6020FS Sample Preparation Log

17.4.3. 6020FM Instrument Maintenance Log

Table 1: ICP-MS ELEMENTS & ISOTOPES

ELEMENT	SYMBOL	MASS	Tune Mode	Internal Standard
Aluminum	Al	27	3	Sc45
Antimony	Sb	121	3	In115
Arsenic	As	75	2	Ge72
Barium	Ba	137	3	In115
Beryllium	Be	9	3	Li6
Boron	B	11	3	Li6
Cadmium	Cd	111	3	In115
Calcium	Ca	43	1	Sc45
Chromium	Cr	53	2	Sc45
Cobalt	Co	59	3	Sc45
Copper	Cu	63	2	Sc45
Iron	Fe	57	1	Sc45
Lead	Pb	208	3	Tb159
Lithium	Li	7	3	Li6
Magnesium	Mg	24	3	Sc45
Manganese	Mn	55	3	Sc45
Molybdenum	Mo	95	3	In115
Nickel	Ni	60	2	Sc45
Potassium	K	39	3	Sc45
Selenium	Se	82	1	Ge72
Silicon	Si	28	1	Sc45
Silver	Ag	107	3	In115
Sodium	Na	23	1	Sc45
Strontium	Sr	88	3	Y89
Thallium	Tl	205	3	Tb159
Tin	Sn	118	3	In115
Titanium	Ti	47	3	Sc45
Uranium	U	238	3	Tb159
Vanadium	V	50	2	Sc45
Zinc	Zn	66	3	Ge72

Tune Mode: 1=Reaction H_2 Mode; 2=Collision He Mode; 3= Normal Mode

Table 2 : CALIBRATION STANDARD AND VERIFICATION PREPARATION

Standard #	Mixed Standard Name	Conc. (µg/mL)	Source	Preparation		
				Aliquot (mL)	Final Vol. (mL)	Final Conc. (µg/mL)
S1	SM-2208-01	10	High Purity	0.025	50	0.005
	SM-2208-02	10		0.025		0.005
	SM-2208-03	1000		0.025		0.5
S2	SM-2208-01	10	High Purity	0.125	50	0.025
	SM-2208-02	10		0.125		0.025
	SM-2208-03	1000		0.125		2.5
S4	SM-2208-01	10	High Purity	0.250	50	0.05
	SM-2208-02	10		0.250		0.05
	SM-2208-03	1000		0.250		5
ICV	EMAX MIX 2	10	CPI	0.150	50	0.03
	EMAX MIX 3	1000		0.150		3
CCV	SM-2208-01	10	High Purity	0.125	50	0.025
	SM-2208-02	10		0.125		0.025
	SM-2208-03	1000		0.125		2.5
LLICV / LLCCV (water)	Mix 7	1/100	High Purity	0.05	50	0.001 / 0.1
	Zn	10		0.045		0.01
LLICV / LLCCV (soil)	Mix 7	1/100	High Purity	0.025	50	0.0005/ 0.05
	Zn	10		0.0025		0.001

Table 3: CALIBRATION STANDARDS CONCENTRATION AND REPORTING LIMIT

ELEMENT	ICAL (mg/L)			ICV / CCV (mg/L)	ICSA (mg/L)	ICSAB (mg/L)	LLICV,LLCCV, LOQ (Water) (µg/L)	LLICV,LLCCV, LOQ (Soil) (mg/Kg)
	S1	S2	S4					
Aluminum	0.5	2.5	5	6	100	100	100	100
Antimony	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Arsenic	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Barium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Beryllium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Boron	0.005	0.025	0.05	0.06	0	0.2	10	10
Cadmium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Calcium	0.5	2.5	5	6	100	100	100	100
Chromium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Cobalt	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Copper	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Iron	0.5	2.5	5	6	100	100	100	100
Lead	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Lithium	0.005	0.025	0.05	0.06	0	0.02	2	0.5
Magnesium	0.5	2.5	5	6	100	100	100	100
Manganese	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Molybdenum	0.005	0.025	0.05	0.06	2	2	2	0.5
Nickel	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Potassium	0.5	2.5	5	6	100	100	100	100
Selenium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Silver	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Sodium	0.5	2.5	5	6	100	100	100	100
Strontium	0.005	0.025	0.05	0.06	0	0.02	2	0.5
Thallium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Tin	0.005	0.025	0.05	0.06	0	0.02	1	20
Titanium	0.005	0.025	0.05	0.06	2	2	2	0.5
Uranium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Vanadium	0.005	0.025	0.05	0.06	0	0.02	1	0.5
Zinc	0.005	0.025	0.05	0.06	0	0.02	20	2

Table 4: ICP-MS ALYTICAL SEQUENCE

RUN ID LABEL	SAMPLE DESCRIPTION	SOLUTION ID LABEL
S0	Calibration Standard 1 (blank)	S0
S3, S4, S5	ICAL Standards	S3, S4, S5
ICV	Initial Calibration Verification	ICV
LLICV	Low Level Initial Calibration Verification	LLICV
ICB	Initial Calibration Blank	ICB
ICSA	Initial Interference Solution A	ICSA
ICSAB	Initial Interference Solution A and B	ICSAB
CCV1	Continuing Calibration Verification #1	CCV
CCB1	Continuing Calibration Blank #1	S0
IMSSSSB[3]	Preparation Blank	
IMSSSSL/C	Lab Control Sample	
Sample 1	Sample 1	
Sample 1M	Sample 1 Matrix Spike	
Sample 1S	Sample 1 Matrix Spike Duplicate	
Sample 1J	Sample 1 Serial Dilution(5x dilution sample 1)	
Sample 1A	Sample 1 Post Digestion spike	
Samples 2 to 4	Sample 2 to Sample 5	
CCV2	Continuing Calibration Verification #2	CCV
CCB2	Continuing Calibration Blank #2	S0
Samples 5 to 14	Maximum of 10 Samples	
CCV3	Continuing Calibration Verification #3	CCV
CCB3	Continuing Calibration Blank #3	S0
Samples 15 to 20	Sample 15 to 20 or a maximum of 10 samples (sample 15 to 24)	
ICSA	Initial Interference Solution A	ICSA
ICSAB	Initial Interference Solution B	ICSAB
CCV4	Continuing Calibration Verification #4	CCV
LLCCV	Low Level Continuing Calibration Verification	LLCCV
CCB4	Continuing Calibration Blank #4	S0

[3] where IMSSSS is the digestion batch reference.

Table 5: DL, LOD, LOQ AND LINEAR RANGE CONCENTRATION LEVELS

ELEMENT	WATER (mg/L)			SOIL (mg/kg)			LINEAR RANGE µg/L
	DL	LOQ	LOD	DL	LOQ	LOD	
Aluminum	10	100	20	5	100	10	125000
Antimony	0.25	1	0.5	0.1	0.5	0.2	3000
Arsenic	0.1	1	0.2	0.05	0.5	0.1	3000
Barium	0.25	1	0.5	0.072	0.5	0.1	3000
Beryllium	0.05	1	0.1	0.05	0.5	0.1	500
Boron	2.5	10	5	2.5	10	5	250
Cadmium	0.1	1	0.2	0.057	0.5	0.1	3000
Calcium	13	100	25	17	100	20	400000
Chromium	0.1	1	0.2	0.05	0.5	0.1	3000
Cobalt	0.1	1	0.2	0.05	0.5	0.1	3000
Copper	0.25	1	0.5	0.1	0.5	0.2	3000
Iron	5	100	10	5	100	10	300000
Lead	0.05	1	0.1	0.05	0.5	0.1	3000
Lithium	0.25	2	0.5	0.139	0.5	0.2	500
Magnesium	5	100	10	10	100	20	150000
Manganese	0.1	1	0.2	0.153	0.5	0.2	3000
Molybdenum	0.25	2	0.5	0.1	0.5	0.2	3000
Nickel	0.1	1	0.2	0.063	0.5	0.1	3000
Potassium	10	100	20	10	100	20	400000
Selenium	0.15	1	0.3	0.05	0.5	0.1	3000
Silver	0.1	1	0.2	0.05	0.5	0.1	250
Sodium	25	100	50	10	100	20	300000
Strontium	0.5	2	1	0.05	0.5	0.1	3000
Thallium	0.1	1	0.2	0.05	0.5	0.1	3000
Tin	0.1	1	0.2	5	20	10	3000
Titanium	0.25	2	0.5	0.125	0.5	0.25	3000
Uranium	0.05	1	0.1	0.05	0.5	0.1	3000
Vanadium	0.25	1	0.5	0.19	0.5	0.3	3000
Zinc	5	20	10	0.683	2	1	3000

Figure 1: **TYPICAL SAMPLE REPORT**

METHOD 6020A
METALS BY ICP-MS

Client	: XYZ, INC.	Date Collected:	11/17/10
Project	: CLEAN PROJECT	Date Received:	11/19/10
SDG NO.	: 10K283	Date Extracted:	11/30/10 17:15
Sample ID:	YWB10-2578	Date Analyzed:	12/03/10 18:05
Lab Samp ID:	K283-10	Dilution Factor:	0.991
Lab File ID:	98L04043	Matrix :	SOIL
Ext Btch ID:	IMK029S	% Moisture :	11.6
Calib. Ref.:	98L04035	Instrument ID :	EMAXTI98

PARAMETERS	RESULTS (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
Aluminum	18000	112	22.4
Antimony	ND	0.561	0.112
Arsenic	2.03	0.561	0.112
Barium	51.9	0.561	0.112
Beryllium	0.344J	0.561	0.112
Cadmium	ND	0.336	0.112
Calcium	618	112	22.4
Chromium	5.01	0.561	0.112
Cobalt	3.29	0.561	0.112
Copper	3.12	0.561	0.224
Iron	13300	112	22.4
Lead	4.34	0.561	0.112
Magnesium	2750	112	22.4
Manganese	227	0.561	0.112
Molybdenum	1.24	0.561	0.112
Nickel	3.33	0.561	0.112
Potassium	2050	112	22.4
Selenium	0.188J	0.561	0.112
Silver	ND	0.561	0.112
Sodium	ND	112	22.4
Thallium	0.236J	0.561	0.112
Vanadium	30.0	0.561	0.112
Zinc	28.9	1.12	0.561

Figure 2: **TYPICAL LCS/LCD SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
SDG NO.: 10K283
METHOD: METHOD 6020A

MATRIX:	SOIL			% MOISTURE:	NA
DILTN FACTR:	1	1	1		
SAMPLE ID:	MBLK1S				
CONTROL NO.:	IMK029SB	IMK029SL	IMK029SC		
LAB FILE ID:	98L04037	98L04038	98L04039		
DATIME EXTRCTD:	11/30/1017:15	11/30/1017:15	11/30/1017:15	DATE COLLECTED:	NA
DATIME ANALYZD:	12/03/1017:41	12/03/1017:45	12/03/1017:49	DATE RECEIVED:	11/30/10
PREP. BATCH:	IMK029S	IMK029S	IMK029S		
CALIB. REF:	98L04035	98L04035	98L04035		

ACCESSION:

PARAMETER	BLNK RSLT mg/kg	SPIKE AMT mg/kg	BS RSLT mg/kg	BS % REC	SPIKE AMT mg/kg	BSD RSLT mg/kg	BSD % REC	RPD %	QC LIMIT %	MAX RPD %
Aluminum	ND	2500	2370	95	2500	2400	96	1	80-120	20
Antimony	ND	25.0	23.7	95	25.0	23.8	95	1	80-120	20
Arsenic	ND	25.0	23.8	95	25.0	23.5	94	1	80-120	20
Barium	ND	25.0	24.2	97	25.0	24.6	98	2	80-120	20
Beryllium	ND	25.0	23.8	95	25.0	23.9	96	1	80-120	20
Cadmium	ND	25.0	23.5	94	25.0	23.8	95	1	80-120	20
Calcium	ND	2500	2490	99	2500	2490	99	0	80-120	20
Chromium	ND	25.0	24.4	98	25.0	24.7	99	1	80-120	20
Cobalt	ND	25.0	23.8	95	25.0	24.1	96	1	80-120	20
Copper	ND	25.0	24.2	97	25.0	24.4	98	1	80-120	20
Iron	ND	2500	2440	98	2500	2450	98	0	80-120	20
Lead	ND	25.0	24.5	98	25.0	24.4	97	0	80-120	20
Magnesium	ND	2500	2370	95	2500	2390	95	1	80-120	20
Manganese	ND	25.0	23.8	95	25.0	24.0	96	1	80-120	20
Molybdenum	ND	25.0	24.2	97	25.0	24.2	97	0	80-120	20
Nickel	ND	25.0	24.3	97	25.0	24.6	98	1	80-120	20
Potassium	ND	2500	2440	98	2500	2450	98	0	80-120	20
Selenium	ND	25.0	23.8	95	25.0	23.9	95	0	80-120	20
Silver	ND	25.0	23.6	94	25.0	23.9	96	1	80-120	20
Sodium	ND	2500	2460	98	2500	2440	98	1	80-120	20
Thallium	ND	25.0	23.8	95	25.0	24.0	96	1	80-120	20
Vanadium	ND	25.0	24.3	97	25.0	24.5	98	1	80-120	20
Zinc	ND	25.0	25.0	100	25.0	24.7	99	1	80-120	20

Figure 3: **TYPICAL MS/MSD SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
SDG NO.: 10K283
METHOD: METHOD 6020A

MATRIX:	SOIL			% MOISTURE:	11.6
DILTN FACTR:	0.991	0.992	0.992		
SAMPLE ID:	YWB10-2578				
CONTROL NO.:	K283-10	K283-10M	K283-10S		
LAB FILE ID:	98L04043	98L04040	98L04041		
DATIME EXTRCTD:	11/30/1017:15	11/30/1017:15	11/30/1017:15	DATE COLLECTED:	11/17/10
DATIME ANALYZD:	12/03/1018:05	12/03/1017:53	12/03/1017:57	DATE RECEIVED:	11/19/10
PREP. BATCH:	IMK029S	IMK029S	IMK029S		
CALIB. REF:	98L04035	98L04035	98L04035		

ACCESSION:

PARAMETER	SMPL RSLT mg/kg	SPIKE AMT mg/kg	MS RSLT mg/kg	MS % REC	SPIKE AMT mg/kg	MSD RSLT mg/kg	MSD % REC	RPD %	QC LIMIT %	MAX RPD %
Aluminum	18000	2810	21900	139*	2810	23200	187*	6	80-120	20
Antimony	ND	28.1	23.5	84	28.1	24.5	87	4	80-120	20
Arsenic	2.03	28.1	26.7	88	28.1	27.9	92	5	80-120	20
Barium	51.9	28.1	84.3	116	28.1	90.1	136*	7	80-120	20
Beryllium	0.344J	28.1	26.5	93	28.1	27.0	95	2	80-120	20
Cadmium	ND	28.1	25.8	92	28.1	26.8	95	3	80-120	20
Calcium	618	2810	3330	97	2810	3360	98	1	80-120	20
Chromium	5.01	28.1	31.4	94	28.1	33.1	100	5	80-120	20
Cobalt	3.29	28.1	28.5	90	28.1	29.5	93	3	80-120	20
Copper	3.12	28.1	28.6	91	28.1	29.7	95	4	80-120	20
Iron	13300	2810	17000	131*	2810	18300	176*	7	80-120	20
Lead	4.34	28.1	30.8	94	28.1	32.6	101	6	80-120	20
Magnesium	2750	2810	5550	100	2810	5770	108	4	80-120	20
Manganese	227	28.1	274	170*	28.1	285	207*	4	80-120	20
Molybdenum	1.24	28.1	27.2	93	28.1	28.5	97	5	80-120	20
Nickel	3.33	28.1	29.3	92	28.1	30.7	98	5	80-120	20
Potassium	2050	2810	5000	105	2810	5170	111	3	80-120	20
Selenium	0.188J	28.1	24.4	86	28.1	25.1	89	3	80-120	20
Silver	ND	28.1	26.1	93	28.1	27.0	96	3	80-120	20
Sodium	ND	2810	2620	93	2810	2680	96	2	80-120	20
Thallium	0.236J	28.1	25.9	92	28.1	27.3	96	5	80-120	20
Vanadium	30.0	28.1	58.0	100	28.1	63.4	119	9	80-120	20
Zinc	28.9	28.1	57.7	103	28.1	60.5	113	5	80-120	20

Figure 4: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN PROJECT

SDG : 10K283

METHOD 6020A
METALS BY ICP-MS

A total of twelve (12) soil samples were received on 11/19/10 for Total Metals by ICP-MS analysis, Method 6020A in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Initial Calibration was established as prescribed by the method and was verified using a secondary source. Interference checks were performed and results were within required limits. Continuing calibration verifications and continuing calibration blanks were carried out at the frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for IMK029SL/C were all within QC limits.

Matrix QC Sample
Matrix QC sample was analyzed at the frequency prescribed by the project.
Percent recoveries were within project QC limits except for results qualified with [*] in K283-10M/S summary form, most likely due to matrix interference.
Check QC summaries form for details.
In addition Analytical spike and serial dilution were analyzed for matrix interference evaluation. Results were within method acceptance criteria.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURES	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
Tune Check (Mass calibration and resolution check)	Daily before ICAL.	±0.10 AMU (Mass of Isotope) <0.9 AMU full width resolution RSD of 4 replicates : ≤5%	Correct problem and repeat tune check.		
Initial Calibration (multi-point)	Daily initial calibration prior to sample analysis.	r ≥ 0.998	Correct the problem and repeat the initial calibration.		
Initial Calibration Verifications (ICV) Second Source	Daily after the initial calibration.	All analytes within ±10% of expected value RSD of Replicate integrations: < 5%	Correct the problem and repeat the initial calibration.		
Low Level Calibration Verification (LLICV / LLCCV)	LLICV: Daily after initial calibration. LLCCV: At the end of the analysis sequence	All analytes with ± 30% of expected value.	Correct the problem and repeat the initial calibration.		
Calibration Verifications (CCV)	Daily before sample analysis, after every 10 samples and at the end of the analysis sequence.	All analytes within ±10% of expected value. RSD of replicate integrations < 5%.	Repeat calibration and reanalyze all samples since last successful calibration.		
Calibration Blanks (ICB/CCB)	After every calibration verification	All target analytes < LOQ.	Correct problem then reanalyze calibration blank and previous samples.		
Interference Check Sample (ICSA/ICSAB)	Analyze at the beginning of each analytical run or once every 12 hours , whichever is more frequent.	Within ±20% of expected value	Terminate analysis, correct the problem, reanalyze ICS, and reanalyze all affected samples		
Internal Standard (IS)	ICV, LLICV, CCV, LLCCV, CCBs, MB, LCS, every sample	IS Intensities > 70% from Initial Calibration Blank IS Intensity	Correct problem then re-analyze		
Method Blank	One per preparation batch	All target analytes < ½ LOQ.	Re-digest and reanalyze method blank and all samples processed with the contaminated blank.		
Laboratory Control Sample (LCS)	One per preparation batch	% Recovery: 80% - 120%	Re-digest and reanalyze LCS and all associated samples		
Matrix Spikes (MS/MSD)	One MS/MSD every 20 project samples per matrix	% Recovery: 75% - 125% RPD ≤20%	Evaluate post spike and dilution test: • If parent sample result is "ND", evaluate post spike. • If parent sample result is high (i.e., 4x of spike concentration) and post spike failed, evaluate dilution test.		
Post Digestion Spike Addition	When MS fails.	Recovery within 80-120% of expected value	Correct the problem then reanalyze post digestion spike addition		
Dilution Test (5X)	When MS fails.	1:5 dilution must agree within ±10% of the original determination	Evaluate. Discuss in case narrative.		
Instrument Detection Limit (IDL)	Every three months		Correct the problem and repeat the IDL determination.		
Comments: Refer to PSR for flagging criteria.			Reviewed By:		
			Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: µg/L
Sample Amt(ml): 50

Instrument ID: I98
Analysis date: 1/7/2011
Analyzed by: C. Capulong

MATRIX : WATER

PARAMETER	98A04019	98A04020	98A04021	98A04022	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IMA006WL	IMA006WC	IMA006WX	IMA006WY							
Aluminum	2513	2514	2516	2513	2500	2514	101	1.41	0.06	80 - 120	PASSED
Antimony	25.1	25.1	25.2	25.0	25	25	100	0.09	0.36	80 - 120	PASSED
Arsenic	24.6	25.0	24.8	24.8	25	25	99	0.17	0.67	80 - 120	PASSED
Barium	25.7	25.6	25.7	25.4	25	26	102	0.15	0.58	80 - 120	PASSED
Beryllium	26.2	26.4	26.0	26.4	25	26	105	0.18	0.67	80 - 120	PASSED
Boron	27.3	27.8	27.2	27.7	25	28	110	0.31	1.13	80 - 120	PASSED
Cadmium	25.4	25.3	25.5	25.2	25	25	101	0.13	0.50	80 - 120	PASSED
Calcium	2578	2555	2563	2585	2500	2570	103	13.70	0.53	80 - 120	PASSED
Chromium	25.4	25.4	25.3	25.0	25	25	101	0.18	0.72	80 - 120	PASSED
Cobalt	25.4	26.0	25.6	25.6	25	26	103	0.22	0.87	80 - 120	PASSED
Copper	25.6	25.8	25.7	25.3	25	26	102	0.22	0.86	80 - 120	PASSED
Iron	2600	2583	2596	2594	2500	2593	104	7.27	0.28	80 - 120	PASSED
Lead	25.7	25.8	25.5	25.6	25	26	103	0.10	0.40	80 - 120	PASSED
Lithium	24.6	24.9	24.7	25.1	25	25	99	0.22	0.88	80 - 120	PASSED
Magnesium	2510	2516	2492	2506	2500	2506	100	10.20	0.41	80 - 120	PASSED
Manganese	25.6	25.7	25.7	25.4	25	26	102	0.15	0.59	80 - 120	PASSED
Molybdenum	25.1	25.1	25.1	24.7	25	25	100	0.19	0.74	80 - 120	PASSED
Nickel	25.3	25.6	25.4	25.0	25	25	101	0.23	0.91	80 - 120	PASSED
Potassium	2602	2593	2602	2558	2500	2589	104	20.93	0.81	80 - 120	PASSED
Selenium	25.4	25.1	25.3	25.0	25	25	101	0.16	0.62	80 - 120	PASSED
Silver	25.4	25.6	25.5	25.0	25	25	101	0.27	1.05	80 - 120	PASSED
Sodium	2507	2502	2507	2544	2500	2515	101	19.48	0.77	80 - 120	PASSED
Strontium	25.3	25.4	25.3	25.2	25	25	101	0.09	0.35	80 - 120	PASSED
Thallium	25.5	25.9	25.7	25.7	25	26	103	0.16	0.63	80 - 120	PASSED
Tin	25.1	25.2	25.5	25.3	25	25	101	0.15	0.59	80 - 120	PASSED
Titanium	25.2	25.0	25.2	24.8	25	25	100	0.17	0.66	80 - 120	PASSED
Uranium	26.1	26.1	25.9	25.9	25	26	104	0.13	0.50	80 - 120	PASSED
Vanadium	25.3	25.4	25.2	24.8	25	25	101	0.26	1.03	80 - 120	PASSED
Zinc	25.3	25.4	25.6	25.2	25	25	101	0.15	0.59	80 - 120	PASSED

Appendix 2 (Cont.): DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: mg/Kg
Sample Amt(gm): 1

Instrument ID: I98
Analysis date: 1/7/2011
Analyzed by: C. Capulong

MATRIX : SOIL

PARAMETER	98A04027	98A04028	98A04029	98A04030	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IMA007SL	IMA007SC	IMA007SX	IMA007SY							
Aluminum	2439	2397	2422	2435	2500	2423	97	18.95	0.78	80 - 120	PASSED
Antimony	21.1	20.9	20.8	20.8	25	21	84	0.13	0.61	80 - 120	PASSED
Arsenic	20.7	20.5	20.9	20.9	25	21	83	0.22	1.04	80 - 120	PASSED
Barium	21.6	21.5	21.4	21.7	25	22	86	0.12	0.54	80 - 120	PASSED
Beryllium	21.7	21.7	21.7	21.6	25	22	87	0.05	0.23	80 - 120	PASSED
Boron	23.0	23.2	23.4	23.5	25	23	93	0.23	1.00	80 - 120	PASSED
Cadmium	21.1	20.8	20.7	21.0	25	21	83	0.19	0.92	80 - 120	PASSED
Calcium	2535	2511	2502	2524	2500	2518	101	14.49	0.58	80 - 120	PASSED
Chromium	21.3	21.3	21.5	21.2	25	21	85	0.11	0.51	80 - 120	PASSED
Cobalt	21.5	21.2	21.6	21.5	25	21	86	0.20	0.95	80 - 120	PASSED
Copper	21.1	21.2	21.2	20.8	25	21	84	0.17	0.82	80 - 120	PASSED
Iron	2509	2501	2470	2525	2500	2501	100	23.10	0.92	80 - 120	PASSED
Lead	21.8	21.6	21.5	21.6	25	22	87	0.13	0.59	80 - 120	PASSED
Lithium	20.9	21.1	21.1	21.1	25	21	84	0.07	0.31	80 - 120	PASSED
Magnesium	2424	2401	2413	2427	2500	2416	97	11.81	0.49	80 - 120	PASSED
Manganese	21.5	21.5	21.6	21.5	25	22	86	0.06	0.29	80 - 120	PASSED
Molybdenum	21.4	21.2	21.3	21.4	25	21	85	0.11	0.53	80 - 120	PASSED
Nickel	20.9	20.8	21.0	20.8	25	21	83	0.08	0.36	80 - 120	PASSED
Potassium	2493	2499	2495	2483	2500	2493	100	6.81	0.27	80 - 120	PASSED
Selenium	21.1	20.8	21.3	21.1	25	21	84	0.19	0.92	80 - 120	PASSED
Silver	21.6	21.4	21.5	21.8	25	22	86	0.17	0.80	80 - 120	PASSED
Sodium	2440	2435	2390	2464	2500	2432	97	30.88	1.27	80 - 120	PASSED
Strontium	21.5	21.3	21.5	21.7	25	21	86	0.17	0.80	80 - 120	PASSED
Thallium	21.6	21.4	21.4	21.5	25	21	86	0.08	0.39	80 - 120	PASSED
Tin	24.6	24.2	24.1	24.3	25	24	97	0.24	1.00	80 - 120	PASSED
Titanium	21.6	21.4	21.5	21.5	25	22	86	0.08	0.38	80 - 120	PASSED
Uranium	22.4	22.0	22.4	22.4	25	22	89	0.21	0.96	80 - 120	PASSED
Vanadium	21.4	21.2	21.3	21.1	25	21	85	0.12	0.57	80 - 120	PASSED
Zinc	22.6	21.8	21.9	22.7	25	22	89	0.47	2.11	80 - 120	PASSED

Appendix 3: COMPARATIVE STUDY OF MODIFIED 3050B

ANALYTICAL METHOD: SW 6020A
PREPARATION BATCH: IMG031S - Modified Method 3050B
IMG032S - Reference Method 3050B
ANALYTICAL BATCH: I98H01
QC STANDARD: 09G281-02

Preparation Date: 7/27/2010
Extracted by: M. Mendoza
Analytical Run Date: 8/3/2010
Analyzed by: C. Capulong

COMPOUND	TRUE VALUES (mg/Kg)	ACCEPTANCE LIMITS (mg/Kg)	RECOVERY LIMITS (%)	REFERENCE METHOD 3050B				MODIFIED METHOD 3050B			
				Concentration (mg/Kg)		Recovery		Concentration (mg/Kg)		Recovery	
				98H01041 G281-02	98H01043 G281-02D	98H01041 G281-02	98H01043 G281-02D	98H01030 G281-02	98H01032 G281-02D	98H01030 G281-02	98H01032 G281-02D
Aluminum	7320	4940 - 16400	67 - 224	10900	10700	149%	146%	10700	10700	146%	146%
Antimony	110	11.0 - 121	10 - 110	20.0	19	18%	17%	61.4	66.6	56%	61%
Arsenic	84.2	42.8 - 92.7	51 - 110	61.2	61.7	73%	73%	63.6	65.3	76%	78%
Barium	247	186 - 318	75 - 129	255	260	103%	105%	275	273	111%	111%
Beryllium	49.0	29.0 - 53.9	59 - 110	39.7	39.6	81%	81%	42	41.7	86%	85%
Boron	130	61.8 - 149	48 - 115	104	104	80%	80%	126	126	97%	97%
Cadmium	76.5	48.7 - 84.4	64 - 110	65.3	66.7	85%	87%	69.9	69.8	91%	91%
Calcium	10200	7860 - 12900	77 - 126	9360	10700	92%	105%	10200	10300	100%	101%
Chromium	116	74.8 - 140	64 - 121	99.5	98.4	86%	85%	107	110	92%	95%
Cobalt	64.6	47.2 - 79.7	73 - 123	62.1	61.3	96%	95%	63.8	64	99%	99%
Copper	143	99.7 - 166	70 - 116	116	115	81%	80%	127	126	89%	88%
Iron	23300	11500 - 36200	49 - 155	23900	23700	103%	102%	24800	24800	106%	106%
Lead	82.0	41.9 - 90.2	51 - 110	63.3	64.9	77%	79%	67.5	67.6	82%	82%
Magnesium	7400	5300 - 9060	72 - 122	6770	6760	91%	91%	6930	7100	94%	96%
Manganese	475	428 - 724	90 - 152	546	562	115%	118%	584	571	123%	120%
Molybdenum	66.1	36.0 - 72.7	54 - 110	54.9	53.5	83%	81%	60.1	59.4	91%	90%
Nickel	144	88.8 - 158	62 - 110	112	113	78%	78%	122	122	85%	85%
Potassium	3740	2360 - 4990	63 - 133	3620	3600	97%	96%	3690	3560	99%	95%
Selenium	189	97.2 - 208	51 - 110	142	148	75%	78%	154	157	81%	83%
Silver	40.6	21.2 - 44.6	52 - 110	30.9	32.7	76%	81%	34.2	34.9	84%	86%
Sodium	200	31.4 - 324	16 - 162	292	197	146%	99%	192	200	96%	100%
Strontium	135	88.1 - 162	65 - 120	123	121	91%	90%	129	128	96%	95%
Thallium	127	73.2 - 144	58 - 113	110	114	87%	90%	117	112	92%	88%
Tin	250	39.5 - 275	16 - 110	71.2	73.2	28%	29%	84.7	85.2	34%	34%
Titanium	609	426 - 792	70 - 130	737	744	121%	122%	772	760	127%	125%
Uranium	1.12	0.784 - 1.46	70 - 130	0.93	1.1	83%	98%	1.03	1.01	92%	90%
Vanadium	61.8	55.6 - 123	90 - 199	90.2	89.7	146%	145%	92.8	93.1	150%	151%
Zinc	208	145 - 270	70 - 130	208	207	100%	100%	225	214	108%	103%

** Note: Modified 3050B procedure is specified in EMAX-3050 Rev. 4*

6020FA: ANALYSIS RUN LOG

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
ICP-MS

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Start Date:

End Date:

Comments:

Book #: A98-025

Instrument No.: 98

Analytical Batch:

Analytical Sequence:

Method File:

SOP #	Rev. #
☐ EMAX-6020	
☐ EMAX-200.8	
☐ EMAX-	

STANDARDS ID	
S0	
S1	
S2	
S3	
S4	
S5	
S6	
S7	
ICV	
CCV	
ICSA	
ICSAB	
6020 TUNE SOLN.	
200.8 TUNE SOLN.	
CRI/MRL	

Analyzed By:

Date:

6020FS: SAMPLE PREPARATION LOG

EMAX LABORATORIES, INC.

DIGESTION LOG *for* ICP-MS

Page 1

Note: For samples, relevant QCs/Standards digested, refer to attached digestion sequence.

Comments:

Book #: EIM-029

Batch:

Matrix:

SOP #	Rev. #
☐ EMAX-200.8	
☐ EMAX-6020	
☐ EMAX-	

Start	Temp °C	End	Temp °C

Standards	ID	Amount Added (ml)
LCS-1		
LCS-2		
MS		
Reagent	**Lot# / ID**	**Amount Added (ml)**
HNO_3		
HCl		
H_2O_2		
HNO3(1:1)		

Digestate Location	
Extract Location	

☐ Soil Samples: -diluted 1 ml of digestate to 10 ml reagent water (DF=10X)

☐ Reagent Water ID:

☐ HNO_3 dispenser checked @ 5.0 ml with Class A volumetric flask

☐ HCl dispenser checked @ 10.0 ml with Class A volumetric flask

☐ Thermometer ID:

Prepared By:

Standard Added By: Witnessed By:

Extract Rcvd By: Checked By:

Date endorsed to waste Disposal:

Accepted By:

6020FM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

ICP-MS MAINTENANCE LOG

Instrument No: 98 Month: Year: 201_ Book # M98-007

Date							
Argon, Hydrogen, Helium							
Instrument Discharge							
Pump Tubings							
Rinse Bottle							
Printer Paper							
Autosampler							
Cooling Water							
Peri Pump Rate (0.08-0.12 RPS)							
Nebulizer Gas (0.8-1.30 L/min)							
Makeup Gas (0.1-0.3 L/min)							
ICP-MS TUNE							
Li - 7 (≥ 6400 Counts)							
Y - 89 (≥ 16000 Counts)							
Tl - 205 (≥ 9600 Counts)							
Oxides (MO^+) ≤ 2%							
Double Charge (M^{++}) ≤ 2%							
Analyst Initials							
ICP-MS TUNE							
Problem(s) Encountered							
Corrective Action							
Return To Specs (Analyst Initials)							

Code	Problems Encountered	Code	Corrective Action

STANDARD OPERATING PROCEDURE

MERCURY IN SOLID OR SEMISOLID WASTE

SOP No.:	EMAX-7471	Revision No.	5	Effective Date:	31-Mar-10
Prepared By:	Mary Jane Mendoza			Date:	03.30.10
Approved By:	Kenette Pimentel QA Manager			Date:	03.30.10
Approved By:	Caspar Pang Laboratory Director			Date:	3/30/10

Control Number: 7471-05-

1.0 SCOPE AND APPLICATION

1.1. This procedure applies to the measurement of Mercury in domestic and industrial wastes, soils, sediments, extracts and sludge samples by Cold Vapor Absorption Technique. This SOP is an adaptation of Method 7471B.

2.0 SUMMARY OF METHOD

2.1. A representative amount of sample is digested in nitric and hydrochloric acids, followed by oxidation with potassium permanganate.

2.2. Organic mercurial are broken down and converted into mercuric ions in order to respond to the cold vapor atomic absorption technique. Addition of permanganate ensures that organo-mercury compounds are oxidized.

2.3. Absorption of radiation by mercury vapor at 253.7 nm is then measured in the digested samples.

2.4. **Interferences**

2.4.1. Sulfides (as sodium sulfide), copper and chloride at high concentrations are known to interfere with the recovery of mercury. Samples containing such interference may require additional permanganate (about 12.5 mL).

2.4.2. Care must be taken to ensure that free chlorine is absent before the mercury is swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent. In addition, the dead air space in the digestion vessel must be purged before adding stannous sulfate.

2.4.3. Certain volatile organic materials that absorb at this wavelength may also cause interference. A preliminary run without reagents should determine if this type of interference is present.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL)**

3.1.1. Refer to EMAX-QA04 for detection limit generation, evaluation and verification.

3.2. **Limit of Quantitation (LOQ)**

3.2.1. LOQ is equal to the concentration of the lowest calibration point, unless otherwise specified by the project.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable range requiring no dilution is equal to the concentration of the highest calibration point (See Section 9.6). All samples analyzed above this range shall be considered "over-range" and shall require dilution to properly quantitate.

4.2. The lowest quantifiable range of diluted samples is equal to the concentration of the lowest calibration point. All diluted samples analyzed below this range shall be considered "under-range" and shall require lower dilution factor to properly quantitate.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. Check that samples received are contained in HDPE pre-cleaned containers preserved with HNO_3 and cooled at $\leq 6^{o}C$ without freezing.

5.2. Digest all samples within 28 days from date of collection.

6.0 ASSOCIATED SOPs

6.1.	EMAX-QA04	Detection Limit Study
6.2.	EMAX-QA08	Corrective Action
6.3.	EMAX-QC01	Quality Control of Chemicals
6.4.	EMAX-QC02	Analytical Standard Preparation
6.5.	EMAX-QC07	Glassware Cleaning

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves, at all times when performing this procedure. Perform preparation and analysis of mercury in a fume hood equipped with an exhaust fan or blower.

7.3. Place all wastes generated during analytical process in satellite waste containers. Endorse these wastes to waste disposal section for proper disposal.

7.4. If for any reason, sample and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritation persists inform your supervisor immediately so that proper action can be taken.

7.5. Do not look directly at the Mercury Lamp while lit. The radiation may cause damage to your eyes.

7.6. Perform all reagent additions under a fume hood.

7.7. Mercury analyzers are to be used by trained personnel only.

8.0 INSTRUMENTS, CHEMICALS, AND REAGENTS

8.1. **Instruments and Supplies**

8.1.1. Mercury Analyzers

8.1.1.1. Leeman PS-200 Automated Mercury Analyzer with Autosampler, Computer, Printer and PS 200 Software.

8.1.1.2. Leeman Hydra AA Automated Analyzer with Autosampler, Computer, Printer and PS200 Software.

8.1.2. 100 ml Digestion vessel

8.1.3. Digestate containers

8.1.4. Digestion block or equivalent.

8.1.5. Magnetic stirrer

8.1.6. Micropipettes and tips

8.1.7. Thermometer

8.2. **Chemicals and Reagents**

8.2.1. Hydrochloric acid, concentrated. Reagent grade.

8.2.2. Nitric acid, concentrated. Reagent grade.

8.2.3. Stannous chloride: Dissolve 200 g. of $SnCl_2$ in reagent water, add 200-ml concentrated HCl and dilute to 2-liter.

8.2.4. Hydroxylamine hydrochloride, 12% solution: Dissolve 120 g of hydroxylamine hydrochloride in 1 liter reagent water.

8.2.5. Potassium permanganate, 5% solution. Dissolve 50 g of potassium permanganate in 1 liter reagent water.

8.2.6. Reagent water – mercury-free water

9.0 STANDARDS

9.1. Refer to EMAX-QC02 for proper standard preparation procedure.

9.2. Other concentration levels may be prepared to meet the data quality objective of a project.

9.3. **Stock Standard**

9.3.1. Purchase stock standards as certified solutions from two different vendors. Use one as primary standard and the other as secondary standard.

9.3.2. Transfer standards on a properly labeled inert vial with minimal headspace and store at -10°C to -20°C.

9.3.3. Prepare calibration standards from the primary standard.

9.3.4. Prepare initial calibration verification standards and spiking standards from the secondary standard.

Stock Std	Name	Source	CAT #	CONC	NOTES
Primary / CCV	Mercury	Leeman	602-00064	100 mg/L	Or equivalent
ICV/LCS/MS	Mercury	ERA	027	1000 mg/L	Or equivalent

9.4. **Intermediate Standard Solution**

9.4.1. From 100 mg/L stock solution take a 2 ml aliquot and dilute to 200 ml using reagent water. The solution shall have a final concentration of 1.0 mg/L.

9.4.2. Prepare secondary dilution from 1000 mg/L stock solution, take a 1 ml aliquot and dilute to 100 ml using reagent water. This solution shall have a final concentration of 10 mg/L.

9.5. **Working Standard**

9.5.1. From the secondary dilution of intermediate standard, prepare the working standard solution to have a final concentration of 100 µg/L.

9.6. **Initial Calibration Standards**

9.6.1. From the working solution, prepare the following *Leeman* standards.

Level	Aliquot(ml)	Final DigestionVolume(ml)	Concentration (µg/L)
S1	0	100	0
S2	0.2	100	0.2
S3	1.0	100	1.0
S4	2.0	100	2.0
S5	5.0	100	5.0
S6	10.0	100	10.0
CCV	5.0	100	5.0

9.7. **ICV/ LCS/MS**

9.7.1. From the working standard, prepare ICV/CCV/LCS/MS solutions using *ERA* Standards.

Name	Aliquot(ml)	Final Digestion Volume(ml)	Concentration (µg/L)
ICV	2.0	100	2.0
LCS/MS	5.0	100	5.0

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Weigh a representative 0.6 g portion of wet sample into digestion vessels.

10.1.2. Add spike standards to the LCS/MS. Add appropriate standards for Initial Calibration, ICV and CCVs in clean digestion vessels. (Refer to Section 9.6.1 and 9.7.1 for spike amounts).

10.1.3. Add 5 mL of reagent water and 5 mL of aqua regia with mixing after each addition.

10.1.4. Heat for 2 minutes at 95°C ± 3°C in the digestion block, cool and add 50 mL of reagent water.

10.1.5. Add 15 mL of 5% $KMnO_4$ solution to each bottle.

10.1.6. Swirl each vessel to mix and let it stand for 15 mins. Check each vessel if purple color persists. If not, add permanganate solution at 2.5 mL increments swirling the digestion vessel at every addition until purple color persists.

Add the maximum amount of permanganate solution added to a solution, to the method blank, LCS, calibration standards and calibration verification standards.

10.1.7. Place samples on the digestion block for 30 minutes at 95°C ± 3°C.

10.1.8. Allow the samples to cool.

10.1.9. Add 6 mL hydroxylamine hydrochloride solution and dilute to 100 mL using reagent water.

10.2. **Instrument Parameters**

10.2.1. PROTOCOL

10.2.1.1. Set values as follows.

Instrument ID:	PS200	HYDRA AA
Number of Integration	1	
Uptake time	20 sec.	18 sec.
Weight	N	N
Dilution	N	N
On/Off, times, gains		
On	Y	Y
Time	10	10
Gas	0.35 LPM	0.15 LPM
Pump Rate	5 mL/min	7 mL/min
AUTOSAMPLER – Setup		
Station 1 (rack1)	From cup 1 to cup 44	From cup 1 to cup 44
Station 2 (rack 2)	From cup 1 to cup 44	From cup 1 to cup 44
Rinse time	60 sec.	60 sec.

CALIBRATION S1, S2, S3, S4, S5, S6	Concentration, µg/L 0 0,.20, 1.0, 2.0, 5.0, 10.0	Concentration, µg/L 0 0,.20, 1.0, 2.0, 5.0, 10.0

10.2.2. DATA OUTPUT – Specify Report

Data Output	Real Time	Post Run
Samples	Y	Y

Standards	Y	Y
Updates	Y	Y
Peaks	N	N
IEC Stds.	N	N
Check Stds.	Y	Y
Dups and % Diff.	Y	Y
Wavelength	N	N
Rel. Absorbances	N	N
% RSD	Y	Y
Scans to PRN		N
Detail		Y
Summary		N
Post Run Copies		1
Post Run Report Order [1-sorted; 2- sequential]	2	

10.3. **Calibration**

10.3.1. **Initial Calibration (ICAL)**

10.3.1.1. Prepare initial calibration solution as described in Section 9.6.1.

10.3.1.2. Perform the same procedure used for analytical samples as described in Section 10.1.

10.3.1.3. Analyze as described in Section 10.4.

10.3.1.4. Refer to Section 10.6 for calculations.

10.3.1.5. Initiate initial calibration as described in the instrument operations manual and acquire the calibration data for review after calibration is completed.

10.3.1.6. Refer to Appendix 1 for Quality Control acceptance criteria.

10.3.1.7. Verify the initial calibration by a secondary source standard.

10.3.2. **Initial Calibration Verification (ICV)**

10.3.2.1. Prepare ICV as described in Section 9.7.

10.3.2.2. Perform the same procedure used for analytical samples as described in Section 10.1.

10.3.2.3. Analyze the ICV sample to verify the concentration of the ICAL.

10.3.2.4. Refer to Appendix 1 for Quality Control acceptance criteria.

10.3.3. **Continuing Calibration Verification (CCV)**

10.3.3.1. Prepare CCV as described in Section 9.6.

10.3.3.2. Perform the same procedure used for analytical samples as described in Section 10.1.

10.3.3.3. Analyze the CCV sample to verify the concentration of the ICAL.

10.3.3.4. Refer to Appendix 1 for Quality Control acceptance criteria.

10.4. **Analysis**

10.4.1. Calibration and Analytical Sequence

10.4.1.1. Refer to the instrument operations manual for proper calibration and analytical sequence setup (autosampler setup).

10.4.1.2. Analytical batch ID naming convention: MIIMSSS

where:

M – is for Mercury and is always the first character

II – is the instrument number

M – is the month code (A for January, B for February, and so on)

SSS – is a sequential number (resets to 001 for the first folder created each month)

10.4.1.3. Typical Calibration Sequence

- S1 – 0.00000
- S2 – 0.20000
- S3 – 1.00000
- S4 – 2.00000
- S5 – 5.00000
- S6 – 10.0000

10.4.1.4. Typical Analytical Sequence

- ICV
- ICB
- CCV1
- CCB1
- Method Blank
- LCS
- QC Sample
- Post Analytical Spike
- Serial Dilution
- Matrix Spike
- Maximum of 4 samples
- CCV2
- CCB2
- Maximum of 10 samples

- CCV3
- CCB3

10.4.2. Prepare a Dilution Test sample at 5 times dilution. Pipette 2 mL of sample, add 10-mL of S_0 into a sample tube. Seal the tube with parafilm and invert the tube several times to ensure adequate mixing.

10.4.3. Prepare a Post Digestion Spike test sample. Using the un-spiked sample digestate (preferably the QC sample), add MS standard to maintain the same spike level as the MS sample digestate.

10.4.4. Check QC criteria as soon as the data is available.

10.4.4.1. Check the LCS recoveries against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 for QC limits.

10.4.4.2. Check the matrix spike recovery against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 for QC limits.

10.4.4.3. Check that sample result concentrations are within the calibration range.

10.4.5. **Dealing with Carryover**

10.4.5.1. Check the sample analyzed preceded by another sample found to have target analyte concentrations exceeding the calibration range.

10.4.5.2. If no target analyte is detected as found in preceding high concentration sample, proceed with data reduction.

10.4.5.3. If there is any target analyte detected as found in preceding high concentration sample, re-analyze the sample to rule-out carryover. If carryover is confirmed, proceed with data reduction and report the data from re-analysis.

10.4.6. **Method of Standard Addition (MSA)**

10.4.6.1. Perform MSA for all EP extracts, samples for de-listing petition, whenever a new matrix is encountered and/or as indicated above.

10.4.6.2. Prepare three sample solutions (Ms1, Ms2, Ms3) to objectively produce equal increments of concentration in the final solution without diluting the sample more than 50% of its original volume and expected concentrations falls within the linear range.

Example: Sample concentration is tentatively determined at 2 µg/L.

Ms1 – take 10-ml of digestate and add 0.2-ml of 100-µg/L spike standard (≈ 6-µg/L)

Ms2 – take 10-ml of digestate and add 0.4-ml of 100-µg/L spike standard (≈ 7-µg/L)

Ms 3 – take 10-ml of digestate and add 0.6-ml of 100-µg/L spike standard (≈ 8-µg/L)

10.4.6.3. Analyze Ms1, Ms2 and Ms3 and calculate the results using Eq-10.6.7.

10.4.6.4. Download the electronic data to the network.

10.4.6.5. Complete the analytical log and make a copy. Highlight the data to be reported and draft the case narrative.

10.4.6.6. Submit the analytical folder to data processing.

10.5. **Data Reduction**

10.5.1. Check that the analytical data generated which indicates positive results are quantitatively correct.

10.5.2. Check that analytical results are generated by the prescribed calibration schedule of method.

10.5.3. Check for possible carry-over. Reanalyze samples having trace level concentration preceded by a sample having a concentration over the calibration range.

10.5.4. Check the MS/MSD, serial dilution and the post digestion spike results. If a matrix interference is indicated, check the PSR if MSA is waived. Otherwise, refer to Section 10.4.6.

10.6. **Calculations**

10.6.1. **Calibration Factor**

$$CF = \frac{R_a}{C_a} \qquad \textit{Eq. 10.6.1}$$

where:

CF	=	*Calibration factor*
R_a	=	*Response for analyte measured in absorbance*
C_a	=	*Known concentration of analyte measured in µg/L*

10.6.2. **Average Calibration Factor**

$$ACF = \frac{\sum CF}{n} \qquad \textit{Eq. 10.6.2}$$

where:

ACF	=	*Average calibration factor*
ΣCF	=	*Sum of calibration factors*
N	=	*number of calibration factors*

10.6.3. **Correlation Coefficient**

$$r(x,y) = \frac{\frac{1}{N}\sum_{i-1}^{N}(x_1 - \bar{x})(y_1 - \bar{y})}{(SD_x)(SD_y)} \qquad \textit{Eq. 10.6.3}$$

where:

$r(x,y)$	=	*Correlation coefficient*
N	=	*number of measurements*
x_i	=	*found value of the ith measurement*
$\bar{x}$	=	*mean of found values*
y_i	=	*true value of the ith measurement*
$\bar{y}$	=	*mean of true values*
SD_x	=	*standard deviation of the found values*
SD_y	=	*standard deviation of the true values*

10.6.4. **Sample Result**

$$C = (R_s)(CF)(DF)\frac{V_e}{S_a}$$ *Eq. 10.6.4*

where:

C	=	*Sample concentration in µg/L or µg/Kg*
CF	=	*Calibration factor*
DF	=	*Dilution factor*
R_s	=	*Sample absorbance*
V_e	=	*Extract volume in L*
S_a	=	*Sample amount in mL or g*

10.6.5. **Accuracy**

$$\%R = \frac{C_r - C}{C_s} x100\%$$ *Eq. 10.6.5*

where:

$\%R$	=	*Percent recovery*
C_r	=	*Recovered concentration*
C	=	*Sample concentration*
C_s	=	*Known spike concentration*

10.6.6. **Precision**

$$\%RPD = \frac{|C1 - C2|}{\left(\frac{C1 + C2}{2}\right)} x100\%$$ *Eq. 10.6.6*

where:

$\%RPD$	=	*Relative Percent Difference*
C_1	=	*Measured concentration of first sample aliquot*
C_2	=	*Measured concentration of second sample aliquot*

10.6.7. **Calculation for MSA**

$$C_x = \frac{(S_2)(V_s)(C_s)}{(S_2 - S_1)V_x}$$ *Eq. 10.6.7*

where:

C_x	=	*Concentration of the sample*
C_s	=	*Concentration of the spike*
S_1	=	*Analytical signal of MS1*
S_2	=	*Analytical signal of MS2*
V_x	=	*Volume of sample aliquot*
V_s	=	*Volume of spike or reagent water*

10.7. **Report Generation**

10.7.1. Generate the report using the following in-house reporting program:

Executable Files	Required Support Files	Output
WDBX[1].exe	Login File (requires network) Seq_name.sq; Gcints.txt	Method.txt [this file integrates the login sample information and the analytical sample information]
MSRBX.exe	Method.txt; Method.met; Method.crf; Project.pln; Qcell.txt	Sample Results (Form1)
IQCVXC.exe	Method.txt; Method.crf; Method.qc; Project.pln;Qcell.txt	QC Summary for LCS, MS, Post Digestion Spike
CQX.exe	Method.txt; Method.crf; Method.qc; Project.pln;Qcell.txt	Summary for Dilution Test, Sample Duplicate
LABCHRNX.exe	Method.txt	Lab Chronicle
CN2.exe		Case Narrative

10.8. **Data Review**

10.8.1. Check the data entry against the analytical log.

10.8.2. Check the Method Blank against the LOQ.

10.8.3. Check LCS, MS/MSD and dilution test against QC limits.

10.8.4. Evaluate the analytical spike test if dilution test failed.

10.8.5. Check for possible carry-over and if so, check if confirmation is performed.

10.8.6. Check that the case narrative accurately describes what transpired in the analytical process.

10.8.7. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Daily routine maintenance shall be observed religiously. Observe manufacturer's notes regarding Dos and DONTs:

- System preparation is a ***MUST*** before instrument startup.
- Make certain that drying tube has been packed loosely. If drying tube is blocked, liquid may backflow into the optical cell. This will require disassembly and cleaning.

[1] X – latest program version

- Do not shutdown the instrument when operational. Abort the run first if interruption is needed.

10.9.2. Daily routine maintenance, troubleshooting and major repairs shall be recorded in the maintenance log.

10.9.3. Maintain the instrument clean at all times.

10.9.4. For troubleshooting, consult the Operations Manual, Section 4.

11.0 QUALITY CONTROL

11.1. Sample Preparation QC

11.1.1. A preparative batch consists of 20 or fewer samples of the same matrix, that are prepared for analysis simultaneously or sequentially, using the same lot of reagents.

11.1.2. Every preparative batch shall have at least one method blank, one LCS and a set of MS/MSD unless otherwise specified by the project. These QC samples shall be digested together with the field samples.

11.1.3. All reagents shall be subjected to QC check prior to use. Refer to EMAX-QC01.

11.2. Sample Analysis QC

11.2.1. Every analytical run shall be preceded by an initial calibration and an initial calibration verification. The ICV standard should be obtained from a different source from that of the initial calibration. Analyze an instrument calibration blank (ICB) after the ICV. No further analysis shall be valid unless acceptance criteria are met.

11.2.2. Verify calibration with continuing calibration verification (CCV) standard and continuing calibration blank (CCB) after every ten samples and at the end of the analytical run.

11.2.2.1. Dilution Test shall be performed whenever a new or unusual sample matrix is encountered.

11.2.2.2. Evaluate Post Digestion Spike result if the dilution test failed to meet the acceptance criteria.

11.2.3. Use Method of Standard Addition (MSA) technique for analysis of all EP extracts and whenever a new sample matrix is being analyzed.

11.2.4. Refer to Appendix 1 for acceptance criteria.

11.3. Method QC

11.3.1. Detection Limit must be established before the analytical procedure can be used and a quarterly verification must be performed.

11.3.2. Method proficiency must be established before the analytical procedure can be used.

11.3.3. All analysts conducting this analysis must have established demonstration of capability

11.3.4. Perform Instrument Detection Limit quarterly unless otherwise specified by the project.

12.0 CORRECTIVE ACTION

12.1. Calibration

12.1.1. If initial calibration is non-compliant, consider the following suggestions to correct the problem:

- Replace the sample tubing, prepare fresh rinsate and re-prepare fresh $SnCl_2$. Rinse the system for at least 15 minutes prior to calibration.
- If problem persists, run the latest passing calibration standard to check for possible instrumentation problem. If it passes, this is an indication that no instrumentation problem exists. Re-digest the calibration standards. If it fails, clean the lamp prior to re-calibration.
- If problem persists, inform the supervisor for further action

12.1.2. If the ICV is non-compliant, consider the following suggestions to correct the problem:

- Run the latest passing ICV standard to check for possible standards preparation error. If it passes, this is an indication of standards preparation error. Re-digest the ICV and re-analyze. If it fails, refer to 12.1.1 prior to re-calibration.

12.1.3. If the CCV is non-compliant, consider the following suggestions to correct the problem:

- Run the latest passing CCV standard to check for possible standards preparation error. If it passes, this is an indication of standards preparation error. Re-digest the CCV and re-analyze. If it fails, refer to 12.1.1 prior to re-calibration.

12.2. **Sample Prep QCs**

12.2.1. It method blank is non-compliant, consider the following suggestions to correct the problem:

- Check the sample results. If sample results are non-detected, you may report the result upon concurring with the PM. Otherwise, perform the corrective action as specified in the PSR.

12.2.2. If LCS is non-compliant, consider the following suggestions to correct the problem:

- Check for errors in calculation and concentration of the analyte solution.
- Check instrument performance to determine if it is within acceptable guidelines.
- Recalculate the data and/or reanalyze the extract if any of the above checks reveals a problem.
- If re-analysis results are the same as the initial result, consult the Supervisor for further action. If results indicate digestion problem, fill-up an NCR and order re-digestion to include the associated sample(s).

12.2.3. If MS is non-compliant, consider the following suggestions to correct the problem:

- If recovery failed to meet the acceptance criteria, and sample result is > 5X the RL, and the spike amount is >4X of the parent sample concentration, evaluate the serial dilution sample result. Refer to Appendix 1 for acceptance criteria. If it fails to meet the acceptance criteria, perform MSA.
- If recovery failed to meet the acceptance criteria, and sample result is $\leq$ 5X the RL, and the spike amount is >4X the parent sample concentration, evaluate the post digestion spike sample result. Refer to Appendix 1 for acceptance criteria. If it fails to meet the acceptance criteria, perform MSA.

13.0 POLLUTION PREVENTION

13.1. Mercury is a very volatile element, dangerous levels are readily attained in air. Mercury vapor should not exceed 0.1 mg/m^{-3} in air. Air saturated with the vapor at 20°C contains mercury in a concentration far greater than that limit. The danger increases at higher temperatures. It is, therefore, important that mercury be handled with care. Containers of mercury should be securely covered and spillage should be

avoided. Mercury should only be handled under the hood in a well-ventilated area. Prepare all standards in the fume hoods.

13.2. Because of the toxic nature of mercury vapor, precaution must be taken to avoid its inhalation. A by-pass must be included on the system to vent the mercury vapor into an exhaust hood.

13.3. Small amounts of mercury spillage can be cleaned up by addition of sulfur powder. The resulting mixture should be properly labeled and turned over to the waste disposal unit for proper disposal.

14.0 WASTE MANAGEMENT

14.1. Collect all generated waste and properly turn over to the waste disposal unit.

14.2. All expired standards and highly concentrated samples must be separated and properly labeled before endorsement to the waste disposal unit.

15.0 SUPPLEMENTARY NOTES

15.1. Since there is no technical difference between SW846 7471A and 7471B, this SOP may also be applicable for projects requiring method SW846 7471A.

15.2. **Definition of Terms**

15.2.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.2.2. Batch – Is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.2.2.1. Preparation batch is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.2.2.2. Analytical batch is composed of prepared samples (extracts, digestates or concentrates) which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.2.3. Calibration – Is defined as an instrument response per unit measure. It is an experimental value by measuring the response of an instrument per unit target analyte under the method specific condition. A determinant measured from a standard to obtain the correct value of an instrument output.

15.2.4. Corrective Action – Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

15.2.5. Instrument Blank – Is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.2.6. Instrument Method – Is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.2.7. Lab Control Sample (LCS) – Is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.2.8. Matrix – Is a physical state of a sample. Most of environmental samples are classified as water, soil or air.

15.2.9. Matrix Spike (MS) – Is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.2.10. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.2.11. Method Blank – Is a target-analyte-free sample subjected to the entire sample preparation and/or analytical process to monitor contamination.

15.2.12. Mercury – Also known as quicksilver, is a chemical (element) that occurs naturally in the environment in several forms. One form of mercury is used in thermometers. This form is called "metallic mercury". Mercury is also used in barometers and other common consumer products. Mercury can also be combined with other chemicals, such as chlorine, carbon or oxygen to form either "inorganic" or "organic" mercury compounds.

15.2.13. Nonconformance – An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

15.2.14. Raw Data – Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheet, record, memoranda, notes or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

15.2.15. Sample – Is a specimen received in the laboratory bearing a sample label traceable to the accompanying chain of custody. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified in the project.

15.2.16. Sample Duplicate – Is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.2.17. Sub-sample – Is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.3. **Application of EMAX QC Procedures**

15.3.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing analysis for mercury. In instances where there is a project or program QAPP, the requirements given in the project shall take precedence over this SOP.

15.4. **Department of Defense (DoD) Projects**

15.4.1. When samples from DoD sponsored projects are analyzed for mercury, the calibration, QC, corrective action, and data flagging requirements shall follow the specifics outlined in the DoD Quality Systems Manual for Environmental Laboratories, latest version. In the absence of a project QAPP or directive from the client project manager, DoD Quality Systems Manual latest version shall be applied.

15.5. **Department of Energy (DoE) Projects**

15.5.1. When samples from DoE sponsored projects are analyzed for mercury, the calibration, QC, corrective action, and data flagging requirements shall follow the quality assurance project plan

(QAPP). In the absence of QAPP, the DoE Quality Systems for Analytical Services, latest version shall be applied.

16.0 REFERENCES

16.1. Method 7471B, Rev. 2, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, USEPA SW-846, Feb. 2007.

16.2. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Figures**

Figure 1	Autosampler Layout
Figure 2	Typical Calibration Curve
Figure 3	Typical Sample Result Summary
Figure 4	Typical LCS Report Summary
Figure 5	Typical Matrix Spike Report Summary
Figure 6	Typical Dilution Test Report Summary
Figure 7	Typical Post Digestion Spike Report Summary
Figure 8	Typical Case Narrative

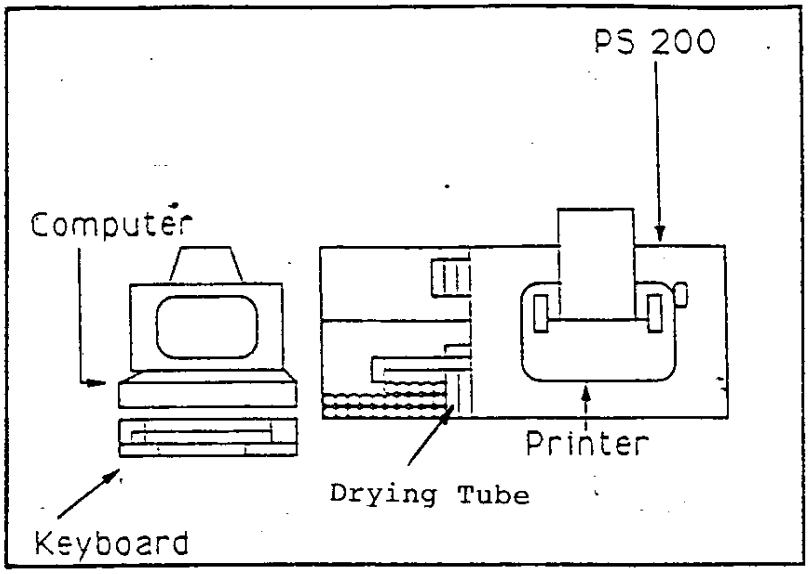
17.2. **Appendices**

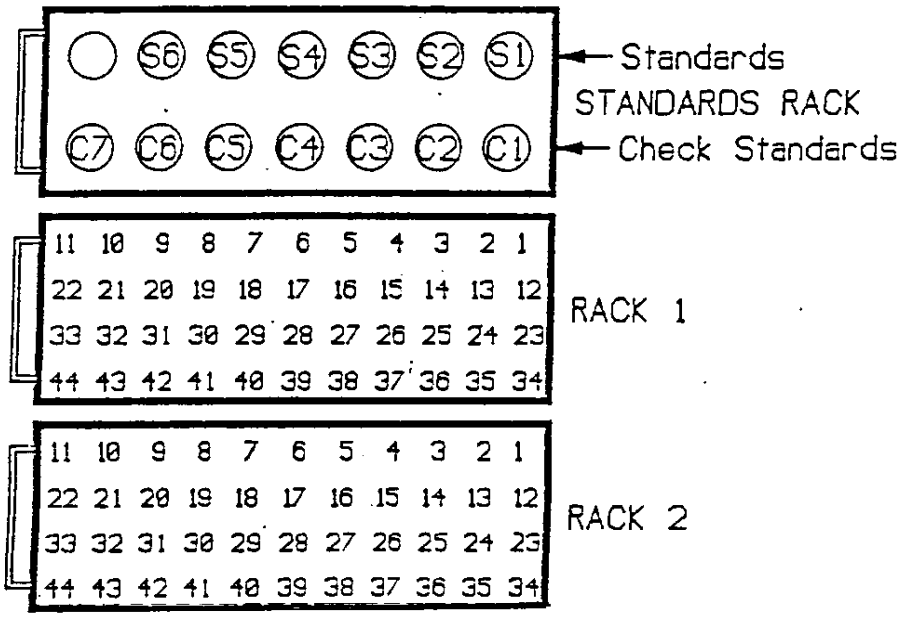
Appendix 1	Summary of Quality Control Procedures
Appendix 2	Demonstration of Capability

17.3. **Forms**

7471FS	Sample Preparation Log
7471FA	Analytical Run Log
7471FM	Instrument Maintenance Log

Figure 1. **AUTOSAMPLER LAYOUT**





Autosampler layout

Figure 2. **TYPICAL CALIBRATION CURVE**

```
RunProt: HGCOM
RunFold: M47C011  Seq: 6    Batch:
                  Prnt: R/T On                    Pump: On
                  Rev: 4.2    15:23:19 12 Mar 2010 Xmit: Off Gas:    0.35 LPM
State: Idle                                       User: NT/JC       A/S: On
CALIBRATION:  Line  proto: HGCOM
     Hg                        Accepted
    Conc.   Calc.    Dev. ->linear
S1  .000   -.032   -.032   Quadratic
S2  .200    .148   -.052   Wtdlinear
S3  1.00    .970   -.030           C
S4  2.00    2.03    .026   Accept   o
S5  5.00    5.19    .191            n
S6  10.0    9.90   -.102            c
A   .0000000      r    .999652
B   8.45241e-6    C   -6.68307e-2
      Mean                                  Relative Absorbance
S1      4115        0 SD      4115
S2     25365        0 %RSD   25365
S3    122632        0 %RSD  122632
S4    247569        0 %RSD  247569
S5    622010        0 %RSD  622010
S6   1178982        0 %RSD 1178982

New cal coefficients stored
```

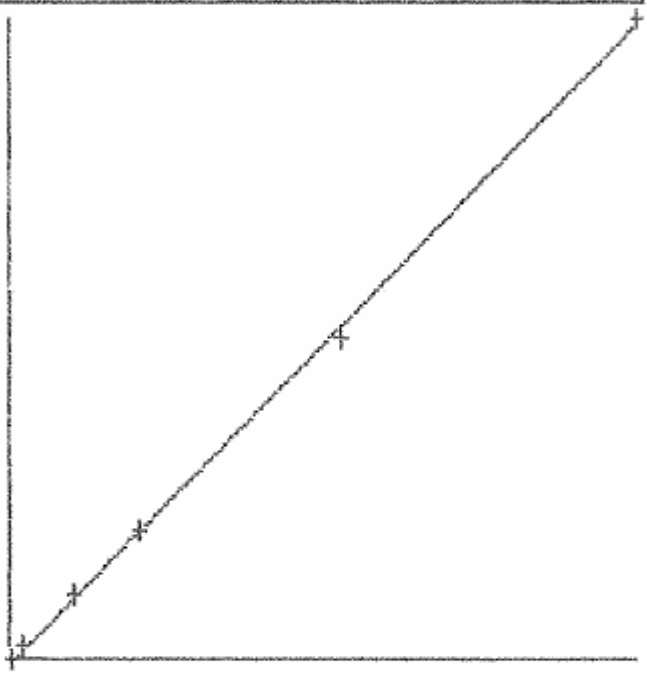


Figure 3. **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 7471B
MERCURY BY COLD VAPOR

Client : XYZ, INC.
Project : CLEAN LAND PROJECT
Batch No. : 10C029
Matrix : SOIL
Instrument ID : TI047

SAMPLE ID	EMAX SAMPLE ID	RESULTS (mg/kg)	DLF	MOIST	LOQ (mg/kg)	LOD (mg/kg)	Analysis DATETIME	Extraction DATETIME	LFID	CAL REF	PREP BATCH	Collection DATETIME	Received DATETIME
MBLK1S	HGC016SB	ND	1	NA	0.100	0.0330	03/12/1015:33	03/12/1011:00	M47C011010	M47C011008	HGC016S	NA	03/12/10
LCS1S	HGC016SL	0.845	1	NA	0.100	0.0330	03/12/1015:35	03/12/1011:00	M47C011011	M47C011008	HGC016S	NA	03/12/10
LCD1S	HGC016SC	0.848	1	NA	0.100	0.0330	03/12/1015:37	03/12/1011:00	M47C011012	M47C011008	HGC016S	NA	03/12/10
B340-002SAS	C029-06A	14.3	1	14.3	0.117	0.0385	03/12/1015:40	03/12/1011:00	M47C011013	M47C011008	HGC016S	03/02/10	03/02/10
B340-002S	C029-06	ND	1	14.3	0.117	0.0385	03/12/1015:42	03/12/1011:00	M47C011014	M47C011008	HGC016S	03/02/10	03/02/10
B340-002SDL	C029-06J	ND	5	14.3	0.583	0.193	03/12/1015:44	03/12/1011:00	M47C011015	M47C011008	HGC016S	03/02/10	03/02/10
B340-002SMS	C029-06M	1.00	1	14.3	0.117	0.0385	03/12/1015:46	03/12/1011:00	M47C011016	M47C011008	HGC016S	03/02/10	03/02/10
B340-002SMSD	C029-06S	0.996	1	14.3	0.117	0.0385	03/12/1015:49	03/12/1011:00	M47C011017	M47C011008	HGC016S	03/02/10	03/02/10
B340-003S	C029-07	ND	1	16.6	0.120	0.0396	03/12/1015:51	03/12/1011:00	M47C011018	M47C011008	HGC016S	03/02/10	03/02/10
B340-004S	C029-08	ND	1	16.1	0.119	0.0393	03/12/1015:53	03/12/1011:00	M47C011019	M47C011008	HGC016S	03/02/10	03/02/10

Figure 4. **TYPICAL LCS REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND PROJECT
SDG NO.: 10C029
METHOD: METHOD 7471B

MATRIX:	SOIL			% MOISTURE:	NA
DILTN FACTR:	1	1	1		
SAMPLE ID:	MBLK1S				
CONTROL NO.:	HGC016SB	HGC016SL	HGC016SC		
LAB FILE ID:	M47C011010	M47C011011	M47C011012		
DATIME EXTRCTD:	03/12/1011:00	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	NA
DATIME ANALYZD:	03/12/1015:33	03/12/1015:35	03/12/1015:37	DATE RECEIVED:	03/12/10
PREP. BATCH:	HGC016S	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008	M47C011008		

ACCESSION:

PARAMETER	BLNK RSLT mg/kg	SPIKE AMT mg/kg	BS RSLT mg/kg	BS % REC	SPIKE AMT mg/kg	BSD RSLT mg/kg	BSD % REC	RPD %	QC LIMIT %	MAX RPD %
Mercury	ND	0.833	0.845	101	0.833	0.848	102	0	80-120	20

Figure 5. **TYPICAL MATRIX SPIKE REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND PROJECT
SDG NO.: 10C029
METHOD: METHOD 7471B

MATRIX:	SOIL			% MOISTURE:	14.3
DILTN FACTR:	1	1	1		
SAMPLE ID:	B340-002S				
CONTROL NO.:	C029-06	C029-06M	C029-06S		
LAB FILE ID:	M47C011014	M47C011016	M47C011017		
DATIME EXTRCTD:	03/12/1011:00	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	03/02/10
DATIME ANALYZD:	03/12/1015:42	03/12/1015:46	03/12/1015:49	DATE RECEIVED:	03/02/10
PREP. BATCH:	HGC016S	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008	M47C011008		

ACCESSION:

PARAMETER	SMPL RSLT mg/kg	SPIKE AMT mg/kg	MS RSLT mg/kg	MS % REC	SPIKE AMT mg/kg	MSD RSLT mg/kg	MSD % REC	RPD %	QC LIMIT %	MAX RPD %
Mercury	ND	0.972	1.00	103	0.972	0.996	102	1	80-120	20

Figure 6. **TYPICAL DILUTION TEST REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
SERIAL DILUTION ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND PROJECT
BATCH NO.: 10C029
METHOD: METHOD 7471B

MATRIX:	SOIL		% MOISTURE:	14.3
DILUTION FACTOR:	1	5		
SAMPLE ID:	B340-002S	B340-002SDL		
EMAX SAMP ID:	C029-06	C029-06J		
LAB FILE ID:	M47C011014	M47C011015		
DATE EXTRACTED:	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	03/02/10
DATE ANALYZED:	03/12/1015:42	03/12/1015:44	DATE RECEIVED:	03/02/10
PREP. BATCH:	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008		

ACCESSION:

PARAMETER	SMPL RSLT (mg/kg)	SERIAL DIL RSLT (mg/kg)	DIF RSLT %	QC LIMIT (%)
Mercury	ND	ND	0	10

Figure 7. **TYPICAL POST DIGESTION SPIKE REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
ANALYTICAL SPIKE ANALYSIS

CLIENT:	XYZ, INC.
PROJECT:	CLEAN LAND PROJECT
SDG NO.:	10C029
METHOD:	METHOD 7471B

MATRIX:	SOIL		% MOISTURE:	14.3
DILTN FACTR:	1	1		
SAMPLE ID:	B340-002S			
CONTROL NO.:	C029-06	C029-06A		
LAB FILE ID:	M47C011014	M47C011013		
DATIME EXTRCTD:	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	03/02/10
DATIME ANALYZD:	03/12/1015:42	03/12/1015:40	DATE RECEIVED:	03/02/10
PREP. BATCH:	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008		

ACCESSION:

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	AS RSLT (mg/kg)	AS % REC	QC LIMIT (%)
Mercury	ND	0.972	1.02	105	85-115

Figure 8. **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN LAND PROJECT

SDG : 10C029

METHOD 7471B
MERCURY BY COLD VAPOR

A total of three (3) soil samples were received on 03/02/10 for Mercury analysis, Method 7471B in accordance with Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, USEPA SW-846.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source. Continuing calibration verifications were carried out at the frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for HGC016SL/C were all within QC limits.

Matrix QC Sample
Matrix QC sample was analyzed at the frequency prescribed by the project.
Percent recoveries for C029-06M/S were within project QC limits.
Analytical spike and serial dilution were analyzed for matrix interference evaluation. Results were within method acceptance criteria.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix **1.** **SUMMARY OF QUALITY CONTROL PROCEDURES**

PARAMETER	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	FLAGING CRITERIA	1ST Rvw	2nd Rvw
Initial multipoint calibration	Daily initial calibration prior to sample analysis	Correlation coefficient R≥0.995 for linear regression	Correct the problem then repeat initial calibration			
Initial calibration verification (second source)	Daily after initial calibration	Analyte within ±10% of expected value	Correct the problem then repeat initial calibration			
Calibration blank	After every calibration verification	No analyte detected ≥ RL	Correct the problem then re-analyze calibration blank and previous samples			
Calibration verification	Daily, before sample analysis, every 10 samples and at the end of analysis sequence	The analyte within ±20% of expected value	Repeat calibration and re-analyze all samples since last successful calibration			
Method blank	One per preparation batch	No analytes detected ≥ RL	Re-prep and re-analyze method blank and all samples processed with the contaminated blank	Apply B on all associated samples		
LCS	One LCS per preparation batch	%Rec.: 80-120%	Re-prep and re-analyze the LCS and all associated samples			
Dilution Test	Each preparatory batch	Within ±10% of the undiluted sample result	Perform recovery test			
Recovery test (Analytical Spike)	When dilution test fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition			
MS/MSD	One MS/MSD per every preparation batch.	%Rec.: 80-120%, RPD=20%	If all other QC samples are in control, discuss in the case narrative, otherwise check the source of the problem and re-analyze the parent sample and the MS/MSD.			
Comments: RL = lowest calibration point				Reviewed by		
				Date		

wibby environmental

ACCREDITED
Certificate # 2427.01

6390 Joyce Drive
100
Golden, CO 80403

Phone 303-940-0033
Fax 866-283-0269
www.wibby.com

Final Report - Soil / Hazardous Waste PT

Study: HW0709

Opening Date: July 20, 2009 - Closing Date: September 4, 2009

Laboratory: EMAX Laboratories
1825 205th Street
Torrance, CA 90501

Contact: Kenette Pimentel, Quality Assurance Manager
310-618-8889 ext. 205

EPA Lab ID: CA00291

Metals (PT-MET-SOIL) **Lot #: 7037-04**

NELAC Code	Analyte	Method Code	Method Description	Units	Assigned Value	Result	Acceptance Limits	Evaluation
1095	Mercury	10166402	SW 7471 B	mg/kg	7.65	6.38	3.27 - 9.50	Acceptable

7470FS. **SAMPLE PREPARATION LOG**

SOP ☐ **EMAX-7470 Rev. No.4** ☐ **EMAX-7471 Rev. No.5** ☐ **EMAX-CLP-245.5** ☐ **EMAX-CLP-245.1** ☐ **EMAX EPA 245.1** ☐

Matrix: **Start Date:** **Time:** **Ending Date:** **Time:** **Book # E47-078**

BATCH: _____

Sample Prep ID	Lab Sample ID	Matrix Description			Sample Amount (g | ml)	Dry Weight	pH	Extract Volume (ml)	Matrix Description	
		Color	Texture / Clarity	Artifacts					Color	Clarity
01										
02										
03										
04										
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										

Standards	ID	Conc. (µg/L)	Amount Added (ml)
ICAL			
CCV			
ICV			
LCS/MS			
Reagent	Lot# / ID		
HNO_3			
HCl			
H_2SO_4			
$KMnO_4$			
$K_2S_2O_8$			
$NH_2OH.HCl$			
$SnCl_2$			
Temp of Digestion Bath: °C			
Legend			
Color			
Bu = blue	Cs = Coarse	Cr = Clear	Rk = rocks
Bk = black	Md = Medium	Cy = Cloudy	Sl = Shale
Bn = Brown	Fn = Fine	Td = Turbid	Vg=Vegetation
Gn = Green			
Og = Orange			
Rd = Red			
Yw = Yellow			

Comments: _____

Prepared By:

Standard Added By: Witnessed By:

Checked By:

Disposed By: Date Disposed:

7470FA. **ANALYTICAL RUN LOG**

ANALYSIS LOG
for
MERCURY

Page

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Start Date: **Start Time:**

End Date: **End Time:**

Comments:

Book #: A47-71

Instrument No.: 47

Analytical Sequence/Batch:

Method File:

SOP #	Rev. #
☐ EMAX-7470	4
☐ EMAX-7471	5
☐ EMAX-245.1	2
☐ EMAX-	

STANDARDS ID
S1
S2
S3
S4
S5
S6
CCV
ICV
LCS
Analytical Spike

Analyzed By:

Date:

LEEMAN -PS200II MERCURY ANALYZER MAINTENANCE LOG

Instrumetnt No: 47 Month: Year: 201_ Book # M47-007

Argon Input Pressure (Input: 75-90 psi)						
Fume Hood						
Gas Outflow/Inflow (0 - 1.0 LPM)						
Pump Rate: 2-15 mL/min						
Reductant Bottle						
Rinse Solution						
Instrument Warm-up						
Perestaltic Pump						
Tubings Pump/Capillary						
Test DAQ: Sample 400,000 - 1,720,000						
Hg Lamp Volt: 4.0 - 10						
Power Supply Voltage: 5V+/-0.25, +12V+/-0.5, -12V+/-0.5						
Computer Date/Time						
Printer Paper						
Analyst Initial						

Trouble Shooting							
Problem(s) Encountered							
Return To Specs (Analyst Initial)							

Code		Code	Corrective Action

Reviewed by: _____

STANDARD OPERATING PROCEDURES

DIESEL RANGE ORGANICS

SOP No.:	EMAX-8015D	Revision No.	4	Effective Date:	05-Apr-10
Prepared By:	Lucita Arzadon			Date:	03-31-10
Approved By:	Kenette Pimentel QA Manager			Date:	03.31.10
Approved By:	Caspar Pang Laboratory Director			Date:	3-31-10

Control Number: 8015D-04-

1.0 SCOPE AND APPLICATION

1.1. This method is used to analyze extractable fuel hydrocarbons in water, soil and other sediment samples. In the vast field of petroleum hydrocarbons, this method is limited to provide semiquantitative results on those extractable hydrocarbons with a comparable aliphatic hydrocarbon range from C_{10} to C_{34}. This is an adaptation of Method 8015C.

2.0 SUMMARY OF METHOD

2.1. Petroleum hydrocarbons are extracted in methylene chloride, analyzed by flame ionization detector (FID) in gas chromatograph and quantified as diesel fuel at C_{10} to C_{28} range. The hydrocarbons that fall in this range are defined as Diesel Range Organics (DRO).

2.2. Other fuel standards that fall in the range of C_{10} to C_{34} can also be quantitated by this method.

2.3. **Interference**

2.3.1. Glassware can be a potential source of contamination. They must be scrupulously cleaned prior to its use.

2.3.2. Carry-over from a highly concentrated sample can be a potential source of contamination. Instrument performance must be observed keenly for possible carry-over. If this is apparent, inject solvent blank until no trace of carry-over is observed.

2.3.3. Deposits may adhere in the injection port/glass liner over a period of time and can cause interference. The injection port and glass liner must be routinely cleaned.

3.0 DETECTION LIMITS

3.1. **Detection Limit (MDL)**

3.1.1. Refer to EMAX QA04 for detection limit generation, evaluation and verification.

3.2. **Limit of Quantitation (LOQ)**

3.2.1. The LOQ is equal to the concentration of the lowest calibration point, unless otherwise specified by the project.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable range requiring no dilution is equal to the concentration of the highest calibration point (See Section 9.5.1). Dilute and reanalyze all samples having results above this range to properly quantitate.

4.2. The lowest quantifiable range of diluted samples is equal to the lowest calibration point (See Section 9.5.1.) Lower the dilution factor and reanalyzed all diluted samples analyzed below this range to properly quantitate

5.0 SAMPLE COLLECTION, PRESERVATION, AND HOLDING TIME

5.1. Holding Time

5.1.1. Water samples must be extracted within 7 days from sampling date.

5.1.2. Soil samples must be extracted within 14 days from sampling date.

5.1.3. All extracts must be analyzed within 40 days from extraction completion date.

5.2. Preservation

5.2.1. All samples and extracts must be stored at ≤ 6°C without freezing.

6.0 ASSOCIATED SOPs

EMAX-QC02	Analytical Standard Preparation
EMAX-SM04	Analytical and QC Sample Labeling
EMAX-QA04	Detection Limit Study
EMAX-QA08	Corrective Action
EMAX-DM01	Data Flow & Review
EMAX-SM03	Waste Disposal
EMAX-LUFTE	Total Petroleum Hydrocarbons by Extraction
EMAX-3510	Extraction, Separatory Funnel
EMAX-3520	Extraction, Continuous Liquid/Liquid
EMAX-3540	Extraction, Soxhlet
EMAX-3550	Extraction , Pulse Sonication
EMAX-3580	Waste Dilution

7.0 SAFETY

7.1. Read all MSDS for chemicals listed in this SOP.

7.2. All reagents, standards, and samples shall be treated as potential hazards. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves, shall be worn at all times when performing this procedure. All sample and standard handling shall be performed in the fume hood.

7.3. All wastes generated during analytical process shall be placed in the wastes containers. These wastes shall be endorsed to the waste disposal section for proper disposal.

7.4. If, for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritation persists, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS, AND SUPPLIES

8.1. Instruments and Supplies

8.1.1. Gas Chromatography: GC HP5890 II with FID and 7673HP Autosampler, or equivalent

8.1.2. Detector: FID

8.1.3. Column: DB5, (0.25 mm x 30 m) 0.25 µm thickness, or equivalent

8.1.4. Data Acquisition: EZ Chrom, or equivalent

8.1.5. Syringes: 10, 25, 100 µL microsyringe

8.1.6. Volumetric Flask: 10, 100 and 1000 mL

8.1.7. Vials: 2,10 and 40 ml, amber

8.1.8. Bottle: 250-ml (amber)

8.2. Chemicals and Reagents

8.2.1. Methylene Chloride

8.2.2. Acetone

8.2.3. High purity He, H_2, Air

9.0 STANDARDS

9.1. Stock Standard

9.1.1. Purchase stock standards as certified solutions from certified vendors as listed below or equivalent:

Standard Name	Catalog Number	Source	Concentration	Solvent	Intended Use
Diesel	Cat # 31259	Restek	50,000 mg/L	$MeCl_2$	ICAL, DCC
Diesel	FU-009N	Accu Std	Neat	$MeCl_2$	ICV, LCS/LCD MS/MSD
Bromobenzene	23987-9	Aldrich	Neat	$MeCl_2$	Surrogate
Hexacosane	24168-7	Aldrich	Neat	$MeCl_2$	Surrogate

9.2. Intermediate Standard

9.2.1. Dilute Diesel Stock Standard first with Methylene Chloride as follows:

Standard Name	Concentration	Amount	Final Conc.	Solvent	Final Volume
Diesel	Neat	1.0 g	100,000 mg/L	$MeCl_2$	10 mL

9.2.2. Then dilute with water-soluble solvent Acetone as follows:

Standard Name	Concentration	Amount	Final Conc.	Solvent	Final Volume
Intermediate Standard	100,000 mg/L	10 mL	5000 mg/L	Acetone	200 ml

9.3. Surrogate Standards

9.3.1. Dilute Surrogate Stock Standards with Methylene Chloride as follows:

Standard Name	Concentration	Amount	Final Conc.	Solvent	Final Volume
Bromobenzene	Neat	1.0 g	10000 mg/L	$MeCl_2$	100 mL
Hexacosane	Neat	0.25 g	2500 mg/L	$MeCl_2$	

9.3.2. Then dilute Surrogate Standards Stock in Acetone as follows:

Standard Name	Concentration	Amount	Final Conc.	Solvent	Final Volume
Surrogate Standard	Bromobenzene – 10000 mg/L	100 mL	Bromobenzene – 1000 mg/L	Acetone	1000 mL
	Hexacosane – 2500 mg/L		Hexacosane – 250 mg/L		

9.4. **Standard Preparation**

9.4.1. The procedure for analytical standard preparation is detailed in EMAX-QC02.

9.4.2. Other concentration levels may be prepared other than the concentration levels specified in this SOP as long as the quality control requirements are met.

9.5. **Initial Calibration Standard**

9.5.1. Prepare a minimum of 5-point calibration standards (ideally 6-point) from the intermediate standard and store in Teflon sealed vial with minimal headspace; suggested concentration and injection volume are as follows:

ICAL Pt.	Stock Standard (50,000mg/L) Aliquot (µL)	Final Volume (mL)	Final Concentration (mg/L)
1	0.2	1	10
2	2.0	1	100
3	10	1	500
4	20	1	1000
5	40	1	2000
6	60	1	3000

9.6. **Continuing Calibration Check Standard**

9.6.1. Prepare certified calibration check standard at 500 mg/L and analyze at designated frequency.

9.7. **Second Source Standard**

9.7.1. Prepare another stock solution of Diesel at 500 mg/L of different source from initial calibration standard to verify the validity of the calibration.

9.8. **Surrogate Initial Calibration Standards**

9.8.1. Prepare a minimum of 5-point calibration standard (ideally 6-point) from the intermediate surrogate standard and store in Teflon sealed vial with minimal headspace; suggested concentration and injection volume are as follows:

Surrogate ICAL Pt.	Surrogate Standard (1,000/250mg/L) Aliquot (µL)	Final Volume (mL)	Final Conc. – Bromobenzene / Hexacosane (mg/L)
1	20	1	20 / 5
2	60	1	60 / 15

3	100	1	100 / 25
4	140	1	140 / 35
5	180	1	180 / 45
6	220	1	220 / 55

9.9. **Alkane Standard**

9.9.1. Prepare a standard containing a homologous series of n-alkanes from C_8 to C_{34} at 100 mg/L for retention time window analysis.

9.10. **Other Fuel Standards**

9.10.1. Refer to SOP EMAX-LUFTE – Total Petroleum Hydrocarbons by Extraction.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. For aqueous samples refer to EMAX-3520 and/or EMAX-3510.

10.1.2. For soil samples refer to EMAX-3540, EMAX-3550**,** or EMAX-3580 and/or EMAX-LUFTE.

10.2. **Instrument Parameters**

10.2.1. Fine tune the instrument guided by the parameter conditions as listed below:

Instrument	Temp (°C)	Rate (°C/min)	Time (min)	Temperature (°C)		Injection Volume (µL)	Head Pressure (psi)
				Injector	Detector		
105	55	0	0.5	280	320	2	21-22
	320	60	5.8				

10.3. **Initial Calibration**

10.3.1. Analyze the initial calibration standards prepared. Sum the area of all peaks eluting between C_{10} to C_{28} for each of the calibration point. Generate this area by rejoining a horizontal baseline between the retention time of C_{10} to C_{28}. Check that the highest point does not have saturated peak(s).

10.3.2. After the initial calibration, analyze a 500-mg/L check standard from a second source to verify the concentration of the original calibration.

10.3.3. Evaluate the results and refer to Appendix 1 for acceptance criteria and corrective action. If the %RSD is out of acceptance criteria, review the results and identify presence of an outlier.

- If one of the standards returns a bias-low or bias-high, that point could be an outlier. Prepare a standard at that ICAL point and re-analyze.
- If the highest ICAL point appears to be saturated, drop the highest point.
- If the lowest point returns a bias low response or the pattern is not distinct and sharp, drop the point.

Note: The lowest calibration point determines the limit of quantitation (LOQ). Therefore, check that the LOQ is in conformance to the current projects where the ICAL will be used.

10.4. **Continuing Calibration (DCC)**

10.4.1. Analyze a continuing calibration at the beginning of a 12-hour shift or as specified by the project.

10.4.2. Refer to Appendix 1for acceptance criteria and corrective action.

10.5. **Analysis**

10.5.1. Extract Preparation

10.5.1.1. Allow the extracts to equilibrate with the room temperature.

10.5.1.2. Transfer about 1 mL of extracts into autosampler vials.

10.5.2. Analytical Sequence

10.5.2.1. Analyze Daily Calibration Check Standard (DCC) and check ICAL validity.

10.5.2.2. Analyze samples to include method blank(s), lab control sample(s) and matrix spike sample(s) up to a maximum of 12 hours, or as per project specific requirement (PSR).

10.5.2.3. Close the analytical sequence with a continuing calibration.

10.5.3. Sample Result Evaluation

10.5.3.1. Check QC Criteria as soon as available.

- Check surrogate recoveries against project specific requirement (PSR). In the absence of PSR, default to in-house QC limits.

10.5.3.2. Qualitative Identification

- Compare the sample chromatogram to the pattern established by the calibration standard.
- When peaks other than diesel pattern are detected within the DRO, take note of it and discuss in the case narrative.

10.5.3.3. Quantitation

- Assign the appropriate hydrocarbon range for quantitation (e.g. $C_{10} – C_{28}$; C_{18} - C_{34}; etc.)
- Integrate all peaks bracketed by the hydrocarbon range baseline to baseline. Set the integration range at least 95% within of the total spectrum of the expected DRO range.
- Calculate the result as specified in Figure 2 based on the appropriate fuel standard (e.g. Diesel: $C_{10} – C_{28}$; Motor Oil: $C_{18} – C_{34}$). In the absence of alkane range specification for the project, request for directive from the PM.
- Check that all positively identified target analytes are quantitated within the calibration range.
- Dilute and re-analyze all positively identified target analytes exceeding calibration range.
- When peaks other than diesel pattern are detected within the DRO range, quantitate using the DRO calibration factor and discuss it in the case narrative (e.g. peaks within the DRO range does not resemble diesel pattern or motor oil pattern). When saturated peaks are present, dilute the extract appropriately until peaks are eluted properly.

10.5.4. Retention Time Range

10.5.4.1. Analyze a mixture containing aliphatic hydrocarbons with chain length from C_{10} to C_{28} at 100 mg/L daily within 72 hours to establish the retention time window of C_{10} and C_{28} alkanes. Establish the lower retention time limit of DRO based on –3 x SD of the gathered retention time of C_{10} and the upper retention time limit base on +3 x SD of the gathered retention time of C_{28}.

10.5.4.2. Use the same technique to establish the retention time for other TPH ranges, e.g. motor oil range is normally from C_{18} to C_{34}.

10.5.5. Manual Integration

10.5.5.1. If re-integration is needed, refer to EMAX-DM01, Section 4.4.

10.6. **Calculations**

10.6.1. Initial Calibration

10.6.1.1. Calculate for Calibration Factor

$$CF = \frac{R_t}{C_v} \qquad \textit{Eq.10.6.1.1}$$

where:

CF – *Calibration Factor*

R_t – *Total response of the integrated peaks*

C_v – *Known value of the standard concentration , mg/L*

10.6.1.2. Calculate for the Average Calibration Factor

$$ACF = \frac{\sum CF}{n} \qquad \textit{Eq.10.6.1.2}$$

where:

ACF – *Average Calibration Factor*

$\sum CF$ – *Summation of Calibration Factors*

n – *Number of measurements*

10.6.1.3. Calculate for Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}} \qquad \textit{Eq.10.6.1.3}$$

where:

SD – *Standard Deviation*

x_i – *Result at the* i^{th} *measurement*

$\bar{x}$ – *mean*

n – *number of measurements*

10.6.1.4. Calculate for Percent Relative Standard Deviation

$$\%RSD = \frac{SD}{ACF} * 100 \qquad \textit{Eq.10.6.1.4}$$

where:

%RSD – Percent Relative Standard Deviation

SD – Standard Deviation

ACF – Average Calibration Factor

10.6.2. Calculate for Percent Difference of DCC from ACF

$$\%D = \frac{C_f - C_k}{C_k} * 100 \qquad \textit{Eq.10.6.2}$$

where:

%D – Percent Difference DCC from known concentration

C_k *– Known concentration of the analyte, in mg/L*

C_f *– Found concentration, in mg/L*

10.6.3. Calculate for Sample Concentration

$$C = \frac{(R_t)(V_e)(DF)}{(ACF)(A_s)(\%S)} \qquad \textit{Eq.10.6.3}$$

where:

C – Concentration of the sample, mg/L or mg/Kg

R_t *– Total response of the integrated peaks*

V_e *– Volume of Extract, ml*

A_s *– Sample amount, ml or g*

DF – Dilution Factor

ACF – Average Calibration Factor

%S – Percent solids (%S for water = 1)

10.6.4. Calculate for Precision

$$\%RPD = \frac{|R_1 - R_2|}{R_{ave}} * 100 \qquad \textit{Eq.10.6.4}$$

where:

%RPD – Relative Percent Difference

R_1 *– result of first measurement*

R_2 – *result of second measurement*

R_{ave} – *average result of first and second measurements*

10.7. **Report Generation and Data Reduction and Review**

10.7.1. Generate the method.txt file using WDBX[1].exe.

10.7.2. Generate Lab Chronicle using LABCHRNX.exe

10.7.3. Generate the sample results using F1VX.exe

10.7.4. Generate the QC summary using QCVX.exe

10.7.5. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration and re-analyses.

- Sample Results
- LCS Summary
- MS/MSD Summary
- ICAL Summary
- ICV Summary
- DCC Summary
- Analysis Log
- Extraction Log

10.7.6. Generate the case narrative using CN1.exe. Check the case narrative to ensure accuracy and edit as necessary to include all issues and/or anomalies encountered during the analytical process.

10.7.7. Perform a 100% data review in accordance to EMAX-DM01 and the project specific requirements.

10.7.8. Submit the analysis package for secondary review.

10.8. **Preventive Maintenance**

10.8.1. Instruments should receive routine preventive maintenance as suggested but not limited to the table below.

Maintenance Activity	Description	Frequency
Autosampler	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis.
Verification	Check instrument parameters to ensure normal operating conditions. Change liner as necessary. Clean injection port as necessary. Check instrument performance (e.g., Daily calibration check, instrument blank)	Daily prior to analysis.
System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector. Check septa and replace as necessary.	Every 6 months or as necessary

[1] X - version number

Maintenance Activity	Description	Frequency
Check Flow Path Components	Check and replace the following as necessary: tubing assembly, union, column	Once a year as necessary
Complete Inspection	Perform general inspection of the complete system. Inspect autosampler cabling and configuration setting.	Once a year
Documentation	Record all instrument maintenance performed in the instrument maintenance log.	Daily prior to analysis

11.0 QUALITY CONTROL

11.1. **Preparative Batch**

11.1.1. A preparative batch shall consist of a method blank, LCS, MS/MSD and a maximum of 20 field samples of similar matrix.

11.1.2. In the absence of MS/MSD, LCS/LCD is prepared.

11.2. **Analytical Batch QC**

11.2.1. Daily Calibration Check (DCC) shall be analyzed:

- at the beginning of each analytical sequence
- every 12 hours thereafter, or as specified by the PSR
- at the end of the analytical sequence.

11.2.2. Refer to Appendix 1 for acceptance criteria.

11.3. **Method QC**

11.3.1. All analysts performing this procedure must have a current certificate of demonstration of proficiency as described in EMAX-QA05.

11.3.2. Establish detection limit (DL), limit of detection (LOD) and limit of quantitation (LOQ).

11.3.3. A valid LOD, LOQ and ICAL must exist prior to analysis.

11.3.4. Instrument performance must be checked prior to analysis.

11.3.5. Check Appendix 1 for acceptance criteria.

11.3.6. Prepare, analyze and control QC samples as required by the project. In the absence of PSR, refer to Appendix 1 for Quality Control Procedures.

11.3.7. Surrogate standard shall be added to all samples, including quality control samples (e.g., method blank, LCS and MS). Check PSR for QC Control Limits. In the absence of PSR default to EMAX QC limits.

12.0 CORRECTIVE ACTION

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures (Appendix 1). Document out-of-control event and corrective action taken in the analytical logbook. If problem persists, consult the supervisor.

12.2. **Continuing Calibration**

12.2.1. If non-compliant, consider the following suggestions to correct the problem:

- Change the liner

- Clean the injection port
- Prepare a new standard
- Cut or replace the column
- Clean the detector
- Rule-out leaks
- Perform new calibration.

12.3. **Preparative Batch**

12.3.1. If method blank is non-compliant, consider the following suggestions to correct the problem:

- Check the sample results. If sample results are non-detected, you may report the result upon concurring with the PM, otherwise, perform the corrective action as specified in the PSR.

12.3.2. If LCS is non-compliant, consider the following suggestions to correct the problem:

- Check the result of MS/MSD. If standard degradation is apparent, prepare a fresh standard and perform the corrective action as described in Appendix 1.
- If no MS/MSD is prepared with the sample and the result is outside the higher QC limit, the solvent of the standard may have evaporated. Prepare a fresh standard and perform the corrective action as described in Appendix 1.

12.4. If samples are out of technical holding time, the analyst fills out a Non-Conformance Report (NCR) and forwards it to the project manager who will consult with the client for further instruction.

12.5. For other out-of-control situations that require another department's participation in the corrective action (i.e., re-extraction, etc.), an NCR shall be filled with the supervisor's approval before proceeding.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped in the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Application of EMAX QC Procedures**

15.1.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing diesel range organics analysis by GC. In the instance where there is project or program specific quality control, the requirements given in the project shall take precedence over this SOP.

15.2. **Department of Defense (DoD) Projects**

15.2.1. When samples from DoD sponsored projects are analyzed for diesel range organic analysis by GC, the analyte list, detection limits, calibration, QC, corrective action, and data requirements

shall be applied as specified by the Quality Assurance Project Plan. In the absence of QAPP, the DoD QSM latest version shall be applied.

15.3. **Department of Energy (DOE) Projects**

15.3.1. When samples from DoE sponsored projects are analyzed for diesel range organic analysis by GC, the analyte list, detection limits, calibration, QC, corrective action, and data requirements shall be applied as specified by the Quality Assurance Project Plan (QAPP). In the absence of a QAPP, the DoE QSAS latest version shall be applied.

15.4. **Definition of Terms**

15.4.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents. Preparation batch is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate. Analytical batch is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.4.2. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.4.3. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.4.4. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.4.5. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.4.6. Matrix – is a component or form of a sample.

15.4.7. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.4.8. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.4.9. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.4.10. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying chain of custody (COC). Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.4.11. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.4.12. Surrogate – compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard; used to evaluate analytical efficiency by measuring recovery. Compounds not expected to be detected in environmental media.

16.0 REFERENCES

16.1. Method 8015C, Rev. 3, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, USEPA SW-846.

16.2. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Figures**

Figure 1	Peak Evaluation Technique
Figure 2A	Typical DRO Chromatogram
Figure 2B	Typical Motor Oil Chromatogram
Figure 2C	Typical n-Alkane Chromatogram
Figure 3	Typical Initial Calibration Summary
Figure 4	Typical Continuing Calibration Summary
Figure 5	Typical Sample Result Summary
Figure 6	Typical LCS Report Summary
Figure 7	Typical Matrix Spike Report Summary
Figure 8	Typical Case Narrative

17.2. **Appendices**

Appendix 1	Summary of Quality Control Procedures
Appendix 2	Demonstration of Capability

17.3. **Forms**

8015D FS	Sample Preparation Log
8015D FA	Analytical Run Log
8015D FM	Instrument Maintenance Log

Figure 1. **PEAK EVALUATION TECHNIQUE**

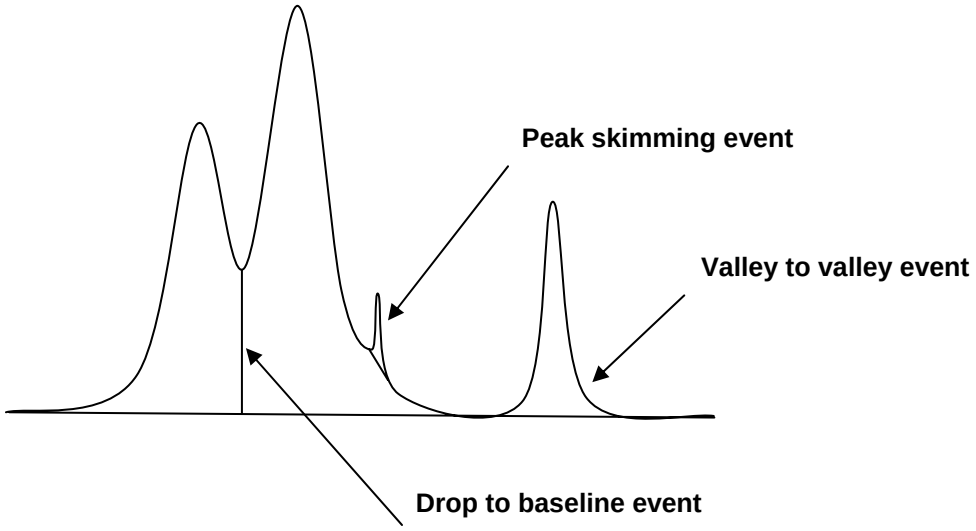


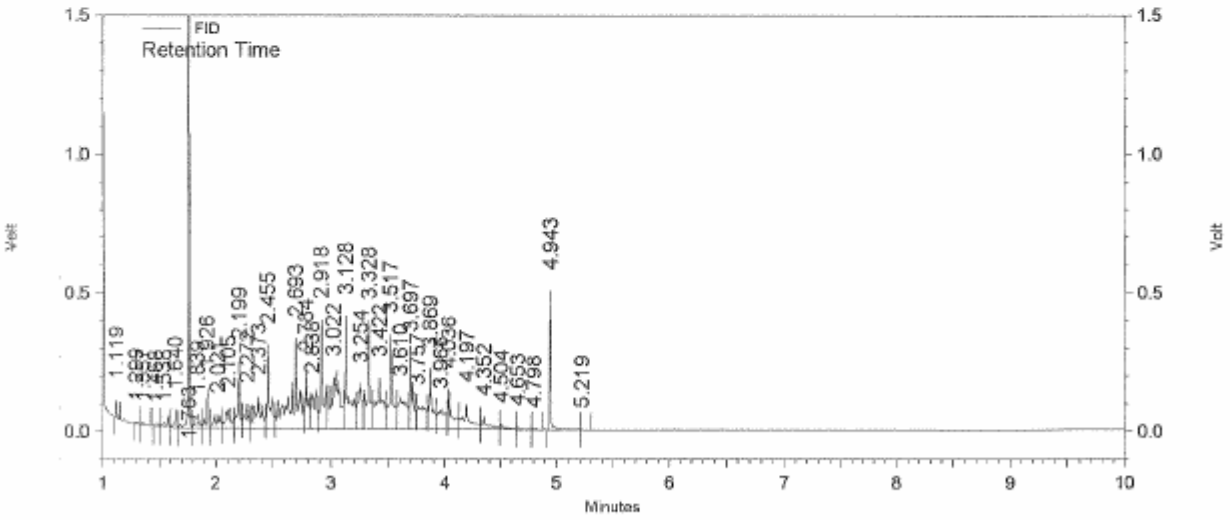
Figure 2B. **TYPICAL MOTOR OIL CHROMATOGRAM**

METHOD 8015 by GC/FID
EMAX Laboratories, Inc.

Inst. Name:	: GCT-105 (Offline)
File	: D:\Projects\EZC331\Data\LB22\LB22028.dat
Method	: D:\Projects\EZC331\Method\DS105B22.met
Sequence:	: D:\Projects\EZC331\Sequence\LB22.seq
Sample ID	: IDS105B22001 500/100/25PPM
Acquired	: 02/23/10 04:07:00
Printed	: 03/25/10 10:28:33
User	: CChen

FID Results

Name	Retention Time	Area	Average RF	ESTD concentration
BROMOBENZENE	1.763	1431362	14899.82809	96.066
HEXACOSANE	4.943	392700	16072.45782	24.433
DIESEL(TOTAL)		12072505	23316.03089	517.777
DIESEL(C10-C24)		11759196	22789.79606	515.985
DIESEL(C10-C28)		11765559	22805.53028	515.908
DIESEL(C10-C25)		11763081	22802.59606	515.866
Totals		49184403		2186.035



Software Version: Version 3.3.1

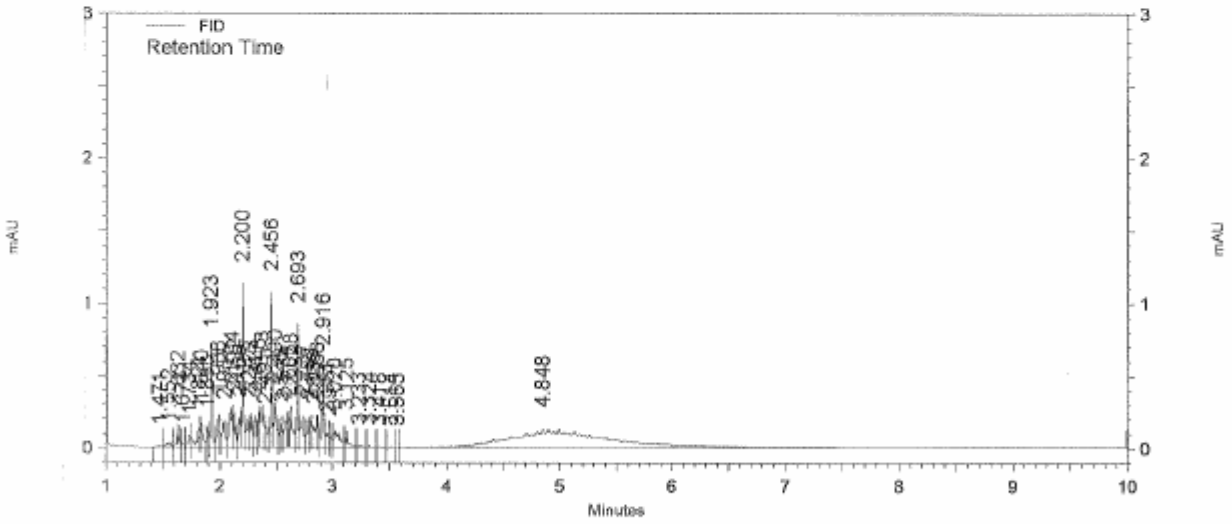
Figure 2B. **TYPICAL MOTOR OIL CHROMATOGRAM**

METHOD 8015 by GC/FID
EMAX Laboratories, Inc.

Inst. Name:	: GCT-105 (Offline)
File	: D:\Projects\EZC331\Data\LB22\LB22064.dat
Method	: D:\Projects\EZC331\Method\JM105B22.met
Sequence:	: D:\Projects\EZC331\Sequence\LB22.seq
Sample ID	: IJM10B22001 500PPM
Acquired	: 02/23/10 16:58:15
Printed	: 03/25/10 10:28:17
User	: CChen

FID Results

Name	Retention Time	Area	Average RF	ESTD concentration
JP5		11780413	22117.92821	532.618
MOTOR OIL		7405379	14277.86681	518.661
Totals		19185792		1051.280

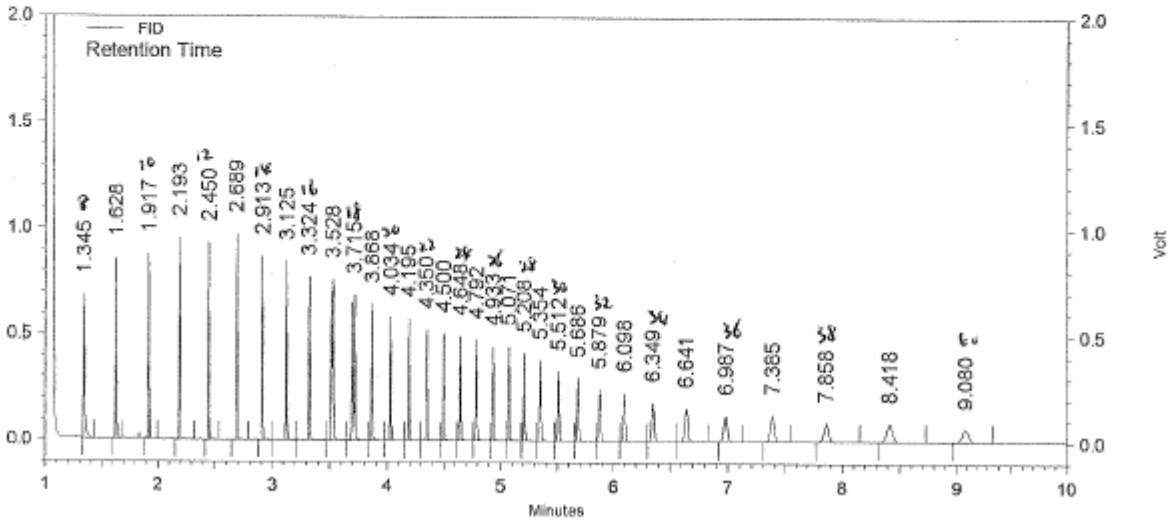


Software Version: Version 3.3.1

Figure 2C. **TYPICAL n-ALKANE CHROMATOGRAM**

METHOD 8015 by GC/FID
EMAX Laboratories, Inc.

Inst. Name:	: GCT-105 (Offline)
File	: D:\Projects\EZC331\Data\LC17\LC17018.dat
Method	: D:\Projects\EZC331\Method\DS105C17.met
Sequence:	: D:\Projects\EZC331\Sequence\LC17.seq
Sample ID	: HC-CHAIN (C8-C40+C9-C39)
Acquired	: 03/17/10 19:54:52
Printed	: 03/18/10 09:39:48
User	: CChen



Software Version: Version 3.3.1

Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD M8015

Lab Name : EMAX Inc
Instrument ID : GCT105
GC Column : HP5
Column size ID : 30MX0.32MM 0.25UM
LFID & Datetime: LB22016A 02/23/10 00:48 LB22022A 02/23/10 02:27
LFID & Datetime: LB22017A 02/23/10 01:05 LB22023A 02/23/10 02:44
LFID & Datetime: LB22018A 02/23/10 01:21 LB22024A 02/23/10 03:00
LFID & Datetime: LB22019A 02/23/10 01:38 LB22025A 02/23/10 03:17
LFID & Datetime: LB22020A 02/23/10 01:54 LB22026A 02/23/10 03:34
LFID & Datetime: LB22021A 02/23/10 02:11 LB22027A 02/23/10 03:50
CONC UNIT: ppm

COMPOUND	CONC X	CALIBRATION FACTORS (AREA)/UNIT 2.00X	10.00X	20.00X	100.00X	300.00X	600.00X	MEAN	%RSD
DIESEL(TOTAL)	5.00	24995	23969	23432	23673	21919	21908	23316.0	5.2
DIESEL(C10-C24)	5.00	24793	23623	23088	22933	21117	21185	22789.8	6.3
DIESEL(C10-C28)	5.00	24819	23632	23095	22947	21136	21204	22805.5	6.3
DIESEL(C10-C25)	5.00	24819	23632	23095	22941	21130	21199	22802.6	6.3
SURROGATE	X	1.00X	2.00X	3.00X	5.00X	7.00X	11.00X	MEAN	%RSD
N-TRIACONTANE	20.00	11985	12094	12200	12466	11822	12203	12128.3	1.8
O-TERPHENYL	5.00	24750	24321	24447	24224	22590	23161	23915.4	3.5

FORM VI DIESEL -2 1/96 Rev 2/2006

Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD M8015

Lab Name : EMAX Inc
Instrument ID : GCT105
GC Column : HP5
Column size ID : 30MX0.32MM 0.25UM
LFID & Datetime: LB22057A 02/23/10 15:02
LFID & Datetime: LB22058A 02/23/10 15:18
LFID & Datetime: LB22059A 02/23/10 15:35
LFID & Datetime: LB22060A 02/23/10 15:51
LFID & Datetime: LB22061A 02/23/10 16:08
LFID & Datetime: LB22062A 02/23/10 16:25
LFID & Datetime: LB22063A 02/23/10 16:41
CONC UNIT: ppm

COMPOUND	CONC X	CALIBRATION FACTORS (AREA)/UNIT 1.00X	2.00X	5.00X	50.00X	100.00X	200.00X	300.00X	MEAN	%RSD
JP5	10.00	19631	19700	21517	22617	23064	24249	24047	22117.9	8.6
MOTOR OIL	10.00	13265	13394	14008	13732	14548	15448	15550	14277.9	6.5

JM105B22.MET

FORM VI JP5+5W30 -2 1/96 Rev 2/2006

Figure 4. **TYPICAL CONTINUING CALIBRATION SUMMARY**

CONTINUE CALIBRATION
METHOD M8015

Lab Name : EMAX Inc
Instrument ID : GCT105
GC Column : HP5
Column size ID : 30MX0.32MM 0.25UM
Mid Conc Init LFID & Datetime: LB22019A 02/23/2010 01:38
Conc Cont LFID & Datetime: LB23002A 02/23/2010 17:48
CONC UNIT : ppm

COMPOUND	RT MINUTES	RT WINDOW FROM	RT WINDOW TO	TRUE CONC	AVERAGE CF	RESULT AREA	RESULT CONC	%D	QL	%D LIMITS
DIESEL(TOTAL)	NA	NA	NA	500.0	23316.0	11828742	507.32	1		15
DIESEL(C10-C24)	NA	NA	NA	500.0	22789.8	11513589	505.21	1		15
DIESEL(C10-C28)	NA	NA	NA	500.0	22805.5	11516143	504.97	1		15
DIESEL(C10-C25)	NA	NA	NA	500.0	22802.6	11516143	505.04	1		15
SURROGATE	**MINUTES**	**FROM**	**TO**	**TRUECON**	**CF**	**AREA**	**CONC**	**%D**	**QL**	**LIMITS**
BROMOBENZENE	1.763	1.760	1.766	100.0	14899.8	1527898	102.54	3		15
HEXACOSANE	4.943	4.793	5.093	25.0	16072.5	438835	27.30	9		15

CONTINUE CALIBRATION
METHOD M8015

Lab Name : EMAX Inc
Instrument ID : GCT105
GC Column : HP5
Column size ID : 30MX0.32MM 0.25UM
Mid Conc Init LFID & Datetime: LB22060A 02/23/2010 15:51
Conc Cont LFID & Datetime: LB23003A 02/23/2010 18:04
CONC UNIT : ppm

COMPOUND	RT MINUTES	RT WINDOW FROM	RT WINDOW TO	TRUE CONC	AVERAGE CF	RESULT AREA	RESULT CONC	%D	QL	%D LIMITS
JP5	NA	NA	NA	500.0	22117.9	11337754	512.60	3		15
MOTOR OIL	NA	NA	NA	500.0	14277.9	7145548	500.46	0		15

Figure 5. **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 3520C/8015C
PETROLEUM HYDROCARBONS BY EXTRACTION WITH SILICA GEL CLEAN UP

Client	: XYZ, INC.	Date Collected:	03/23/10
Project	: CLEAN WATER	Date Received:	03/24/10
Batch No.	: 10C285	Date Extracted:	03/24/10 14:45
Sample ID:	9102-TW03-GW04	Date Analyzed:	03/25/10 13:27
Lab Samp ID:	C285-02	Dilution Factor:	0.94
Lab File ID:	LC25007A	Matrix :	WATER
Ext Btch ID:	DSC036W	% Moisture :	NA
Calib. Ref.:	LC25002A	Instrument ID :	GCT105

PARAMETERS	RESULTS (mg/L)	RL (mg/L)	MDL (mg/L)
DIESEL W/ SG	ND	0.47	0.094
MOTOR OIL W/ SG	ND	0.47	0.094

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
BROMOBENZENE	77	40-130
HEXACOSANE	51	40-150

RL : Reporting Limit

Parameter	H-C Range
Diesel	C10-C24
Motor Oil	C24-C36

Figure 6. **TYPICAL LCS SUMMARY REPORT**

EMAX QUALITY CONTROL DATA
LCS ANALYSIS

CLIENT:	XYZ, INC.			
PROJECT:	CLEAN WATER			
BATCH NO.:	10C285			
METHOD:	METHOD 3520C/8015C			
MATRIX:	WATER		% MOISTURE:	NA
DILUTION FACTOR:	1	1		
SAMPLE ID:	MBLK1W			
LAB SAMP ID:	DSC036WB	DSC036WL		
LAB FILE ID:	LC25005A	LC25004A		
DATE EXTRACTED:	03/24/1014:45	03/24/1014:45	DATE COLLECTED:	NA
DATE ANALYZED:	03/25/1012:54	03/25/1012:37	DATE RECEIVED:	03/24/10
PREP. BATCH:	DSC036W	DSC036W		
CALIB. REF:	LC25002A	LC25002A		

ACCESSION:

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	QC LIMIT (%)
Diesel w/ SG	ND	5.00	4.00	80	60-130

SURROGATE PARAMETER	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	QC LIMIT (%)
Bromobenzene	1.00	0.793	79	50-130
Hexacosane	0.250	0.234	94	60-140

Figure 7. **TYPICAL MATRIX SPIKE SUMMARY REPORT**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER
BATCH NO.: 10C285
METHOD: METHOD 3520C/8015C

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	0.94	0.94	0.94		
SAMPLE ID:	9102-TW03-GW04				
LAB SAMP ID:	C285-02	C285-02M	C285-02S		
LAB FILE ID:	LC25007A	LC25008A	LC25009A		
DATE EXTRACTED:	03/24/1014:45	03/24/1014:45	03/24/1014:45	DATE COLLECTED:	03/23/10
DATE ANALYZED:	03/25/1013:27	03/25/1013:44	03/25/1014:00	DATE RECEIVED:	03/24/10
PREP. BATCH:	DSC036W	DSC036W	DSC036W		
CALIB. REF:	LC25002A	LC25002A	LC25002A		

ACCESSION:

PARAMETER	SMPL RSLT (mg/L)	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Diesel w/ SG	ND	4.70	1.94	41	4.70	2.24	48	15	20-150	30

SURROGATE PARAMETER	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	QC LIMIT (%)
Bromobenzene	0.940	0.712	76	0.940	0.631	67	40-130
Hexacosane	0.235	0.140	59	0.235	0.183	78	40-150

Figure 8. **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN WATER

SDG : 10C285

METHOD 3520C/8015C
PETROLEUM HYDROCARBONS BY EXTRACTION WITH SILICA GEL CLEAN UP

A total of seven (7) water samples were received on 03/24/10 for TPH Diesel & Motor Oil analysis, Method 3520C/8015C in accordance with Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, USEPA SW-846.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source (ICV). Continuing calibration (CCV) verifications were carried on a frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A lab control sample was analyzed with the samples in this SDG.
Percent recoveries for DSC036WL were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for C285-02M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1. **SUMMARY OF QUALITY CONTROL PROCEDURES**

QC Procedure	Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	1st Rvw	2nd Rvw
Minimum five-point initial calibration	Initially; as needed	Linear - mean RSD ≤20%	Correct the problem then repeat initial calibration			
Second-source calibration verification	After initial calibration	Within ±25% of expected value	Correct the problem then repeat initial calibration			
Initial calibration verification	Daily, before sample analysis	Within ±20% of expected value	Correct the problem then repeat initial calibration			
Calibration verification	Every 12 hours of analysis time and at the end of analysis sequence	Within ±20% of expected value	Correct the problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification			
Method blank	One per preparation batch	No analyte detected ≥ RL	Reprep and reanalyze method blank and all samples processed with the contaminated blank	Apply B to specific analyte(s) on all associated samples		
LCS	One LCS per preparation batch	Within EMAX QC Limits	Reprep and reanalyze the LCS and all associated samples			
Surrogate spike	Every sample, spiked sample, standard, and method blank	Within EMAX QC Limits	Correct the problem then reextract and analyze sample			
MS/MSD	One MS/MSD per every 20 project samples per matrix	Refer to EMAX QC Limits	None			
Chromatogram	All sample results	Within calibration range NO SATURATED PEAK(s)	Dilute and re-analyze all samples over the calibration range Diluted and re-analyzed all samples demonstrating saturated peak(s) even if the total integrated peaks do not exceed the calibration range.			
Results reported between MDL and RL	None	None	None			
Comments: RL= lowest calibration point				Reviewed By		
				Date		

PERFORMANCE TEST SAMPLE RESULTS

Prepared by Siu, Catherine and Analyzed by Chen, Chia Wen

PT # UST0110 1/18/2010 - 3/4/2010 10A272

LID	Method	Analyte	Result	Assigned Value	Acceptance Limits	UNIT	Comment
10A272-17	SW 3550 B/SW	Diesel	769	929	245 - 1170	mg/kg	Acceptable

PERFORMANCE TEST SAMPLE RESULTS

Prepared by Muertigue, Juanita and Analyzed by Chen, Chia Wen

PT # UST0110 1/18/2010 - 3/4/2010 10A272

LID	Method	Analyte	Result	Assigned Value	Acceptance Limits	UNIT	Comment
10A272-03	SW 3520 C/SW 8015 C	Diesel	3210	3510	866 - 4520	µg/L	Acceptable

EXTRACTION LOG FOR TPH

SOP ☐ EMAX-3550 Rev. No.2 ☐ EMAX-3520 Rev. No.2 ☐ EMAX-LUFT E Rev. No.3 ☐ EMAX-3540 Rev. No.0 ☐ EMAX-3510Rev.No. 1

Matrix: Start Date: Time: End Date: Time: Book # EDS-048

PREPARATION BATCH * _____

Sample Prep ID	Lab Sample ID	Sonicator Number	Sample Amount (g | ml)	Extract Volume (ml)	Silica Gel Clean-up	Notes
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						

Standards	ID	Amount Added (ml)
Surrogate		
LCS/MS		

Reagent	Lot# / ID
CH_2Cl_2	
Na_2SO4	
HCl	
Silica Sand	
Silica Gel	

TUNING	
Sonicator #	Reading

Concentrator Water Bath Temp. (C)		
1		
2		
3		
4		
5		
6		

Comments: Test thermometer = T_1

Prepared By: Standard Added By:

Witnessed By: Checked By:

Extract Received by: Extract Location:

Disposal Date: Disposed By:

This page is checked during data review.

EMAX LABORATORIES, INC.

ANALYSIS LOG FOR TPH

Page 1

Note:
For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Comments:

Book #: A105-012

Instrument No.: 105

Analytical Sequence:

Method File:

Analytical Batch:

SOP #	Rev. #
☐ EMAX-8015D	4
☐ EMAX-LUFT	3
☐ EMAX-AK102	2

STANDARDS ID	Conc (mg/L)
ICAL	
☐ Diesel ☐ Alcohol	
☐ Motor Oil ☐ JP5	
CH_2Cl_2	
DSL DCC	
LCS	
JP5/5W30 DCC	

ELECTRONIC DATA ARCHIVAL	
Location	Date
☐ EZCELITE-11	
☐	

Analyzed By:

Date:

INSTRUMENT MAINTENANCE LOG

Instrument No: 105 Month Year: 201_ Book # M105-003

Date							
Column Head Pressure							
Column Temperature							
FID lit up							
FID signal within specs							
Autosampler							
Check make up gas flow							
Run instrument blank							
Computer Date/Time							
Computer Paper							
Analyst Initial							

Trouble Shooting							
Problem(s) Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

PRINT DRF

STANDARD OPERATING PROCEDURES

GASOLINE RANGE ORGANICS

SOP No.:	EMAX-8015G	Revision No.	3	Effective Date:	14-Jan-11
Prepared By:	Lucita Arzadon			Date:	01-13-11
Approved By:	Kenette Pimentel QA Manager			Date:	01.13.11
Approved By:	Caspar Pang Laboratory Director			Date:	01-13-11

Control Number: 8015G-03-

1.0 SCOPE AND APPLICATION

1.1. This method is applicable for analyzing purgeable petroleum hydrocarbons bracketed by the range of alkanes from C_6 to C_{10} as gasoline range organics (GRO) in samples of various matrices (i.e. soils, water, sludge). Other range of alkanes may be applied (e.g., C_5 to C_{10}, C_6 to C_{12}, etc.) or other purgeable fuel patterns may be analyzed provided that qualitative identification and quantitative determination is properly established. This SOP is an adaptation of SW846 Method 8015C.

2.0 SUMMARY OF METHOD

2.1. A known amount of sample is purged by inert gas into a trap and retains the purgeable organic compounds. The trap is back flushed into the GC system equipped with flame ionization detector (FID). The instrument is calibrated with a gasoline standard. Hydrocarbon markers (C_5 to C_{12}) are analyzed to determine elution time. Quantitation of typical GRO is based on C_6 to C_{10} alkane range.

2.2. **Interferences**

2.2.1. Glassware can be a potential source of contamination. They must be scrupulously cleaned prior to use.

2.2.2. Carry-over from a highly concentrated sample can be a potential source of contamination. Instrument performance must be observed keenly for possible carry-over. If this is apparent, inject solvent blank until no trace of carry-over is observed.

2.2.3. Deposits may adhere in the injection port/glass liner over a period of time and can cause interference. The injection port and glass liner must be routinely cleaned.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Established DL, LOD and LOQ are:

Analyte	Water (µg/L)			Soil 1 gm to 5 ml (µg/Kg)			Soil 1 gm to 5 ml (µg/Kg)		
	DL	LOD	LOQ	DL	LOD	LOQ	DL	LOD	LOQ
Gasoline	5	10	20	20	40	100	350	500	1000
Bromofluorobenzene	2.5	5	20	10	20	100	50	100	1000
1,1,1-Trifluorotoluene	2.5	5	20	10	20	100	50	100	1000

4.0 DYNAMIC RANGE

4.1. The highest quantifiable range requiring no dilution is equal to the concentration of the highest calibration point (See Section 9.6.1). Dilute and re-analyze all samples having results above this range for proper quantitation.

4.2. The lowest quantifiable range of diluted samples is equal to the lowest calibration point (See Section 9.6.1). Lower the dilution factor and re-analyze all diluted samples analyzed below this range for proper quantitation.

5.0 SAMPLE HOLDING TIME & PRESERVATION

5.1. Water samples received are expected to be contained in 40 ml vial with teflon-lined septa preserved at pH < 2 with HCl with zero head space.

Note: The size of any bubble caused by degassing upon cooling the sample should not exceed 6 mm.[1]

5.2. Soil samples are expected to be contained in encore tubes and frozen or in jars or brass tubes.

5.3. Aqueous samples are stored at ≤ 6°C if not analyzed immediately.

5.4. Analyze all samples within 14 days from the date of collection. Analyze unpreserved water samples within 7 days from the date of collection.

5.5. Analyze frozen encore tube samples within 14 days or as specified by the project.

6.0 ASSOCIATED SOPs

6.1. EMAX-5030 Purge and Trap

6.2. EMAX-5035 Closed System Purge and Trap

6.3. EMAX-DM01 Data Flow and Review

6.4. EMAX-QA04 Method Detection Limit

6.5. EMAX-QA08 Corrective Action

6.6. EMAX-QC01 Quality Control of Chemicals

6.7. EMAX-QC02 Analytical Standard Preparation

6.8. EMAX-QC07 Glassware Cleaning

6.9. EMAX-SM03 Waste Disposal

6.10. EMAX-SM04 Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

[1] Referenced from SW846 Method 5030B, Section 6.1.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure.

7.3. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS & REAGENTS

8.1. Instruments and Supplies

Purge and Trap System (Concentrator)	LSC 2000 Tekmar/OI4560 or equivalent
Autosampler	Archon or equivalent
Gas Chromatography	HP 5890 Series II, GC with FID
Column	DB5 – 30m x .53 mm, 1.5 µm thickness, or equivalent
Gas	ultra-high purity helium, ultra-high purity hydrogen, hydrogen generator unit, compressed air
Syringes	5 ml Luerlok hypodermic gas-tight with shut-off valve
Microsyringes	Hamilton or equivalent
Data System	EZ-Chrom
Purge Trap	Supelco, Trap “G” or equivalent

9.0 STANDARDS

9.1. Stock Standard

9.1.1. All stock standards are purchased as certified solutions. Intermediate and working standards are prepared according to EMAX-QC02.

9.1.2. All standards should be transferred in inert vials labeled with ID from standard preparation logbook, date of expiration, concentration, and stored with minimal headspace at –10°C to -20°C.

9.2. Calibration Standards

Name	Source	Catalog #	Conc. (µg/ml)	Notes
Unleaded Gas Comp. Std.	Restek	30081	2500	or equivalent

9.3. Surrogate Standards

Name	Source	Catalog #	Conc. (µg/ml)	Notes
Bromofluorobenzene/TFT	Ultra Scientific	STM-410	2000	or equivalent

9.4. LCS/Matrix Spike/Second Source Standard

Name	Source	Catalog #	Conc. (µg/ml)	Notes
Cert. BTEX in Unleaded Gas	AccuStd	30237	5000	or equivalent

9.5. **Intermediate Standard**

Using the stock standard solution, prepare in methanol and store with minimal headspace in an inert vial. Prepare secondary dilution standards from the stock standards at concentration levels as follows:

Gasoline	Surrogate	LCS/Matrix Spike
2500 mg/L	50 mg/L	5000 mg/L

9.6. **Working Standard**

9.6.1. Initial Calibration Standard

Prepare initial calibration standards in 5 ml organic free water with concentrations as suggested below:

Standard	2500 mg/L	50 mg/L (BFB)	Final Conc. (gas, µg/L)
1	0.04 µl	1 µl	20/10
2	0.1µl	2 µl	50/20
3	0.2 µl	3 µl	100/30
4	1 µl	4 µl	500/40
5	2 µl	5 µl	1000/50
6	4 µl	7.5 µl	2000/75
7	6 µl	10 µl	3000/100

9.6.2. Continuing Calibration Standard

Using intermediate standards, prepare daily calibration standards in a syringe with 5 ml of organic free water as suggested below:

Standard	2500 mg/L (Gas)	50 mg/L (BFB)	Final Conc. µg/L
DCC	2.0 µl	5.0 µl	1000/50

9.6.3. Surrogate Solution

Blank	Surrogate Standard	Conc. µg/L
5 ml	4.0 µl	40

9.6.4. Spiking Solution

Sample (Blank)	Spiking Standard (5000 mg/L)	Surrogate (50 mg/L)	Conc. (µg/L)
5 ml	0.5 µl	4 µl	500/40

9.7. **Initial Calibration Verification/Second Source Standard: Accu Standard**

Sample (Blank)	Spiking Standard (5000 mg/L)	Surrogate (50 mg/L)	Conc. (µg/L)
5 ml	0.5 µl	4 µl	500/40

9.7.1. Prepare an intermediate standard at 5000 mg/L from an independent source to verify the concentration after the initial calibration. Use this standard to spike ICV sample.

9.8. **Retention Time Window Standard**

9.8.1. Prepare a standard containing a mixture of 2-methylpentane and 1,2,4-trimethylbenzene (or C_6 to C_{10}) at 10 mg/L for retention time analysis. Use this standard to spike RTW sample.

9.9. Other concentration levels may be used as appropriate.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Prepare aqueous samples in accordance with EMAX-5030. Add surrogates to all samples to yield 40µg/L prior to purging unless otherwise specified by the project.

10.1.2. Prepare soil samples in accordance with EMAX-5035. Add surrogates to all samples to yield 40µg/Kg prior to purging unless otherwise specified by the project.

10.1.3. Prepare LCS/LCD by spiking a reagent blank to yield 500 µg/L spike standard unless otherwise specified by the project. Add surrogate at the same level as the samples.

10.1.4. Prepare MS/MSD sample using the assigned matrix QC sample similarly as the LCS sample.

10.2. **Instrument Parameters**

10.2.1. Initially, set the instrument parameters as suggested in the table below.

10.2.2. Gas Chromatographic Condition

Carrier gas flow (column) helium	9-10 ml/min			
Make up gas (He)	20-21 ml/min			
Helium Tank	80 psi			
Detector Temperature	Detector A: OFF; Detector B: 235°C			
Temperature programming:	Initial temperature: 35°C Initial time: 6 minutes			
	Level	Rate (°C/min)	Initial Temp(°C)	Final Time (min)
	1	8.00	70.0	0
	2(A)	5.00	120	5.0
	2(B)	25.0	230	5.0

10.2.3. Purge and Trap Condition

Purge	10 min. at room temperature

Desorb	2 min. at 180°C
Bake	15 min. at 185°C

10.2.4. Optimize the instrument for its intended use.

10.2.5. Record the instrument operating condition on the instrument maintenance log and post the latest instrument parameter setup in front of the instrument for ease when performing the instrument routine check.

10.2.6. When instrument parameter setup requires change due to instrument optimization document the change as described in 10.2.5.

10.3. **Calibration**

10.3.1. Initial Calibration (ICAL)

10.3.1.1. Prepare initial calibration solution as described in Section 9.6.1. Analyze them as described in Section 10.4.

10.3.1.2. Refer to Section 10.5 for calculation.

10.3.1.3. Acceptance criteria are specified in Appendix 1.

10.3.2. Initial Calibration Verification (ICV)

10.3.2.1. Spike 5 ml water reagent with 0.5 µl of 5000 mg/L ICV standard and 4µl of 50 mg/L of surrogate standard. The ICV result is expected to yield 500 µg/L of GRO and 40 µg/L of surrogate.

10.3.2.2. After establishing ICAL, analyze the ICV standard to verify the concentration of the ICAL. Refer Appendix 1 for acceptance criteria. If non-compliant refer to Section 12 for corrective action.

10.3.3. Retention Time Window Check (RTW)

10.3.3.1. Spike 5 ml water reagent with 0.5 µl of 2000 mg/L RTW standard.

10.3.3.2. Analyze the RTW check sample after every ICAL to ensure retention time window validity. Refer to Section 10.4.3 for establishing RTW.

10.3.4. Continuing Calibration (DCC)

10.3.4.1. Spike 5 ml water reagent with 2.0 µl of 2500 mg/L DCC standard and 5 µL of 50 mg/L of surrogate standard. The sample result is expected to yield 500 µg/L of GRO and 50 µg/L of surrogate.

10.3.4.2. Analyze the DCC (Refer to Section 9.6.2 for standard preparation) standard to verify the validity of the ICAL. Refer to Appendix 1 for acceptance criteria. If non-compliant refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. Analytical Sequence

10.4.1.1. Analyze instrument blank to ensure that the instrument is free from contamination.

10.4.1.2. Analyze DCC to check ICAL validity.

10.4.1.3. Analyze Method Blank to check for prep batch contamination

10.4.1.4. Analyze Lab Control Sample to check accuracy

10.4.1.5. Analyze Lab Control Sample Duplicate (if required by the project)

10.4.1.6. Analyze samples to a maximum number of 12-hour runs or as specified by the project.

10.4.1.7. Analyze a pair of matrix spikes (MS/MSD) per project requirement.

10.4.1.8. Record the analytical sequence in the GC Run Log.

10.4.1.9. Print instrument sequence before and after the analysis run and attached it to the analytical run. Document any changes that occurred during the process.

10.4.2. Identification and Quantitation

10.4.2.1. Identification is based on pattern recognition. Hence, compare sample chromatograms to reference hydrocarbons standard chromatograms for their response hydrocarbon range and peak distribution to determine the most probable petroleum product. Gasoline falls within the C_6-C_{10} range.

10.4.2.2. All peaks eluting within the established RT window identifies the GRO.

10.4.2.3. When the elution profile of a sample does not match that of gasoline standard, but falls within the retention time window, quantitate results as gasoline range organics (GRO) and denote the observed deviation in case narrative.

10.4.2.4. Quantitation is achieved by the summation of all peaks in the chromatogram minus the solvent peak, and the sample result is calculated using Equation 10.5.3.

10.4.2.5. Integrate the total peak area response and quantitate the total area by using the ACF of gasoline (see section 10.5.1).

10.4.2.6. When manual integration is necessary follow the procedures described in EMAX-DM01, Manual Integration section.

10.4.3 Retention Time Windows (RTW)

10.4.3.1 Establishing RTW

10.4.3.1.1 Run RTW standard over a period of 72 hours.

10.4.3.1.2 Calculate the Standard Deviation (SD) of absolute retention time obtained for each analyte.

10.4.3.1.3 The width of RTW is defined by ±3XSD obtained from 10.4.3.1.2.

10.4.3.2 Evaluating RTW

10.4.3.2.1 If the SD is equal to 0.00, default to the previous study until historical data is obtained to define the RTW for the current instrument.

10.4.3.2.2 For new instruments, use the established retention time from another instrument having the same instrument parameters (e.g. detector, temperature program and column.) If there are no instruments with the

same instrument parameter, use 0.03 minutes as the default RTW until historical data is obtained to define the RTW for the current instrument parameters condition.

10.4.3.3 Application of RTW

10.4.3.3.1 Establish the center of absolute retention time for each analyte to include the surrogate(s) from the daily calibration check at the beginning of the analytical shift then apply the established RTW.

10.4.3.3.2 Whenever the observed retention time is outside the established RTW, the analyst is advised to determine the cause and perform necessary corrective action before continuing analyses.

10.4.3.4 Updating RTW

10.4.3.4.1 Re-establish the RTW as described in Section 10.4.3.1 when any of the following conditions occur.

- Yearly RTW update
- Significant shifting is observed (e.g. succeeding calibration checks or LCS are out of the RTW)
- Major instrument maintenance (e.g. replacements of detector or column, temperature program change, etc.)

10.4.3.4.2 If the calculated new RTW is significantly narrower than the previously established RTW, default to the previously established RTW.

10.4.4 Sample Result Evaluation

10.4.4.1 Check surrogate recoveries against project specific requirement (PSR). In the absence of PSR, default to in-house QC procedures described in Appendix 1.

10.4.4.2 Dilute and re-analyze samples having concentrations greater than the highest calibration range.

10.4.4.3 Dilute and re-analyze samples having saturated peak(s) within C_6 – C_{10}. See Figure 1 for typical saturated peak.

10.4.4.4 Re-analyze samples suspected of carry-over from a proceeding sample that has high concentration.

10.4.4.5 Report discrete peak(s) observed as required by the project. Column bleed subtraction is not generally required in GRO analysis.

10.5 **Calculations**

10.5.1 Initial Calibration

10.5.1.1 Calculate the Calibration Factor (CF).

$$CF = \frac{R_a}{C_k} \qquad \textit{Eq. 10.5.1.1}$$

where:

CF - *is the calibration factor*

R_a - *is the analyte response measured in peak area*

C_k - *is the known concentration of the analyte in µg/L (H_2O); µg/Kg (Soil)*

10.5.1.2 Calculate the Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}} \qquad \textit{Eq. 10.5.1.2}$$

where:

SD - *is the standard deviation*

x_i - *is the result at the ith measurement*

$\bar{x}$ - *is the mean*

N - *is the number of measurements*

10.5.1.3 Calculate the Percent Relative Standard Deviation (%RSD).

$$\%RSD = \left[\frac{SD}{ACF}\right] 100 \qquad \textit{Eq. 10.5.1.3}$$

where:

%RSD - *is the percent relative standard deviation*

SD - *is the standard deviation*

ACF - *is the average calibration factor*

10.5.1.4 Calculate the Average Calibration Factor (ACF)

$$ACF = \frac{\sum CF}{N} \qquad \textit{Eq. 10.5.1.4}$$

where:

ACF - *is the average calibration factor*

∑CF - *is the summation of the calibration factors*

N - *is the number of calibration points*

10.5.2 Calculate the Percent Difference for DCC from ACF

$$\%D = @\,abs\left[\frac{Ck - Cf}{Ck}\right] * 100 \qquad \textit{Eq. 10.5.2}$$

where:

%D - *is the percent difference DCC from the ACF*

Ck - *known concentration of analyte, in µg/L*

Cf - *is the concentration found, in µg/L*

10.5.3 Calculate Sample Results

$$C = \left[\frac{R_a}{ACF}\right]\left[\frac{V_e}{S_a}\right] DF$$ *For water samples* *Eq. 10.5.3.1*

$$C = \left[\frac{R_a}{ACF}\right]\left[\frac{V_e}{(S_a)(\%S)}\right] DF$$ *For soil samples* *Eq. 10.5.3.2*

where:

C - *is the concentration of analyte in µg/L (H2O), µg/Kg (soil)*

R_a - *is the analyte response measured in peak area*

ACF - *is the average calibration factor from initial standard calibration*

V_e - *is the purgeable volume in ml*

S_a - *is the sample amount in ml (H_2O); g (Soil)*

DF - *is the dilution factor*

%S - *is the percent solid of the sample*

10.5.4 Calculate the percent recovery of spike in LCS.

$$\% R = \left[\frac{C_f}{C_o}\right] 100$$ *Eq. 10.5.4*

where:

%R - *is the percent recovery*

C_f -*is the concentration found, in µg/L*

C_o - *is the known concentration of spiked solution, in µg/L*

10.5.5 Calculate the MS recovery

$$\% R = \left[\frac{(C_f - C_s)}{C_o}\right] 100$$ *Eq. 10.5.5*

where:

%R - *is the percent recovery*

C_f - *is the concentration found, in µg/L*

C_s - *is the concentration of the sample, in µg/L (H_2O); in µg/Kg (Soil)*

C_o - *is the known concentration of spiked solution*

10.5.6 Calculate the precision.

$$\% RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \textit{Eq. 10.5.6}$$

where:

RPD - is the relative percent recovery

C1 – Measured concentration of the first sample aliquot

C2 – Measured concentration of the second sample aliquot

10.6 **Data Reduction**

10.6.1 Make a copy of the analytical run log and highlight the data to be reported.

10.6.2 Collate the reportable raw data separating the QC results from the sample results.

10.6.3 Keep all other data generated with the analytical folder marked with "For record only".

10.7 **Report Generation**

10.7.1 Generate the method.txt file using WBDX[2].exe.

10.7.2 Generate the sample results using F1NVX[2].exe

10.7.3 Generate the QC summary using QCVX[2].exe

10.7.4 Generate Lab Chronicle using LABCHRNX[2].exe

10.7.5 Generate the Case Narrative using CN1.exe

10.8 **Data Review**

10.8.1 Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analyses.

- Case Narrative
- Lab Chronicle
- Sample Results
- LCS/LCSD Summary
- MS/MSD Summary
- ICAL Summary
- ICV Summary
- DCC Summary
- Analytical Log

X[2] - version number

- Sample Preparation Log

10.8.2 Perform a 100% data review in accordance to EMAX-DM01 and the PSR.

10.8.3 Check that qualitative identification is done properly.

10.8.4 Check that samples results are integrated properly and results over calibration range are diluted and re-analyzed within the calibration range.

10.8.5 Where manual integration was performed, checked that it was done properly and documentation was retained in accordance to EMAX-DM01, Manual Integration Section.

10.8.6 Check that presence of saturated peak(s) are diluted, and quantitated properly.

10.8.7 Check that suspected carry-overs are re-analyzed and results are reported accordingly.

10.8.8 Check that discrete peaks [other than column bleeds] are reported according to project requirement.

10.8.9 Review the case narrative and edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.10 Submit the analysis package for secondary review.

10.9 **Preventive Maintenance**

10.9.1 Perform daily instrument check prior to sample analysis. Refer to Form 8015GFM – Instrument Maintenance Log.

Maintenance Activity	Description	Frequency
Autosampler	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis.
Verification	Check gas pressure Check instrument parameters to ensure normal operating conditions. Change liner as necessary. Check instrument performance (e.g., Daily calibration check, instrument blank)	Daily prior to analysis.
Documentation	Record all instrument maintenance performed in the instrument maintenance log.	Daily prior to analysis
System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector. Check septa and replace as necessary.	Every 6 months or as necessary
Check Flow Path Components	Check and if necessary, change injection port liners, septa and O-rings. Change the carrier gas trap(s) and purifier	Once a year or as necessary
Complete Inspection	Perform general inspection of the complete system. Inspect autosampler cabling and configuration setting.	Once a year

10.9.2 Maintain an inventory of instrument parts and supplies for routinely maintenance.

11.0 QUALITY CONTROL

11.1. **Sample Preparation**

11.1.1. A preparation batch shall consist of a MB, LCS, MS/MSD and ≤ 20 field samples.

11.1.2. Decontaminate volumetric flasks used for standard preparation with methanol.

11.1.3. All solvents and reagents shall undergo quality control check in the stationary laboratory prior to its use.

11.2. **Analytical Batch**

11.2.1. Initial Calibration must be established and verified by daily continuing calibration as described in Appendix 1.

11.2.2. Analytical batch shall consist of a valid ICAL, QC samples and field samples bracketed with DCC every 12-hour analytical sequence, unless other frequency is prescribed by the project.

11.2.3. A record must be established that the analytical instrument is free from contamination prior to any analysis. This can be achieved by analyzing a solvent blank and identifying its result as instrument blank.

11.2.4. Organic free water shall be used for method blank and LCS for water matrix.

11.2.5. Organic free sand shall be used for method blank and LCS for soil matrix.

11.3. **Method QC**

11.3.1. LOD and LOQ must be established before the analytical procedure can be used and verified according to EMAX-QA04.

11.3.2. Retention Time Window must be established and updated accordingly.

11.3.3. Demonstration of capability must be established before the analytical procedure can be used.

11.3.4. All analysts conducting this analysis must have established demonstration of capability.

12.0 CORRECTIVE ACTION

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures in Appendix 1. Document the out of control event and corrective action in the analytical logbook. If the problem persists, consult the supervisor

12.2. **Calibration**

12.2.1. If initial calibration is non-compliant, consider the following suggestions to correct the problem:

12.2.1.1. If RSD > 20%, check each calibration point. If an outlier exists, re-analyze that calibration point.

12.2.1.2. If ICV not within the expected recovery range, review the chromatogram.

- Bias low results are indicative of poor purging or standard degradation.
- Bias high is indicative of inaccurate standard injection of instrument contamination.

- Consider preparing a fresh ICV standard and re-analyze the ICV.

12.2.1.3. If problem persist, inform the Supervisor prior to re-calibration

12.2.2. If the continuing calibration is non-compliant, consider the suggestions described in correcting ICV.

12.2.3. If instrument blank/reagent blank is non-compliant, consider the following suggestions to correct the problem:

12.2.3.1. Check the reagent water source e.g. same source is used by a similar analysis on a different instrument to rule out reagent contamination.

12.2.3.2. Bake the sample concentrator and or GC column for at least 15 min.

12.2.3.3. Re-calculate the data and/or re-analyze the extract if any of the above checks reveals a problem.

12.2.3.4. If problem persists, inform the Supervisor prior to re-analysis.

12.3. **Surrogates**

12.3.1. If surrogates are non-compliant, and are not due to matrix effects, consider the following suggestions to correct the problem:

12.3.1.1. Check that the surrogate peak is properly integrated.

12.3.1.2. Check for calculation errors and that the concentrations of the surrogate solutions are correct.

- High recoveries may be due to co-eluting matrix interference, examine the sample chromatogram.
- Low recoveries may be due to a poor purge, check the purge tube with a blank before re-analyzing the sample.

12.3.1.3. Check instrument performance to determine if it is within acceptable guidelines.

12.4. **Sample Preparation QCs**

12.4.1. If method blank is non-compliant, consider the following suggestions to correct the problem:

- Check the sample results. If sample results are non-detected, you may report the result upon concurring with the PM, otherwise perform the corrective action as specified in the PSR.

12.4.2. If LCS is non-compliant, consider the following suggestions to correct the problem:

- Check for errors in calculation and concentration of the analyte solution.
- Check instrument performance to determine if it is within acceptable guidelines.
- Re-calculate the data and/or re-analyze the extract if any of the above checks reveals a problem.

12.5. **Technical Holding Time**

12.5.1. If samples are out of technical holding time, fill-out a Non-Conformance Report (NCR) and forward it to the project manager who will consult with the client for further instruction**.** Refer to EMAX-QA08 for NCR details**.**

12.6. **Sample Preservation**

12.6.1. If water samples are not labeled preserved or samples were received out of the expected range of refrigeration, inform the PM for the PM to consult with the client for further instruction.

12.6.2. If water samples are marked preserved and pH is > 2, discuss it in the case narrative.

12.7. **Non-conformance Report**

12.7.1. Generate an NCR when the following circumstances occur

- Sample was not analyzed within the holding time
- Sample was insufficient to perform analysis

12.7.2. Refer to EMAX-QA08 for details.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to Waste Disposal Unit.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents. Preparation batch is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate. Analytical batch is compose of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Duplicate Sample – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.4. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.5. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.6. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyze to monitor the accuracy of the analytical system.

15.1.7. Matrix – is a component or form of a sample.

15.1.8. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyze to monitor matrix effect on a method's recovery efficiency.

15.1.9. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.10. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.11. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.12. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing volatile analysis by GC unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied

15.4. **Department of Energy Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. U.S. EPA Method 8015C, SW846, as updated

16.2. EMAX Quality Systems Manual (EMAX-QS00), as updated.

17.0 APPENDICES

17.1. Figures

17.1.1. Figure 1 Typical Peak Evaluation

17.1.2. Figure 2 Typical Chromatogram

17.1.3. Figure 3 Typical ICAL Summary

17.1.4. Figure 4 Typical Continuing Calibration Summary

17.1.5. Figure 5 Typical Raw Data

17.1.6. Figure 6 Typical Sample Report

17.1.7. Figure 7 Typical LCS Summary

17.1.8. Figure 8 Typical MS/MSD Summary

17.1.9. Figure 9 Typical Case Narrative

17.2. Appendices

17.2.1. Appendix 1 Summary of Quality Control Procedures

17.2.2. Appendix 2 Demonstration of Capability

17.3 Forms

17.3.1 8015GFA Analytical Run Log

17.3.2 8015GFM Instrument Maintenance Log

Figure 1: TYPICAL PEAK EVALUATION

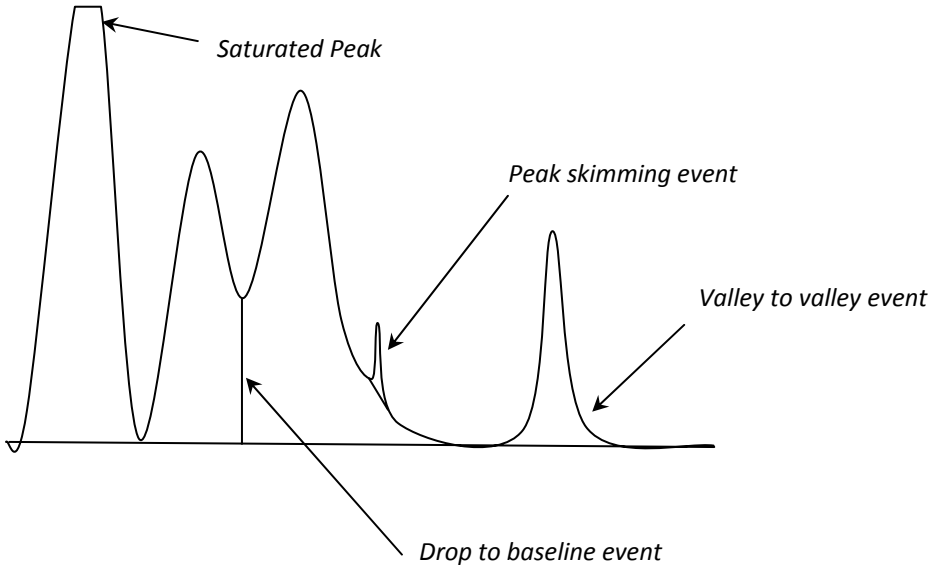


Figure 2: TYPICAL CHROMATOGRAM

METHOD 8015 by FID
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\ek15\ek15.013
Method : c:\ezchrom\methods\vg39k01.met
Sample ID : CVG37K01045 1000/50
Acquired : Nov 15, 2010 18:36:04
Printed : Dec 13, 2010 10:59:26
User : RAYMOND

Channel A Results

#	Peak Name	Ret.Time(Min)	Area	Ave. CF	ESTD Conc.(PPB)
13	1,1,1-TFT	3.150	1109789.0	23512.2	47.20
35	Bromofluorobenzene	10.667	783034.0	15956.4	49.07
G1	GASOLINE(TOTAL)		14306482.0	15508.5	922.49
G2	GRO(C6-C10)		12458496.0	12779.8	974.86
G3	GRO(2MP-124TMB)		12458496.0	12764.9	976.00
G4	GRO(C5-C12)		14306482.0	15501.9	922.89
G5	GRO(C6-C12)		14189894.0	15415.5	920.50

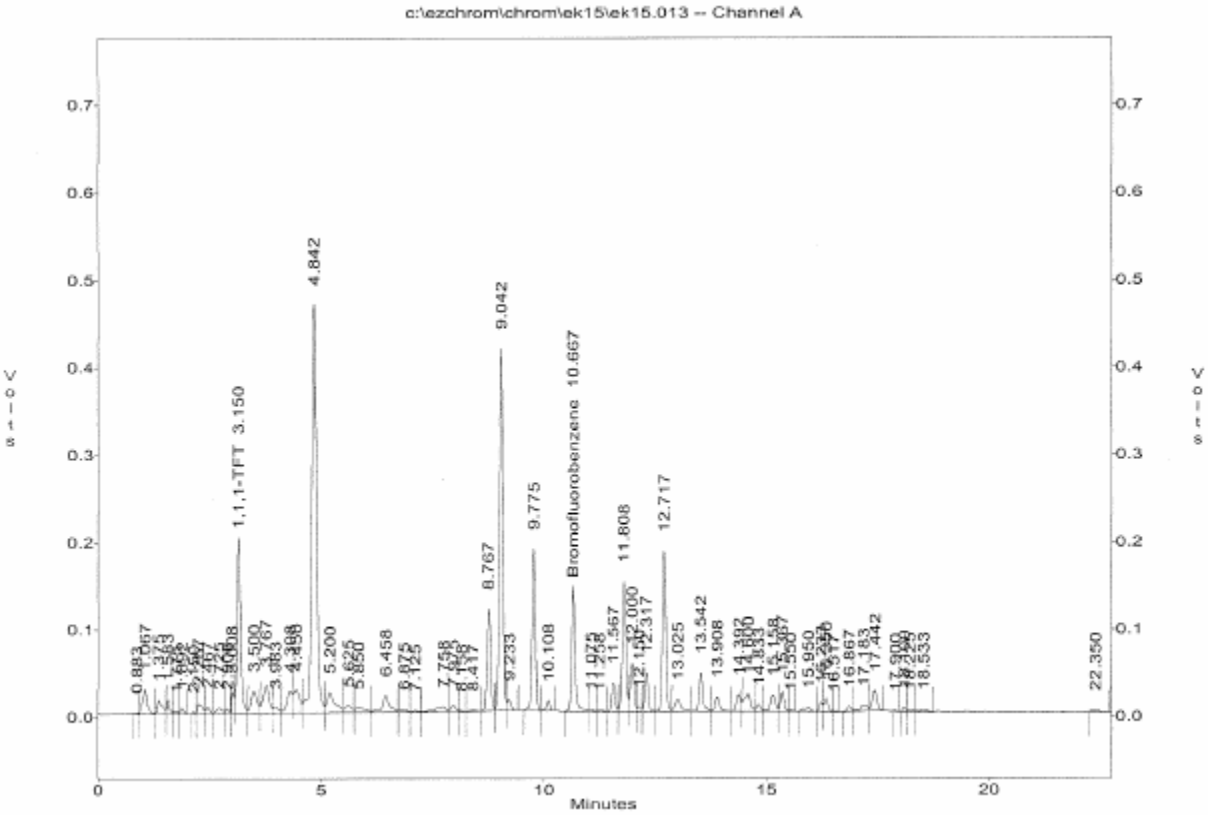


Figure 3: **TYPICAL ICAL SUMMARY**

INITIAL CALIBRATION
5030B/M8015

Lab Name : EMAX Inc
Instrument ID : GCT39
GC Column : DB-5
Column size ID : 30MX.53MM
LFID & Datetime: EK01002A 11/01/10 11:06
LFID & Datetime: EK01003A 11/01/10 11:48
LFID & Datetime: EK01004A 11/01/10 12:29
LFID & Datetime: EK01005A 11/01/10 13:11
LFID & Datetime: EK01009A 11/01/10 15:55
LFID & Datetime: EK01007A 11/01/10 14:33
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS 1.00X	2.50X	5.00X	25.00X	(AREA)/UNIT 50.00X	100.00X	MEAN	%RSD	
Gasoline(TOTAL)	20.00	14203	16029	15706	15253	15738	16122	15508.5	4.6	✓
GRO(C6-C10)	20.00	10800	12361	12524	13429	13700	13865	12779.8	9.0	✓
GRO(2MP-124TMB)	20.00	10800	12361	12524	13429	13700	13776	12764.9	8.9	✓
GRO(C5-C12)	20.00	14203	16029	15682	15253	15726	16118	15501.9	4.5	✓
GRO(C6-C12)	20.00	14203	15978	15633	15100	15587	15990	15415.5	4.4	✓
SURROGATE	**X**	**1.00X**	**2.00X**	**3.00X**	**4.00X**	**5.00X**	**7.50X**	**MEAN**	**%RSD**	
Bromofluorobenzene	10.00	14034	14082	14613	15800	18344	18864	15956.4	13.5	✓
1,1,1-Trifluorotoluene	10.00	22522	21994	21284	23018	25519	26737	23512.2	9.1	✓

VG39K01.MET

INITIAL CALIBRATION
5030B/M8015

Lab Name : EMAX Inc
Instrument ID : GCT39
GC Column : DB-5
Column size ID : 30MX.53MM
LFID & Datetime: EK01002A 11/01/10 11:06
LFID & Datetime: EK01003A 11/01/10 11:48
LFID & Datetime: EK01004A 11/01/10 12:29
LFID & Datetime: EK01005A 11/01/10 13:11
LFID & Datetime: EK01009A 11/01/10 15:55
LFID & Datetime: EK01007A 11/01/10 14:33

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.5X	5.0X	25.0X	50.0X	100.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
Gasoline(TOTAL)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GRO(C6-C10)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GRO(2MP-124TMB)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GRO(C5-C12)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GRO(C6-C12)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURROGATE	**1.0X**	**2.0X**	**3.0X**	**4.0X**	**5.0X**	**7.5X**	**RT**	**FROM**	**TO**	**WIDTH**
Bromofluorobenzene	10.667	10.675	10.667	10.675	10.658	10.650	10.665	10.612	10.718	0.053
1,1,1-Trifluorotoluene	3.158	3.158	3.158	3.158	3.150	3.142	3.154	3.053	3.255	0.101

VG39K01.MET

Figure 4: TYPICAL CONTINUING CALIBRATION SUMMARY

CONTINUE CALIBRATION
5030B/M8015

Lab Name : EMAX Inc
Instrument ID : GCT39
GC Column : DB-5
Column size ID : 30MX.53MM
Mid Conc Init LFID & Datetime: EK01009A 11/01/2010 15:55
Conc Cont LFID & Datetime: EK15013A 11/15/2010 18:36
CONC UNIT : ppb

COMPOUND	RT MINUTES	RT WINDOW FROM	RT WINDOW TO	TRUE CONC	AVERAGE CF	RESULT AREA	RESULT CONC	%D	QL	%D LIMITS
Gasoline(TOTAL)	NA	NA	NA	1000.0	15508.5	14306482	922.49	-8		15
GRO(C6-C10)	NA	NA	NA	1000.0	12779.8	12458496	974.86	-3		15
GRO(2MP-124TMB)	NA	NA	NA	1000.0	12764.9	12458496	976.00	-2		15
GRO(C5-C12)	NA	NA	NA	1000.0	15501.9	14306482	922.89	-8		15
GRO(C6-C12)	NA	NA	NA	1000.0	15415.5	14189894	920.50	-8		15
SURROGATE	**MINUTES**	**FROM**	**TO**	**TRUECON**	**CF**	**AREA**	**CONC**	**%D**	**QL**	**LIMITS**
Bromofluorobenzene	10.667	10.614	10.720	50.0	15956.4	783034	49.07	-2		15
1,1,1-Trifluorotoluene	3.150	3.049	3.251	50.0	23512.2	1109789	47.20	-6		15

Figure 5: **TYPICAL RAW DATA**

METHOD 8015 by FID
EMAX Analytical Laboratories, Inc.

```
File          : c:\ezchrom\chrom\ek15\ek15.014
Method        : c:\ezchrom\methods\vg39k01.met
Sample ID     : 10K080-03 5.0ML W
Acquired      : Nov 15, 2010 19:17:24
Printed       : Dec 13, 2010 11:00:34
User          : RAYMOND
```

Channel A Results

#	Peak Name	Ret.Time(Min)	Area	Ave. CF	ESTD Conc.(PPB)
1	1,1,1-TFT	3.150	803320.0	23512.2	34.17
3	Bromofluorobenzene	10.658	552551.0	15956.4	34.63
G1	GASOLINE(TOTAL)		185238.0	15508.5	11.94
G2	GRO(C6-C10)		43346.0	12779.8	3.39
G3	GRO(2MP-124TMB)		43346.0	12764.9	3.40
G4	GRO(C5-C12)		185238.0	15501.9	11.95
G5	GRO(C6-C12)		185238.0	15415.5	12.02

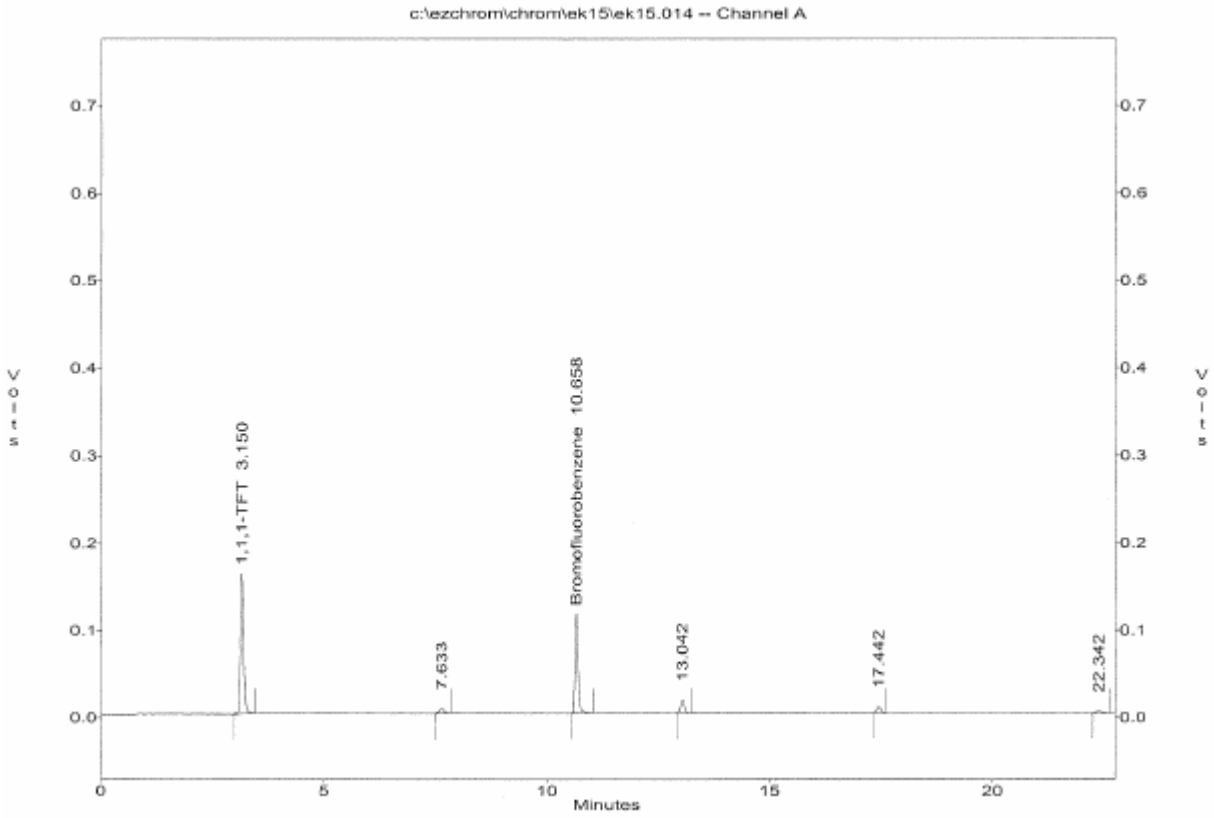


Figure 6: TYPICAL SAMPLE RESULT SUMMARY

METHOD 5030B/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

Client : XYZ, INC.	Date Collected: 11/08/10
Project : CLEAN PROJECT	Date Received: 11/08/10
Batch No. : 10K080	Date Extracted: 11/15/10 19:17
Sample ID: 54-050	Date Analyzed: 11/15/10 19:17
Lab Samp ID: K080-03	Dilution Factor: 1
Lab File ID: EK15014A	Matrix : WATER
Ext Btch ID: VA39K17	% Moisture : NA
Calib. Ref.: EK15013A	Instrument ID : GCT039

PARAMETERS	RESULTS (mg/L)	LOQ (mg/L)	LOD (mg/L)
GASOLINE	ND	0.10	0.020

SURROGATE PARAMETERS	RESULTS	SPK_AMT	% RECOVERY	QC LIMIT
BROMOFLUOROBENZENE	0.0346	0.0400	87	60-140

Parameter	H-C Range
Gasoline	C6-C10

Figure 7: **TYPICAL LCS/LCSD SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
BATCH NO.: 10K080
METHOD: METHOD 5030B/M8015

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	MBLK1W				
LAB SAMP ID:	VA39K17B	VA39K17L	VA39K17C		
LAB FILE ID:	EK15003A	EK15004A	EK15005A		
DATE EXTRACTED:	11/15/1011:42	11/15/1012:23	11/15/1013:05	DATE COLLECTED:	NA
DATE ANALYZED:	11/15/1011:42	11/15/1012:23	11/15/1013:05	DATE RECEIVED:	11/15/10
PREP. BATCH:	VA39K17	VA39K17	VA39K17		
CALIB. REF:	EK15002A	EK15002A	EK15002A		

ACCESSION:

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Gasoline	ND	0.500	0.461	92	0.500	0.474	95	3	60-130	30

SURROGATE PARAMETER	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	QC LIMIT (%)
Bromofluorobenzene	0.0400	0.0380	95	0.0400	0.0376	94	70-130

Figure 8: **TYPICAL MS/MSD SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
BATCH NO.: 10K080
METHOD: METHOD 5030B/M8015

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	54-050				
LAB SAMP ID:	K080-03	K080-03M	K080-03S		
LAB FILE ID:	EK15014A	EK15015A	EK15016A		
DATE EXTRACTED:	11/15/1019:17	11/15/1019:58	11/15/1020:40	DATE COLLECTED:	11/08/10
DATE ANALYZED:	11/15/1019:17	11/15/1019:58	11/15/1020:40	DATE RECEIVED:	11/08/10
PREP. BATCH:	VA39K17	VA39K17	VA39K17		
CALIB. REF:	EK15013A	EK15013A	EK15013A		

ACCESSION:

PARAMETER	SMPL RSLT (mg/L)	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Gasoline	ND	0.500	0.426	85	0.500	0.416	83	2	50-130	30

SURROGATE PARAMETER	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	QC LIMIT (%)
Bromofluorobenzene	0.0400	0.0382	95	0.0400	0.0373	93	60-140

Figure 9: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN PROJECT

SDG : 10K080

METHOD 5030B/M8015
TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP

A total of four (4) water samples were received on 11/08/10 for TPH Gasoline analysis, Method 5030B/M8015 in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source (ICV). Continuing calibration (CCV) verifications were carried on a frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for VA39K17L/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for K080-03M/S were within project QC limits.

Surrogate
Surrogate was added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC Procedure	Frequency	Acceptance Criteria	Corrective Action	1st Rvw	2nd Rvw
Five-point initial calibration for all analytes	Initially; as needed	ACF RSD: ≤ 20%	Correct the problem then repeat initial calibration		
Initial calibration verification (ICV)	After initial calibration	Within ± 20% of expected value	Correct the problem then repeat initial calibration		
Calibration verification (DCC)	Every 12 hours of analysis time and at the end of analysis sequence	Within ± 20% of expected value	Correct the problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification		
Method blank	One per preparation batch	No analytes detected ≥ ½ LOQ	If sample results are ND or contamination is < 10X of sample result, consult with the PM if results are reportable. Otherwise, determine the source of contamination and correct the problem. Reanalyze method blank and all samples processed with the contaminated blank. If re-analysis is not possible, apply B to specific analyte(s) on all associated.		
LCS	One LCS per preparation batch	within project QC Limits	Re-prep and reanalyze the LCS and all associated samples		
Surrogate spike	Every sample, spiked sample, standard, and method blank	Within project QC Limits	If no apparent matrix interference is observed, reanalyze the sample. Otherwise inform the PM for further instruction.		
MS/MSD	One MS/MSD per every 20 project samples per matrix	Refer to project QC Limits	Ensure that spike concentration, spike addition was accurate and calculation is correct. If chromatogram exhibits matrix interference narrate observation in the case narrative.		
Chromatogram	All sample results	Within calibration range No saturated peak(s)	Dilute and re-analyze all samples over the calibration range Diluted and re-analyzed all samples demonstrating saturated peak(s) even if the total integrated peaks do not exceed the calibration range.		
Notes: Discrete peaks are included for GRO Discrete peaks are subtracted for Gasoline Refer to PSR for flagging criteria. Report results between LOD and LOQ.				Reviewed By Date	

Appendix 2: **DEMONSTRATION OF CAPABILITY**

INITIAL DEMONSTRATION OF CAPABILITY
GASOLINE RANGE ORGANICS
METHOD: SW 8015C

SOP: EMAX-8015G
Conc Unit: µg/L
Sample Amount(ml): 5

Instrument ID: 39
Analysis date: 11/2/2010
Analyzed by: R. Huang

PARAMETER	EK01030A	EK01031A	EK01032A	EK01033A	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	VA39K01L	VA39K01C	VA39K02L	VA39K02C							
Gasoline (Total)	405.3	418.9	403.0	416.8	500	411	82	8.01	2	70 - 130	PASSED
GRO (C6-C10)	406.7	416.6	403.3	413.1	500	410	82	6.07	1	70 - 130	PASSED
GRO (2MP - 124TMB)	403.7	412.5	400.3	413.6	500	408	82	6.56	2	70 - 130	PASSED
GRO (C5-C12)	405.5	419.1	403.0	417.0	500	411	82	8.07	2	70 - 130	PASSED
GRO (C6-C12)	402.5	416.4	400.1	414.4	500	408	82	8.28	2	70 - 130	PASSED
1,1,1-TFT	39.8	38.5	38.4	39.2	40	39.0	97	0.67	2	70 - 130	PASSED
Bromofluorobenzene	37.9	36.0	36.3	35.9	40	36.5	91	0.92	3	70 - 130	PASSED

8015FA: **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
NONHALOGENATED VOLATILES

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Comments:

Book #: A39- 036

Instrument No.: 39

Analytical Sequence:

Method File: ☐ FID Channel A ☐ PID Channel B

Analytical Batch:

SOP #	Rev. #
☐ EMAX-5030B	
☐ EMAX-BTEXM	
☐ EMAX-8015G	
☐ EMAX-AK101	
☐ EMAX-	

STANDARDS ID	CONC. (mg/L)
ICAL	
ICV	
DCC GAS	
DCC BTEX	
BFB/TFT	
LCS/LCSD	
MS/MSD	

Purge Volume	5 ml

SOLVENT	ID
Methanol	

ELECTRONIC DATA ARCHIVAL	
Location	Date
☐ EZC-3-BTEX	
☐	

Analyzed By:

Date:

8015GFS: **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

EXTRACTION LOG
for
NONHALOGENATED VOLATILES

Page 1

Note: For samples, relevant QCs/Standards extracted, refer to attached extraction sequence.

Comments:

Book #.: E39-025

Preparation Batch:

Matrix

SOP	Rev. #
☐ EMAX-5035	
☐ EMAX-AK101	
☐ EMAX-	

Standards	ID	Amount Added (ml)
Surrogate		
LCS/MS		
Methanol		
Methanol w/ Surrogate		

Reagent	Lot # / ID
Silica Sand	

Prepared By:

Standard Added By: Checked By:

Extract Location:

Disposal By: Disposal Date:

8015GFM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

INSTRUMENT MAINTENANCE LOG

Instrument No: 39 Month: Year: 201_ Book # M39-008

DATE							
Computer Date/Time							
Printer Paper							
GC Keyboard Check							
Check Temperature Program							
Column Head Pressure (5-10 psi)							
Carrier Source Pressure (He @ 50psi)							
H_2 Generator: 40-50 psi							
Air Pressure (45 psi)							
Analyst's Initial							
Trouble Shooting							
Problem(s) Encountered							
Return-to-Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrrective Action / Maintenance

STANDARD OPERATING PROCEDURES

ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY

SOP No.:	EMAX-8081	Revision No.	7	Effective Date:	10-Aug-10
Prepared By:	Tu Nisamaneepong			Date:	08-10-10
Approved By:	Kenette Pimentel QA Manager			Date:	08.10.10
Approved By:	Caspar Pang Laboratory Director			Date:	08-10-10.

Control Number: 8081-07-

1.0 SCOPE AND APPLICATION

1.1. This procedure is used to determine the concentration of various Organochlorine Pesticides in soil, sediment, sludge, and wastewater samples by gas chromatography method. This SOP is an adaptation of Method 8081B. Since Method 8081B is an update and enhancement of 8081A, this SOP is also applicable to Method 8081A.

2.0 SUMMARY OF METHOD

2.1. This method provides gas chromatographic conditions for the identification and quantitation of Organochlorine Pesticides with dual Electron Capture Detectors (ECD). The samples are extracted in methylene chloride and exchanged to hexane before GC analysis.

2.2. **Interferences**

2.2.1. Interferences by phthalate esters introduced during sample preparation can pose a major problem in pesticide determinations. Avoiding contact with any plastic materials and checking all solvents for phthalate contamination can minimize interferences. Glassware must be scrupulously cleaned.

2.2.2. The presence of elemental sulfur will result in broad peaks that interfere with the detection of early-eluting organochlorine pesticides. Sulfur contamination is most likely present in sediment samples. The TBA procedure, GPC or other cleanup technique can be used for sulfur removal.

2.2.3. Other interferences such as aliphatic compounds, aromatics and nitrogen-containing compounds may be eliminated by using Florisil cleanup.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Table 8 lists the DL, LOD and LOQ values of the target analytes of this method.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point. All samples analyzed above this concentration are considered "over-range" and shall require dilution for proper quantitation.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required for proper quantitation.

4.3. The linear dynamic range for this method as determined in this SOP is listed on the table below.

Analytes	Water (µg/L)	Soil (µg/Kg)
alpha-BHC, Endosulfan I, gamma-BHC, Heptachlor, Aldrin, alpha-Chlordane, beta-BHC, delta-BHC, gamma-Chlordane, Heptachlor Epoxide	0.05 – 0.6	2 – 20
DDD, DDE, DDT, Dieldrin, Endrin, Endosulfan II, Endosulfan Sulfate, Endrin Aldehyde, Endrin Ketone	0.1 – 1.2	4 – 40
Methoxychlor	0.5 – 6	20 - 200

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Holding Time**

5.1.1. Extract water and soil samples within 7 and 14 days respectively, from the date of collection.

5.1.2. Analyze extracts within 40 days after extraction completion date.

5.2. **Preservation**

5.2.1. Store samples and extract at ≤6°C.

6.0 ASSOCIATED SOPs

6.1. EMAX-DM01 Data Flow and Review

6.2. EMAX-QA04 Method Detection Limit Study

6.3. EMAX-QA08 Corrective Action

6.4. EMAX-QC01 Quality Control for Chemicals

6.5. EMAX-QC02 Analytical Standard Preparation

6.6. EMAX-QC07 Glassware Cleaning

6.7. EMAX-SM03 Waste Disposal

6.8. EMAX-SM04 Analytical and QC Labeling

6.9. EMAX-3510 Extraction, Separatory Funnel

6.10. EMAX-3520 Extraction, Continuous Liquid/Liquid

6.11. EMAX-3545 Extraction, Pressurized Fluid

6.12. EMAX-3550 Extraction, Pulse Sonication

6.13. EMAX-3540 Extraction, Soxhlet

6.14. EMAX-3620 Cleanup, Florisil

6.15. EMAX-3640 Cleanup, GPC

6.16. EMAX-3660 Cleanup, Sulfur

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards.

7.3. ECD contains minute quantity of Radioactive Ni (63). Conduct a wipe test (experienced personnel or manufacturer respectively only) semi-annually or sooner if potential problem is suspected.

7.4. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves at all times when performing this procedure.

7.5. If, for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS, AND REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatography	HP 5890 Series II
Detector	Dual Electron Capture Detectors
Column	RTX CLPEST I (30 m x 0.32 mm x 0.5 µm) RTX CLPEST II (30 m x 0.32 mm x 0.25 µm) (Alternate columns may be used after verification of performance)
Data System	EZ Chrom
Auto Sampler	HP Model 7673A or equivalent
Gas	ultra-high purity nitrogen ultra-high purity hydrogen
Microsyringes	10, 25, 100and 500 ul with a 0.006 mm ID needle (Hamilton 702N or equivalent) for dilution purposes
Automatic Pipettes	Pipetman, 1000 and 200 µl
Transfer Pipette	Pasteur

8.2. **Chemicals and Reagents**

Solvent [GC-grade]	Methylene Chloride, Hexane

9.0 STANDARDS

9.1. **Standard Preparation**

9.1.1. Follow procedures for all standard preparations and labeling as described in EMAX-QC02 and EMAX-SM04, respectively.

9.1.2. Other concentration levels may be prepared to meet the data quality objective of a project.

9.2. **Stock Standard**

9.2.1. Purchase Primary Calibration stock standards as certified solutions in one mixture. After opening, transfer the stock standard to an inert vial and store with a minimum of headspace.

9.2.2. Purchase a Secondary set of stock standards from a different source to verify the concentration of the first set of standard. Treat the secondary standard similarly as the primary standard.

9.2.3. Purchase LCS/MS, surrogate and performance evaluation standards as certified solutions from various suppliers.

9.2.4. All standards shall be stored at ≤ 6°C.

9.3. **Intermediate Standard**

9.3.1. Prepare intermediate standards as suggested in Tables 3 (primary source) and 4 (secondary source).

9.3.2. Store all prepared standards in an inert vial with minimum headspace at ≤ 6°C.

9.4. **Initial Calibration Standard (ICAL)**

9.4.1. Prepare five or more calibration standards as suggested in Table 2 from primary intermediate standard (refer to Table 3).

9.5. **Initial Calibration Verification (ICV)**

9.5.1. Prepare ICV at concentration levels suggested in Table 5 using intermediate standard from second source stock standard (refer to Table 4).

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Prepare DCC from the same source as the ICAL standard as suggested in Table 5.

9.7. **Surrogate Standard**

9.7.1. Prepare surrogate standard as suggested in Table 6.

9.8. **LCS/MS Spike Standard**

9.8.1. Prepare LCS solution as suggested in Table 4.

9.8.2. Prepare MS spike standard as suggested in Table 7.

9.9. **Performance Evaluation Mixture (PEM)**

9.9.1. Prepare PEM as suggested in Table 8.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Prepare aqueous samples as described in EMAX-3520 or EMAX-3510.

10.1.2. Prepare solid samples as described in EMAX-3550, EMAX-3540 or EMAX-3545.

10.1.3. Perform extract clean up (if necessary) as described in EMAX-3620, EMAX-3640 or EMAX-3660, whichever is appropriate.

10.2. **Instrument Parameters**

10.2.1. Method 8081A requires an analytical system complete with a temperature programmable gas chromatograph equipped with an autosampler suitable for on column injection of 1 to 5 µl.

10.2.2. Gas Pressure

N_2 Tank : 40 psi

H_2 Tank : 80 psi

10.2.3. Temperature Program

Initial Temp	130°C, hold for 0 minute
Rate 1	25°C/min.
Temperature 1	230°C, hold for 2 minutes
Rate 2	3°C/min
Temperature 2	260°C, hold for 1 minute
Rate 3	25°C/ min
Final Temperature	300°C, hold for 1 minute
Injector	230°C
Detector	300°C
Injection Volume	2µL

10.3. **Calibration**

10.3.1. **Performance Evaluation Check**

10.3.1.1. Analyze instrument blank and a PEM containing DDT and Endrin to monitor the system performance at 12-hour interval prior to performing any calibration.

10.3.1.2. Calculate the breakdown by using Equations 10.6.6 ($\%B_T$) for DDT and 10.6.7 ($\%B_E$) for Endrin.

10.3.1.3. Check Appendix 1 for acceptance criteria before proceeding with sample analysis.

10.3.1.4. If system failed to meet the acceptance criteria, refer to Section 12 for corrective action.

10.3.2. **Initial Calibration (ICAL)**

10.3.2.1. Perform ICAL if instrument is new, ICV or DCC failed to meet acceptance criteria or after a major instrument repair.

10.3.2.2. A minimum of five calibration standards, or as suggested in Table 1, over the concentration range of interest are sequentially injected into the GC. Refer to Table 1 for ICAL concentrations. Peak areas are obtained from each analyte.

10.3.2.3. Calculate the calibration factor (CF) using the peak areas and their respective concentration according to Eq-10.6.1.

10.3.2.4. Calculate the Average Calibration Factor (ACF) and the RSD according to Eq. 10.6.4 and 10.6.3 respectively.

10.3.2.5. Refer to Appendix 1 for acceptance criteria. If acceptance criteria are not met refer to Section 12 for corrective action.

10.3.3. **Initial Calibration Verification (ICV)**

10.3.3.1. Analyze ICV prepared from another source as described in Section 9.5 to verify the concentrations of the ICAL.

10.3.3.2. Calculate the CF and the percent difference (%D) according to Eq-10.6.1 and 10.6.5 respectively. Refer to Appendix 1 for acceptance criteria. If acceptance criteria are not met refer to Section 12 for corrective action.

10.3.4. **Multicomponent Target Analyses**

10.3.4.1. For multicomponent target analytes (Toxaphene), a five-point calibration standard shall be included in initial calibration for pattern recognition and quantitation.

10.3.4.2. Integrate the total response of the chromatogram to obtain the total area. Calculate the calibration factor (CF) by using Equation 10.6.1.

10.3.5. **Daily Calibration Check (DCC)**

10.3.5.1. Analyze DCC at the start of the 12-hour shift prior to sample analysis and close the analytical run with an ending DCC.

10.3.5.2. Calculate the %D by using Equation 10.6.5. Check Appendix 1 for acceptance criteria. If acceptance criteria are not met refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. **Analytical Sequence**

10.4.1.1. Following the instrument data acquisition software, prepare the analytical sequence file as suggested below:

- IB - instrument blank
- PEM – performance evaluation mixture
- ICAL – initial calibration standards
- ICV or DCC1 – initial calibration verification or continuing calibration standard
- MB – method blank
- LCS – lab control sample
- Samples – up to 12 hours
- DCC2 – continuing calibration standard or ending DCC

10.4.2. **Sample Analysis**

10.4.2.1. Transfer approximately 0.5 ml of extract to a 2-ml amber auto sampler vial (or

equivalent) using a Pasteur pipette. Seal the vial with a Teflon lined septum and aluminum rim cap. Similarly, prepare the analytical standards and QC samples.

10.4.2.2. Introduce sample extract into the GC using direct injection technique (1 to 5 µl) after all system quality control criteria have been met.

10.4.3. **Sample Result Evaluation**

10.4.3.1. Check QC parameters as soon as the data is available.

- ✓ Check LCS recoveries against Appendix 1.
- ✓ Check MB that it is project compliant.
- ✓ Check retention time.
- ✓ Check surrogate recoveries against Appendix 1.
- ✓ Check concentration of target analytes. If the response exceeds the calibration range, dilute and re-analyze the sample until the response falls within the calibration range.
- ✓ If any of the above checkpoints indicate a problem, re-analysis is required. If re-analysis results are the same as the initial result, consult the Supervisor for further action. If results indicate extraction problem, fill-up an NCR and order re-extraction for the affected sample(s).

10.4.3.2. Positive identification is made when a peak falls within the retention time window of a target analyte on both columns established by the standard reference compound.

10.4.3.3. If one column meets the retention time criteria and a retention time shift is suspected on the other column, use the following guideline in reporting the data:

- ✓ Check that the expanded window does not exceed the RTW of the column in control or the established RTW or the CLP RTW (refer to table 7) whichever is greater.
- ✓ If the above condition is met, report the data and include a description of the observation in the case narrative.

10.4.4. **Retention Time Windows**

10.4.4.1. Establishing RTW

10.4.4.1.1. Collect at least three Daily Calibration Standards analyzed over a period of 72 hours.

10.4.4.1.2. Calculate the Standard Deviation (SD) of absolute retention time obtained for each analyte.

10.4.4.1.3. The width of RTW is defined by ±3X SD obtained from 10.4.4.1.2.

10.4.4.2. Evaluating RTW

10.4.4.2.1. If the SD is equal to 0.00, default to the previous study until historical data is obtained or use the CLP[1] retention time window (refer to Table 9) which ever is narrower.

10.4.4.2.2. For new instruments, in the interim use the CLP retention time window (refer to Table 9) until RTW is obtained for the new instrument parameters condition.

10.4.4.3. Application of RTW

10.4.4.3.1. Establish the center of absolute retention time for each analyte to include the surrogate(s) from the daily calibration check at the beginning of the analytical shift then apply the established RTW.

10.4.4.3.2. Whenever the observed retention time is outside the established RTW, the analyst is advised to determine the cause and perform necessary corrective action before continuing the analyses.

10.4.4.4. Updating RTW

10.4.4.4.1. Re-establish the RTW as described in Section 10.4.4.1 when any of the following conditions occur:

- Yearly RTW update
- Significant shifting is observed (e.g. succeeding calibration checks or LCS are out of RTW)
- Major instrument maintenance (e.g. replacement of detector or column; temperature program change, etc.)

10.4.5. **Manual Integration**

10.4.5.1. Refer to EMAX-DM01 for details of manual integration.

10.4.6. **Dealing with Carryover**

- ✓ Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.
- ✓ If there was no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction.
- ✓ If there was a target analyte detected as found in the sample that exceeded the calibration range, re-analyze the sample to rule-out carry over. If carry over is confirmed, proceed with data reduction and report the data from re-analysis.

10.5. **Data Reduction**

10.5.1. Check the chromatogram of positively identified peaks.

- ✓ Peaks fall within the established retention time window on both columns.
- ✓ Peaks are sharp and not saturated.
- ✓ Peaks are properly integrated (refer to Figure 1 for Peak Evaluation Techniques).

[1] CLP-OLM4.2 Table 1 D-79/PEST

✓ Target analyte peak is present in both columns to confirm positive identification.

10.5.2. Positive identification is confirmed when the identified analyte is present in both columns. The agreement between the quantitative results should be evaluated after the identification is made. Calculate the relative percent difference (RPD) between the two results according to Equation 10.6.10.2.

10.5.2.1. If the RPD is less than 40% and the peaks do not indicate any anomalies, report the higher result.

10.5.2.2. If the RPD is less than 40% and one of the peaks indicate an anomaly, report the result from the better peak.

10.5.2.3. If the RPD is greater than 40%, use professional judgment to select the most appropriate result. If no evidence of any chromatographic interference, report the higher result.

10.6. **Calculations**

10.6.1. Calculate for Calibration Factor (CF).

$$CF = \frac{R_a}{C_k} \qquad \textit{Eq. 10.6.1}$$

where:

CF - *is the calibration factor*

R_a - *is the analyte response measured in peak area*

C_k - *is the known concentration of the analyte in µg/L*

10.6.2. Calculate for Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}} \qquad \textit{Eq. 10.6.2}$$

where:

SD - *is the standard deviation*

x_i - *is the result at the* i^{th} *measurement*

$\bar{x}$ - *is the mean*

N - *is the number of measurements*

10.6.3. Calculate for Percent Relative Standard Deviation (%RSD).

$$\%RSD = \left[\frac{SD}{ACF}\right] 100 \qquad \textit{Eq.10.6.3}$$

where:

%RSD - *is the percent relative standard deviation*

SD - *is the standard deviation*

ACF - *is the average calibration factor*

10.6.4. Calculate for Average Calibration Factor (ACF)

$$ACF = \frac{\sum CF}{N} \qquad \textit{Eq. 10.6.4}$$

where:

ACF - *is the average calibration factor*

∑CF - *is the summation of the calibration factors*

N - *is the number of calibration points*

10.6.5. Calculate for Percent Difference for DCC from ACF

$$\%D = \left[\frac{ACF - CF}{ACF}\right] 100 \qquad \textit{Eq. 10.6.5}$$

where:

ACF - *is the average calibration factor*

CF - *is the calibration factor of the DCC*

10.6.6. Calculate for % Breakdown for DDT ($\%B_T$).

$$\%B_T = \frac{A_D + A_E}{A_T + A_D + A_E} \qquad \text{Eq-10.6.6}$$

where:

$\%B_T$ - *% DDT Breakdown*

A_D - *Total area of DDD*

A_E - *Total area of DDE*

A_T - *Total area of DDT*

10.6.7. Calculate for % Breakdown for Endrin ($\%B_E$).

$$\%B_E = \frac{A_A + A_K}{A_E + A_A + A_K} \qquad \text{Eq-10.6.7}$$

where:

$\%B_E$ - *% Endrin Breakdown*

A_A - *Total area of Endrin Aldehyde*

A_K - *Total area of Endrin Ketone*

A_E - *Total area of Endrin*

10.6.8. Sample Results

10.6.8.1. Water Samples

$$C = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a}\right)DF \qquad \text{Eq-10.6.8.1}$$

where:

C	-	*Concentration of sample measured in µg/L*
R_a	-	*Total response of analyte in peak area*
ACF	-	*Average response factor measure in ICAL*
V_e	-	*Volume of extract in ml*
S_a	-	*Sample amount in ml*
DF	-	*Dilution factor of sample extract*

10.6.8.2. Soil Samples

$$C = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a(\%Solid)}\right)DF \qquad \text{Eq.10.6.8.2}$$

where

C	-	*Concentration of analyte to be measured (µg/kg)*
R_a	-	*Total response of analyte in peak area*
ACF	-	*Average response factor*
V_e	-	*Volume of extract in ml*
S_a	-	*Sample Amount in g*
% Solid	-	$\frac{100 - \%\ moisture}{100}$
DF	-	*Dilution factor of the sample extract*

10.6.9. Multi-peak Compound in Sample (Toxaphene)

10.6.9.1. Total area is integrated and concentration is determined by equation 10.6.8.1 or 10.6.8.2.

10.6.10. Accuracy and Precision

10.6.10.1. Percent Recovery

$$\%R = \frac{C_f - C}{C_s} * 100 \qquad \text{Eq. 10.6.10.1}$$

where:

%R	-	*percent recovery*
C_f	-	*concentration found in spiked sample*
C	-	*concentration of unspiked sample (For LCS, C=0)*

C_s - *theoretical concentration of surrogate spike*

10.6.10.2. Relative Percent Difference (RPD)

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq. 10.6.10.2}$$

where:

%RPD - *Relative Percent Difference*

C_1 - *Measured concentration of the first sample aliquot*

C_2 - *Measured concentration of the second sample aliquot*

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C.exe.

10.7.2. Generate Lab Chronicle using LABCHRN1.exe.

10.7.3. Generate sample results using F1V3C.exe.

10.7.4. Generate the QC Summary file using QCV3C.exe.

10.7.5. Generate the case narrative using CN1.exe.

10.7.6. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analyses.

- Sample Results
- LCS Summary
- MS/MSD Summary
- DCC Summary
- ICAL Summary
- ICV Summary
- Copy of Analysis Log
- Copy of Preparation Log

10.8. **Data Review**

10.8.1. Perform a 100% data review in accordance to EMAX-DM01and the Project Specific Requirements (PSR).

- ✓ Check that all samples required for analysis are performed.
- ✓ Check that samples are extracted and analyzed within Holding Time.
- ✓ Check that all calibration requirements are fulfilled.
- ✓ Check the chromatogram of all positively identified peak(s).
- ✓ Check surrogate recoveries against required limits.

✓ Check that concentration of target analytes are within calibration range.

If any of the above checkpoints indicate a problem, re-analysis is required.

10.8.2. Review the case narrative and edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Refer to Form 8081FM for daily routine maintenance check points.

10.9.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back in control.

10.9.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

Maintenance Activity	Description	Frequency
Autosampler Check	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis
Verification	Check instrument parameters to ensure normal operating conditions. Check liner as necessary. Check instrument performance (e.g., daily calibration check, instrument blank, DDT/Endrin breakdown).	Daily prior to analysis
Documentation	Record maintenance in instrument service logs.	Daily prior to analysis
Leak Test	Perform inlet pressure decay test.	Every 6 months or as necessary
System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector where applicable.	Every 6 months or as necessary
Check Flow Path Components	Check and replace the following as necessary: tubing assembly, union, sample probe, and loop.	Once a year or as necessary
Complete Inspection	Perform general inspection of the complete system. Inspect autosampler cabling and configuration setting.	Once a year

11.0 QUALITY CONTROL

11.1. **Preparative Batch**

11.1.1. A preparative batch shall consist of a method blank, LCS, MS/MSD (when required by the project) and a maximum of 20 field samples of similar matrix.

11.1.2. In the absence of MS/MSD, prepare LCS/LCD to check for precision.

11.1.3. Surrogate standard shall be added to all samples, including method blank LCS/LCD and MS/MSD. Check PSR for QC Control Limits.

11.1.4. Perform QC check prior to utilizing the surrogate and LCS/MS spike standards by analyzing the prepared standard at the spiking level. Results should be within ± 20% of the expected value.

11.2. **Analytical Batch QC**

11.2.1. Instrument Performance Evaluation Check must be analyzed daily. Acceptance criteria and corrective action are discussed in Section 10.3.1.4 and Appendix 1.

11.2.2. A continuing calibration shall be performed before any other analysis is done. The continuing calibration procedure and the acceptance criteria are discussed in Section 10.3.5 and Appendix 1.

11.3. **Method QC**

11.3.1. Analyst demonstration of proficiency is a must prior to performing this analysis.

11.3.2. A valid LOD and LOQ must exist prior to sample analysis.

11.3.3. A valid ICAL must exist prior to sample analysis.

11.3.4. Instrument performance must be checked prior to sample analysis. Check Appendix 1 for acceptance criteria.

11.3.5. Prepare and analyze QC samples, to include, method blank, LCS (LCD), and MS/MSD. QC Control Limits shall follow the Project Specific Requirement (PSR) in each analytical folder.

12.0 CORRECTIVE ACTION

12.1. Corrective actions associated with this analytical procedure are described in the Summary of In-House Quality Control Procedures in Appendix 1. Document out-of-control event/s and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. If PEM failed to meet the DDT and Endrin breakdown acceptance criteria, consider the following suggestions to correct the problem:

12.2.1. Deactivate or replace the injection liner.

12.2.2. Check that the injector nut is leak-free.

12.2.3. If problem persists, inform the Supervisor.

12.3. If Initial calibration is non-compliant, consider the following suggestions to correct the problem:

12.3.1. If %RSD is out of acceptance criteria, review result and identify presence of an outlier.

12.3.2. If one of the standard returns a bias-low or bias-high on all of the analytes, then that point is considered an outlier, prepare a standard at that ICAL point and reanalyze.

12.3.3. If the highest ICAL point appears to be saturated, drop the highest point.

12.3.4. If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

Note: The lowest calibration point identifies the reporting limit (RL). Therefore, check that the RL is in conformance to the current projects where the ICAL will be used.

12.3.5. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

12.3.5.1. Check the connections and make sure they are air-tight and perform maintenance as needed.

12.3.5.2. Check the gas flow.

12.3.5.3. Prepare a fresh standard and repeat calibration.

12.3.6. If the problem persists, inform the supervisor.

12.4. If the ICV is non-compliant, consider the following suggestions to correct the problem:

12.4.1. Re-analyze ICV (to rule out poor injection).

12.4.2. If ICV is still out of acceptance criteria, prepare a fresh standard and re-analyze to rule out any preparation error

12.4.3. If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration.

12.4.4. If the problem persists, inform the supervisor.

12.5. If the instrument blank is non-compliant, consider the following suggestions to correct problem:

12.5.1. Rule out instrument contamination by performing the instrument daily maintenance, such as changing septum, cleaning liner, cleaning or using new auto sampler syringe.

12.5.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.5.3. Rule out preparation contamination by preparing a new instrument blank.

12.5.4. If the problem persists, inform the supervisor.

12.6. If Continuing Calibration is non-compliant, consider the following suggestions to correct the problem:

12.6.1. Change the liner.

12.6.2. Clean injection port.

12.6.3. Prepare new standard.

12.6.4. Cut or replace column.

12.6.5. Clean the detector.

12.6.6. Rule out leaks by checking all connections.

12.6.7. If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL.

12.7. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

12.7.1. Rule out instrument contamination by checking instrument blank.

12.7.2. Rule out reagent contamination by testing each reagent used for extraction as described in

EMAX-QC01.

12.7.3. Rule out glassware contamination used for extraction as described in EMAX-QC07.

12.7.4. Re-extract MB and the associated samples with reagents free of contamination or with newly opened reagents.

12.7.5. If the problem persists, inform the supervisor.

12.8. If LCS is non-compliant, perform the following suggestions to correct the problem:

12.8.1. If result is bias-high or bias-low, check the LCS Standard by analyzing at the spike level.

12.8.2. If LCS check is within 80-120% of expected value, check calibration of the micropipette or syringe used for spiking. Re-extract and re-analyze the LCS and the associated samples.

12.8.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS Standard, re-extract and re-analyze LCS and the associated samples.

12.9. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.9.1. If corrective action needs the function of other department; e.g., if the sample needs to be re-extracted, refer to EMAX-QA08 for details of completing an NCR.

12.9.2. If corrective action needs the assistance of the project manager; e.g. If the sample is non-compliant to the technical holding time requirement, insufficient amount of sample, or other non-conforming issues.

12.10. For other problems encountered, inform the supervisor immediately for further instructions.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.1.2. Batch – A group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.2.1. **Preparation batch** is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.2.2. **Analytical batch** is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.3. Calibration – A determinant measured from a standard to obtain the correct value of an instrument output.

15.1.4. Corrective Action - Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

15.1.5. Instrument Blank – A target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.6. Lab Control Sample (LCS) – A target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.7. Matrix – A component or form of a sample.

15.1.8. Matrix Spike (MS) – A sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.9. Matrix Spike Duplicate (MSD) – A replicate of MS analyzed to monitor precision or recovery.

15.1.10. Method Blank – A target-analyte-free sample subjected to the entire sample preparation and/or analytical process to monitor contamination.

15.1.11. Non-conformance - An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

15.1.12. Raw Data - Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

15.1.13. Sample – A specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.14. Sub-sample – An aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.15. Surrogate - A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing organochlorine pesticides analysis by GC, unless otherwise specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluating Solid Waste, Physical / Chemical Methods", EPA Publication SW-846 Methods 8000B and 8081B.

16.2. EMAX Quality Systems Manual, latest update.

17.0 APPENDICES

17.1. **Figures**

17.1.1.	Figure 1	Peak Evaluation Technique
17.1.2.	Figure 2	Typical Chromatogram
17.1.3.	Figure 3	Typical Initial Calibration Summary
17.1.4.	Figure 4	Typical Retention Time Window Summary
17.1.5.	Figure 5	Typical PEM PEST Breakdown Calculation Summary
17.1.6.	Figure 6	Typical Sample Result Summary
17.1.7.	Figure 7	Typical LCS Report Summary
17.1.8.	Figure 8	Typical MS/MSD Report Summary
17.1.9.	Figure 9	Typical Case Narrative

17.2. **Tables**

17.2.1.	Table 1	ICAL Concentration of Individual Analytes
17.2.2.	Table 2	ICAL Standard Preparation
17.2.3.	Table 3	Intermediate Primary Standard Preparation
17.2.4.	Table 4	Intermediate Secondary Standard Preparation
17.2.5.	Table 5	Check Standard Preparation
17.2.6.	Table 6	Surrogate Standard Preparation
17.2.7.	Table 7	Spike Standard Preparation

17.2.8. Table 8 Performance Evaluation Mixture Preparation

17.2.9. Table 9 CLP Retention Time Window for Pesticides

17.2.10. Table 10 Established Limit of Detection (LOD) & Limit of Quantitation (LOQ)

17.3. **Appendices**

17.3.1. Appendix 1 Summary of In-House Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.4. **Forms**

17.4.1. 8081FA Analytical Run Log

17.4.2. 8081FS Sample Preparation Log

17.4.3. 8081FM Instrument Maintenance Log

Figure 1. **PEAK EVALUATION TECHNIQUE**

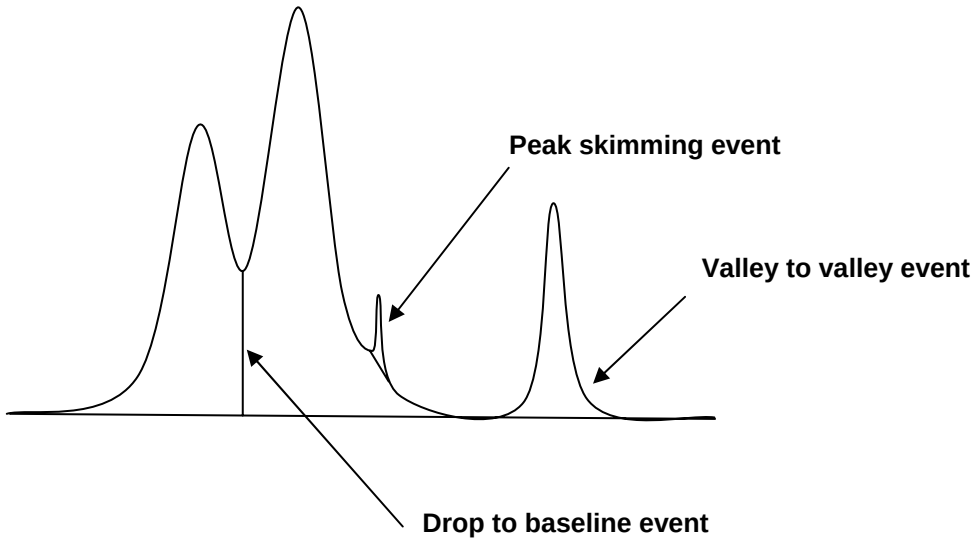
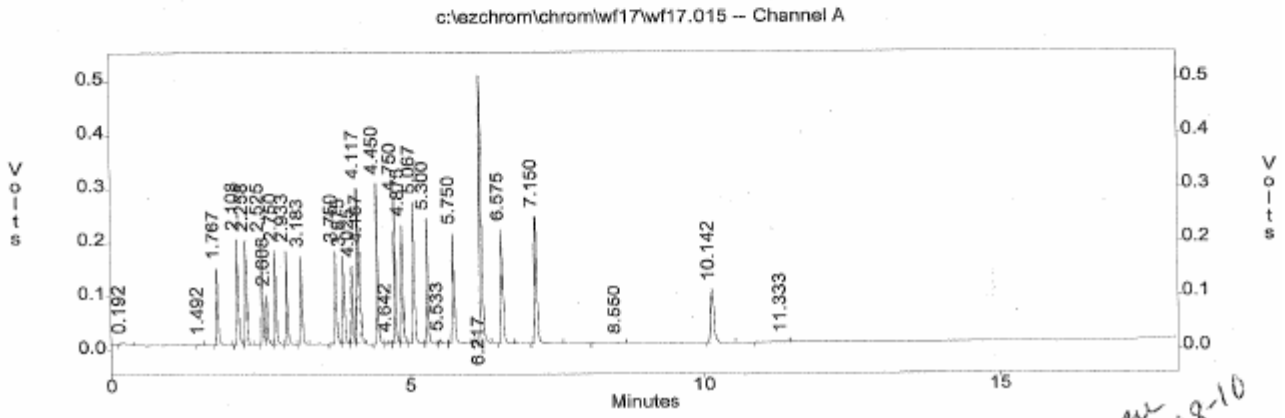


Figure 2. **TYPICAL CHROMATOGRAM**

EPA 8081 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\wf17\wf17.015
Method : c:\ezchrom\methods\cp16f17.met
Sample ID : CP16F1705
Acquired : Jun 17, 2010 20:37:18
Printed : Jun 18, 2010 13:15:17
User : Enrico
Channel A Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc. (ppb)
3	TCX	1.767	316042	10149.5	30.0
4	Hexachlorobenzene	2.108	406480	14033.4	30.0
5	alpha-BHC	2.258	356081	10162.1	30.0
6	gamma-BHC	2.525	333835	9936.0	30.0
7	beta-BHC	2.608	181112	5986.1	30.0
8	delta-BHC	2.750	306513	8901.2	30.0
9	Heptachlor	2.933	293328	9639.1	30.0
10	Aldrin	3.183	282876	8810.2	30.0
11	Heptachlor Epoxide	3.750	304436	10213.6	30.0
12	gamma-Chlordane	3.875	311461	10394.9	30.0
13	alpha-Chlordane	4.025	276649	9158.2	30.0
14	DDE	4.117	550449	8142.2	60.0
15	Endosulfan I	4.167	326942	10965.6	30.0
16	Dieldrin	4.450	577715	9219.0	60.0
18	Endrin	4.750	520296	8357.5	60.0
19	DDD	4.875	427374	6372.5	60.0
20	Endosulfan II	5.067	573361	9477.7	60.0
21	DDT	5.300	514874	7946.9	60.0
23	Endrin Aldehyde	5.750	506475	8526.0	60.0
24	Methoxychlor	6.217	1280315	4520.4	300.0
25	Endosulfan Sulfate	6.575	553093	9053.5	60.0
26	Endrin Ketone	7.150	667060	10554.7	60.0
28	DCB	10.142	370883	13167.0	30.0



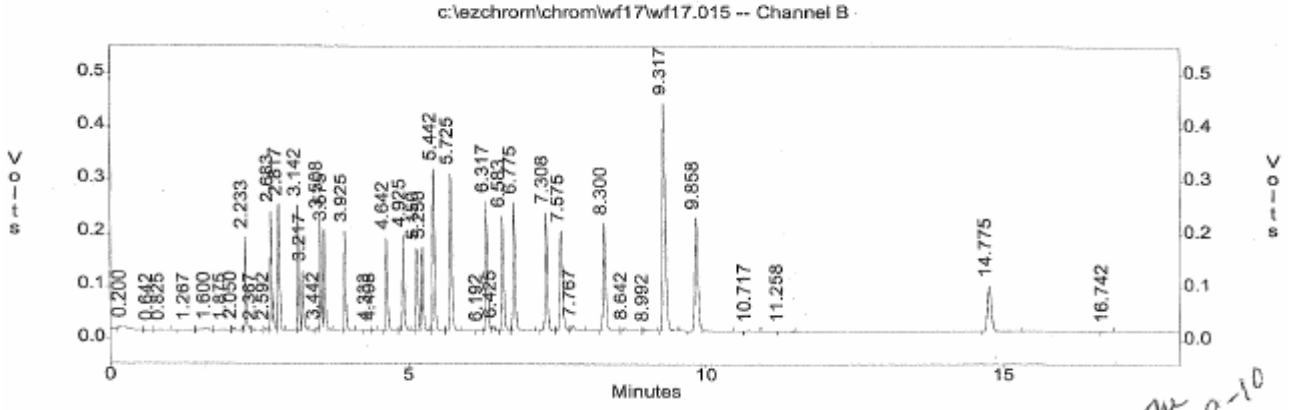
6-28-10

Figure 2. **TYPICAL CHROMATOGRAM**

EPA 8081 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\wf17\wf17.015
Method : c:\ezchrom\methods\cp16f17.met
Sample ID : CP16F1705
Acquired : Jun 17, 2010 20:37:18
Printed : Jun 18, 2010 13:15:18
User : Enrico
Channel B Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
8	TCX	2.233	342477	11675.1	30.0
11	Hexachlorobenzene	2.683	428866	15458.7	30.0
12	alpha-BHC	2.817	411378	12715.4	30.0
13	gamma-BHC	3.142	385043	12271.7	30.0
14	beta-BHC	3.217	198895	6945.2	30.0
16	delta-BHC	3.508	356330	10941.3	30.0
17	Heptachlor	3.575	337642	11361.9	30.0
18	Aldrin	3.925	344050	11109.0	30.0
21	Heptachlor Epoxide	4.642	368353	12612.0	30.0
22	gamma-Chlordane	4.925	382524	13141.1	30.0
23	alpha-Chlordane	5.150	348076	11864.3	30.0
24	Endosulfan I	5.250	353922	11948.6	30.0
25	DDE	5.442	672880	10653.3	60.0
26	Dieldrin	5.725	681418	11113.9	60.0
28	Endrin	6.317	589669	9716.0	60.0
30	DDD	6.583	523165	8133.0	60.0
31	Endosulfan II	6.775	652188	11103.2	60.0
32	DDT	7.308	605130	9754.6	60.0
33	Endrin Aldehyde	7.575	561061	9678.5	60.0
35	Endosulfan Sulfate	8.300	616636	10489.1	60.0
38	Methoxychlor	9.317	1420894	5043.7	300.0
39	Endrin Ketone	9.858	737942	12171.3	60.0
42	DCB	14.775	387410	13540.6	30.0



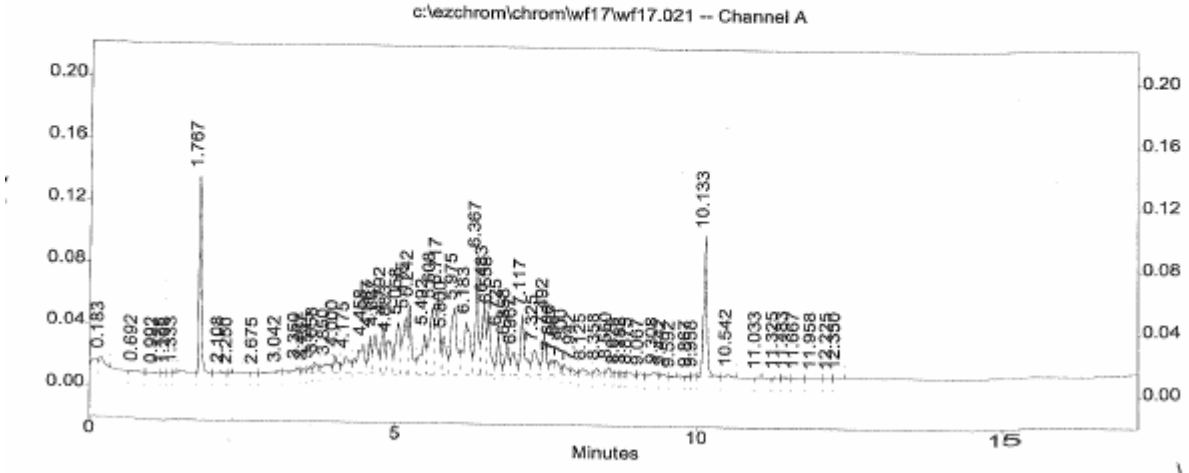
6-28-10

Figure 2. **TYPICAL CHROMATOGRAM**

EPA Toxaphene by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\WF17\WF17.021
Method : c:\ezchrom\methods\to16f17.met
Sample ID : TO16F1703
Acquired : Jun 17, 2010 22:55:09
Printed : Jun 18, 2010 13:54:34
User : Enrico
Channel A Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
7	TCX	1.767	286173	11111.0	25.0
58	DCB	10.133	348818	13899.7	25.0
G1	TOXAPHENE		4416101	9045.5	500.0



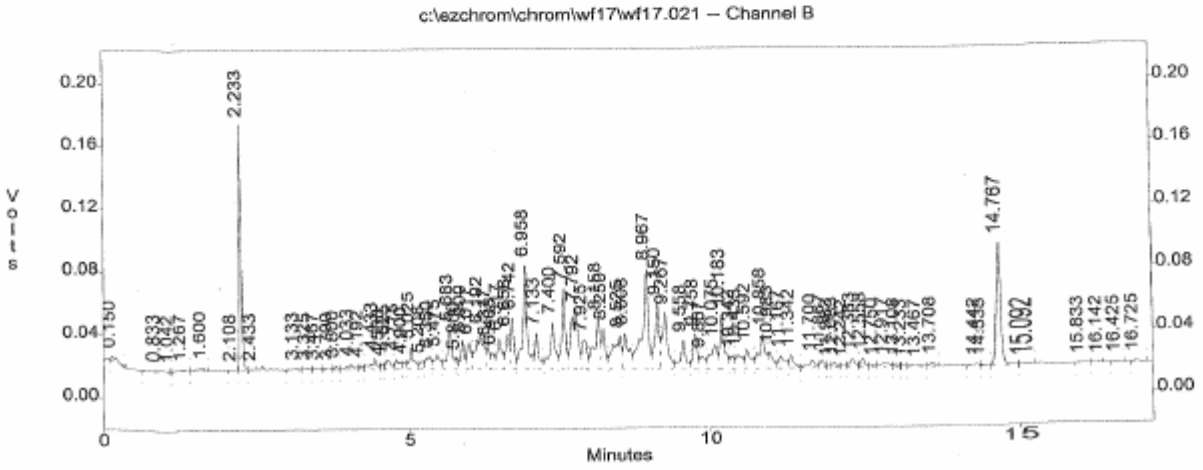
m 6-28-10

Figure 2. **TYPICAL CHROMATOGRAM**

EPA Toxaphene GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\WF17\WF17.021
Method : c:\ezchrom\methods\to16f17.met
Sample ID : TO16F1703
Acquired : Jun 17, 2010 22:55:09
Printed : Jun 18, 2010 13:54:35
User : Enrico
Channel B Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
7	TCX	2.233	311967	12305.5	25.0
75	DCB	14.767	345238	13786.1	25.0
G1	TOXAPHENE		5369542	11217.1	500.0



RW 6-28-10

Figure 2. **TYPICAL CHROMATOGRAM**

EPA Chlordane by GC/ECD
EMAX Analytical Laboratories, Inc.

```
File          : c:\ezchrom\chrom\wc26\wc26.028
Method        : c:\ezchrom\methods\cr16c26.met
Sample ID     : CR16C2603 500 PPB
Acquired      : Mar 27, 2010 02:00:57
Printed       : Mar 29, 2010 15:35:35
User          : Enrico
```

Channel A Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
10	TCX	1.925	253723	10109.8	25.0
66	DCB	10.983	323479	12934.2	25.0
G1	CHLORDANE		4394530	8908.9	500.0

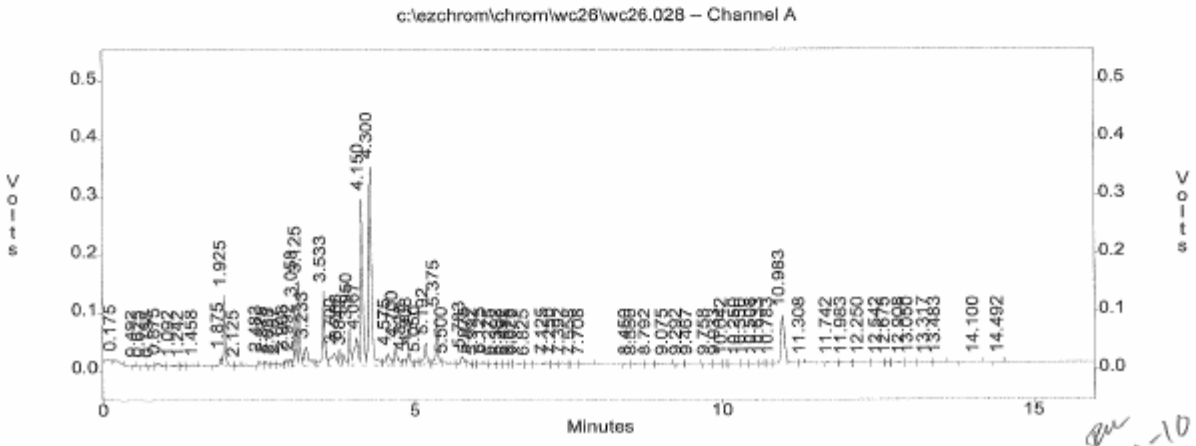


Figure 2. **TYPICAL CHROMATOGRAM**

EPA Chlordane by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\wc26\wc26.028
Method : c:\ezchrom\methods\cr16c26.met
Sample ID : CR16C2603 500 PPB
Acquired : Mar 27, 2010 02:00:57
Printed : Mar 29, 2010 15:35:35
User : Enrico

Channel B Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
11	TCX	2.308	269060	10641.9	25.0
74	DCB	15.217	292100	11687.1	25.0
G1	CHLORDANE		4353253	8729.7	500.0

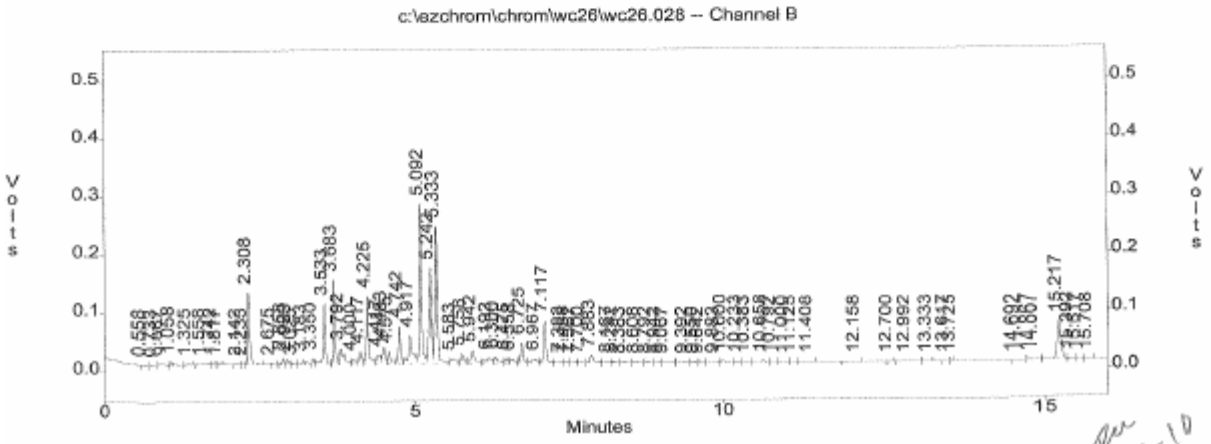


Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPEST
Column size ID : .32MMX30M
LFID & Datetime: WF17011A 06/17/10 19:05
LFID & Datetime: WF17012A 06/17/10 19:28
LFID & Datetime: WF17013A 06/17/10 19:51
LFID & Datetime: WF17014A 06/17/10 20:14
LFID & Datetime: WF17015A 06/17/10 20:37
LFID & Datetime: WF17016A 06/17/10 21:00
LFID & Datetime: WF17017A 06/17/10 21:23
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS (AREA)/UNIT 1.00X	2.00X	4.00X	6.00X	12.00X	16.00X	24.00X	MEAN	%RSD
alpha-BHC	2.50	7012	7922	9661	10827	11869	12073	11771	10162.1	20.0
Hexachlorobenzene	2.50	15106	14969	14761	14561	13549	13114	12173	14033.4	7.9
gamma-BHC	2.50	7514	8339	9695	10671	11128	11295	10909	9936.0	14.9
beta-BHC	2.50	5953	6032	6130	6121	6037	5994	5636	5986.1	2.8
delta-BHC	2.50	6424	7096	8467	9373	10217	10491	10240	8901.2	18.3
Heptachlor	2.50	9528	9474	9711	9924	9778	9754	9304	9639.1	2.2
Aldrin	2.50	7844	7890	8585	9094	9429	9587	9243	8810.2	8.1
Heptachlor Epoxide	2.50	10603	10366	10376	10470	10148	10047	9486	10213.6	3.6
gamma-Chlordane	2.50	10671	10454	10501	10625	10382	10328	9803	10394.9	2.8
alpha-Chlordane	2.50	9232	9128	9285	9423	9222	9163	8655	9158.2	2.6
DDE	5.00	6501	6967	8070	8613	9174	9304	8366	8142.2	13.0
Endosulfan I	2.50	10579	10788	10866	11344	10898	10843	11441	10965.6	2.8
Dieldrin	5.00	8471	8721	9336	9674	9629	9593	9109	9219.0	5.1
Endrin	5.00	7897	7888	8395	8629	8672	8704	8319	8357.5	4.2
DDD	5.00	4987	5221	6117	6695	7123	7338	7126	6372.5	15.0
Endosulfan II	5.00	9442	9455	9698	9833	9556	9441	8919	9477.7	3.0
DDT	5.00	6729	7114	7856	8313	8581	8666	8369	7946.9	9.5
Endrin Aldehyde	5.00	8850	8674	8700	8765	8441	8365	7887	8526.0	3.9
Methoxychlor	25.00	4945	4855	4775	4686	4268	4183	3933	4520.4	8.6
Endosulfan Sulfate	5.00	8929	8874	9130	9290	9218	9190	8743	9053.5	2.3
Endrin Ketone	5.00	9522	9945	10686	11069	11118	11061	10481	10554.7	5.9
SURROGATE	X	1.00X	2.00X	4.00X	6.00X	12.00X	16.00X	24.00X	MEAN	%RSD
TCX	2.50	9451	9676	10235	10530	10535	10554	10066	10149.5	4.4
DCB	2.50	15146	14425	13789	13420	12363	12005	11021	13167.0	11.0

Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPESTII
Column size ID : .32MMX30M
LFID & Datetime: WF17011B 06/17/10 19:05
LFID & Datetime: WF17012B 06/17/10 19:28
LFID & Datetime: WF17013B 06/17/10 19:51
LFID & Datetime: WF17014B 06/17/10 20:14
LFID & Datetime: WF17015B 06/17/10 20:37
LFID & Datetime: WF17016B 06/17/10 21:00
LFID & Datetime: WF17017B 06/17/10 21:23
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS (AREA)/UNIT 1.00X	2.00X	4.00X	6.00X	12.00X	16.00X	24.00X	MEAN	%RSD
alpha-BHC	2.50	10662	11421	12809	13349	13713	13812	13243	12715.4	9.5
Hexachlorobenzene	2.50	18115	17160	16309	15707	14296	13862	12762	15458.7	12.4
gamma-BHC	2.50	11068	11639	12453	12880	12835	12833	12193	12271.7	5.7
beta-BHC	2.50	7721	7370	7191	7079	6630	6498	6129	6945.2	7.9
delta-BHC	2.50	9113	9790	10846	11463	11878	12019	11480	10941.3	10.1
Heptachlor	2.50	11756	11612	11474	11705	11255	11154	10578	11361.9	3.6
Aldrin	2.50	10648	10625	11047	11394	11468	11518	11062	11109.0	3.3
Heptachlor Epoxide	2.50	13691	13110	12836	12784	12278	12125	11459	12612.0	5.8
gamma-Chlordane	2.50	14147	13846	13377	13211	12751	12637	12019	13141.1	5.6
alpha-Chlordane	2.50	12786	12263	12100	12049	11603	11469	10781	11864.3	5.4
DDE	5.00	9539	9928	10718	11167	11215	11232	10775	10653.3	6.3
Endosulfan I	2.50	12627	12267	12113	12189	11797	11651	10995	11948.6	4.4
Dieldrin	5.00	10804	10825	11226	11491	11357	11313	10782	11113.9	2.7
Endrin	5.00	9714	9612	9856	9930	9828	9757	9316	9716.0	2.1
DDD	5.00	7058	7333	8017	8464	8719	8817	8523	8133.0	8.5
Endosulfan II	5.00	11826	11475	11372	11330	10870	10719	10131	11103.2	5.1
DDT	5.00	9205	9308	9728	10028	10086	10138	9791	9754.6	3.8
Endrin Aldehyde	5.00	10625	10107	9882	9847	9351	9232	8706	9678.5	6.5
Methoxychlor	25.00	5720	5513	5257	5105	4736	4632	4342	5043.7	9.9
Endosulfan Sulfate	5.00	11191	10786	10670	10619	10277	10196	9685	10489.1	4.6
Endrin Ketone	5.00	12025	12077	12424	12581	12299	12220	11574	12171.3	2.7
SURROGATE	X	1.00X	2.00X	4.00X	6.00X	12.00X	16.00X	24.00X	MEAN	%RSD
TCX	2.50	12336	12106	12087	11991	11416	11224	10566	11675.1	5.4
DCB	2.50	15878	14980	14155	13638	12914	12063	11158	13540.6	12.1

Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8081

Lab Name : EMAX Inc
Instrument ID : GCTO16 HP-5890
GC Column : RTX-CLPEST
Column size ID : .32MMX30M
LFID & Datetime: WF17019A 06/17/10 22:09
LFID & Datetime: WF17020A 06/17/10 22:32
LFID & Datetime: WF17021A 06/17/10 22:55
LFID & Datetime: WF17022A 06/17/10 23:18
LFID & Datetime: WF17023A 06/17/10 23:41
LFID & Datetime: WF17024A 06/18/10 00:04
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
Toxaphene	100.00	9195.27	8610.96	8832.20	8970.05	9258.53	9406.23	9045.540	3.3

Lab Name : EMAX Inc
Instrument ID : GCTO16 HP-5890
GC Column : RTX-CLPESTII
Column size ID : .32MMX30M
LFID & Datetime: WF17019B 06/17/10 22:09
LFID & Datetime: WF17020B 06/17/10 22:32
LFID & Datetime: WF17021B 06/17/10 22:55
LFID & Datetime: WF17022B 06/17/10 23:18
LFID & Datetime: WF17023B 06/17/10 23:41
LFID & Datetime: WF17024B 06/18/10 00:04
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
Toxaphene	100.00	13632	11541	10739	10462	10519	10410	11217.1	11.2

Figure 3. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8081

Lab Name : EMAX Inc
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPEST
Column size ID : .32MMX30M
LFID & Datetime: WC26026A 03/27/10 01:16
LFID & Datetime: WC26027A 03/27/10 01:38
LFID & Datetime: WC26028A 03/27/10 02:00
LFID & Datetime: WC26029A 03/27/10 02:23
LFID & Datetime: WC26030A 03/27/10 02:45
LFID & Datetime: WC26031A 03/27/10 03:08
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
CHLORDANE	100.00	9864.09	9192.39	8789.06	8657.43	8632.94	8317.59	8908.917	6.1

Lab Name : EMAX Inc
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPESTII
Column size ID : .32MMX30M
LFID & Datetime: WC26026B 03/27/10 01:16
LFID & Datetime: WC26027B 03/27/10 01:38
LFID & Datetime: WC26028B 03/27/10 02:00
LFID & Datetime: WC26029B 03/27/10 02:23
LFID & Datetime: WC26030B 03/27/10 02:45
LFID & Datetime: WC26031B 03/27/10 03:08
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
CHLORDANE	100.00	8974.77	8985.03	8706.51	8739.83	8630.71	8341.48	8729.722	2.7

Figure 4. **TYPICAL ICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPEST
Column size ID : .32MMX30M
LFID & Datetime: WF17011A 06/17/10 19:05
LFID & Datetime: WF17012A 06/17/10 19:28
LFID & Datetime: WF17013A 06/17/10 19:51
LFID & Datetime: WF17014A 06/17/10 20:14
LFID & Datetime: WF17015A 06/17/10 20:37
LFID & Datetime: WF17016A 06/17/10 21:00
LFID & Datetime: WF17017A 06/17/10 21:23

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.0X	4.0X	6.0X	12.0X	16.0X	24.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
alpha-BHC	2.258	2.258	2.258	2.258	2.258	2.250	2.250	2.256	2.230	2.282	0.026
Hexachlorobenzene	2.108	2.108	2.108	2.108	2.108	2.108	2.100	2.107	2.081	2.133	0.026
gamma-BHC	2.525	2.533	2.533	2.533	2.525	2.525	2.525	2.528	2.490	2.566	0.038
beta-BHC	2.608	2.608	2.608	2.608	2.608	2.608	2.600	2.607	2.583	2.631	0.024
delta-BHC	2.750	2.758	2.758	2.758	2.750	2.750	2.750	2.753	2.715	2.791	0.038
Heptachlor	2.933	2.942	2.933	2.933	2.933	2.933	2.933	2.934	2.896	2.972	0.038
Aldrin	3.192	3.192	3.192	3.192	3.183	3.183	3.183	3.188	3.150	3.226	0.038
Heptachlor Epoxide	3.750	3.758	3.750	3.750	3.750	3.750	3.750	3.751	3.713	3.789	0.038
gamma-Chlordane	3.883	3.883	3.883	3.883	3.875	3.875	3.875	3.880	3.827	3.933	0.053
alpha-Chlordane	4.025	4.025	4.025	4.025	4.025	4.017	4.017	4.023	3.971	4.075	0.052
DDE	4.125	4.125	4.125	4.125	4.117	4.117	4.117	4.122	4.070	4.174	0.052
Endosulfan I	4.167	4.167	4.167	4.167	4.167	4.167	4.158	4.166	4.091	4.241	0.075
Dieldrin	4.458	4.458	4.450	4.458	4.450	4.450	4.450	4.453	4.377	4.529	0.076
Endrin	4.750	4.750	4.750	4.750	4.750	4.750	4.742	4.749	4.662	4.836	0.087
DDD	4.875	4.883	4.875	4.883	4.875	4.875	4.875	4.877	4.802	4.952	0.075
Endosulfan II	5.075	5.075	5.067	5.075	5.067	5.067	5.067	5.070	4.979	5.161	0.091
DDT	5.308	5.308	5.308	5.308	5.300	5.300	5.300	5.305	5.216	5.394	0.089
Endrin Aldehyde	5.758	5.758	5.750	5.758	5.750	5.750	5.750	5.753	5.653	5.853	0.100
Methoxychlor	6.225	6.225	6.217	6.225	6.217	6.217	6.217	6.220	6.121	6.319	0.099
Endosulfan Sulfate	6.583	6.583	6.583	6.583	6.575	6.575	6.575	6.580	6.455	6.705	0.125
Endrin Ketone	7.158	7.158	7.158	7.158	7.150	7.150	7.150	7.155	7.017	7.293	0.138
SURROGATE	**1.0X**	**2.0X**	**4.0X**	**6.0X**	**12.0X**	**16.0X**	**24.0X**	**RT**	**FROM**	**TO**	**WIDTH**
TCX	1.775	1.775	1.775	1.775	1.767	1.767	1.767	1.772	1.734	1.810	0.038
DCB	10.150	10.150	10.150	10.150	10.142	10.142	10.142	10.147	10.084	10.210	0.063

FORM VI PC -1 1/96 Rev 2/2006

6-28-16

Figure 4. **TYPICAL ICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : GCTO16 HP-5890
GC Column : RTX-CLPESTII
Column size ID : .32MMX30M
LFID & Datetime: WF17011B 06/17/10 19:05
LFID & Datetime: WF17012B 06/17/10 19:28
LFID & Datetime: WF17013B 06/17/10 19:51
LFID & Datetime: WF17014B 06/17/10 20:14
LFID & Datetime: WF17015B 06/17/10 20:37
LFID & Datetime: WF17016B 06/17/10 21:00
LFID & Datetime: WF17017B 06/17/10 21:23

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.0X	4.0X	6.0X	12.0X	16.0X	24.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
alpha-BHC	2.808	2.817	2.817	2.817	2.817	2.808	2.808	2.813	2.775	2.851	0.038
Hexachlorobenzene	2.683	2.692	2.683	2.692	2.683	2.683	2.683	2.686	2.648	2.724	0.038
gamma-BHC	3.142	3.142	3.142	3.142	3.142	3.142	3.133	3.141	3.103	3.179	0.038
beta-BHC	3.217	3.217	3.217	3.217	3.217	3.217	3.217	3.217	3.179	3.255	0.038
delta-BHC	3.508	3.508	3.508	3.508	3.508	3.508	3.500	3.507	3.469	3.545	0.038
Heptachlor	3.575	3.575	3.575	3.575	3.575	3.575	3.575	3.575	3.524	3.626	0.051
Aldrin	3.925	3.933	3.933	3.933	3.925	3.925	3.925	3.928	3.876	3.980	0.052
Heptachlor Epoxide	4.642	4.650	4.642	4.650	4.642	4.642	4.642	4.644	4.581	4.707	0.063
gamma-Chlordane	4.925	4.925	4.925	4.925	4.925	4.925	4.917	4.924	4.847	5.001	0.077
alpha-Chlordane	5.150	5.158	5.150	5.158	5.150	5.150	5.150	5.152	5.065	5.239	0.087
DDE	5.442	5.442	5.442	5.442	5.442	5.442	5.433	5.441	5.351	5.531	0.090
Endosulfan I	5.250	5.250	5.250	5.250	5.250	5.250	5.242	5.249	5.160	5.338	0.089
Dieldrin	5.725	5.733	5.725	5.733	5.725	5.725	5.725	5.727	5.614	5.840	0.113
Endrin	6.317	6.317	6.317	6.317	6.317	6.317	6.308	6.316	6.191	6.441	0.125
DDD	6.583	6.583	6.583	6.583	6.583	6.583	6.575	6.582	6.456	6.708	0.126
Endosulfan II	6.775	6.775	6.775	6.775	6.775	6.775	6.767	6.774	6.661	6.887	0.113
DDT	7.308	7.317	7.308	7.317	7.308	7.308	7.308	7.311	7.173	7.449	0.138
Endrin Aldehyde	7.575	7.575	7.575	7.575	7.575	7.575	7.567	7.574	7.436	7.712	0.138
Methoxychlor	9.325	9.325	9.317	9.317	9.317	9.317	9.317	9.319	9.232	9.406	0.087
Endosulfan Sulfate	8.300	8.300	8.300	8.300	8.300	8.300	8.292	8.299	8.161	8.437	0.138
Endrin Ketone	9.858	9.858	9.858	9.858	9.858	9.858	9.850	9.857	9.772	9.942	0.085

SURROGATE	1.0X	2.0X	4.0X	6.0X	12.0X	16.0X	24.0X	RT	FROM	TO	WIDTH
TCX	2.233	2.233	2.233	2.233	2.233	2.233	2.225	2.232	2.190	2.274	0.042
DCB	14.783	14.783	14.775	14.775	14.775	14.775	14.775	14.777	14.714	14.840	0.063

FORM VI PC -1 1/96 Rev 2/2006

6-28-10

Figure 5. **TYPICAL PEM PEST BREAKDOWN CALCULATION SUMMARY**

PEM PEST BREAKDOWN CALCULATION
METHOD 8081

Lab Name : EMAX
Instrument ID : GCTO16 HP-5890
GC Column : RTX-CLPEST RTX-CLPESTII
Column size ID : .32MMX30M .32MMX30M
PEM LFID & Datetime : WF17026A WF17026B 06/18/10 00:50

Base on AREA

	AREA				% Breakdown				
LFID	DDD	DDE	DDT	TOTAL	DDD	DDE	TOTAL	QL	QCLIMIT
WF17026A	0.0	11917.0	826713.0	838630.0	0.00	1.42	1.42		15
WF17026B	21368.0	17092.0	933363.0	971823.0	2.20	1.76	3.96		15
LFID	ENDRIN	ENDRIN ALDEHYDE	ENDRIN KETONE	TOTAL	ENDRIN ALDEHYDE	ENDRIN KETONE	TOTAL	QL	QCLIMIT
WF17026A	893765.0	48233.0	35430.0	977428.0	4.93	3.62	8.56		15
WF17026B	945951.0	60214.0	48710.0	1054875.0	5.71	4.62	10.33		15

Figure 6. **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 3550B/8081B
PESTICIDES

Client	: XYZ, INC.	Date Collected:	06/08/10
Project	: CLEAN LAND	Date Received:	06/10/10
Batch No.	: 10F137	Date Extracted:	06/16/10 15:30
Sample ID:	2B-10-46-10-10.5	Date Analyzed:	06/18/10 11:10
Lab Samp ID:	F137-19	Dilution Factor:	1
Lab File ID:	WF17053A	Matrix :	SOIL
Ext Btch ID:	CPF030S	% Moisture :	20.9
Calib. Ref.:	WF17051A	Instrument ID :	GCT016

PARAMETERS	RESULTS (mg/kg)	LOQ (mg/kg)	(mg/kg)
ALPHA-BHC	(ND)|ND	0.0025	0.00051|0.00051
GAMMA-BHC (LINDANE)	(ND)|ND	0.0025	0.00051|0.00051
BETA-BHC	0.00089J|(ND)	0.0025	0.00051|0.00051
HEPTACHLOR	(ND)|ND	0.0025	0.00051|0.00051
DELTA-BHC	(ND)|ND	0.0025	0.00051|0.00051
ALDRIN	(ND)|ND	0.0025	0.00051|0.00051
HEPTACHLOR EPOXIDE	(ND)|ND	0.0025	0.00051|0.00051
GAMMA-CHLORDANE	(ND)|ND	0.0025	0.00051|0.00051
ALPHA-CHLORDANE	(ND)|ND	0.0025	0.00051|0.00051
ENDOSULFAN I	(ND)|ND	0.0025	0.00051|0.00051
4,4'-DDE	(ND)|ND	0.0025	0.00051|0.00051
DIELDRIN	(ND)|ND	0.0025	0.00051|0.00051
ENDRIN	(ND)|ND	0.0025	0.00051|0.00051
4,4'-DDD	(ND)|ND	0.0025	0.00051|0.00051
ENDOSULFAN II	(ND)|ND	0.0025	0.00051|0.00051
4,4'-DDT	(ND)|ND	0.0025	0.00051|0.00051
ENDRIN ALDEHYDE	(ND)|ND	0.0025	0.00051|0.00051
ENDOSULFAN SULFATE	(ND)|ND	0.0025	0.00051|0.00051
ENDRIN KETONE	(ND)|ND	0.0025	0.00051|0.00051
METHOXYCHLOR	(ND)|ND	0.025	0.0025|0.0025
TOXAPHENE	(ND)|ND	0.063	0.013|0.013

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(100)|90	70-125
DECACHLOROBIPHENYL	(91)|91	55-130

LOW : Limit of Quantitation
Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )

Figure 7. **TYPICAL LCS REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
LCS ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND
BATCH NO.: 10F137
METHOD: METHOD 3550B/8081B

MATRIX:	SOIL		% MOISTURE:	NA
DILUTION FACTOR:	1	1		
SAMPLE ID:	MBLK1S			
LAB SAMP ID:	CPF030SB	CPF030SL		
LAB FILE ID:	WF17029A	WF17030A		
DATE EXTRACTED:	06/16/1015:30	06/16/1015:30	DATE COLLECTED:	NA
DATE ANALYZED:	06/18/1001:59	06/18/1002:22	DATE RECEIVED:	06/16/10
PREP. BATCH:	CPF030S	CPF030S		
CALIB. REF:	WF17027A	WF17027A		

ACCESSION:

PARAMETER	BLNK RSLT (mg/kg)	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	QC LIMIT (%)
alpha-BHC	(ND)|ND	0.0133	(0.0135)|0.0123	(102)|92	60-125
gamma-BHC (Lindane)	(ND)|ND	0.0133	(0.0131)|0.0121	(98)|91	60-125
beta-BHC	(ND)|ND	0.0133	(0.0125)|0.0115	(94)|86	60-125
Heptachlor	(ND)|ND	0.0133	(0.0131)|0.0122	(98)|92	50-140
delta-BHC	(ND)|ND	0.0133	(0.0158)|0.0144	(119)|108	55-130
Aldrin	(ND)|ND	0.0133	(0.0127)|0.0121	(95)|91	45-140
Heptachlor Epoxide	(ND)|ND	0.0133	(0.0130)|0.0123	(98)|92	65-130
gamma-Chlordane	(ND)|ND	0.0133	(0.0134)|0.0124	(101)|93	65-125
alpha-Chlordane	(ND)|ND	0.0133	(0.0148)|0.0134	(111)|101	65-120
Endosulfan I	(ND)|ND	0.0133	(0.0136)|0.0127	(102)|95	15-135
4,4'-DDE	(ND)|ND	0.0133	(0.0143)|0.0141	(108)|106	70-125
Dieldrin	(ND)|ND	0.0133	(0.0154)|0.0148	(116)|111	65-125
Endrin	(ND)|ND	0.0133	(0.0160)|0.0151	(120)|114	60-135
4,4'-DDD	(ND)|ND	0.0133	(0.0160)|0.0159	(120)|120	30-135
Endosulfan II	(ND)|ND	0.0133	(0.0144)|0.0137	(108)|103	35-140
4,4'-DDT	(ND)|ND	0.0133	(0.0176)|0.0147	(132)|111	45-140
Endrin aldehyde	(ND)|ND	0.0133	(0.0145)|0.0133	(109)|100	35-145
Endosulfan Sulfate	(ND)|ND	0.0133	(0.0163)|0.0156	(123)|117	60-135
Endrin Ketone	(ND)|ND	0.0133	(0.0169)|0.0159	(127)|120	65-135
Methoxychlor	(ND)|ND	0.133	(0.138)|0.137	(104)|103	55-145

SURROGATE PARAMETER	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	QC LIMIT (%)
Tetrachloro-m-xylene	0.0133	(0.0104)|0.00909	(78)|68*	70-125
Decachlorobiphenyl	0.0133	(0.0128)|0.0120	(96)|90	55-130

Figure 8. **TYPICAL MS/MSD REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND
BATCH NO.: 10F137
METHOD: METHOD 3550B/8081B

MATRIX: SOIL % MOISTURE: 20.9

DILUTION FACTOR:	1	1	1		
SAMPLE ID:	2B-10-46-10-10.5				
LAB SAMP ID:	F137-19	F137-19M	F137-19S		
LAB FILE ID:	WF17053A	WF17054A	WF17055A		
DATE EXTRACTED:	06/16/1015:30	06/16/1015:30	06/16/1015:30	DATE COLLECTED:	06/08/10
DATE ANALYZED:	06/18/1011:10	06/18/1011:33	06/18/1011:56	DATE RECEIVED:	06/10/10
PREP. BATCH:	CPF030S	CPF030S	CPF030S		
CALIB. REF:	WF17051A	WF17051A	WF17051A		

ACCESSION:

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
alpha-BHC	(ND)|ND	0.0168	0.0229|(0.0203)	136*|(121)	0.0168	0.0228|(0.0202)	136*|(120)	0|(0)	60-125	30
gamma-BHC (Lindane)	(ND)|ND	0.0168	0.0212|(0.0188)	126*|(112)	0.0168	0.0212|(0.0189)	126*|(112)	0|(1)	60-125	30
beta-BHC	0.00089J|(ND)	0.0168	(0.0198)|0.0147	(112)|87	0.0168	(0.0197)|0.0158	(112)|94	(1)|7	60-125	30
Heptachlor	(ND)|ND	0.0168	0.0192|(0.0201)	114|(120)	0.0168	0.0198|(0.0201)	118|(120)	3|(0)	50-140	30
delta-BHC	(ND)|ND	0.0168	0.0238|(0.0211)	142*|(125)	0.0168	0.0237|(0.0209)	141*|(124)	0|(1)	55-130	30
Aldrin	(ND)|ND	0.0168	(0.0206)|0.0190	(123)|113	0.0168	(0.0206)|0.0191	(123)|114	(0)|1	45-140	30
Heptachlor Epoxide	(ND)|ND	0.0168	0.0175|(0.0177)	104|(105)	0.0168	(0.0176)|0.0175	(105)|104	(1)|1	65-130	30
gamma-Chlordane	(ND)|ND	0.0168	(0.0186)|0.0179	(111)|106	0.0168	(0.0185)|0.0180	(110)|107	(1)|1	65-125	30
alpha-Chlordane	(ND)|ND	0.0168	0.0205|(0.0192)	122*|(114)	0.0168	0.0205|(0.0192)	122*|(114)	0|(0)	65-120	30
Endosulfan I	(ND)|ND	0.0168	0.0174|(0.0175)	103|(104)	0.0168	(0.0176)|0.0175	(105)|104	(1)|0	15-135	30
4,4'-DDE	(ND)|ND	0.0168	0.0211|(0.0197)	125*|(117)	0.0168	(0.0207)|0.0197	(123)|117	(2)|0	70-125	30
Dieldrin	(ND)|ND	0.0168	(0.0207)|0.0201	(123)|120	0.0168	(0.0205)|0.0199	(122)|118	(1)|1	65-125	30
Endrin	(ND)|ND	0.0168	(0.0203)|0.0194	(121)|115	0.0168	(0.0200)|0.0192	(119)|114	(1)|1	60-135	30
4,4'-DDD	(ND)|ND	0.0168	(0.0219)|0.0215	(130)|128	0.0168	(0.0218)|0.0213	(130)|127	(0)|1	30-135	30
Endosulfan II	(ND)|ND	0.0168	(0.0185)|0.0180	(110)|107	0.0168	(0.0184)|0.0179	(109)|106	(1)|1	35-140	30
4,4'-DDT	(ND)|ND	0.0168	0.0237|(0.0196)	141*|(117)	0.0168	(0.0234)|0.0195	(139)|116	(1)|1	45-140	30
Endrin aldehyde	(ND)|ND	0.0168	(0.0198)|0.0194	(118)|115	0.0168	(0.0198)|0.0194	(118)|115	(0)|0	35-145	30
Endosulfan Sulfate	(ND)|ND	0.0168	(0.0210)|0.0203	(125)|121	0.0168	(0.0209)|0.0203	(124)|121	(0)|0	60-135	30
Endrin Ketone	(ND)|ND	0.0168	(0.0213)|0.0211	(127)|125	0.0168	(0.0212)|0.0210	(126)|125	(0)|0	65-135	30
Methoxychlor	(ND)|ND	0.168	(0.176)|0.176	(105)|105	0.168	0.175|(0.176)	104|(105)	1|(0)	55-145	30

SURROGATE PARAMETER	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	QC LIMIT (%)
Tetrachloro-m-xylene	0.0168	(0.0184)|0.0152	(109)|91	0.0168	(0.0177)|0.0148	(105)|88	70-125
Decachlorobiphenyl	0.0168	(0.0163)|0.0152	(97)|91	0.0168	(0.0160)|0.0153	(95)|91	55-130

Figure 9. **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN LAND

SDG : 10F137

METHOD 3550B/8081B
PESTICIDES

A total of twenty (20) soil samples were received on 06/10/10 for Pesticides Organochlorine analysis, Method 3550B/8081B in accordance with “Test Methods for Evaluating Solid Waste, Physical / Chemical Methods”, EPA Publication SW846.

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument performance was checked prior to calibration. DDT and Endrin breakdown were within specification. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source (ICV). Continuing calibration (CCV) was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms for ICAL, ICV and CCV for details.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A lab control sample was analyzed with the samples in this SDG.
Percent recoveries for CPF030SL were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries were within project QC limits except for results qualified with [*] in F137-19M/S summary form. Check QC summary form for details.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter. Positive sample results were confirmed by a second column. Relative percentage difference (RPD) between the two results was evaluated. If RPD is less than 40% and peaks are well defined the higher result is reported. Where RPD is greater than 40% the chromatogram is checked for anomalies and results are selected based on processed knowledge. If there is no evidence of any chromatographic ambiguity, the higher result is reported.

Table 1. **ICAL CONCENTRATION OF INDIVIDUAL ANALYTES**

PARAMETERS	ICAL STANDARD CONCENTRATION (µg/L)							
PESTICIDES	1	2	3	4	5	6	7	8
Tetrachloro-m-xylene (surrogate)	2.5	5	10	20	30	40	60	80
alpha-BHC	2.5	5	10	20	30	40	60	80
gamma-BHC	2.5	5	10	20	30	40	60	80
beta-BHC	2.5	5	10	20	30	40	60	80
delta-BHC	2.5	5	10	20	30	40	60	80
Heptachlor	2.5	5	10	20	30	40	60	80
Aldrin	2.5	5	10	20	30	40	60	80
Heptachlor Epoxide	2.5	5	10	20	30	40	60	80
gamma-Chlordane	2.5	5	10	20	30	40	60	80
alpha-Chlordane	2.5	5	10	20	30	40	60	80
DDE	5	10	20	40	60	80	120	160
Endosulfan I	2.5	5	10	20	30	40	60	80
Dieldrin	5	10	20	40	60	80	120	160
Endrin	5	10	20	40	60	80	120	160
DDD	5	10	20	40	60	80	120	160
Endosulfan II	5	10	20	40	60	80	120	160
DDT	5	10	20	40	60	80	120	160
Endrin Aldehyde	5	10	20	40	60	80	120	160
Methoxychlor	25	50	100	200	300	400	600	800
Endosulfan Sulfate	5	10	20	40	60	80	120	160
Endrin Ketone	5	10	20	40	60	80	120	160
Decachlorobiphenyl (Surrogate)	2.5	5	10	20	30	40	60	80
TOXAPHENE	100	250	500	750	1000	1500	-	-
TECHNICAL CHLORDANE	100	250	500	750	1000	1500	-	-

Table 2. **ICAL STANDARD PREPARATION**

Standard #	Compound Name	Stock/Intermediate Solution Conc. (µg/L)	Preparation			Final Conc. (µg/L)
			Aliquot (µL)	Solvent	Final Volume (µL)	
PESTICIDES						
1	Pest ICAL Mix	80 / 160 / 800	25	Hexane	800	2.5 / 5 / 25
2	Pest ICAL Mix	80 / 160 / 800	50	Hexane	800	5 / 10 / 50
3	Pest ICAL Mix	80 / 160 / 800	100	Hexane	800	10 / 20 / 100
4	Pest ICAL Mix	80 / 160 / 800	200	Hexane	800	20 / 40 / 200
5	Pest ICAL Mix	80 / 160 / 800	300	Hexane	800	30 / 60 / 300
6	Pest ICAL Mix	80 / 160 / 800	400	Hexane	800	40 / 80 / 400
7	Pest ICAL Mix	80 / 160 / 800	600	Hexane	800	60 / 120 / 600
8	Pest ICAL Mix	80 / 160 / 800	800	Hexane	800	80 / 160 / 800
TOXAPHENE						
1	Tox. ICAL	2000	40	Hexane	800	100
2	Tox. ICAL	2000	100	Hexane	800	250
3	Tox. ICAL	2000	200	Hexane	800	500
4	Tox. ICAL	2000	300	Hexane	800	750
5	Tox. ICAL	2000	400	Hexane	800	1000
6	Tox. ICAL	2000	600	Hexane	800	1500
TECHNICAL CHLORDANE						
1	T. Chlor. ICAL	2000	40	Hexane	800	100
2	T. Chlor. ICAL	2000	100	Hexane	800	250
3	T. Chlor. ICAL	2000	200	Hexane	800	500
4	T. Chlor. ICAL	2000	300	Hexane	800	750
5	T. Chlor. ICAL	2000	400	Hexane	800	1000
6	T. Chlor. ICAL	2000	600	Hexane	800	1500

Table 3. **INTERMEDIATE PRIMARY STANDARD PREPARATION**

PESTICIDES*: RESTEK Pesticide Mix*	Stock Std. Conc. (µg/mL)	Final Conc. (µg/L)	Preparation
alpha-BHC	8	80	Using a gas-tight syringe, measure 1000 µL of (Restek) Pesticides Mix and 40 µL of (AccuStandard) Pest Surrogate and dilute with hexane to 100 mL.
gamma-BHC	8	80	
beta-BHC	8	80	
delta-BHC	8	80	
Heptachlor	8	80	
Aldrin	8	80	
Heptachlor Epoxide	8	80	
gamma-Chlordane	8	80	
alpha-Chlordane	8	80	
DDE	16	160	
Endosulfan I	8	80	
Dieldrin	16	160	
Endrin	16	160	
DDD	16	160	
Endosulfan II	16	160	
DDT	16	160	
Endrin Aldehyde	16	160	
Methoxychlor	80	800	
Endosulfan Sulfate	16	160	
Endrin Ketone	16	160	
AccuStandard Surrogate			
Tetrachloro-m-xylene	200	80	
Decachlorobiphenyl	200	80	
TOXAPHENE: *AccuStandard*			
Toxaphene	1000	2000	Using a gas-tight syringe, measure 200 µL of (AccuStandard) Toxaphene standard and 50 µL of (AccuStandard) Pest Surrogate and dilute with hexane to 100 mL.
AccuStandard Surrogate			
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	
TECHNICAL CHLORDANE: *AccuStandard*			
Technical Chlordane	1000	2000	Using a gas-tight syringe, measure 200 µL of (AccuStandard) Tech. Chlordane standard and 50 µL of (AccuStandard) Pest Surrogate and dilute with hexane to 100 mL.
AccuStandard Surrogate			
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	

Table 4. **INTERMEDIATE SECONDARY STANDARD PREPARATION**

	Stock Std. Conc. (µg/mL)	Final Conc. (µg/L)	Preparation
PESTICIDES*: SUPELCO Pesticide Mix*			
alpha-BHC	200	200	Using a gas-tight syringe, measure 1000 µL of (Supelco) Pesticides Mix and 180 µL of (SpexCertiPrep) Methoxychlor solution and dilute with hexane to 100 mL.
gamma-BHC	200	200	
beta-BHC	200	200	
delta-BHC	200	200	
Heptachlor	200	200	
Aldrin	200	200	
Heptachlor Epoxide	200	200	
gamma-Chlordane	200	200	
alpha-Chlordane	200	200	
DDE	200	200	
Endosulfan I	200	200	
Dieldrin	200	200	
Endrin	200	200	
DDD	200	200	
Endosulfan II	200	200	
DDT	200	200	
Endrin Aldehyde	200	200	
Methoxychlor	200	2,000	
Methoxychlor (SpexCertiPrep)	1,000		
Endosulfan Sulfate	200	200	
Endrin Ketone	200	200	
Tetrachloro-m-xylene	200	200	
Decachlorobiphenyl	200	200	
TOXAPHENE: *Ultra Scientific*			
Toxaphene	2500	2000	Using a gas-tight syringe, measure 20 µL of (Ultra Scientific) Toxaphene standard and 12.5 µL of (Supelco) Pest Surrogate Mix and dilute with hexane to 25 mL.
Supelco Surrogate			
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	
TECHNICAL CHLORDANE: *Ultra Scientific*			
Technical Chlordane	2500	2000	Using a gas-tight syringe, measure 20 µL of (Ultra Scientific) Technical Chlordane standard and 12.5 µL of (Supelco) Pest Surrogate Mix and dilute with hexane to 25 mL.
Supelco Surrogate			
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	

Note: Table 2 and Table 2A may be interchanged. However, the source of LCS shall follow the source of the secondary standard or from a third vendor.

Table 5. CHECK STANDARD PREPARATION(DCC/ICV)

Standard	Compound Name	Intermediate Soln. Conc. (µg/L)	Source	Preparation			Final Conc. (µg/L)
				Aliquot (µL)	Dil.Soln./ Modifier	Final Vol. (µL)	
PESTICIDES							
DCC	Pest ICAL Mix	80/160/800	Restek	200	Hexane	800	20/40/200
	Surrogate Mix	80	AccuStandard				20
ICV	Pest ICV Mix	200/2000	Supelco / SpexCertiPrep	100	Hexane	1000	20/200
	Surrogate Mix	200	Supelco				20
TOXAPHENE							
DCC	Toxaphene ICAL	2000	AccuStandard	200	Hexane	800	500
	Surrogate Mix	100	AccuStandard				25
ICV	Toxaphene ICV	200	Ultra Scientific	200	Hexane	800	500
	Surrogate Mix	100	Supelco				25
TECHNICAL CHLORDANE							
DCC	Toxaphene ICAL	2000	AccuStandard	200	Hexane	800	500
	Surrogate Mix	100	AccuStandard				25
ICV	Toxaphene ICV	200	Ultra Scientific	200	Hexane	800	500
	Surrogate Mix	100	Supelco				25

Table 6. SURROGATE STANDARD PREPARATION

Compound Name	Stock Soln. Conc. (µg/mL)	Source	Preparation			Final Conc. (µg/L)
			Aliquot (mL)	Dil.Soln./ Modifier	Final Vol. (mL)	
Surrogate Mix (Tetrachloro-m-xylene & Decachlorobiphenyl)	200	Supelco	2.0	Hexane	1,000	400

Table 7. SPIKE STANDARD PREPARATION

Compound Name	Stock/Intermediate Soln. Conc. (µg/mL)	Source	Preparation			Final Conc. (µg/L)
			Aliquot (µL)	Dil.Soln./ Modifier	Dil. Vol. (mL)	
Pesticide Matrix Spike Mix	2,000	Supelco	20	Hexane	100	400/4000
Methoxychlor	1,000	SpexCertiPrep	360			

Table 8. **PERFORMANCE EVALUATION MIXTURE PREPARATION**

Compound Name	Stock/Intermediate Soln. Conc. (µg/mL)	Source	Preparation			Final Conc (µg/L)
			Aliquot (µL)	Dil.Soln./ Modifier	Dil. Vol. (mL)	
PEM (DDT + Endrin Mix)	500	Supelco	20	Hexane	100	100/100

Table 9. **CLP RETENTION TIME WINDOWS**
(CLP OLM4.2 D-79/PEST)

Compound	Retention Time Window (minutes)	Compound	Retention Time Window (minutes)
alpha-BHC	± 0.05	Endrin Ketone	± 0.07
beta-BHC	± 0.05	4,4'-DDD	± 0.07
gamma-BHC(Lindane)	± 0.05	4,4'-DDE	± 0.07
delta-BHC	± 0.05	4,4'-DDT	± 0.07
Heptachlor	± 0.05	Endosulfan II	± 0.07
Aldrin	± 0.05	Endosulfan Sulfate	± 0.07
alpha-Chlordane	± 0.07	Methoxychlor	± 0.07
gamma-Chlordane	± 0.07	Aroclors	± 0.07
Heptachlor Epoxide	± 0.07	Toxaphene	± 0.07
Dieldrin	± 0.07		
Endrin	± 0.07	Tetrachloro-m-xylene	± 0.05
Endrin Aldehyde	± 0.07	Decachlorobiphenyl	± 0.10

Table 8. ESTABLISHED LIMIT OF DETECTION (LOD) & LIMIT OF QUANTITATION (LOQ)

MATRIX: AQUEOUS	DL	LOD	LOQ	Unit
Aldrin	0.005	0.01	0.1	µg/L
Alpha-BHC	0.005	0.01	0.1	µg/L
Beta-BHC	0.007	0.01	0.1	µg/L
Delta-BHC	0.007	0.01	0.1	µg/L
Gamma-BHC (Lindane)	0.005	0.01	0.1	µg/L
DDD (4,4)	0.005	0.01	0.1	µg/L
DDE (4,4)	0.005	0.01	0.1	µg/L
DDT (4,4)	0.005	0.01	0.1	µg/L
Dieldrin	0.005	0.01	0.1	µg/L
Endosulfan I	0.008	0.01	0.1	µg/L
Endosulfan II	0.005	0.01	0.1	µg/L
Endosulfan Sulfate	0.005	0.01	0.1	µg/L
Endrin	0.008	0.01	0.1	µg/L
Endrin Aldehyde	0.005	0.01	0.1	µg/L
Heptachlor	0.007	0.01	0.1	µg/L
Heptachlor epoxide	0.005	0.01	0.1	µg/L
Methoxychlor	0.05	0.1	1	µg/L
Alpha-Chlordane	0.005	0.01	0.1	µg/L
Gamma-Chlordane	0.005	0.01	0.1	µg/L
Endrin Ketone	0.005	0.01	0.1	µg/L
Toxaphene	0.25	0.5	2	µg/L
Technical Chlordane	0.005	0.25	1	µg/L
SURROGATES				
Tetrachloro-m-xylene	0.005	0.01	0.02	µg/L
Decachlorobiphenyl	0.005	0.01	0.02	µg/L

Reference: Detection Limit Study dated April 20,2010.

PARAMETER (MATRIX: SOIL)	DL	LOD	LOQ	Unit
Aldrin	0.02	0.4	2	µg/Kg
Alpha-BHC	0.02	0.4	2	µg/Kg
Beta-BHC	0.02	0.4	2	µg/Kg
Delta-BHC	0.27	0.4	2	µg/Kg
Gamma-BHC (Lindane)	0.2	0.4	2	µg/Kg
DDD (4,4)	0.02	0.4	2	µg/Kg
DDE (4,4)	0.02	0.4	2	µg/Kg
DDT (4,4)	0.02	0.4	2	µg/Kg
Dieldrin	0.02	0.4	2	µg/Kg
Endosulfan I	0.2	0.4	2	µg/Kg
Endosulfan II	0.2	0.4	2	µg/Kg
Endosulfan Sulfate	0.2	0.4	2	µg/Kg
Endrin	0.2	0.4	2	µg/Kg
Endrin Aldehyde	0.35	0.4	2	µg/Kg
Heptachlor	0.2	0.4	2	µg/Kg
Heptachlor epoxide	0.2	0.4	2	µg/Kg
Methoxychlor	2	4	10	µg/Kg
Alpha-Chlordane	0.2	0.4	2	µg/Kg
Gamma-Chlordane	0.2	0.4	2	µg/Kg
Endrin Ketone	0.2	0.4	2	µg/Kg
Toxaphene	5	10	50	µg/Kg
Technical Chlordane	10	20	50	µg/Kg
SURROGATES				
Tetrachloro-m-xylene	0.167	0.33	0.7	µg/Kg
Decachlorobiphenyl	0.167	0.33	0.7	µg/Kg

Reference: Detection Limit Study dated April 5,2010.

SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	FLAGGING CRITERIA	1ST Rvw	2ND Rvw
5 point Initial Calibration for analytes	Initially, as needed	RSD for all analytes ≤20%. Linear – least squares regression r^2>0.995.	Correct then problem then repeat initial calibration.			
Second-source calibration verification for all analytes	Once per 5-point initial calibration	All analytes within ±20of expected value from the ICAL.	Repeat injection of ICV. If the problem persists then perform troubleshooting and repeat the ICAL.			
Initial calibration verification	Daily, before sample analysis	All analytes within ±20%	Correct the problem then repeat initial calibration			
Calibration verification	Every 12 hours of analysis time and at the end of the analysis sequence	All analytes within ±20%	Correct the problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification			
Breakdown check (Endrin and DDT)	Every 12-hours	Degradation ≤15% of each analyte.	Repeat breakdown check			
Method Blank	One per preparation batch	No analytes detected > ½ LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Re-prep and re-analyze method blank and all samples processed with the contaminated blank	Apply B to specific analyte(s) on all associated samples		
LCS	One LCS per preparation batch	Within project QC limits	Re-prep and re-analyze the LCS and all associated samples			
Surrogate spike	Every sample, spiked sample, standard and method blank	Within project QC limits	Correct the problem then re-extract and analyze sample			
MS/MSD	One MS/MSD per every 20 project samples per matrix	Within project QC limits	If chromatogram is indicative of matrix interference, discuss in case narrative. Otherwise, check for probably source of error and perform corrective action as necessary			
Confirmation	100% for al positive results	Same as primary column	If quantitation criteria are not met, use confirmation for qualitative identification only.			
Comments: Apply J to all values between LOD and LOQ.				Reviewed By:		
				Date		

DEMONSTRATION OF CAPABILITY

PT # WP0110 Water Pollution Proficiency Testing **PT Study Closing Date: Feb. 18, 2010**

Method: SW 3520 C / SW 8081 B Analyst: Enrico Santos

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aldrin	4	µg/L	3.97	1.13	-	5.49	Acceptable
2	alpha-BHC	12	µg/L	10.6	4.77	-	14.3	Acceptable
3	beta-BHC	9.27	µg/L	9.25	3.85	-	12.5	Acceptable
4	delta-BHC	3.55	µg/L	3.32	1.11	-	4.66	Acceptable
5	gamma-BHC (Lindane)	6.08	µg/L	5.8	2.35	-	8.03	Acceptable
6	alpha-Chlordane	3.54	µg/L	3.25	1.45	-	4.49	Acceptable
7	gamma-Chlordane	5.67	µg/L	5.61	2.31	-	7.64	Acceptable
8	DDD (4,4)	4.74	µg/L	4.76	1.79	-	6.85	Acceptable
9	DDE (4,4)	2.88	µg/L	2.7	1.16	-	3.62	Acceptable
10	DDT (4,4)	8.71	µg/L	8.27	3.09	-	11.7	Acceptable
11	Dieldrin	9.32	µg/L	8.53	4.18	-	11.6	Acceptable
12	Endosulfan I	4.85	µg/L	4.81	1.12	-	6.68	Acceptable
13	Endosulfan II	7.03	µg/L	6.55	2.19	-	8.91	Acceptable
14	Endosulfan Sulfate	16.48	µg/L	14.8	5.53	-	21.3	Acceptable
15	Endrin	7.89	µg/L	9.12	3.24	-	13.6	Acceptable
16	Endrin aldehyde	15.11	µg/L	13.5	4.12	-	20.1	Acceptable
17	Heptachlor	2.17	µg/L	2.33	0.759	-	3.25	Acceptable
18	Heptachlor Epoxide (beta)	8.13	µg/L	8.15	4.08	-	11.4	Acceptable
19	Methoxychlor	6.95	µg/L	5.62	1.43	-	9.03	Acceptable
20	Endrin Ketone	10.84	µg/L	8.91	4.9	-	12.9	Acceptable
21	Chlordane (total)	14.3	µg/L	13.7	5.12	-	19.7	Acceptable
22	Toxaphene (total)	28.78	µg/L	25.7	2.57	-	46.6	Acceptable

DEMONSTRATION OF CAPABILITY

PT # **HW0110 Soil/Hazardous Waste Proficiency Testing** **PT Study Closing Date: Mar. 4, 2010**

Method: SW 3550 C / SW 8081 B Analyst: Enrico Santos

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aldrin	419	µg/Kg	412	130	-	562	Acceptable
2	alpha-BHC	428	µg/Kg	236	126	-	555	Acceptable
3	beta-BHC	156	µg/Kg	172	30.4	-	263	Acceptable
4	delta-BHC	307	µg/Kg	344	77.7	-	431	Acceptable
5	gamma-BHC (Lindane)	276	µg/Kg	299	84.6	-	412	Acceptable
6	alpha-Chlordane	200	µg/Kg	194	65.3	-	262	Acceptable
7	gamma-Chlordane	303	µg/Kg	331	139	-	428	Acceptable
8	DDD (4,4)	288	µg/Kg	324	118	-	464	Acceptable
9	DDE (4,4)	47.9	µg/Kg	57.6	11.1	-	96.4	Acceptable
10	DDT (4,4)	130	µg/Kg	181	44.4	-	276	Acceptable
11	Dieldrin	475	µg/Kg	483	190	-	653	Acceptable
12	Endosulfan I	329	µg/Kg	374	123	-	487	Acceptable
13	Endosulfan II	252	µg/Kg	265	76.1	-	361	Acceptable
14	Endosulfan Sulfate	105	µg/Kg	124	21.9	-	180	Acceptable
15	Endrin	155	µg/Kg	186	60.8	-	228	Acceptable
16	Endrin aldehyde	172	µg/Kg	371	37.1	-	409	Acceptable
17	Endrin Ketone	407	µg/Kg	459	121	-	634	Acceptable
18	Heptachlor	70.0	µg/Kg	86.4	22.9	-	118	Acceptable
19	Heptachlor Epoxide (beta)	56.2	µg/Kg	71.7	21.9	-	98.3	Acceptable
20	Methoxychlor	374	µg/Kg	392	43.4	-	601	Acceptable
21	Chlordane (total)	572	µg/Kg	652	140	-	926	Acceptable
22	Toxaphene (total)	783	µg/Kg	785	78.5	-	1130	Acceptable

8081FA. **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
PESTICIDES/PCBs

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Comments:

Book #:	A16-022
Instrument No.:	16
Analytical Sequence:	
Method File:	
Analytical Batch:	

SOP #	Rev. #
☐ EMAX-8081	
☐ EMAX-8082	
☐ EMAX-608	
☐ EMAX-CLP-PEST	
☐ EMAX-	

ICAL REFERENCE		
ICAL ID	BATCH	DATE

STANDARDS ID	Conc (µg/L)
Hexane	

Column	A. RTX CLPEST I B. RTX CLPEST II

ELECTRONIC DATA ARCHIVAL	
Location	Date
☐ EZC_4_Pesticides	
☐ EZC_10_Pesticides	

Analyzed By: Date:

Date Disposed: Disposed By:

This page is checked during data review.

EMAX LABORATORIES, INC.

FileID: CP10H01W.xls

EXTRACTION LOG FOR PESTICIDES AND PCBs

PrepBatchID	Lab Sample ID	Aliquot	Unit	DateTime	Sonicator	pH	Ve(ml)	DateTime	Cleanup	Comments

Prepared By: _____

Checked By: _____ Date _____

8081FM. **INSTRUMENT MAINTENANCE LOG**

Instrument No: 08 **Month:** **Year: 200_** **Book #: M08-005**

Date							
Column Head Pressure (8-15 psi)							
Column Temperature							
Signal # 1 10-150							
Signal #2 10-150							
Autosampler							
Update Cal. Table							
Computer Date/Time							
Computer Paper							
Septa Change							
Liner Clean-up							
Analyst Initial							

TroubleShooting							
Problems Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

PRINT DRF

STANDARD OPERATING PROCEDURES

POLYCHLORINATED BIPHENYLS (PCB) BY GAS CHROMATOGRAPHY

SOP No.:	EMAX-8082	Revision No.	3	Effective Date:	10-Aug-10
Prepared By:	Tu Nisamaneepong			Date:	08-10-10
Approved By:	Kenette Pimentel QA Manager			Date:	08.10.10
Approved By:	Caspar Pang Laboratory Director			Date:	08-10-10.

Control Number: 8082-03-

1.0 SCOPE AND APPLICATION

1.1. This procedure is used to determine the concentration of Polychlorinated Biphenyls as Aroclors in soil, sediment, sludge, and wastewater samples by gas chromatography method. This SOP is an adaptation of Method 8082A. Since Method 8082A is an update and enhancement of 8082, this SOP is also applicable to Method 8082.

2.0 SUMMARY OF METHOD

2.1. This method provides gas chromatographic conditions for the detection of polychlorinated biphenyls compounds with dual Electron Capture Detector (ECD). The samples are extracted in methylene chloride, exchanged to hexane and clean up by appropriate method before GC analysis.

2.2. **Interferences**

2.2.1. Interferences by phthalate esters co-extracted from the sample or introduced during sample preparation can pose a major problem in PCB determinations. Interferences can be minimized by avoiding contact with any plastic materials and checking all solvents for phthalate contamination. Glassware must be scrupulously cleaned. Sulfuric acid/permanganate cleanup technique can be used for Phthalate esters removal from the extract.

2.2.2. The presence of elemental sulfur will result in broad peaks that may cause chromatographic interfere with the determination of PCBs. Sulfur contamination is most likely present in sediment samples. The TBA procedure, GPC or other cleanup technique can be used for sulfur removal from the extract.

2.2.3. Other interferences such as aliphatic compounds, aromatics and nitrogen-containing compounds may be eliminated by using Florisil cleanup.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point (see Sec. 9.4). All samples analyzed above this concentration are considered "over-range" and shall require

dilution to properly quantitate.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required to properly quantitate.

4.3. Typical dynamic ranges are:

4.3.1. Water – 1.0 to 10.0 µg/L

4.3.2. Soil – 33 to 330 µg/kg

5.0 SAMPLE HOLDING TIME AND PRESERVATION,

5.1. **Holding Time**

5.1.1. Water samples must be extracted within 7 days from the time of sample collection.

5.1.2. Soil and sediment samples must be extracted within 14 days from the time of sample collection.

5.1.3. Analysis should be within 40 days after extraction completion date.

5.2. **Preservation**

5.2.1. Samples and extract should be kept at ≤ 6°C.

6.0 ASSOCIATED SOPs

6.1.	EMAX-DM01	Data Flow and Review
6.2.	EMAX-QC02	Analytical Standard Preparation
6.3.	EMAX-SM04	Analytical and QC Labeling
6.4.	EMAX-QA08	Corrective Action
6.5.	EMAX-3510	Separatory Funnel Liquid/Liquid Extraction
6.6.	EMAX-3520	Extraction of Organic Compounds by Continuous Liquid/Liquid Extraction
6.7.	EMAX-3550	Extraction of Organic Compounds from Solid Samples by Pulse Sonication
6.8.	EMAX-3540	Soxhlet Extraction
6.9.	EMAX-3620	Florisil Cleanup
6.10.	EMAX-3640	GPC Cleanup
6.11.	EMAX-3660	Sulfur Cleanup
6.12.	EMAX-3665	Sulfuric Acid/Permanganate Cleanup

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. All reagents, standards, and samples shall be treated as potential hazards. ECD contains minute quantity of Radioactive Ni (63), a wipe test performed by experienced personnel or manufacturer should be conducted semiannually or sooner if potential problem is suspected. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves, shall be worn at all times when performing this procedure.

7.3. All wastes generated during analytical process shall be placed in the waste containers. These wastes shall be endorsed to the waste disposal section for proper disposal.

7.4. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS, AND REAGENTS

8.1. Instruments and Supplies

Gas Chromatography	:	HP 5890 Series II
Detector	:	Dual Electron Capture Detectors
Column	:	RTX CLPESTI (30 m x 0.32 mm x 0.5 μm)
		RTX CLPESTII (30 m x 0.32 mm x 0.25 μm)
		(or equivalents)
Data System	:	EZ Chrom
Auto Sampler	:	HP Model 7673B or equivalent
Gas	:	Ultra-high purity hydrogen
		Ultra-high purity nitrogen
Microsyringes	:	10, 25, 100 and 500 μL with a 0.006 mm ID needle
Volumetric Flasks	:	0,50, and 100 ml with ground glass stopper
Automatic Pipette	:	Pipetman, 1000 and 200μL
Transfer Pipette	:	Pasteur

8.2. Chemicals and Reagents

Solvent	:	Pesticide-free grade hexane, methylene chloride

9.0 STANDARDS

9.1. Preparation

9.1.1. Prepare and label analytical standards according to EMAX-QC02 and EMAX-SM04.

9.2. Stock Standard

9.2.1. Calibration stock standards are purchased as certified solutions at 1000 mg/L. All stock standards should be transferred to an inert vial and stored with minimum headspace after opening.

9.2.2. Additional set of stock standards should be purchased from a different source to verify the concentration of the first set of standards. The verification should take place whenever a new lot of stock solution is used. It is prepared using the same procedure as that of the working standard.

9.2.3. Surrogate and matrix standards are purchased as certified solutions from various suppliers.

9.2.4. Store all standards at ≤ 6°C, unless otherwise specified.

9.3. **Intermediate Standard**

9.3.1. Prepare intermediate standards at 2000 µg/L as suggested in Table 1.

9.4. **Initial Calibration Standard (ICAL)**

9.4.1. Prepare five calibration standards according to Table 2.

9.5. **Initial Calibration Verification (ICV)**

9.5.1. Prepare ICV using an intermediate standard prepared from a second source stock standard similarly as described in Table 3.

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Prepare DCC using the an intermediate standard prepared from the same source as the ICAL standard as described in Table 3.

9.7. **Surrogate Standard**

9.7.1. Prepare surrogate standard as described in Table 4.

9.8. **LCS/MS Spike Standard**

9.8.1. Prepare LCS/MS spike standard as described in Table 4.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Aqueous samples shall be prepared as described in EMAX-3520.

10.1.2. Solid samples shall be prepared as described in EMAX-3550 and clean up with concentrated sulfuric acid as described in EMAX-3665.

10.2. **Instrument Parameters**

10.2.1. Method 8082 requires an analytical system complete with a temperature programmable gas chromatograph equipped with an autosampler suitable for on column injection of 2 to 5 µl.

10.2.2. **Gas Pressure**

Nitrogen Pressure	:	40 psi
Hydrogen Pressure	:	50 psi

10.2.3. **Temperature Program**

Column	RESTEK STXCLPesticides 1 & 2	PHENOMENEX ZB-Multiresidue 1 & 2
Initial Temp	130°C, hold for 0 minute	180°C, hold for 0 minute
Rate 1	25°C/min	25°C/min
Temp 1	230°C, hold for 2 minutes	240°C, hold for 0 minute
Rate 2	3°C/min	5°C/min
Temp 2	260°C, hold for 1 minute	260°C, hold for 0 minute
Rate 3	25°C/min	12°C/min
Final Temp	300°C, hold for 1 minute	300°C, hold for 10 minutes
Injector	230°C	250°C
Detector	300°C	300°C
Injection Volume	2µL	1µL

10.3. **Calibration**

10.3.1. Initial Calibration (ICAL)

10.3.1.1. A standard containing a mixture of Aroclor 1016 and Aroclor 1260 will include many of the peaks represented in other five Aroclor mixtures. As a result, a multi-point initial calibration employing a mixture of Aroclor 1016 and 1260 at five concentrations should be sufficient to demonstrate the linearity of the detector response without the necessity of performing initial calibration for each of the seven Aroclors.

10.3.1.2. The five levels of calibration standards (or as suggested in Table 2) of Aroclors 1016 and 1260 are analyzed by direct injection.

10.3.1.3. Three to five characteristic peaks from each Aroclor are chosen for quantitation. Peaks should be at least 25% of the height of the largest Aroclor peak. Tabulate each peak area response against concentration of injected standard. Calculate each calibration factor according to Equation 10.6.1.1. Five sets of calibration factors will be generated for each Aroclor. Calculate the average mean calibration factor (Equation 10.6.1.2), standard deviation (Equation 10.6.1.3) and the relative standard deviation (Equation 10.6.1.4) for each Aroclor peak. The average RSD of five calibration factors for each Aroclor should be equal to or less than 20 before linearity to be assumed and the average calibration factor to be used in quantitation.

10.3.1.4. Prepare a mid-level calibration standard of Aroclors (1260 + 1016) from a second source. Analyze it after the initial calibration to verify the standard. The %D should be equal to or less than 15%.

10.3.1.5. The standards of the other five Aroclors are used to determine a single-point calibration factor for each Aroclor and pattern recognition. It can be analyzed before or after the five 1016/1260 standards.

10.3.1.6. In situations where a particular Aroclor is of interest for a specific project, a five point calibration curve of that Aroclor may be employed instead of 1016/1260 mixture.

10.3.2. Daily Calibration Check (DCC)

10.3.2.1. For daily analysis, a mid-level Aroclors (1016 + 1260) standard should be analyzed. A same calibration standard must also be injected at interval of not less than 20 samples interval and at the end of the analysis sequence.

10.3.2.2. The calibration verification process does not require analysis of the other Aroclor standards used for pattern recognition.

10.3.2.3. The calibration factor calculated from each DCC must not exceed a difference of more than 15% when compared to the mean CF from the initial calibration curve (Equation 10.6.1.2).

10.3.2.4. Continuing calibration for sites that specific PCB is expected to be found, 500 µg/L of that particular PCB shall be analyzed.

10.4. **Analysis**

10.4.1. **Sample Analysis**

10.4.1.1. Introduce extract into the gas chromatograph using direct injection technique (1 to 5 µl) after all quality control criteria have been met. Positive identification is made when a target peak falls within the retention time window on both columns established by the standard reference compound.

10.4.1.2. Identification of a multicomponent analyte in the sample is based on pattern recognition in conjunction with the elution of three or five sample peaks on both GC columns.

10.4.2. **Analytical Sequence**

10.4.2.1. Before analysis, approximately 0.5 ml of extract is transferred to a 2 ml amber auto sampler vial (or equivalent) with a Pasteur pipette, sample vial is capped with a teflon septum and sealed with an aluminum rim. Standards and QC samples are sealed the same way.

10.4.2.2. Following the data acquisition software's instruction, prepare the analytical sequence as suggested below:

- Instrument Blank
- Five Calibration Standards of Aroclors 1016/1260
- Calibration Standard of Aroclor 1254*
- Calibration Standard of Aroclor 1248*
- Calibration Standard of Aroclor 1242*
- Calibration Standard of Aroclor 1232*

* Calibrate if the pattern is found in a sample

- Calibration Standard of Aroclor 1221*
- Initial Calibration Verification of Aroclor 1016/1260 by a Second Source
- Method Blank
- Lab Control Sample
- Samples (up to 20 samples)
- Continuing Calibration Standard of Aroclors 1016/1260 or other calibrated Aroclors

10.4.3. **Sample Result Evaluation**

10.4.3.1. Check QC parameters as soon as the data is available.

- ✓ Check LCS recovery that it is within QC limits.
- ✓ Check MB that is compliant to PSR.
- ✓ Check surrogate recoveries against Appendix 1.
- ✓ Check concentration of target analytes. If the response exceeds the calibration range, dilute and re-analyze the sample until the response falls within the calibration range.
- ✓ If any of the above checkpoints indicate a problem, re-analysis is required. If re-analysis results are the same as the initial result, consult the Supervisor for further action. If results indicate extraction problem, fill-up an NCR and order re-extraction for the affected sample(s).

10.4.3.2. For positive identification, check that the PCB pattern characteristic peaks are detected in both columns within the established retention time window.

10.4.3.3. If one column meets the retention time criteria and a retention time shift is suspected on the other column, use the following guideline in reporting the data:

- ✓ Check that the expanded window does not exceed the RTW of the column in control or the established RTW or the CLP RTW[1] whichever is greater.
- ✓ If the above condition is met, report the data and include a description of the observation in the case narrative.

10.4.4. **Retention Time Windows**

10.4.4.1. Establishing RTW

10.4.4.1.1. Collect at least three Daily Calibration Standards analyzed over a period of 72 hours.

10.4.4.1.2. Calculate the Standard Deviation (SD) of absolute retention time obtained for each of the major peaks used for calibration.

10.4.4.1.3. Determine the width of RTW by ±3X SD.

[1] CLP-OLM4.2 Table 1 D-79/PEST

10.4.4.2. Evaluating RTW

10.4.4.2.1. If the SD is equal to 0.00, default to the previous study until historical data is obtained or use the CLP retention time window for Aroclors (±0.07 minutes) which ever is narrower.

10.4.4.2.2. For new instruments, in the interim use the CLP retention time window for Aroclors (±0.07 min) until RTW is obtained for the new instrument parameters condition.

10.4.4.3. Application of RTW

10.4.4.3.1. Establish the center of absolute retention time for each of the characteristic peak to include the surrogate(s) from the daily calibration check at the beginning of the analytical shift then apply the established RTW.

10.4.4.3.2. Whenever the observe retention time is outside the established RTW, the analyst is advised to determine the cause and perform necessary corrective action before continuing analyses.

10.4.4.4. Updating RTW

10.4.4.4.1. Re-establish the RTW as described in Section 10.4.4.1 when any of the following conditions occur:

- Yearly RTW update
- Significant shifting is observed (e.g. succeeding calibration checks or LCS are out of RTW)
- Major instrument maintenance (e.g. replacements of detector or column; temperature program change, etc.)

10.4.5. **Manual Integration**

10.4.5.1. Refer to EMAX-DM01 for details of manual integration.

10.4.6. **Dealing with Carryover**

✓ Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.

✓ If there was no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction.

✓ If there was a target analyte detected as found in the sample that exceeded the calibration range, re-analyze the sample to rule-out carry over. If carry over is confirmed, proceed with data reduction and report the data from re-analysis.

10.5. **Data Reduction**

10.5.1. Identification of a multicomponent analyte in the sample is based on pattern recognition in conjunction with the elution of three to five peaks on both GC columns.

10.5.2. The agreement between the quantitative results should be evaluated after the identification is made. Calculate the relative percent difference (RPD) between the two results according to Equation 10.6.5.2.

10.5.2.1. If the RPD is less than 40% and the pattern peaks do not indicate any anomalies, report the higher result.

10.5.2.2. If the RPD is less than 40% and the pattern peaks indicate an anomaly, report the result from the better pattern peaks.

10.5.2.3. If the RPD is greater than 40%, use professional judgment. If no anomaly is found, report the higher result.

10.6. **Calculations**

10.6.1. Initial Calibration

10.6.1.1. Calculate for Calibration Factor (CF).

$$CF = \frac{R_a}{C_a}$$ Eq.-10.6.1.1

where:

R_a - *response for analyte measured in peak area*

C_a - *Concentration of analyte (µgL) x 1/N*

N - *number of identification peak in each Aroclor*

10.6.1.2. Calculate for Average Calibration Factor (ACF)

$$ACF = \frac{\sum CF_a}{n}$$ Eq.-10.6.1.2

where:

ACF - *average calibration factor*

ΣCF_a - *sum of calibration factors*

n - *number of calibration points*

10.6.1.3. Calculate for Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}}$$ Eq.-10.6.1.3

where:

SD - *standard deviation*

x_i - *result at i^{th} measurement*

$\bar{x}$ - *mean*

N - *number of measurements*

10.6.1.4. Calculate for % relative standard deviation (%RSD).

$$\%RSD = \frac{SD}{ACF} * 100\% \qquad \text{Eq.-10.6.1.4}$$

where:

RSD - *relative standard deviation*

SD - *standard deviation*

ACF - *average calibration factor*

10.6.2. Calibration Check/Continuing Calibration

10.6.2.1. Calculate Percent Difference.

$$\%D = \frac{ACF - CF}{ACF} * 100\% \qquad \text{Eq.-10.6.2.1}$$

where:

ACF - *average calibration factor*

CF - *calibration factor at calibration check standard*

10.6.3. Sample Results

10.6.3.1. Identify 3 to 5 major peaks as quantitative peaks for each Aroclor. Establish the ACF of each peak as outlined in Section 10.6.1.1. Calculate C of each peak in Aroclor according to Equations 10.6.3.2 or 10.6.3.3. The concentration of Aroclor equals to the sum of the concentrations of these major peaks according to Equation 10.6.3.4.

10.6.3.2. Water Samples

$$C_n = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a}\right)DF \qquad \text{Eq-10.6.3.2}$$

where:

C_n - *Concentration of characteristic peak n measured (µg/L)*

R_a - *Total response of analyte in peak area*

ACF - *Average response factor*

V_e - *Volume of extract in ml*

S_a - *Sample amount in ml*

DF - *Dilution factor of sample extract*

10.6.3.3. Soil Samples

$$C_n = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a(\%Solid)}\right)DF \qquad \text{Eq.10.6.3.3}$$

where

C_n	-	*Concentration of characteristic peak n measured (µg/kg)*
R_a	-	*Total response of analyte in peak area*
ACF	-	*Average response factor*
V_e	-	*Volume of extract in ml*
S_a	-	*Sample Amount in g*
% Solid	-	$\frac{100 - \%\ moisture}{100}$
DF	-	*Dilution factor of the sample extract*

10.6.3.4. Final Aroclor Concentration

$$C = C_1 + C_2 + \ldots C_n \qquad \text{Eq.-10.6.3.4}$$

where:

C	-	*Concentration of Aroclor in sample (µg/L or µg/kg)*
C_1	-	*Concentration of characteristic peak 1*
C_2	-	*Concentration of characteristic peak 2*
n	-	*Characteristic peak number in each Aroclor*

10.6.4. Accuracy and Precision

10.6.4.1. Percent Recovery

$$\%R = \frac{C_f - C}{C_s} * 100 \qquad \text{Eq.-10.6.4.1}$$

where:

%R	-	*percent recovery*
C_f	-	*concentration of spiked sample*
C_s	-	*concentration of spike*
C	-	*concentration of unspiked sample (For LCS recovery, C=0)*

10.6.4.2. Relative Percent Difference

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.6.4.2}$$

where:

%RPD - *Relative Percent Difference*

C_1 - *Measured concentration of the first sample aliquot*

C_2 - *Measured concentration of the second sample aliquot*

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C .exe

10.7.2. Generate Lab Chronicle using LABCHRN1.exe

10.7.3. Generate sample results using F1V3C .exe

10.7.4. Generate the QC Summary file using QCV3C .exe

10.7.5. Generate the case narrative using CN1.exe.

10.7.6. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analyses.

- Sample Results
- LCS Summary
- MS/MSD Summary
- DCC Summary
- ICAL Summary
- ICV Summary
- Copy of Analysis Log
- Copy of Preparation Log

10.8. **Data Review**

10.8.1. Perform a 100% data review in accordance to EMAX-DM01 and the project specific requirements (PSR).

- ✓ Check that samples are extracted and analyzed within Holding Time.
- ✓ Check that all calibration requirements are fulfilled.
- ✓ Check that all samples required for analysis are performed.
- ✓ Check the chromatogram of all positively identified Aroclor patterns that they are qualitatively identified and qualitatively accurate.
- ✓ Check surrogate recoveries against required limits.

- ✓ Check that concentration of target analytes are within calibration range.
- ✓ If any of the above checkpoints indicate a problem, re-analysis is required.

10.8.2. Review the case narrative and edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Refer to Form 8081FM for daily routine maintenance check points.

10.9.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back in control.

10.9.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

Maintenance Activity	Description	Frequency
Autosampler Check	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis
Verification	Check instrument parameters to ensure normal operating conditions. Check liner as necessary. Check instrument performance (e.g., daily calibration check, instrument blank, DDT/Endrin breakdown).	Daily prior to analysis
Documentation	Record maintenance in instrument service logs.	Daily prior to analysis
Leak Test	Perform inlet pressure decay test.	Every 6 months or as necessary
System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector where applicable.	Every 6 months or as necessary
Check Flow Path Components	Check and replace the following as necessary: tubing assembly, union, sample probe, and loop.	Once a year or as necessary
Complete Inspection	Perform general inspection of the complete system. Inspect autosampler cabling and configuration setting.	Once a year

11.0 QUALITY CONTROL

11.1. **Preparative Batch**

11.1.1. A preparative batch shall consist of a method blank, LCS, MS/MSD and a maximum of 20 field samples of similar matrix.

11.1.2. In the absence of MS/MSD, LCS/LCD is prepared.

11.1.3. Surrogate standard shall be added to all samples, including method blank LCS/LCD and MS/MSD. Check PSR for QC Control Limits.

11.1.4. Perform QC check prior to utilizing the surrogate and LCS/MS spike standards by analyzing the prepared standard at the spiking level. Results should be within ± 20% of the expected value.

11.2. **Analytical Batch QC**

11.2.1. Instrument Blank must be analyzed daily to establish zero baseline or background value.

11.2.2. A continuing calibration shall be performed before any other analysis is done. The continuing calibration procedure and the acceptance criteria are discussed in Section 10.3.2 and Appendix 1.

11.3. **Method QC**

11.3.1. Analyst demonstration of proficiency is a must prior to performing this analysis.

11.3.2. A valid LOD and LOQ must exist prior to sample analysis.

11.3.3. A valid ICAL must exist prior to sample analysis.

11.3.4. Instrument performance must be checked prior to sample analysis. Check Appendix 1 for acceptance criteria.

11.3.5. Prepare and analyze QC samples, to include, method blank, LCS (LCD), and MS/MSD. QC Control Limits shall follow the Project Specific Requirement (PSR) in each analytical folder.

12.0 CORRECTIVE ACTION

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures in Appendix 1. Document out-of-control event and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. If Initial calibration is non-compliant, consider the following suggestions to correct the problem:

12.2.1. If %RSD is out of acceptance criteria, review result and identify presence of an outlier.

12.2.2. If one of the standard returns a bias-low or bias-high on all of the analytes, then that point is considered an outlier, prepare a standard at that ICAL point and reanalyze.

12.2.3. If the highest ICAL point appears to be saturated, drop the highest point.

12.2.4. If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

Note: The lowest calibration point identifies the limit of quantitation (LOQ). Therefore, check that the LOQL is in conformance to the current projects where the ICAL will be used.

12.2.5. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

12.2.5.1. Check the connections and make sure they are air-tight and perform maintenance as needed.

12.2.5.2. Check the gas flow

12.2.5.3. Prepare a fresh standard and repeat calibration

12.2.6. If the problem persists, inform the supervisor.

12.3. If the ICV is non-compliant, consider the following suggestions to correct the problem:

12.3.1. Re-analyze ICV (to rule out poor injection)

12.3.2. If ICV is still out of acceptance criteria, prepare a fresh standard and re-analyze to rule out any preparation error

12.3.3. If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration

12.3.4. If the problem persists, inform the supervisor

12.4. If the instrument blank is non-compliant, consider the following suggestions to correct problem:

12.4.1. Rule out instrument contamination by performing the instrument daily maintenance, such as changing septum, cleaning liner, cleaning or using new auto sampler syringe.

12.4.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.4.3. Rule out preparation contamination by preparing a new instrument blank

12.4.4. If the problem persists, inform the supervisor.

12.5. If Continuing Calibration is non-compliant, consider the following suggestions to correct the problem:

12.5.1. Change the liner

12.5.2. Clean injection port

12.5.3. Prepare new standard

12.5.4. Cut or replace column

12.5.5. Clean the detector

12.5.6. Rule out leaks by checking all connections

12.5.7. If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL

12.6. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

12.6.1. Rule out instrument contamination by checking instrument blank

12.6.2. Rule out reagent contamination by testing each reagent used for extraction as described in EMAX-QC01

12.6.3. Rule out glassware contamination used for extraction as described in EMAX-QC07

12.6.4. Re-extract MB and the associated samples with reagents free of contamination or with newly opened reagents

12.6.5. If the problem persists, inform the supervisor

12.7. If LCS is non-compliant, perform the following suggestions to correct the problem:

12.7.1. If result is bias-high or bias-low, check the LCS Standard by analyzing at the spike level

12.7.2. If LCS check is within 80-120% of expected value, check calibration of the micropipette or syringe used for spiking. Re-extract and re-analyze the LCS and the associated samples.

12.7.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS Standard, re-extract and re-analyze LCS and the associated samples.

12.8. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.8.1. If corrective action needs the function of other department; e.g., if the sample needs to be re-extracted, refer to EMAX-QA08 for details of completing an NCR.

12.8.2. If corrective action needs the assistance of the project manager; e.g. If the sample is non-compliant to the technical holding time requirement, insufficient amount of sample, or other non-conforming issues.

12.9. For other problems encountered, inform the supervisor immediately for further instructions.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to WDU shall be disposed in accordance to EMAX-SM03

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents. Preparation batch is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate. Analytical batch is compose of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Characteristic Peaks – are major identifying and quantifying peaks for each type of Aroclor.

15.1.4. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.5. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.6. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.7. Matrix – is a component or form of a sample.

15.1.8. Matrix Spike (MS) – is a sample spiked with a verified known amount of target anayte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.9. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.10. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.11. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.12. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing PCB analysis by GC/MS unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. Methods 8000B and 8082A, Test Methods for Evaluating Solid Wastes, USEPA SW846.

16.2. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Figures**

17.1.1.	Figure 1	Peak Evaluation Technique
17.1.2.	Figure 2	Typical PCB Patterns
17.1.3.	Figure 3	Typical 1016/1260 Chromatogram
17.1.4.	Figure 4	Typical Initial Calibration Summary
17.1.5.	Figure 5	Typical Retention Time Window Summary
17.1.6.	Figure 6	Typical Sample Result Summary
17.1.7.	Figure 7	Typical LCS Report Summary
17.1.8.	Figure 8	Typical Matrix Spike Summary
17.1.9.	Figure 9	Typical Case Narrative

17.2. **Tables**

17.2.1.	Table 1	Intermediate Standard Preparation
17.2.2.	Table 2	Initial Calibration Standard Preparation
17.2.3.	Table 3	Calibration Check Standard Preparation
17.2.4.	Table 4	Spike Standard and Surrogate Standards Preparation
17.2.5.	Table 5	Compound List
17.2.6.	Table 6	Established Limit of Detection (LOD) and Limit of Quantitation (LOQ)

17.3. **Appendices**

17.3.1.	Appendix 1	Summary of In-House Quality Control Procedures
17.3.2.	Appendix 2	Demonstration of Capability

17.4. **Forms**

17.4.1.	8082FA	Analysis Run Log
17.4.2.	8082FP	Sample Preparation Log
17.4.3.	8082FM	Instrument Maintenance Log

Figure 1. **PEAK EVALUATION TECHNIQUE**

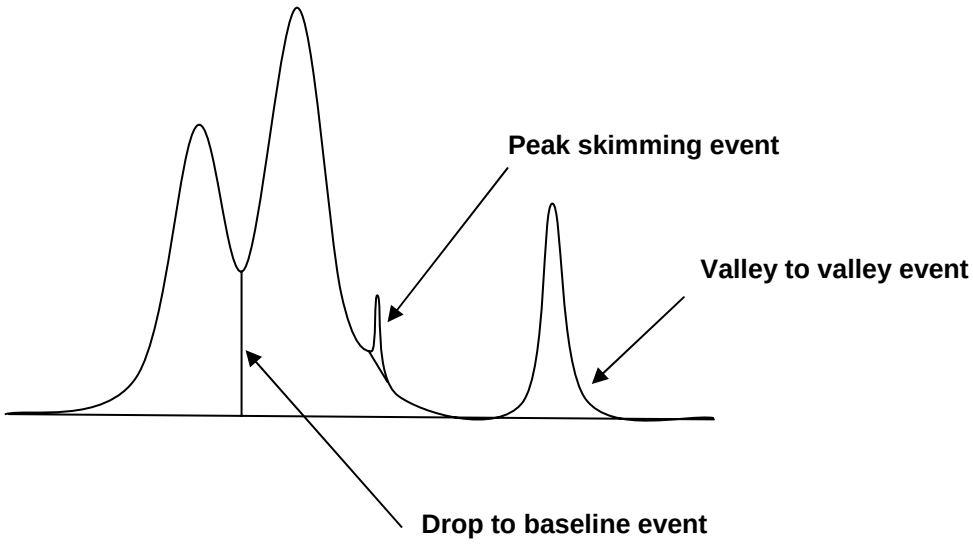


Figure 2. **TYPICAL PCB PATTERNS**

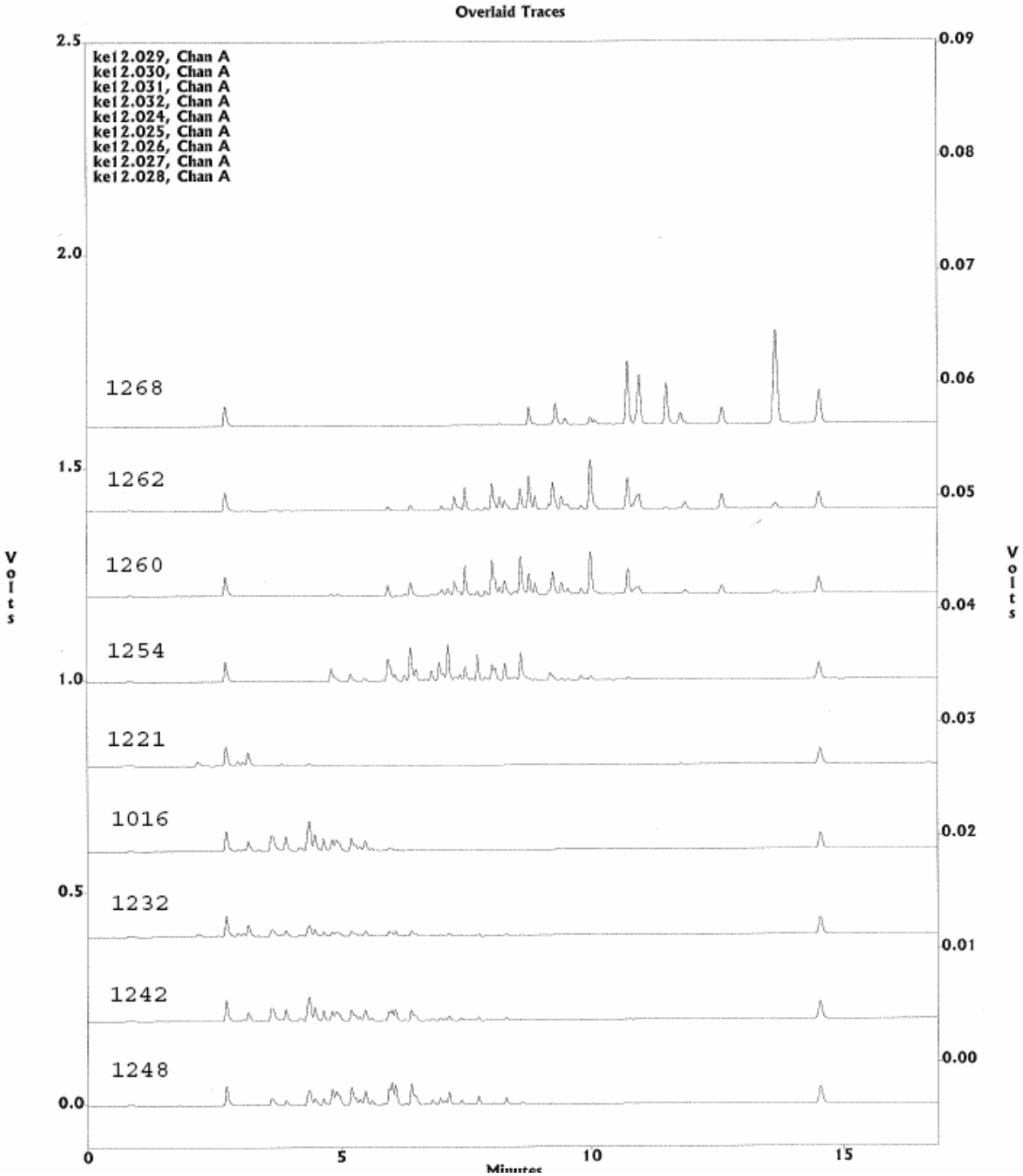


Figure 2. **TYPICAL PCB PATTERNS**

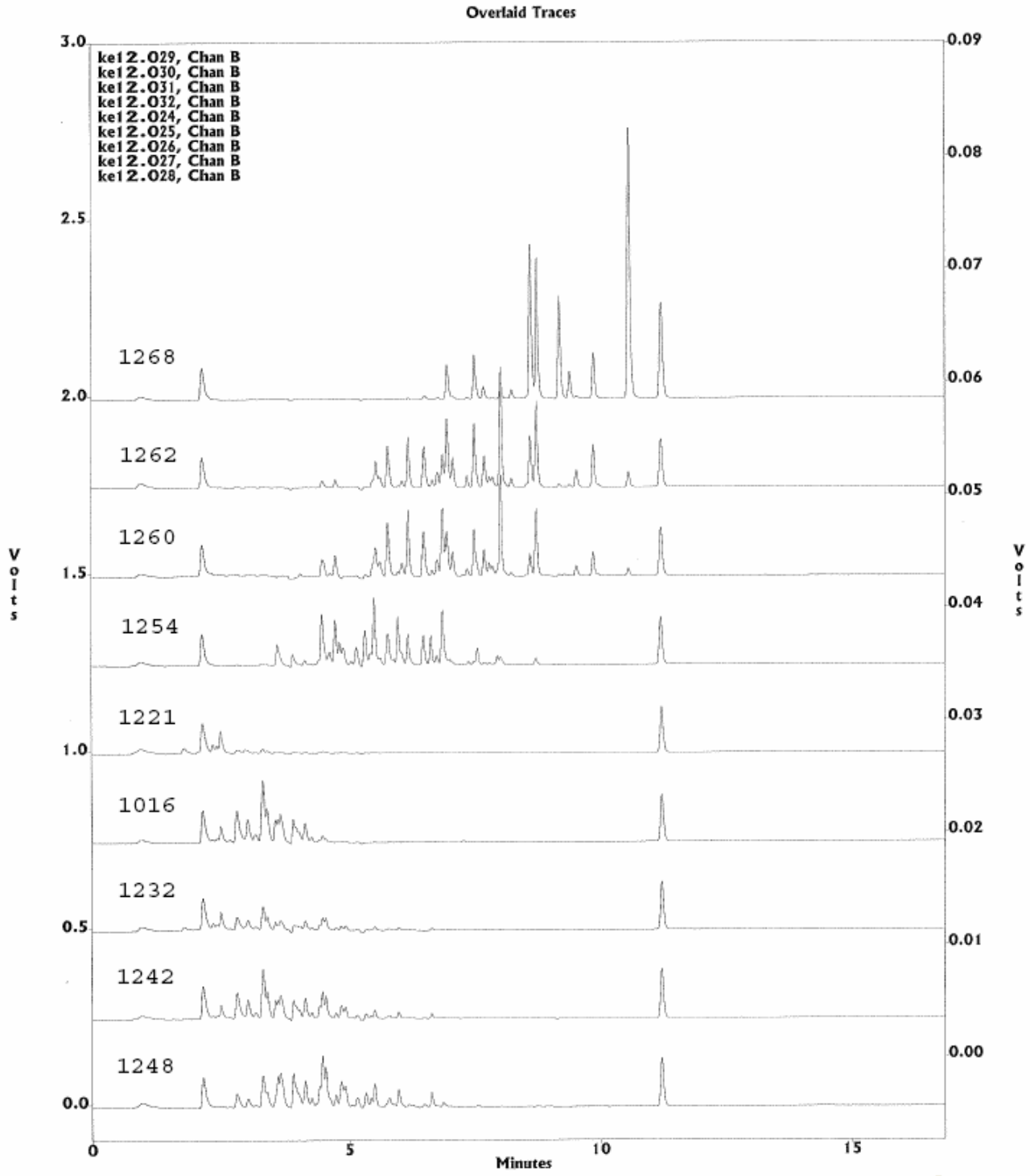


Figure 3. **TYPICAL 1016 / 1260 CHROMATOGRAM**

EPA 8082 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\ke12\ke12.005
Method : c:\ezchrom\methods\6071e12.met
Sample ID : 6071E1203 500 PPB
Acquired : May 12, 2010 13:46:34
Printed : Jul 06, 2010 11:47:48
User : SUPAKIT

Channel A Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
2	TCX	2.742	184646	7843.7	25.0
5	1016-1	3.183	98764	966.5	100.0
8	1016-2	3.917	130541	1300.0	100.0
10	1016-3	4.375	331618	3303.7	100.0
11	1016-4	4.483	156449	1528.8	100.0
18	1016-5	5.475	94509	943.5	100.0
29	1260-1	7.500	226712	2257.3	100.0
37	1260-2	8.617	308711	3204.4	100.0
41	1260-3	9.267	182078	1940.0	100.0
46	1260-4	10.008	334873	3400.9	100.0
47	1260-5	10.750	205847	2092.8	100.0
54	DCB	14.542	190472	8157.5	25.0

Channel A Group Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
G1	PCB1016		811881	0.0	500.0
G2	PCB1260		1258221	0.0	500.0

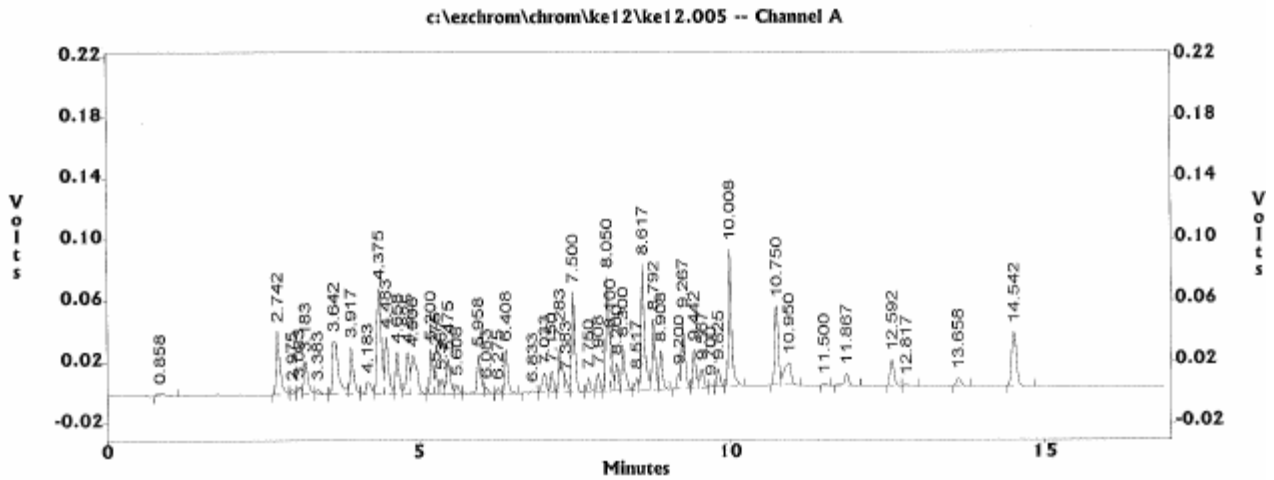


Figure 3. **TYPICAL 1016 / 1260 CHROMATOGRAM**

EPA 8082 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\ke12\ke12.005
Method : c:\ezchrom\methods\6071e12.met
Sample ID : 6071E1203 500 PPB
Acquired : May 12, 2010 13:46:34
Printed : Jul 06, 2010 11:47:48
User : SUPAKIT

Channel B Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
2	TCX	2.058	405999	17227.8	25.0
5	1016-1	2.417	216146	2158.1	100.0
7	1016-2	2.750	492961	4918.2	100.0
8	1016-3	2.967	292033	2947.8	100.0
10	1016-4	3.258	707016	6870.8	100.0
16	1016-5	4.108	228031	2312.7	100.0
27	1260-1	5.775	547555	5532.4	100.0
31	1260-2	6.483	560272	5650.6	100.0
34	1260-3	6.858	723859	7144.4	100.0
38	1260-4	7.492	473088	4839.6	100.0
42	1260-5	8.008	952668	9596.1	100.0
53	DCB	11.217	518117	22340.3	25.0

Channel B Group Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)
G1	PCB1016		1936187	0.0	500.0
G2	PCB1260		3257442	0.0	500.0

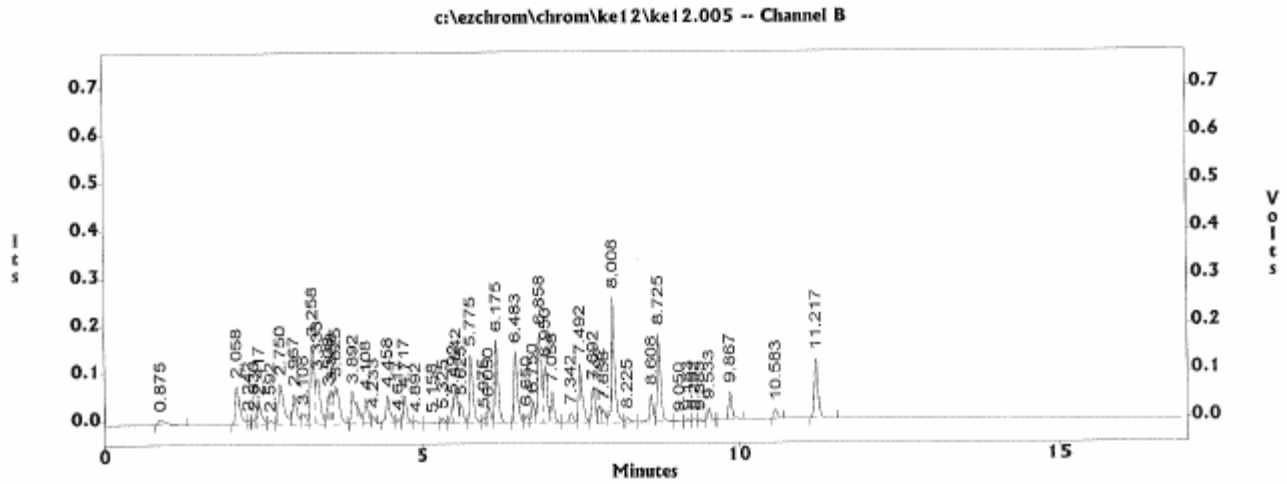


Figure 4. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12003A 05/12/10 13:04
LFID & Datetime: KE12004A 05/12/10 13:25
LFID & Datetime: KE12005A 05/12/10 13:46
LFID & Datetime: KE12006A 05/12/10 14:07
LFID & Datetime: KE12007A 05/12/10 14:28
LFID & Datetime: KE12008A 05/12/10 14:49
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1016-1	20.00	987.05	1038.88	987.64	960.15	934.82	890.44	966.497	5.3
PCB1016-2	20.00	1413.40	1343.84	1305.41	1293.97	1250.43	1193.01	1300.011	5.8
PCB1016-3	20.00	3364.75	3317.44	3316.18	3346.63	3309.61	3167.37	3303.663	2.1
PCB1016-4	20.00	1679.15	1544.80	1564.49	1488.03	1467.24	1429.37	1528.846	5.8
PCB1016-5	20.00	971.00	958.40	945.09	941.39	934.59	910.50	943.497	2.2
PCB1260-1	20.00	2569.85	2405.92	2267.12	2189.85	2126.44	1984.86	2257.338	9.2
PCB1260-2	20.00	3844.05	3256.32	3087.11	3075.08	3054.09	2910.04	3204.448	10.4
PCB1260-3	20.00	2156.30	2283.26	1820.78	1831.65	1809.52	1738.57	1940.013	11.5
PCB1260-4	20.00	3726.55	3512.28	3348.73	3351.35	3306.04	3160.39	3400.892	5.7
PCB1260-5	20.00	2183.05	2130.60	2058.47	2092.66	2072.56	2019.48	2092.805	2.7
SURROGATE	**X**	**1.00X**	**2.50X**	**5.00X**	**7.50X**	**10.00X**	**15.00X**	**MEAN**	**%RSD**
TCX	5.00	9588.80	7204.40	7385.84	7544.72	7664.22	7674.35	7843.721	11.1
DCB	5.00	10811.20	8312.32	7618.88	7590.00	7476.86	7136.00	8157.543	16.6

6071E12.MET

Figure 4. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12003B 05/12/10 13:04
LFID & Datetime: KE12004B 05/12/10 13:25
LFID & Datetime: KE12005B 05/12/10 13:46
LFID & Datetime: KE12006B 05/12/10 14:07
LFID & Datetime: KE12007B 05/12/10 14:28
LFID & Datetime: KE12008B 05/12/10 14:49
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1016-1	20.00	2531.45	2306.74	2161.46	2075.43	2003.85	1869.80	2158.122	10.9
PCB1016-2	20.00	5998.70	5331.48	4929.61	4653.03	4475.03	4121.31	4918.193	13.6
PCB1016-3	20.00	3400.80	3158.40	2920.33	2854.77	2734.06	2618.29	2947.775	9.8
PCB1016-4	20.00	7446.30	7058.40	7070.16	6812.91	6638.33	6198.53	6870.771	6.2
PCB1016-5	20.00	2554.75	2406.06	2280.31	2245.73	2230.83	2158.41	2312.682	6.2
PCB1260-1	20.00	6709.55	5976.02	5475.55	5249.51	5061.71	4722.36	5532.450	12.9
PCB1260-2	20.00	6475.75	5952.82	5602.72	5484.26	5350.77	5037.32	5650.606	8.9
PCB1260-3	20.00	7890.30	7385.60	7238.59	7049.84	6869.64	6432.58	7144.424	6.9
PCB1260-4	20.00	5623.90	5052.46	4730.88	4677.04	4583.27	4370.15	4839.618	9.2
PCB1260-5	20.00	10787.75	10010.90	9526.68	9400.84	9168.59	8681.76	9596.087	7.6
SURROGATE	**X**	**1.00X**	**2.50X**	**5.00X**	**7.50X**	**10.00X**	**15.00X**	**MEAN**	**%RSD**
TCX	5.00	22174	16063	16240	16423	16416	16051	17227.8	14.1
DCB	5.00	30064	22874	20725	20671	20389	19319	22340.3	17.7

6071E12.MET

Figure 4. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12017A 05/12/10 17:59
LFID & Datetime: KE12018A 05/12/10 18:20
LFID & Datetime: KE12019A 05/12/10 18:41
LFID & Datetime: KE12020A 05/12/10 19:02
LFID & Datetime: KE12021A 05/12/10 19:23
LFID & Datetime: KE12022A 05/12/10 19:44
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1254-1	20.00	1745.15	1508.44	1541.66	1508.27	1524.72	1449.51	1546.292	6.6
PCB1254-2	20.00	2968.10	2825.48	2598.64	2504.80	2465.00	2329.33	2615.225	9.1
PCB1254-3	20.00	2712.95	2670.38	2516.27	2486.73	2970.83	2883.74	2706.817	7.1
PCB1254-4	20.00	2061.75	1996.88	1827.72	1717.84	1811.94	1748.45	1860.762	7.4
PCB1254-5	20.00	1290.55	1236.58	1137.25	1131.21	1165.51	1158.65	1186.624	5.3

5471E12.MET

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12017B 05/12/10 17:59
LFID & Datetime: KE12018B 05/12/10 18:20
LFID & Datetime: KE12019B 05/12/10 18:41
LFID & Datetime: KE12020B 05/12/10 19:02
LFID & Datetime: KE12021B 05/12/10 19:23
LFID & Datetime: KE12022B 05/12/10 19:44
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1254-1	20.00	7034.10	6630.54	6135.43	5886.83	5495.82	5114.34	6049.510	11.7
PCB1254-2	20.00	5282.65	4879.32	4430.71	4305.54	3938.39	3517.12	4392.288	14.4
PCB1254-3	20.00	8787.45	7704.46	7407.97	7251.58	6952.21	6575.30	7446.497	10.2
PCB1254-4	20.00	5818.55	5466.08	5323.35	5128.29	5100.35	4325.48	5193.684	9.6
PCB1254-5	20.00	3664.55	3506.54	3238.12	3257.10	3171.97	2955.18	3298.910	7.6

5471E12.MET

Figure 4. **TYPICAL INITIAL CALIBRATION SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12010A 05/12/10 15:31
LFID & Datetime: KE12011A 05/12/10 15:52
LFID & Datetime: KE12012A 05/12/10 16:13
LFID & Datetime: KE12013A 05/12/10 16:34
LFID & Datetime: KE12014A 05/12/10 16:56
LFID & Datetime: KE12015A 05/12/10 17:17
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1248-1	20.00	1843.10	1763.30	1715.84	1697.99	1687.93	1654.19	1727.057	3.9
PCB1248-2	20.00	1521.90	1411.90	1303.59	1260.51	1205.49	1131.78	1305.861	10.8
PCB1248-3	20.00	1286.25	1237.96	1214.85	1192.17	1197.47	1187.97	1219.445	3.1
PCB1248-4	20.00	1623.60	1561.46	1562.23	1519.13	1553.84	1543.37	1560.604	2.2
PCB1248-5	20.00	1717.60	1631.02	1442.60	1526.57	1481.25	1423.11	1537.026	7.5

4871E12.MET

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12010B 05/12/10 15:31
LFID & Datetime: KE12011B 05/12/10 15:52
LFID & Datetime: KE12012B 05/12/10 16:13
LFID & Datetime: KE12013B 05/12/10 16:34
LFID & Datetime: KE12014B 05/12/10 16:56
LFID & Datetime: KE12015B 05/12/10 17:17
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.50X	5.00X	7.50X	10.00X	15.00X	MEAN	%RSD
PCB1248-1	20.00	3818.70	3696.56	3596.55	3554.63	3490.39	3327.74	3580.761	4.7
PCB1248-2	20.00	3214.65	3076.66	2982.88	2939.41	2875.33	2765.65	2975.765	5.3
PCB1248-3	20.00	5261.95	4964.34	4747.95	4590.34	4487.60	4255.45	4717.939	7.6
PCB1248-4	20.00	2924.55	2790.58	2696.63	2655.51	2598.89	2468.50	2689.110	5.8
PCB1248-5	20.00	2529.30	2430.32	2484.94	2368.52	2368.48	2269.00	2408.426	3.9

4871E12.MET

Figure 5. **TYPICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12003A 05/12/10 13:04
LFID & Datetime: KE12004A 05/12/10 13:25
LFID & Datetime: KE12005A 05/12/10 13:46
LFID & Datetime: KE12006A 05/12/10 14:07
LFID & Datetime: KE12007A 05/12/10 14:28
LFID & Datetime: KE12008A 05/12/10 14:49

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
PCB1016-1	3.183	3.183	3.183	3.183	3.183	3.183	3.183	3.145	3.221	0.038
PCB1016-2	3.925	3.925	3.917	3.925	3.917	3.925	3.922	3.893	3.951	0.029
PCB1016-3	4.375	4.375	4.375	4.375	4.375	4.375	4.375	4.361	4.389	0.014
PCB1016-4	4.492	4.492	4.483	4.492	4.483	4.492	4.489	4.475	4.503	0.014
PCB1016-5	5.475	5.483	5.475	5.475	5.475	5.483	5.478	5.440	5.516	0.038
PCB1260-1	7.500	7.508	7.500	7.500	7.500	7.508	7.503	7.465	7.541	0.038
PCB1260-2	8.617	8.617	8.617	8.617	8.617	8.617	8.617	8.601	8.633	0.016
PCB1260-3	9.267	9.267	9.267	9.267	9.267	9.267	9.267	9.239	9.295	0.028
PCB1260-4	10.008	10.008	10.008	10.008	10.008	10.008	10.008	9.970	10.046	0.038
PCB1260-5	10.750	10.750	10.750	10.750	10.750	10.750	10.750	10.712	10.788	0.038
SURROGATE	**1.0X**	**2.5X**	**5.0X**	**7.5X**	**10.0X**	**15.0X**	**RT**	**FROM**	**TO**	**WIDTH**
TCX	2.742	2.750	2.742	2.750	2.742	2.750	2.746	2.718	2.774	0.028
DCB	14.533	14.542	14.542	14.542	14.542	14.542	14.541	14.478	14.604	0.063

6071E12.MET

Figure 5. **TYPICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCTO71 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12003B 05/12/10 13:04
LFID & Datetime: KE12004B 05/12/10 13:25
LFID & Datetime: KE12005B 05/12/10 13:46
LFID & Datetime: KE12006B 05/12/10 14:07
LFID & Datetime: KE12007B 05/12/10 14:28
LFID & Datetime: KE12008B 05/12/10 14:49

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
PCB1016-1	2.417	2.417	2.417	2.417	2.417	2.417	2.417	2.379	2.455	0.038
PCB1016-2	2.750	2.750	2.750	2.750	2.750	2.750	2.750	2.712	2.788	0.038
PCB1016-3	2.967	2.967	2.967	2.967	2.967	2.967	2.967	2.929	3.005	0.038
PCB1016-4	3.258	3.258	3.258	3.258	3.258	3.258	3.258	3.220	3.296	0.038
PCB1016-5	4.108	4.117	4.108	4.108	4.108	4.117	4.111	4.073	4.149	0.038
PCB1260-1	5.783	5.783	5.775	5.783	5.783	5.783	5.782	5.729	5.835	0.053
PCB1260-2	6.492	6.492	6.483	6.492	6.492	6.492	6.490	6.452	6.529	0.038
PCB1260-3	6.858	6.858	6.858	6.858	6.858	6.858	6.858	6.815	6.901	0.043
PCB1260-4	7.492	7.492	7.492	7.492	7.492	7.492	7.492	7.440	7.544	0.052
PCB1260-5	8.008	8.017	8.008	8.008	8.008	8.008	8.009	7.966	8.052	0.043
SURROGATE	**1.0X**	**2.5X**	**5.0X**	**7.5X**	**10.0X**	**15.0X**	**RT**	**FROM**	**TO**	**WIDTH**
TCX	2.058	2.058	2.058	2.058	2.058	2.058	2.058	2.020	2.096	0.038
DCB	11.217	11.225	11.217	11.217	11.217	11.225	11.220	11.168	11.272	0.052

6071E12.MET

Figure 5. **TYPICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCTO71 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12017A 05/12/10 17:59
LFID & Datetime: KE12018A 05/12/10 18:20
LFID & Datetime: KE12019A 05/12/10 18:41
LFID & Datetime: KE12020A 05/12/10 19:02
LFID & Datetime: KE12021A 05/12/10 19:23
LFID & Datetime: KE12022A 05/12/10 19:44

COMPOUND	RT OF STANDARDS (MIN)						MEAN	RT WINDOW		RTWINDOW
	1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	RT	FROM	TO	WIDTH
PCB1254-1	5.967	5.967	5.933	5.933	5.958	5.958	5.953	5.915	5.991	0.038
PCB1254-2	6.417	6.417	6.417	6.417	6.417	6.417	6.417	6.374	6.460	0.043
PCB1254-3	7.167	7.167	7.167	7.167	7.158	7.158	7.164	7.126	7.202	0.038
PCB1254-4	7.767	7.767	7.767	7.767	7.758	7.758	7.764	7.735	7.793	0.029
PCB1254-5	8.317	8.317	8.317	8.317	8.308	8.308	8.314	8.285	8.343	0.029

5471E12.MET

Lab Name : EMAX Inc
Instrument ID : GCTO71 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12017B 05/12/10 17:59
LFID & Datetime: KE12018B 05/12/10 18:20
LFID & Datetime: KE12019B 05/12/10 18:41
LFID & Datetime: KE12020B 05/12/10 19:02
LFID & Datetime: KE12021B 05/12/10 19:23
LFID & Datetime: KE12022B 05/12/10 19:44

COMPOUND	RT OF STANDARDS (MIN)						MEAN	RT WINDOW		RTWINDOW
	1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	RT	FROM	TO	WIDTH
PCB1254-1	4.467	4.467	4.467	4.467	4.458	4.458	4.464	4.421	4.507	0.043
PCB1254-2	4.733	4.733	4.733	4.725	4.725	4.725	4.729	4.686	4.772	0.043
PCB1254-3	5.517	5.517	5.517	5.517	5.508	5.517	5.516	5.473	5.559	0.043
PCB1254-4	5.983	5.983	5.992	5.983	5.983	5.983	5.984	5.946	6.022	0.038
PCB1254-5	6.183	6.183	6.183	6.183	6.183	6.183	6.183	6.155	6.211	0.028

5471E12.MET

Figure 5. **TYPICAL RETENTION TIME WINDOW SUMMARY**

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-1
Column size ID : .32MMX30M
LFID & Datetime: KE12010A 05/12/10 15:31
LFID & Datetime: KE12011A 05/12/10 15:52
LFID & Datetime: KE12012A 05/12/10 16:13
LFID & Datetime: KE12013A 05/12/10 16:34
LFID & Datetime: KE12014A 05/12/10 16:56
LFID & Datetime: KE12015A 05/12/10 17:17

COMPOUND	RT OF STANDARDS (MIN)						MEAN	RT WINDOW		RTWINDOW
	1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	RT	FROM	TO	WIDTH
PCB1248-1	4.383	4.383	4.383	4.383	4.383	4.383	4.383	4.359	4.407	0.024
PCB1248-2	4.833	4.833	4.833	4.833	4.833	4.833	4.833	4.807	4.859	0.026
PCB1248-3	5.483	5.483	5.483	5.483	5.483	5.483	5.483	5.445	5.521	0.038
PCB1248-4	6.092	6.092	6.092	6.092	6.092	6.092	6.092	6.068	6.116	0.024
PCB1248-5	6.408	6.408	6.408	6.408	6.408	6.417	6.410	6.384	6.436	0.026

4871E12.MET
Lab Name : EMAX Inc
Instrument ID : GCT071 HP-5890
GC Column : ZB-MULTIRESIDUE-2
Column size ID : .32MMX30M
LFID & Datetime: KE12010B 05/12/10 15:31
LFID & Datetime: KE12011B 05/12/10 15:52
LFID & Datetime: KE12012B 05/12/10 16:13
LFID & Datetime: KE12013B 05/12/10 16:34
LFID & Datetime: KE12014B 05/12/10 16:56
LFID & Datetime: KE12015B 05/12/10 17:17

COMPOUND	RT OF STANDARDS (MIN)						MEAN	RT WINDOW		RTWINDOW
	1.0X	2.5X	5.0X	7.5X	10.0X	15.0X	RT	FROM	TO	WIDTH
PCB1248-1	3.258	3.258	3.258	3.258	3.258	3.258	3.258	3.244	3.272	0.014
PCB1248-2	4.117	4.117	4.117	4.117	4.117	4.117	4.117	4.091	4.143	0.026
PCB1248-3	4.458	4.458	4.458	4.458	4.458	4.458	4.458	4.434	4.482	0.024
PCB1248-4	4.842	4.842	4.842	4.842	4.842	4.842	4.842	4.813	4.871	0.029
PCB1248-5	5.517	5.517	5.517	5.517	5.517	5.517	5.517	5.479	5.555	0.038

4871E12.MET

Figure 6. **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 3520C/8082A
PCBs

Client	: XYZ, INC.	Date Collected:	05/19/10
Project	: CLEAN WATER	Date Received:	05/24/10
Batch No.	: 10E287	Date Extracted:	05/26/10 16:00
Sample ID:	YWEC-MW3-2487	Date Analyzed:	05/27/10 18:12
Lab Samp ID:	E287-01	Dilution Factor:	0.94
Lab File ID:	KE26087A	Matrix :	WATER
Ext Btch ID:	CPE068W	% Moisture :	NA
Calib. Ref.:	KE26084A	Instrument ID :	GCT071

PARAMETERS	RESULTS (ug/L)	LOQ (ug/L)	LOD (ug/L)
PCB-1016	(ND)|ND	0.94	0.47|0.47
PCB-1221	(ND)|ND	0.94	0.47|0.47
PCB-1232	(ND)|ND	0.94	0.47|0.47
PCB-1242	(ND)|ND	0.94	0.47|0.47
PCB-1248	(ND)|ND	0.94	0.47|0.47
PCB-1254	(ND)|ND	0.94	0.47|0.47
PCB-1260	(ND)|ND	0.94	0.47|0.47

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(84)|88	70-125
DECACHLOROBIPHENYL	(100)|91	40-135

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

Figure 7. **TYPICAL LCS REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
LCS ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER
BATCH NO.: 10E287
METHOD: METHOD 3520C/8082A

MATRIX: WATER % MOISTURE: NA
DILUTION FACTOR: 1 1
SAMPLE ID: MBLK1W
LAB SAMP ID: CPE068WB 60E068WL
LAB FILE ID: KE26085A KE26086A
DATE EXTRACTED: 05/26/1016:00 05/26/1016:00 DATE COLLECTED: NA
DATE ANALYZED: 05/27/1017:30 05/27/1017:51 DATE RECEIVED: 05/26/10
PREP. BATCH: CPE068W CPE068W
CALIB. REF: KE26084A KE26084A

ACCESSION:

PARAMETER	BLNK RSLT (ug/L)	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	QC LIMIT (%)
PCB-1016	(ND)|ND	5.00	(5.16)|4.81	(103)|96	25-145
PCB-1260	(ND)|ND	5.00	(5.52)|4.77	(110)|95	30-145

SURROGATE PARAMETER	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	QC LIMIT (%)
Tetrachloro-m-xylene	0.400	(0.353)|0.342	(88)|85	70-125
Decachlorobiphenyl	0.400	(0.397)|0.363	(99)|91	40-135

Figure 8. **TYPICAL MATRIX SPIKE SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER
BATCH NO.: 10E287
METHOD: METHOD 3520C/8082A

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	0.94	1.04	0.98		
SAMPLE ID:	YWEC-MW3-2487				
LAB SAMP ID:	E287-01	E287-01M	E287-01S		
LAB FILE ID:	KE26087A	KE26088A	KE26089A		
DATE EXTRACTED:	05/26/1016:00	05/26/1016:00	05/26/1016:00	DATE COLLECTED:	05/19/10
DATE ANALYZED:	05/27/1018:12	05/27/1018:33	05/27/1018:54	DATE RECEIVED:	05/24/10
PREP. BATCH:	CPE068W	CPE068W	CPE068W		
CALIB. REF:	KE26084A	KE26084A	KE26084A		

ACCESSION:

PARAMETER	SMPL RSLT (ug/L)	SPIKE AMT (ug/L)	MS RSLT (ug/L)	MS % REC	SPIKE AMT (ug/L)	MSD RSLT (ug/L)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
PCB-1016	(ND)|ND	5.20	(4.92)|4.59	(95)|88	4.90	(4.88)|4.60	(100)|94	(1)|0	25-145	30
PCB-1260	(ND)|ND	5.20	(5.38)|4.64	(103)|89	4.90	(5.32)|4.58	(109)|93	(1)|1	30-145	30

SURROGATE PARAMETER	SPIKE AMT (ug/L)	MS RSLT (ug/L)	MS % REC	SPIKE AMT (ug/L)	MSD RSLT (ug/L)	MSD % REC	QC LIMIT (%)
Tetrachloro-m-xylene	0.416	(0.338)|0.330	(81)|79	0.392	(0.344)|0.331	(88)|84	70-125
Decachlorobiphenyl	0.416	(0.404)|0.369	(97)|89	0.392	(0.392)|0.357	(100)|91	40-135

* : Outside of QC limits

Figure 9. **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN WATER

SDG : 10E287

METHOD 3520C/8082
PCBS

A total of five (5) water samples were received on 05/24/10 for Polychlorinated Biphenyls (PCBs) analysis, Method 3520C/8082A in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source (ICV). Continuing calibration (CCV) verifications were carried on a frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A lab control sample was analyzed with the samples in this SDG.
Percent recoveries for 60E068WL were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for E287-01M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Table 1. **INTERMEDIATE STANDARD PREPRATION**

Standard Name	Stock Standard Conc. (ppm)	Preparation			Final Conc. (µg/L)
		Aliquot (ml)	Solvent	Final Vol. (ml)	
PCB 1016	1000	0.2	Hexane	100	2000
PCB 1260	1000	0.2	Hexane	100	2000
PCB 1221	1000	0.2	Hexane	100	2000
PCB 1232	1000	0.2	Hexane	100	2000
PCB 1242	1000	0.2	Hexane	100	2000
PCB 1248	1000	0.2	Hexane	100	2000
PCB 1254	1000	0.2	Hexane	100	2000
Surrogate					
TCX	200	0.05	Hexane	100	100
DCB	200	0.05	Hexane	100	100

Table 2. **INITIAL CALIBRATION STANDARD PREPARATION**

Standard #	Standard Name	Intermediate Std. (µg/L)	Preparation			Final Conc. (µg/L)
			Aliquot (µl)	Solvent	Final Vol. (µl)	
1	PCB 1016/1260	2000	40	Hexane	800	100
	Surrogate	100				5
2	PCB 1016/1260	2000	100	Hexane	800	250
	Surrogate	100				12.5
3	PCB 1016/1260	2000	200	Hexane	800	500
	Surrogate	100				25
4	PCB 1016/1260	2000	300	Hexane	800	750
	Surrogate	100				37.5
5	PCB 1016/1260	2000	400	Hexane	800	1000
	Surrogate	100				50
6	PCB 1016/1260	2000	600	Hexane	800	1500
	Surrogate	100				75

Table 3. CALIBRATION CHECK STANDARD PREPRATION

Standard Name	Intermediate Standard Conc. (mg/L)	Preparation			Final Conc. (µg/L)
		Aliquot (µl)	Solvent	Final Vol. (ml)	
PCB 1016	2000	200	Hexane	800	500
PCB 1260	2000	200			
PCB 1221	2000	400	Hexane	800	1000
PCB 1232	2000	200	Hexane	800	500
PCB 1242	2000	200	Hexane	800	500
PCB 1248	2000	200	Hexane	800	500
PCB 1254	2000	200	Hexane	800	500
Surrogate					
TCX	100	200	Hexane	800	25
DCB	100	200	Hexane	800	25

Table 4 SPIKE STANDARD AND SURROGATE STANDARDS PREPARATION

Standard Name	Stock Standard Conc. (mg/L)	Preparation			Final Conc. (µg/L)
		Aliquot (ml)	Solvent	Final Vol. (ml)	
PCB 1016	1000	1.0	Hexane	100	10,000
PCB 1260	1000	1.0	Hexane		
Surrogate					
TCX	200	2	Hexane	1000	400
DCB	200	2	Hexane	1000	400

Table 5. COMPOUND LIST

Analyte		Surrogate
PCB-1016	PCB-1248	Decachlorobiphenyl
PCB-1221	PCB-1254	Tetrachloro-m-xylene
PCB-1232	PCB-1260	
PCB-1242		

Table 6. ESTABLISHED LIMIT OF DETECTION (LOD) AND LIMIT OF QUANTITATION (LOQ)

MATRIX: AQUEOUS	DL	LOD	LOQ	Unit
PCB1016	0.454	0.5	1	µg/L
PCB1221	0.287	0.5	1	µg/L
PCB1232	0.165	0.5	1	µg/L
PCB1242	0.196	0.5	1	µg/L
PCB1248	0.149	0.5	1	µg/L
PCB1254	0.196	0.5	1	µg/L
PCB1260	0.309	0.5	1	µg/L
PCB1262	0.191	0.5	1	µg/L
PCB1268	0.170	0.5	1	µg/L
SURROGATES				
Tetrachloro-m-xylene	0.020	0.025	0.05	µg/L
Decachlorobiphenyl	0.025	0.025	0.05	µg/L

Reference: Detection Limit Study dated January 2010.

MATRIX: SOIL	DL	LOD	LOQ	Unit
PCB1016	13.2	16.7	33.3	µg/Kg
PCB1221	7.04	16.7	33.3	µg/Kg
PCB1232	9.04	16.7	33.3	µg/Kg
PCB1242	9.33	16.7	33.3	µg/Kg
PCB1248	6.51	16.7	33.3	µg/Kg
PCB1254	6.62	16.7	33.3	µg/Kg
PCB1260	9.86	16.7	33.3	µg/Kg
PCB1262	4.18	16.7	33.3	µg/Kg
PCB1268	6.15	16.7	33.3	µg/Kg
SURROGATES				
Tetrachloro-m-xylene	1.2	1.2	1.67	µg/Kg
Decachlorobiphenyl	0.3	1.2	1.67	µg/Kg

Reference: Detection Limit Study dated January 2010.

MATRIX: SOIL (LOW LEVEL)	DL	LOD	LOQ	Unit
PCB1016	1.26	5	10	µg/Kg
PCB1221	2.93	5	10	µg/Kg
PCB1232	2.08	5	10	µg/Kg
PCB1242	2.07	5	10	µg/Kg
PCB1248	1.52	5	10	µg/Kg
PCB1254	1.33	5	10	µg/Kg
PCB1260	1.43	5	10	µg/Kg
PCB1262	1.64	5	10	µg/Kg
PCB1268	1.11	5	10	µg/Kg
SURROGATES				
Tetrachloro-m-xylene	0.07	0.25	0.5	µg/Kg
Decachlorobiphenyl	0.08	0.25	0.5	µg/Kg

Reference: Detection Limit Study dated February/March 2010.

SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	FLAGGING CRITERIA	1ST Rvw	2ND Rvw
5 Point Initial Calibration for PCB 1016 + 1260	Initially, as needed	Mean RSD for each PCB ≤20%. Linear – least squares regression r>0.995.	Correct then problem then repeat initial calibration			
Initial calibration verification for PCB 1016/1260 mix (Second Source)	Once per 5-point initial calibration	All analytes within ±20% of expected value from the ICAL.	Correct then problem then repeat initial calibration			
Continuing calibration verification for PCB 1016/1260 mix	After every 12 hours and at the end of the analytical sequence	All analytes within ± 20% of expected value	Correct the problem then reanalyze all samples since last successful continuing calibration			
Method Blank	One per preparation batch (≤ 20 samples per matrix)	No analytes detected ≥ ½ LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Re-prep and re-analyze method blank and all samples processed with the contaminated blank	Apply B to specific analyte(s) on all associated samples		
LCS (PCB 1016/1260)	One LCS per analytical batch (≤20 samples per matrix)	Within project QC Limits	Correct the problem then re-prep and re-analyze the LCS and all samples in the affected AFCEE analytical batch			
Surrogate Spike	Every sample, spiked sample, standard, and method blank	Within project QC Limits	Re-extract and re-analyze the sample when both surrogates are out of control.			
Matrix Spike/ Matrix Spike Duplicate (PCB 1016/1260 mix)	One MS/MSD per 20 project samples per matrix	Within project QC Limits	If chromatogram is indicative of matrix interference, discuss in case narrative. Otherwise, check for probable source of error and perform corrective action as necessary.			
Comments: Apply J to all values between LOD and LOQ				Reviewed By:		
				Date:		

DEMONSTRATION OF CAPABILITY

PT # WP0110 Water Pollution Proficiency Testing **PT Study Closing Date: Feb. 18, 2010**

Method: SW 3520 C / SW 8082 A Analyst: Supakit Deesopha

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aroclor 1016	0	µg/L	0				Acceptable
2	Aroclor 1221	0	µg/L	0				Acceptable
3	Aroclor 1232	3.05	µg/L	2.77	0.542	-	4.54	Acceptable
4	Aroclor 1242	0	µg/L	0				Acceptable
5	Aroclor 1248	0	µg/L	0				Acceptable
6	Aroclor 1254	0	µg/L	0				Acceptable
7	Aroclor 1260	0	µg/L	0				Acceptable

PT # WP0110 Water Pollution Proficiency Testing **PT Study Closing Date: Feb. 18, 2010**

Method: SW 3580 / SW 8082 A Analyst: Supakit Deesopha

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aroclor 1016	18.6	mg/Kg	30.1	4.83	-	42.0	Acceptable
4	Aroclor 1242	0	mg/Kg	0				Acceptable
6	Aroclor 1254	0	mg/Kg	0				Acceptable
7	Aroclor 1260	0	mg/Kg	0				Acceptable

PT # HW0110 Soil/Hazardous Waste Proficiency Testing **PT Study Closing Date: Mar. 4, 2010**

Method: SW 3550 C / SW 8081 B Analyst: Enrico Santos

#	Analyte	Result		Assigned Value	Acceptance Limits			Comments
1	Aroclor 1016	5.81	mg/kg	6.03	1.22	-	8.42	Acceptable
2	Aroclor 1221	<0.05	mg/kg	<0.2				Acceptable
3	Aroclor 1232	<0.05	mg/kg	<0.2				Acceptable
4	Aroclor 1242	<0.05	mg/kg	<0.2				Acceptable
5	Aroclor 1248	<0.05	mg/kg	<0.2				Acceptable
6	Aroclor 1254	<0.05	mg/kg	<0.2				Acceptable
7	Aroclor 1260	<0.05	mg/kg	<0.2				Acceptable
8	Total PCBs	5.81	mg/kg	6.03	1.22	-	8.42	Acceptable

ANALYSIS RUN LOG
for
PESTICIDES/PCBs

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Comments:

Book #: A071-25

Instrument No.: 71

Analytical Sequence:

Method File:

Analytical Batch:

SOP #	Rev. #
☐ EMAX-8081	6
☐ EMAX-8082	3
☐ EMAX-608	0
☐ EMAX-CLP-PEST	
☐ EMAX-	

ICAL REFERENCE

ICAL ID	BATCH	DATE

STANDARDS ID	Conc (µg/L)
Hexane	

Column	A. ZB-MULTI RES I B. ZB-MULTI RES I I

ELECTRONIC DATA ARCHIVAL

Location	Date
☐ EZC_4_Pesticides	
☐ EZC_10_Pesticides	

Analyzed By: Date:

Date Disposed: Disposed By:

This page is checked during data review.

8082FP. **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

FileID: CP10H01W.xls

EXTRACTION LOG FOR PESTICIDES AND PCBs

PrepBatchID	Lab Sample ID	Aliquot	Unit	DateTime	Sonicator	pH	Ve(ml)	DateTime	Cleanup	Comments

Prepared By: _____

Checked By: _____ Date _____

INSTRUMENT MAINTENANCE LOG

Instrument No: 72 **Month** **Year: 200_** **Book #** **M72-001**

Date							
Column Head Pressure							
Column Temperature							
FID lit up							
FID signal within specs							
Autosampler							
Check make up gas flow							
Run instrument blank							
Computer Date/Time							
Computer Paper							
Analyst Initial							

Trouble Shooting							
Problem(s) Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

STANDARD OPERATING PROCEDURES

VOLATILE ORGANICS BY GC/MS

SOP No.:	EMAX-8260	Revision No.	6	Effective Date:	25-Oct-10
Prepared By:	W. Tu Nisamaneepong			Date:	10-29-10
Approved By:	Kenette Pimentel QA Manager			Date:	10-25-10
Approved By:	Caspar Pang Laboratory Director			Date:	10-25-10

Control Number: 8260-06-

1.0 SCOPE AND APPLICATION

1.1. This analytical method is used to determine the concentration of volatile organic compounds whose boiling points are below 200°C and are water insoluble or slightly water-soluble found in solid or liquid samples. The list of compounds is summarized in Tables 7 and 8. Additional analytes may be added after verification. This SOP is an adaptation of Method 8260B.

2.0 SUMMARY OF METHOD

2.1. A measured sample is extracted using a purge and trap concentrator system. The extract is introduced to a temperature-programmed GC. The analytes are eluted through the GC column separating each analyte relative to its volatility. These analytes are captured and ionized by the mass spectrometer. The ionized fragments are measured by mass to charge ratio. Analyte qualitative identification is based on the characteristic electron impact mass spectra. Analyte quantitative identification is based on the response of the major ion relative to an internal standard using a multi-point calibration curve.

2.2. **Interferences**

2.2.1. Contamination may occur by diffusion of volatile organics (particularly chlorofluorocarbons and methylene chloride) through sample container septum during shipment and storage. Trip blanks and storage blanks can serve as means of monitoring.

2.2.2. Glassware and other sample processing materials in which the samples come into contact with are possible sources of contamination. All glassware and other materials used must be purchased pre-cleaned or decontaminated prior to use.

2.2.3. Solvents and reagents are possible sources of contamination. All solvents and reagents must be GC grade and must pass the QC checks prior to use.

2.2.4. Contamination by carry-over can occur whenever high concentration samples are analyzed in sequence with a low concentration sample. To reduce potential carry-over, the concentrator must be thoroughly baked-out between samples and the sample syringe and purging device must be thoroughly rinsed with an appropriate solvent between samples.

2.2.5. Another possible source of contamination is the analytical instrument itself. This can be monitored by analyzing an instrument blank prior to any analysis.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Refer to Tables 7 and 8 for established DL, LOD and LOQ levels.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point (see Sec. 9.4). All samples analyzed above this concentration are considered "over-range" and shall require dilution to properly quantitate.

4.2. The concentration in the diluted sample should be at or above the project reporting limit. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required to properly quantitate.

4.3. **Typical Dynamic Range**

4.3.1. Water: 5 µg/L to 200 µg/L (5 ml purge)
1 µg/L to 40 µg/L (25 ml purge)

4.3.2. Soil: 5 µg/kg to 200 µg/kg

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Aqueous Samples**

5.1.1. Samples received in the laboratory should be contained in 40 ml vials with teflon lined septa with zero headspace.

Note: The size of any bubble caused by degassing upon cooling the sample should not exceed 6 mm.[1]

5.1.2. All samples must be stored at $\leq 6^{o}$C).

5.1.3. Samples preserved in HCL shall be analyzed within 14 days from the date of sampling. Samples with no chemical preservative must be analyzed within 7 days from the date of sampling.

5.2. **Soil Samples**

5.2.1. Samples receive in a glass jars or brass tubes shall be stored at $\leq 6^{o}$C. Samples must be analyzed within 14 days from sampling date.

5.2.2. Samples received in encore tubes are frozen, preserved with sodium bisulfate or extracted with methanol prior to analysis.

- Frozen encore tubes must be analyzed within 14 days from sampling date.
- Samples preserved with sodium bisulfate within 48 hours from sampling date must be analyzed within 14 days from sampling date.
- Methanol extracts shall be analyzed within 14 days from sampling date.
- Preserved samples and extracts shall be stored at $\leq 6^{o}$C.

[1] Referenced from SW846 Method 5030B, Section 6.1.

6.0 ASSOCIATED SOPs

6.1. EMAX-5030 - Purge and Trap For Aqueous Samples

6.2. EMAX-5035 - Closed-System Purge and Trap For Solid Samples

6.3. EMAX-DM01- Data Flow and Review

6.4. EMAX-QA04 - Method Detection Limit

6.5. EMAX-QA05 - Training

6.6. EMAX-QA08 - Corrective Action

6.7. EMAX-QC01 - Quality Control for Chemicals

6.8. EMAX-QC02 - Analytical Standard Preparation

6.9. EMAX-QC07 - Glassware Cleaning

6.10. EMAX-SM03 - Waste Disposal

6.11. EMAX-SM04 - Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. All reagents, standards, and samples shall be treated as potential hazards. Observe standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, and gloves, shall be worn at all times when performing this procedure. All sample and standard handling shall be performed in the fume hood.

7.3. All waste generated during analytical process shall be placed in the waste containers. Waste shall be endorsed to the waste disposal section for proper disposal.

7.4. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatography	HP 5890 Series II or equivalent
Detector	HP 5970 MSD or equivalent
Column	RTX 502.2 (0.32 mm x 60 m), 1.8um thickness or equivalent after verification that the four gases (chloromethane, bromomethene, chloroethane, and vinyl chloride) can be resolved > 90% from each other in the total ion chromatogram
Data Acquisition Software	ChemStation or equivalent
Purge & Trap Device	2000/OI 4460A/Dyna Tech/EST or equivalent

Multiple purging module	DynaTech/Archon or equivalent
Gases	Ultra-high purity helium/Air
Syringes	5-ml, 25-ml Luerlok gas-tight
Microsyringes	1, 10, 20, 25, 50, 100, and 1000 µL (Hamilton 702N or equivalent) for dilution purposes
Volumetric Flasks	2,5,10, 50, and 100 ml with ground glass stopper
Heated Jacket	Tekmar or O.I. Automatic sample heating jacket or equivalent

8.2. **Chemicals and Reagents**

Extraction Solvent	Purge & Trap Grade Methanol or equivalent
Reagent Water	Organic-free water
Reagent Soil	Organic-free Ottawa Sand or equivalent
Preservative	Sodium Bisulfate

9.0 STANDARDS

9.1. Standard preparation for VOA is summarized in Tables 1 to 4. Refer to EMAX-QC02 for proper analytical standard preparation. Other concentration levels may be prepared provided it complies with the method and project requirements.

9.2. **Stock Standard**

9.2.1. Purchase Stock Standards as certified solutions.

9.2.2. Purchase one set of calibration standard (Refer to Tables 1) for calibration and a secondary source Stock Standard for calibration verification (Refer to Table 2).

9.2.3. Purchase Surrogate Mix at 2500 mg/L and Internal Standard at 2000 mg/L (Refer to Table 3).

9.2.4. Purchase BFB as Tuning Standard at 5000 mg/L (refer to Table 4).

9.2.5. After opening, transfer in inert vials with minimal headspace and store at -10°C to -20°C.

9.3. **Intermediate Standards**

9.3.1. Using the stock standard solutions, prepare intermediate standards in methanol according to Tables 1 to 4 and store with minimal headspace in an inert vial.

9.4. **Initial Calibration Standards (ICAL)**

9.4.1. ICAL for 5-ml Purge.

9.4.1.1. Using intermediate standards, prepare a minimum of 6 calibration standards as suggested below.

Calibration Pt.	VOA (µg/L)*	Surrogate (µg/L)	Internal Std (µg/L)
1	5	5	50
2	10	10	50
3	20	20	50
4	50	50	50
5	100	100	50
6	200	200	50

* Ketones, Acrolein, Acrylonitrile and tert-Butanol are 5X the indicated concentration and m/p-Xylene is 2x the indicated concentration.

9.4.2. ICAL for 25-ml Purge

9.4.2.1. Using intermediate standards, prepare a minimum of 6 calibration standards as suggested below:

Calibration Pt.	VOA (µg/L)*	Surrogate (µg/L)	Internal Std (µg/L)
1	0.5	0.5	10
2	1	1	10
3	2	2	10
4	10	10	10
5	20	20	10
6	40	40	10

* Ketones, Acrolein, Acrylonitrile and tert-Butanol are 5X the indicated concentration and m/p-Xylene is 2x the indicated concentration.

9.5. **Initial Calibration Verification Standard (ICV)**

9.5.1. Using the Intermediate Standard prepared from the secondary source, spike into 5-ml or 25-ml purge. Refer to Table 5 for concentration levels of each analyte.

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Using the Intermediate Standard prepared from the same source as the ICAL Standard, spike into 5-ml or 25-ml purge. Spike also Surrogate Standard. Refer to Table 5 for concentration levels of each analyte.

9.7. **LCS and Matrix Spike Standard**

9.7.1. For spike standards, use the ICV standard unless otherwise specified by the project. Refer to Table 5.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Refer to EMAX-5030 and EMAX-5035.

10.2. **Instrument Parameters**

10.2.1. From the main gas supply (gas Tanks) regulate gas pressure at 80 psi.

10.1.1. Fine-tune the instrument guided by the parameter conditions suggested below. Adjust the parameter conditions accordingly to obtain optimum condition. Print the instrument parameter and post it on the instrument for daily routine maintenance check.

10.2.2. Typical GC Parameters

Carrier gas flow (column) helium	1 - 5 ml/min
Initial Temp	40°C; hold for 1 min.
Rate	6°C/min.
Final Temp	200°C; hold for 1 min.
Inject Port	160°C
Interface	250°C

10.2.3. Mass Spectrometer Parameter

Scan Start	0.5 min.
Splitless value time	0 min.
Mass Range	35 to 300
Multiplier	1200 to 2700

10.2.4. Typical Purge and Trap Condition

10.2.4.1. Purge samples at 40°C for 11 minutes, desorbed at 250°C for 2 minutes and then bake the trap at 260°C for 11 minutes.

10.3. **Calibration**

10.3.1. Set GC/MS operating condition as described in Section 10.2.

10.3.2. **Perform Tune Check**

10.3.2.1. Introduce a BFB[2] to yield 5 – 50ng on column by either direct injection or purge and trap in 5-ml or 25-ml organic-free water.

10.3.2.2. Evaluate the tune check by the highest scan on the peak or the average of at least 3 scans (before, at, and after the apex) with a background subtraction using a single scan no more than 20 scans prior to the elution of BFB.

10.3.2.3. Check Table 6 for acceptance criteria or follow the manufacturer's recommendation for tuning. A valid tune check expires after 12 hours.

10.3.2.4. If non-compliant refer to Section 12 for corrective action.

10.3.3. **Initial Calibration (ICAL)**

[2] Alternatively, BFB in DCC can be used to evaluate tuning.

10.3.3.1. Perform ICAL when one of the conditions occurs.

- Instrument is new
- Instrument undergoes a major repair
- DCC failed to meet the acceptance criteria

10.3.3.2. Analyze minimum of 6-point initial calibration curve (Refer to Section 9.4) after a valid tune check.

10.3.3.3. Check for completeness of target compound list. If there is/are missing compound(s), perform the following:

- Check the established retention time window
- Check the relative intensity of major ions
- Adjust accordingly if necessary.

10.3.3.4. Establish a summary of Relative Response Factors for each analyte at each concentration. Calculate the Average Relative Response Factor (RRF_m), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to Eq. 10.6.1.2, Eq. 10.6.1.5 and Eq. 10.6.1.6, respectively.

10.3.3.5. Evaluate System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) as specified in Appendix 1.

10.3.3.6. Evaluate the ICAL for appropriate quantitation method.

- Use RRF_m if the RSD of individual analyte $\leq$15%.
- Apply Inverse Weighting Factor (1/y or $1/y^2$; where y is the instrument response) if it is determined to be the best fit for the specific analytes. This approach may be applied to any analyte including analyte that has RSD of $\leq$15% and correlation coefficient of ≥0.99.
- Apply linear least squares regression if past experience or priori knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of $\leq$15% and correlation coefficient of ≥0.99.
- It may be appropriate to force the regression through zero for specific analytes.[3] When exercising this option (as included in the data acquisition software) make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.3.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.4. **Initial Calibration Verification (ICV)**

10.3.4.1. Analyze ICV to verify the concentration of the ICAL standards (refer to Section 9.5).

[3] SW846 Method 8000B, Section 7.5.3

10.3.4.2. Check for completeness of analytes as described in Section 10.4.2.

10.3.4.3. Compare the retention times of the internal standards to the ICAL mid-point. Excursion of ± 30 seconds indicates instrument malfunction. When non-compliant check the column head pressure, gas supply or leaks. Corrective action is required prior to further analysis.

10.3.4.4. Compare the area of the Internal Standards (IS) acquired against the midpoint of the initial calibration point. The extracted ion current profile (EICP) must be within a factor of two (-50% to +100%).

10.3.4.5. Refer to Appendix 1 for ICV acceptance criteria and/or corrective action.

10.3.4.6. When non-compliant refer to Section 12 for corrective action.

10.3.5. **Daily Continuing Calibration (DCC)**

10.3.5.1. Analyze DCC to check the validity of the ICAL (refer to 9.6).

10.3.5.2. Check for completeness of analytes as described in Section 10.4.2.

10.3.5.3. Evaluate System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) as specified in Appendix 1.

10.3.5.4. Compare the retention times of the internal standards to the ICAL mid-point. Excursion of ± 30 seconds indicates instrument malfunction. When non-compliant check the column head pressure, gas supply or leaks. Corrective action is required prior to further analysis.

10.3.5.5. Compare the area of the Internal Standards (IS) acquired against the midpoint of the initial calibration point. The extracted ion current profile (EICP) must be within a factor of two (-50% to +100%).

10.3.5.6. Establish RRF of each analyte, calculate %D (Eq. 10.6.2.1) against the ICAL.

10.3.5.7. Refer to Appendix 1 for DCC acceptance criteria and/or corrective action.

10.3.5.8. When non-compliant refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. **Analytical Sequence**

10.4.1.1. Analyze BFB and evaluate tuning

10.4.1.2. Analyze DCC and check ICAL validity

10.4.1.3. Analyze Lab Control Sample

10.4.1.4. Analyze Lab Control Sample Duplicate (if required)

10.4.1.5. Analyze Method Blank

10.4.1.6. Analyze samples to a maximum number of 12-hours from the time of BFB injection.

10.4.1.7. Analyze a pair of matrix spikes (MS/MSD) for every 20 samples of the same matrix.

10.4.1.8. Record analytical sequence in the analytical run log.

10.4.2. **Sample Result Evaluation**

10.4.2.1. Check the QC criteria as soon as the data is available.

- Check surrogate recoveries against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 QC limits.
- Check concentration of target analytes if calibration range is exceeded.
- If any of the above checkpoints indicate a problem, re-analysis is required. Note observations on the analytical run log. When results arise to questionable result, e.g. inconsistency from the first analysis, consult the Supervisor for further action.

10.4.3. **Qualitative Identification**

- The intensities of the characteristic ions maximize in the same scan or within one scan of each other.
- The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
- The relative intensity of the characteristic ions agrees within 30% of the relative intensity of these ions in the reference spectrum.
- Check the chromatogram for possible misidentified analytes. Investigate visible peaks in the chromatogram that were not identified in the data output. Manually integrate the peak if necessary.

10.4.3.1. For samples containing components not associated with the calibration standards, perform a library search for purposes of tentative identification4 (TIC). Execute *FTICB exe (HP RTE-1000 program) or LSC (Chem Station program) to initiate the library search using NIST/EPA/MSDC mass spectral library. Visually inspect each extracted mass ion chromatograph to determine the identification of the unknown before final reporting following the guidelines below.

- Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within + 20%. Example: for an ion with an abundance of 50% of the standard spectra, the corresponding sample ion abundance must be between 30 and 70%.
- Molecular ions present in reference spectrum should be present in sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting analytes.
- Ions present in the reference spectrum but not present in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting analytes. Data system library reduction programs can sometimes create these discrepancies.

10.4.3.2. Reporting TICs

- If the library search produces a match at or above 85%, report the analyte.

[4] Library search is performed only when indicated in the PSR.

- If the library search produces more than one analyte at or above 85%, report the first analyte (highest).
- If the library search produces no matches at or above 85%, the compound should be reported as unknown.

10.4.4. **Quantitation**

- Apply the appropriate quantitation method (Section 10.3.3.6). Calculate the concentration of any positively identified target analyte using the appropriate equation in Section 10.6.3. Apply the dilution factor for diluted samples to calculate for the final concentration of the sample.

10.4.5. **Manual Integration**

10.4.5.1. Refer to EMAX-DM01, Section 4.4.3.

10.4.6. **Dealing with Carryover**

10.4.6.1. Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.

10.4.6.2. If there is no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction.

10.4.6.3. If there is any target analyte detected as found in the sample that exceeded the calibration range, re-analyze the sample to rule out carry over. If carry over is confirmed, proceed with data reduction and report the data from re-analysis.

10.4.6.4. For decontaminating the sample purger consider the following suggestion:

- Rinse the purging apparatus and the contaminated port with organic-free reagent water containing 10% methanol. Dry purge the system overnight and analyze reagent blank prior to sample analysis. Repeat the process until no evidence of contamination is observed.

10.5. **Data Reduction**

10.5.1. Make a copy of the analytical run log and highlight the data to be reported.

10.5.2. Check that all positively identified analytes are within the calibration range.

10.5.3. Collate the reportable raw data separating the QC results from the sample results.

10.5.4. Keep all other data generated with the analytical folder marked with “For record only”.

10.5.5. Proceed to report generation.

10.6. **Calculations**

10.6.1. Initial Calibration

10.6.1.1. Calculate for the Relative Response Factor (RRF)

$$RRF = \frac{A_X C_{IS}}{A_{IS} C_X} \qquad \textit{Eq. 10.6.1.1}$$

where:

RRF – Relative Response Factor

A_X – Area of characteristic ion for the compound being measured

A_{IS} – Area of characteristic ion for the specific internal standard

C_X – Concentration of the compound being measured

C_{IS} – Concentration of the specific internal standard

10.6.1.2. Calculate for the Average Relative Response Factor (RRF_m).

$$RRF_m = \frac{\sum RRF}{n} \qquad \textit{Eq. 10.6.1.2}$$

where:

RRF_m – Average response factor

$\sum RRF$ – Summation of response factors

n – Number of measurements

10.6.1.3. Calculate for Least Square Linear Regression

$$y = ax + b \qquad \textit{Eq. 10.6.1.3}$$

where:

y – Response ratio (A_X/A_{IS})

x – Amount ratio (C_X/C_{IS})

a – x1 = slope of the line

$$a = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2}$$

where: $\bar{x}$ = average of amount ratios

$\bar{y}$ = average of response ratios

b – x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.6.1.4. Calculate for Inverse Weighting Factor

$$y = ax + b \qquad \textit{Eq. 10.6.1.4}$$

where:

y – Response ratio (A_X/A_{IS})

x – Amount ratio (C_X/C_{IS})

a – x1 = slope of the line

$$a = \frac{\sum (x - x_a)(y - y_a)}{\sum (x - x_a)^2}$$

where: $x_a = \sum \left[x(1/x) / \sum (1/x) \right]$

$y_a = \sum \left[y(1/x) / \sum (1/x) \right]$

or $x_a = \sum \left[x(1/x^2) / \sum (1/x^2) \right]$

$y_a = \sum \left[y(1/x^2) / \sum (1/x^2) \right]$

b – x0 = intercept of the line

$$b = y_a - a * x_a$$

10.6.1.5. Calculate the Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}} \qquad \textit{Eq. 10.6.1.5}$$

where:

SD – Standard deviation

x_i – Result at i^{th} measurement

$\bar{x}$ – Mean of the n measurements

n – Number of measurements

10.6.1.6. Calculate the % relative standard deviation (%RSD).

$$\%RSD = \frac{SD}{RRF_m} * 100\% \qquad \textit{Eq. 10.6.1.6}$$

where:

SD – Standard deviation

RRF_m – Average response factor

10.6.2. Calibration Check/Continuing Calibration

10.6.2.1. Calculate Percent Difference (%D)

$$\%D = \frac{[RRF_c - RRF_m]}{RRF_m} * 100\% \qquad \textit{Eq. 10.6.2.1}$$

where:

RRF_c – Response factor from continuing calibration standard

RRF_m – Average response factor

10.6.2.2. % Drift

$$\%Drift = \frac{[found\ Conc. - true\ Conc]}{true\ Conc.} * 100\% \qquad Eq.\ 10.6.2.2$$

10.6.3. Calculation of Sample Concentration (Water and Soil/Sediment Samples). When a compound is identified, the quantitation of that compound shall be based on the integrated abundance from the EICP of the primary characteristic ion.

10.6.3.1. Water Samples

$$Concentration\ (ug/L) = \frac{(Ax)(Is)}{(Ais)(RRF_m)}\ x\ DF \qquad Eq.\ 10.6.3.1$$

where:

A_x – Area of characteristic ion for the compound to be measured

I_s – Concentration of internal standard added in µg/L

A_{is} – Area of characteristic ion for the internal standard

RRF_m – Average response factor

DF – Dilution factor = $\frac{purge\ volume\ in\ ml\ \ (5\ ml\ or\ 25\ ml)}{sample\ \ amount\ \ in\ ml}$

10.6.3.2. Soil/Sediment Samples (Dry weight basis)

$$Concentration\ (ug/kg) = \frac{(Ax)(Is)}{(Ais)(RRF_m)(DW)}\ x\ DF \qquad Eq.\ 10.6.3.2$$

where:

A_x – Area of characteristic ion for the compound to be measured

I_s – Concentration of internal standard added in µg/L

A_{is} – Area of characteristic ion for the internal standard

RRF_m – Average response factor

DF – Dilution factor = $\frac{5\ g}{(sample\ \ amount\ \ in\ g)}$

DW – % solid = $\frac{100 - \%moisture}{100}$

10.6.3.3. Extracted Soil/Sediment Samples (Dry weight basis)

$$Concentration\ (ug/kg) = \frac{(Ax)(Is)}{(Ais)(RRF_m)(DW)}\ x\ DF \qquad Eq.\ 10.6.3.3$$

where:

A_x – Area of characteristic ion for the compound to be measured

I_s – Concentration of internal standard added in µg/L

A_{is} – Area of characteristic ion for the internal standard

RRF_m – Average response factor

DF – Dilution factor = $\frac{(purged\ \ volume\ \ in\ \mu L)(5\,g)}{(extract\ \ aliquot\ \ in\ \mu L)(sample\ \ amount\ \ in\ g)}$

DW – % solid = $\frac{100 - \%moisture}{100}$

10.6.4. Alternatively, the regression line (area ratio of Ax/Ais versus concentration using first degree) fitted to the initial calibration may be used for determination of the sample concentration when RSD of the analyte is greater than 15% (Section 10.3.3.6).

10.6.5. Concentration of TIC is estimated by the same method as target compounds with the following assumptions:

10.6.5.1. The area Ax and Ais are derived from total ion chromatogram. Ais refers to the closest internal standard (IS) free of interference.

10.6.5.2. RRF of the TIC is 1.

10.6.6. Method Proficiency

10.6.6.1. Percent Recovery

$$\%\ \mathrm{Recovery} = \frac{C_f - C}{C_s} * 100\% \qquad \textit{Eq. 10.6.6.1}$$

where:

C_f – Concentration found

C – Concentration of sample

C_s – Concentration of spike

10.6.6.2. Relative Percent Difference (%RPD)

$$\%\ RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \textit{Eq. 10.6.6.2}$$

where:

RPD – Relative Percent Difference

$C1$ – Measured concentration of the first sample aliquot

$C2$ – Measured concentration of the second sample aliquot

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WBDX[5].exe.

10.7.2. Generate Lab Chronicle using Labchron.exe

10.7.3. Generate the sample results using F1VX[5].exe

10.7.4. Generate the QC summary using QCVX[5].exe

10.7.5. Generate Case Narrative using CN1.exe

10.8. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration and re-analyses.

- Sample Results
- LCS Summary
- MS/MSD Summary
- ICAL Summary
- ICV Summary
- DCC Summary

10.8.2. Perform a 100% data review in accordance to EMAX-DM01and the PSR.

- Check internal standard area. They should be within -50 to +100% of DCC to be acceptable.
- Check surrogate recoveries against project specific criteria (PSR). In the absence of PSR, default to in-house QC limits.
- Check concentration of target analytes if calibration range is exceeded.
- If any of the above checkpoints indicate a problem, re-analysis is required.

10.8.3. Review case narrative that it accurately describes what transpired in the analytical process

10.8.4. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Perform instrument routine preventive maintenance and record on instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction that may affect data quality.

10.9.2. The table below list suggested routine maintenance schedule.

Task	**Every Day**	**Every Week**	**Every Month**	**Every 3 Months**	**Every 6 Months**	**As Needed**
Quick Tune	✓					

[5] X - version number

Task	Every Day	Every Week	Every Month	Every 3 Months	Every 6 Months	As Needed
Tune Check	✓					
Check the tightness of the column nuts.	✓					
Check gas cylinders pressure	✓					
Check the foreline pump oil level		✓				
Check the calibration vial			✓			
Check and if necessary, change injection port liners, septa and O-rings.				✓		
Clean the split/splitless inlet vent line trap.					✓	
Replace the foreline pump oil					✓	
Replace the diffusion pump fluid					✓	
Replace the traps and filters					✓	
Clean the ion source						✓
Change the carrier gas trap(s) and purifier						✓
Replace column						✓
AutoTune the MSD						✓
Replace the worn out parts						✓

11.0 QUALITY CONTROL

11.1. Sample Preparation Batch QC

11.1.1. Analyze Method Blank (MB) to demonstrate that preparation of samples was free from contamination.

11.1.2. Analyze Lab Control Sample (LCS/LCD) to assess preparative batch accuracy and precision.

11.1.3. Analyze Matrix Spike (MS/MSD) to assess matrix interference.

11.1.4. All lab wares used in the sample preparation shall be properly treated as specified in EMAX-QC07.

11.1.5. All solvents and reagents shall undergo quality control check in the stationary laboratory prior to its use.

11.2. Analytical Batch QC

11.2.1. Perform tune check to verify that the mass spectrometer meets standard mass spectra abundance criteria prior to calibration and check for any contamination.

11.2.2. Perform initial calibration (ICAL) to establish a calibration curve for the quantification of the analytes of interest.

11.2.3. Establish retention time window position for each analyte every after ICAL for proper qualitative identification.

11.2.4. Perform initial continuing calibration verification (ICV) every after ICAL to verify accuracy of ICAL.

11.2.5. Perform continuing calibration verification (CCV) every 12 hours to verify that instrument response is reliable, and has not changed significantly from the current ICAL curve.

11.2.6. Evaluate relative retention time for each anlaytes in every sample to be within ±0.06 RRT units.

11.2.7. Verify internal standards(IS) for quantitative accuracy and that its Retention time is within ± 30 seconds from retention time of the midpoint standard in the ICAL and EICP area is within -50% to +100% of ICAL midpoint standard.

11.2.8. Evaluate surrogate recovery to monitor instrument response on every sample.

11.3. **Method QC**

11.3.1. Establish detection limit (DL) to determine the smallest analyte concentration that can be demonstrated to be different from zero.

11.3.2. Establish limit of detection (LOD) to determine the smallest concentration of an analyte that can be qualitatively identified in a sample with 99% confidence level.

11.3.3. Establish limit of quantitation (LOQ) to determine the lowest concentration that produces a quantitative result within specified limits of precision and bias.

11.3.4. Demonstrate capability by understanding and applying procedures set forth by this SOP and culminating it with demonstration of capability as described in EMAX-QA05.

11.4. Refer to Appendix 1 for all related Quality Control parameters, frequency, acceptance criteria and corrective action

12.0 CORRECTIVE ACTION

12.1. **Sample Preparation QC**

12.1.1. If MB is non-compliant, consider the following suggestions to correct the problem:

- If contaminant is trace level, bake the trap at 260 ^{o}C for about 30 minutes.
- If contamination is high, flush the sample line with methanol and replace the trap.
- If problem persist, inform the supervisor for further advice.

12.1.2. LCS is non-compliant, consider the following suggestions to help you correct the problem:

- If majority of the analyte response are low and no evidence of leak is apparent, it is indicative of a bad purge or standard degradation. Prepare a fresh standard and re-analyze LCS and the associated samples.

- If result is bias high, rule out contamination. Refer to 12.2.1
- If problem persist, inform the supervisor for further advice.

12.1.3. If MS is non-compliant consider the following suggestion to correct the problem:

- Verify that the spike amount added is accurate by checking the record and the micropipette calibration
- If LCS is within acceptance criteria then and the right amount of spike is added into the sample then it is indicative of matrix interference. Discuss the probable matrix interference in the case narrative

12.2. **Analytical Batch QC**

12.2.1. **Tune Check.** If tune check is non-compliant consider the following suggestion to correct the problem:

- Check the abundance of mass 95 and 174. If it is significantly less than previous tune checks, it is indicative of insufficient amount of BFB injected. Probable causes are: improper spiking, leaks, standard degradation or low vacuum system. Repeat tune check ensuring that BFB was properly spiked or rule out leaks, prepare a fresh BFB standard and repeat the tune check.
- If problem persist, retune the instrument and repeat tune check.

12.2.2. **Initial Calibration.**

12.2.2.1. If the %RSD is out of acceptance criteria, consider the following suggestions to correct the problem.

- If one of the standards returns a bias low or bias high on all of the analytes then that point is considered an out-liner. Prepare a standard at that ICAL point and re-analyze.
- If the highest ICAL point appears to be saturated, drop the highest point.
- If the lowest point returns a bias low or bias high response or the peaks are not distinct and sharp, drop the lowest point.

Note : The lowest calibration point identifies the reporting limit (RL). Therefore, check that the RL is in conformance to the current projects where the ICAL will be used.

12.2.3. **Daily Continuing Calibration Check (DCC)** If DCC is non-compliant consider the following suggestions to correct the problem

- If majority of the analyte response are low and no evidence of leak is apparent, it is indicative of a bad purge or leak. Re-analyze DCC.
- If problem persist, rule out standard degradation. Prepare a fresh standard and repeat DCC.
- Otherwise execute instrument maintenance and perform ICAL.

12.2.4. **Instrument Blank.** If instrument blank is non-compliant, consider the following suggestions to correct the problem

- If contaminant is trace level, bake the trap at 260 ^{o}C for about 30 minutes.

- If contamination is high, flush the sample line with methanol and replace the trap.
- If problem persist, inform the supervisor for further action.

12.3. Generate a Non-Conformance Report (NCR) when an anomaly other than specified in Appendix 1 is observed. Refer to EMAX-QA08 for NCR details.

12.4. Discuss water samples that are labeled preserved having a pH value > 2 in the case narrative.

13.0 POLLUTION PREVENTION

13.1. Endorse all unused samples to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. Separate and properly identify all unused expired analytical standards prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM-03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – A group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.1.1 ***Preparation batch*** is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.2 ***Analytical batch*** is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – A determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Carry-over – Are contaminants retained in the instrument/apparatus from a highly contaminated sample that is passed into the succeeding sample(s).

15.1.4. CCC – Calibration check compounds that evaluate the integrity of the system. Variability of these compounds may indicate system leak or reactive sites in the column.

15.1.5. Instrument Method – A file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.6. Instrument Blank – A target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.7. Lab Control Sample (LCS) – A target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the

entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.8. Matrix – is a component or form of a sample.

15.1.9. Matrix Spike (MS) –A sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.10. Matrix Spike Duplicate (MSD) – A replicate of MS analyzed to monitor precision or recovery.

15.1.11. Method Blank – A target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.12. MSDS – Material safety data sheet is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.13. Response Factor – The ratio of the peak area of the target compound in the sample or sample extracts to the peak area of the internal standard in the sample or sample extract.

15.1.14. Sample – A specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.15. Sample Duplicate – A replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.16. SPCC – System performance check compounds are compounds that are used to check compound stability and to check for degradation cause by contaminated lines or active sites in the system.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing volatile analysis by GC/MS. The standard analyte list and RL are presented in Tables 7 & 8. In instances where there is a project or program QAPP, the requirements given in the project shall take precedence over this SOP.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied

15.4. **Department of Energy Basic Ordering Agreement (DOE-BOA) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. U.S. EPA Method 8260B; SW846, as updated.

16.2. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Figures**

17.1.1.	Figure 1	Peak Evaluation Techniques
17.1.2.	Figure 2	Typical Chromatogram
16.1.1.	Figure 3	Typical ICAL Summary
16.1.2.	Figure 4	Typical Instrument Performance Check (Tuning)
16.1.3.	Figure 5	Typical Internal Standard Area and Retention Time Summary
16.1.4.	Figure 6	Typical Sample Result Summary
16.1.5.	Figure 7	Typical LCS Report Summary
16.1.6.	Figure 8	Typical MS/MSD Report Summary
16.1.7.	Figure 9	Typical Case Narrative

17.2. **Tables**

17.2.1.	Table 1	Initial Calibration Intermediate Standard Preparation
17.2.2.	Table 2	Initial Calibration Verification Intermediate Standard Preparation
17.2.3.	Table 3	Surrogate/Internal Standards Preparation
17.2.4.	Table 4	Tuning Solution Standard Preparation
17.2.5.	Table 5	Typical Initial Calibration and QC Standards Concentration Levels
17.2.6.	Table 6	BFB Key Ion Abundance Criteria
17.2.7.	Table 7	Established DL, LOD and LOQ
17.2.8.	Table 8	Characteristic Ions for Purgeable Organic Compounds
17.2.9.	Table 9	Internal Standards with Corresponding Target Compounds and Surrogates Assigned for Quantitation

17.3. **Appendices**

17.3.1.	Appendix 1	Summary of Quality Control Procedures
17.3.2.	Appendix 2	Demonstration of Capability

17.4. **Forms**

17.4.1.	8260FA	Analytical Run Log
17.4.2.	8260FM	Instrument Maintenance Log

Figure 1: **PEAK EVALUATION TECHNIQUES**

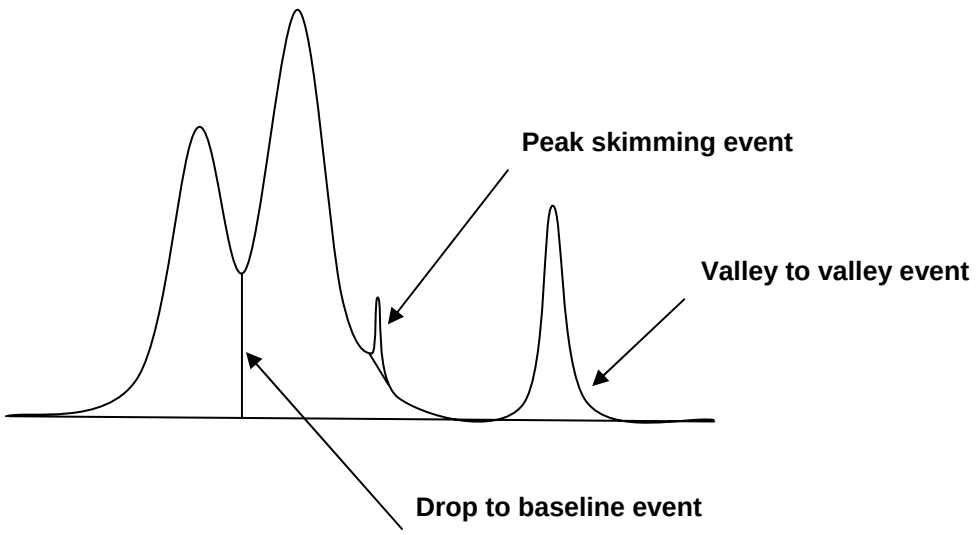
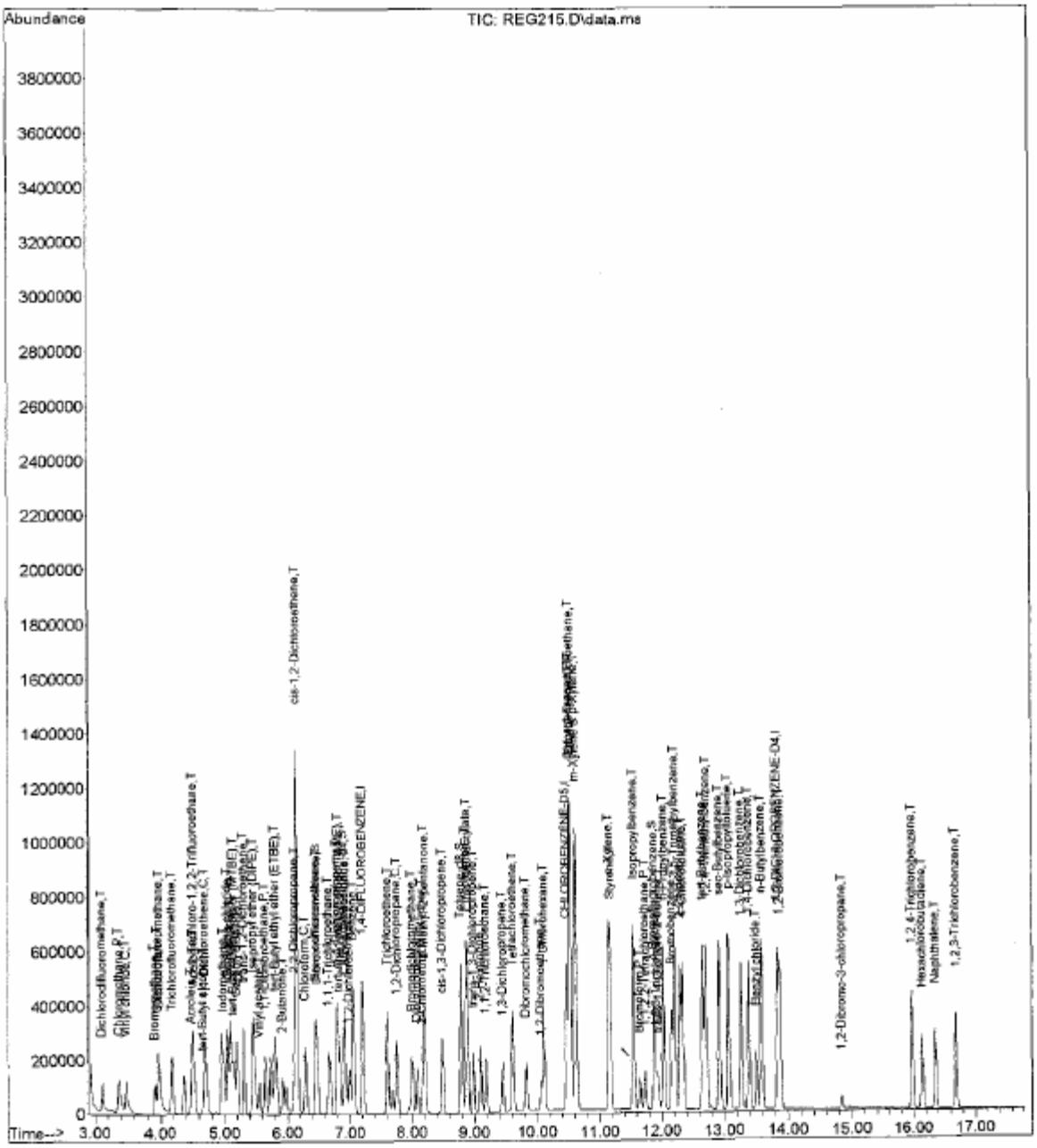


Figure 2: **TYPICAL CHROMATOGRAM**

Quantitation Report (Not Reviewed)

```
Data File : D:\Data\09E08\REG215.D                          Vial: 14
Acq On    :  8 May 2009  16:45                          Operator: CGM
Sample    : IVOE2E081                                   Inst    : E2
Misc      : 10ppb 8260/50ppb KET-A-TBA/60ppb AC         Multiplr: 1.00
Integrator: RTE
Quant Time: May 13 13:20:08 2009
Quant Results File: VOE2E08.RES

Quant Method : C:\msdchem\1\METHODS\VOE2E08.M
Quant Title  : METHOD  8260  10mL
QLast Update : Wed May 13 13:16:50 2009
Response via : Initial Calibration
DataAcq Meth:VOE2E08.M
```



VOE2E08.M Wed May 13 13:20:09 2009 Page: 3

Figure 3: **TYPICAL ICAL SUMMARY**

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E2
Beginning DateTime :05/08/09 12:03
Spike Units :PPB
IC File :REG208

Column Spec :RTX-502.2 ID :0.32MM
Ending DateTime :05/08/09 15:33
HPChem Method :VOE2E08

M	IDX	Parameters	.3 12:03 REG203	.5 12:26 REG204	1 12:49 REG205	2 13:13 REG206	5 13:36 REG207	10 14:00 REG208	30 14:23 REG209	50 14:47 REG210	100 15:10 REG211	200 15:33 REG212	Av_RRF	%_RSD	Av_Rt_M
	1	1,4-DIFLUOROBENZENE	1	1	1	1	1	1	1	1	1	1	1	0	7.2174
	2	Dichlorodifluoromethane	0.243	0.210	0.233	0.223	0.275	0.267	0.267	0.261	0.238	0.238	0.245	8.72	3.1069
	3	Chloromethane	------	0.891	0.649	0.552	0.523	0.509	0.468	0.458	0.400	0.403	0.539	28.34	3.3674
	4	Vinyl chloride	0.439	0.385	0.353	0.361	0.380	0.378	0.357	0.348	0.276	------	0.364	11.78	3.4775
	5	Bromomethane	0.192	0.242	0.195	0.194	0.217	0.219	0.236	0.251	0.233	0.239	0.222	9.78	3.9081
	6	Chloroethane	0.174	0.202	0.203	0.202	0.216	0.219	0.215	0.217	0.192	0.193	0.203	7.00	3.9543
	7	Dichlorofluoromethane	0.466	0.453	0.495	0.517	0.581	0.548	0.517	0.535	0.482	0.489	0.508	7.70	3.9653
	8	Trichlorofluoromethane	0.521	0.502	0.426	0.455	0.484	0.470	0.468	0.477	0.431	0.416	0.465	7.25	4.1832
5	9	Acrolein	0.028	0.026	0.029	0.030	0.032	0.028	0.029	0.030	0.028	0.031	0.029	6.59	4.4837
	10	1,1,2-Trichloro-1,2,2-Trifluoroethane	0.178	0.227	0.217	0.196	0.239	0.238	0.227	0.236	0.220	0.217	0.220	8.89	4.5134
5	11	Acetone	0.079	0.071	0.069	0.062	0.069	0.052	0.055	0.057	0.051	0.058	0.062	14.78	4.5156
	12	1,1-Dichloroethene	0.346	0.374	0.392	0.371	0.420	0.403	0.386	0.401	0.371	0.361	0.383	5.81	4.6917
5	13	tert-Butyl alcohol	------	------	0.016	0.015	0.020	0.014	0.014	0.016	0.014	0.018	0.016	12.76	4.6697
	14	Iodomethane	0.285	0.360	0.368	0.407	0.455	0.465	0.438	0.456	0.410	0.406	0.405	13.66	4.9888
	15	Methylene chloride	0.505	0.478	0.462	0.479	0.499	0.471	0.449	0.459	0.412	0.416	0.463	6.69	5.0549
6	16	Acrylonitrile	0.090	0.096	0.100	0.091	0.102	0.084	0.086	0.089	0.082	0.090	0.091	7.35	5.0989
	17	Carbon disulfide	0.880	0.806	0.718	0.692	0.738	0.708	0.670	0.700	0.647	0.647	0.721	10.12	5.1979
	18	tert-Butyl methyl ether (MTBE)	0.485	0.532	0.533	0.509	0.591	0.501	0.507	0.527	0.483	0.517	0.519	5.97	5.1429
	19	trans-1,2-Dichloroethene	0.451	0.406	0.413	0.412	0.448	0.414	0.402	0.424	0.388	0.380	0.414	5.54	5.3091
	20	Isopropyl ether (DIPE)	1.136	0.993	1.019	1.051	1.159	1.055	1.018	1.058	0.964	0.969	1.042	6.22	5.4620
	21	Vinyl acetate	0.444	0.455	0.453	0.444	0.522	0.448	0.443	0.465	0.425	0.462	0.456	5.68	5.5501
	22	1,1-Dichloroethane	0.487	0.518	0.513	0.518	0.560	0.519	0.502	0.518	0.476	0.464	0.507	5.33	5.6392
	23	tert-Butyl ethyl ether (ETBE)	0.790	0.793	0.768	0.806	0.910	0.786	0.788	0.826	0.764	0.801	0.803	5.18	5.8021
5	24	2-Butanone	0.108	0.095	0.109	0.097	0.113	0.089	0.093	0.097	0.090	0.104	0.099	8.40	5.9132
	25	2,2-Dichloropropane	0.326	0.360	0.361	0.359	0.388	0.384	0.367	0.385	0.352	0.358	0.364	5.10	6.1223
	26	cis-1,2-Dichloroethene	0.514	0.509	0.496	0.483	0.511	0.479	0.455	0.481	0.437	0.421	0.479	6.67	6.1543
	27	Chloroform	0.476	0.447	0.455	0.465	0.497	0.464	0.440	0.462	0.424	0.417	0.455	5.27	6.2863
5	28	tert-Amyl alcohol (TAA)	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
	29	Bromochloromethane	0.332	0.308	0.297	0.308	0.330	0.299	0.287	0.299	0.270	0.270	0.300	7.07	6.4525
	30	Dibromofluoromethane	------	0.315	0.328	0.355	0.373	0.349	0.346	0.362	0.328	0.328	0.343	5.56	6.4770
	31	1,1,1-Trichloroethane	0.393	0.390	0.396	0.405	0.445	0.429	0.411	0.432	0.399	0.396	0.410	4.68	6.6693
	32	tert-Amyl methyl ether (TAME)	0.724	0.640	0.657	0.604	0.661	0.584	0.592	0.625	0.581	0.625	0.629	6.95	6.8245
	33	1,2-Dichloroethane-d4	------	0.303	0.297	0.301	0.345	0.297	0.301	0.309	0.281	0.293	0.303	5.79	6.9148
	34	CHLOROBENZENE-D5	1	1	1	1	1	1	1	1	1	1	1	0	10.4694
	35	1,1-Dichloropropene	0.147	0.163	0.176	0.151	0.161	0.172	0.152	0.167	0.143	0.124	0.156	9.93	6.7981
	36	Carbon tetrachloride	0.432	0.492	0.483	0.472	0.455	0.497	0.437	0.477	0.412	0.354	0.451	9.75	6.9257
	37	1,2-Dichloroethane	0.431	0.440	0.406	0.413	0.402	0.395	0.363	0.387	0.329	0.301	0.387	11.39	6.9973
	38	Benzene	1.445	1.318	1.187	1.132	1.145	1.153	1.030	1.119	0.960	------	1.166	12.37	7.0627
	39	Trichloroethene	0.439	0.419	0.380	0.361	0.360	0.369	0.329	0.365	0.317	0.277	0.362	12.98	7.6081
	40	1,2-Dichloropropane	0.380	0.359	0.340	0.329	0.331	0.333	0.303	0.332	0.289	0.266	0.326	10.15	7.7610
20	41	1,4-Dioxane	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
	42	Bromodichloromethane	0.440	0.446	0.417	0.407	0.425	0.424	0.383	0.417	0.362	0.332	0.405	8.84	8.0031
	43	Dibromomethane	0.194	0.175	0.185	0.175	0.178	0.170	0.156	0.170	0.145	0.137	0.169	10.40	8.0791
	44	2-Chloroethyl vinyl ether	0.118	0.126	0.127	0.120	0.138	0.135	0.133	0.145	0.129	0.134	0.130	6.37	8.1693
5	45	4-Methyl-2-pentanone	0.270	0.271	0.294	0.254	0.275	0.242	0.245	0.264	0.231	0.236	0.258	7.70	8.2023
	46	cis-1,3-Dichloropropene	0.452	0.423	0.425	0.419	0.429	0.435	0.407	0.442	0.394	0.379	0.420	5.28	8.4885
	47	Toluene-d8	------	1.163	1.121	1.138	1.125	1.191	1.133	1.239	1.103	1.024	1.137	5.21	8.7942
	48	Toluene	1.261	1.121	1.134	1.070	1.099	1.122	1.038	1.143	1.021	0.950	1.096	7.65	8.8736
	49	Ethyl methacrylate	0.169	0.172	0.197	0.185	0.217	0.200	0.198	0.217	0.193	0.205	0.195	8.42	8.8813
	50	trans-1,3-Dichloropropene	0.345	0.320	0.315	0.331	0.337	0.340	0.323	0.354	0.317	0.320	0.330	4.02	8.9837

Figure 3 (cont.): **TYPICAL ICAL SUMMARY**

5	51	2-Hexanone	0.131	0.140	0.155	0.131	0.146	0.128	0.130	0.142	0.124	0.132	0.136	7.13	9.0938
	52	1,1,2-Trichloroethane	0.187	0.178	0.220	0.215	0.221	0.205	0.194	0.210	0.189	0.192	0.201	7.54	9.1818
	53	1,3-Dichloropropane	0.338	0.316	0.333	0.307	0.336	0.316	0.295	0.322	0.288	0.292	0.314	5.88	9.4470
	54	Tetrachloroethene	0.284	0.279	0.282	0.258	0.269	0.291	0.262	0.289	0.266	0.250	0.273	5.07	9.6110
	55	Dibromochloromethane	0.299	0.307	0.309	0.306	0.319	0.313	0.299	0.330	0.299	0.303	0.308	3.20	9.8212
	56	1,2-Dibromoethane	0.245	0.245	0.226	0.211	0.234	0.221	0.210	0.228	0.206	0.210	0.223	6.48	10.0611
	57	1-Chlorohexane	0.296	0.312	0.351	0.314	0.345	0.380	0.349	0.392	0.358	0.345	0.344	8.70	10.1084
	58	Chlorobenzene	0.896	0.869	0.798	0.779	0.775	0.822	0.756	0.841	0.767	0.723	0.803	6.71	10.5233
	59	1,1,1,2-Tetrachloroethane	0.362	0.335	0.335	0.328	0.344	0.343	0.320	0.354	0.317	0.292	0.333	6.02	10.5354
	60	Ethylbenzene	1.321	1.245	1.312	1.204	1.213	1.302	1.187	1.331	1.216	1.141	1.247	5.25	10.5354
2	61	m-Xylene & p-Xylene	1.007	0.942	0.937	0.898	0.926	0.967	0.900	1.017	0.934	0.873	0.940	4.91	10.6191
	62	o-Xylene	1.168	1.073	1.077	0.995	1.012	1.074	0.988	1.101	0.997	0.913	1.040	6.97	11.1484
	63	Styrene	0.720	0.670	0.702	0.688	0.714	0.762	0.716	0.821	0.740	0.701	0.723	5.92	11.1737
	64	1,2-DICHLOROBENZENE-D4	1	1	1	1	1	1	1	1	1	1	1	0	13.8370
	65	Isopropylbenzene	2.356	2.408	2.391	2.389	2.578	2.600	2.456	2.776	2.749	2.521	2.522	5.99	11.5468
	66	Bromoform	0.292	0.316	0.342	0.335	0.407	0.350	0.357	0.400	0.404	0.421	0.362	11.98	11.6459
	67	1,1,2,2-Tetrachloroethane	0.432	0.525	0.524	0.494	0.567	0.477	0.470	0.517	0.497	0.513	0.502	7.36	11.7306
	68	4-Bromofluorobenzene	------	0.810	0.728	0.779	0.839	0.826	0.813	0.910	0.907	0.890	0.834	7.30	11.8744
	69	1,2,3-Trichloropropane	------	0.085	0.150	0.139	0.169	0.144	0.142	0.153	0.150	0.154	0.143	16.39	11.9123
	70	trans-1,4-Dichloro-2-butene	------	0.107	0.133	0.121	0.157	0.129	0.136	0.146	0.142	0.154	0.136	11.64	11.9453
	71	n-Propylbenzene	2.881	2.798	2.797	2.827	3.036	3.090	2.899	3.279	3.203	3.014	2.983	5.72	12.0310
	72	Bromobenzene	0.772	0.713	0.671	0.660	0.710	0.715	0.680	0.765	0.761	0.750	0.720	5.67	12.1642
	73	1,3,5-Trimethylbenzene	1.903	1.911	2.069	2.004	2.217	2.226	2.146	2.391	2.209	2.111	2.118	7.21	12.2082
	74	2-Chlorotoluene	1.982	1.892	1.923	1.801	1.919	1.952	1.793	2.011	1.927	1.793	1.899	4.16	12.2963
	75	4-Chlorotoluene	1.544	1.467	1.536	1.495	1.628	1.610	1.535	1.753	1.729	1.715	1.601	6.39	12.3403
	76	tert-Butylbenzene	1.950	2.047	2.140	2.118	2.328	2.354	2.293	2.525	2.285	2.162	2.220	7.59	12.6594
	77	1,2,4-Trimethylbenzene	2.032	1.882	1.956	2.006	2.207	2.203	2.115	2.328	2.164	2.088	2.098	6.36	12.7123
	78	sec-Butylbenzene	2.509	2.613	2.684	2.628	2.930	2.993	2.878	3.160	2.862	2.708	2.797	7.20	12.9236
	79	p-Isopropyltoluene	2.163	2.221	2.237	2.315	2.540	2.584	2.518	2.713	2.528	2.399	2.422	7.52	13.0765
	80	1,3-Dichlorobenzene	1.440	1.410	1.430	1.334	1.466	1.455	1.361	1.502	1.442	1.425	1.427	3.44	13.2647
	81	1,4-Dichlorobenzene	1.607	1.367	1.413	1.323	1.431	1.431	1.355	1.495	1.429	1.419	1.427	5.58	13.3858
	82	Benzyl chloride	0.908	0.889	0.918	0.870	1.003	0.931	0.941	1.013	0.959	1.067	0.950	6.47	13.5068
	83	n-Butylbenzene	1.847	1.937	2.070	1.948	2.194	2.208	2.138	2.286	2.201	2.042	2.087	6.83	13.5839
	84	1,2-Dichlorobenzene	1.491	1.286	1.342	1.282	1.413	1.358	1.294	1.375	1.314	1.305	1.346	4.94	13.8711
	85	1,2-Dibromo-3-chloropropane	0.121	0.077	0.103	0.099	0.127	0.103	0.105	0.110	0.107	0.116	0.107	12.84	14.8407
	86	1,2,4-Trichlorobenzene	0.878	0.790	0.816	0.821	0.902	0.895	0.875	0.950	0.900	0.839	0.867	5.65	15.9830
	87	Hexachlorobutadiene	0.218	0.311	0.340	0.331	0.352	0.379	0.346	0.385	0.366	0.321	0.335	14.16	16.1392
	88	Naphthalene	1.482	1.446	1.661	1.550	1.785	1.544	1.590	1.730	1.636	1.620	1.604	6.56	16.3572
	89	1,2,3-Trichlorobenzene	0.704	0.664	0.766	0.715	0.809	0.742	0.746	0.801	0.756	0.704	0.741	6.11	16.6884

Spike Amount = Nominal Amount * M
Ave_%RSD : 7.8 Max_%RSD : 28.3

Use Least Square Linear Regression with weighting factor of inverse concentration for comps with %_RSD > 15
Resp_Ratio = xo + x1 * Amt_Ratio

IDX	Parameter	x0	x1	CCF
3	Chloromethane	0.02923	0.41361	0.9980
69	1,2,3-Trichloropropane	-0.00215	0.15213	0.9996

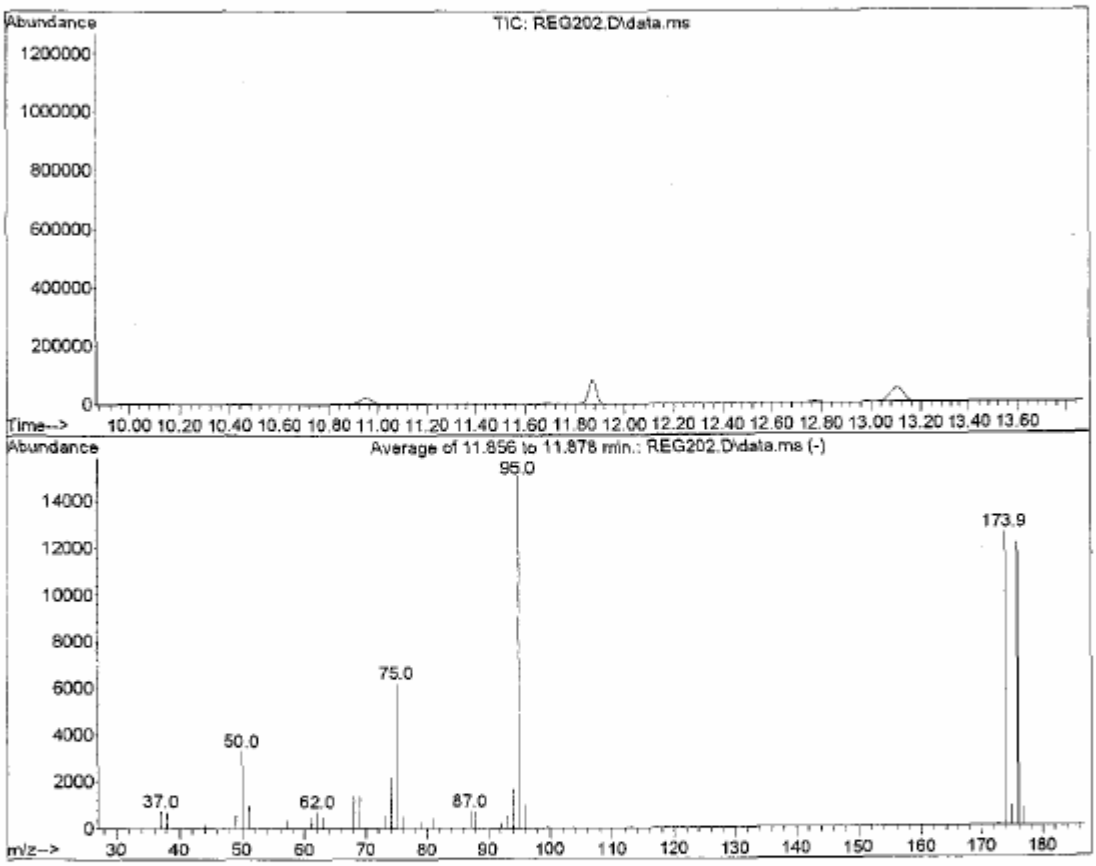
Figure 4: **TYPICAL INSTRUMENT PERFORMANCE CHECK (TUNING)**

BFB

```
Data Path : D:\Data\09E08\
Data File : REG202.D
Acq On    :  8 May 2009  11:08
Operator  : CGM
Sample    : BFBE2E10
Misc      : T/CHK
ALS Vial  : 1   Sample Multiplier: 1

Integration File: rteint.p

Method    : C:\msdchem\1\METHODS\VOE2E08.M
Title     : METHOD  8260  10mL
Last Update  : Wed May 13 13:05:40 2009
```



AutoFind: Scans 815, 816, 817; Background Corrected with Scan 810

Target Mass	Rel. to Mass	Lower Limit%	Upper Limit%	Rel. Abn%	Raw Abn	Result Pass/Fail
50	95	15	40	21.8	3288	PASS
75	95	30	60	40.9	6175	PASS
95	95	100	100	100.0	15091	PASS
96	95	5	9	6.5	976	PASS
173	174	0.00	2	0.9	111	PASS
174	95	50	100	83.1	12540	PASS
175	174	5	9	6.8	849	PASS
176	174	95	101	96.3	12070	PASS
177	176	5	9	6.3	765	PASS

VOE2E08.M Wed May 13 13:06:56 2009 Page: 1

Figure 5: TYPICAL INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

8A
VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: REG208
Instrument ID: TOE2
GC Column: RTX502.2 ID: 0.32mm (mm)

Project: XYZ, INC.
SDG No.: 09E108
Date Analyzed: 05/08/09
Time Analyzed: 14:00
Heated Purge: (Y/N) N

		IS1(DBF)		IS2(CBZ)		IS3(DCB)	
		AREA #	RT #	AREA #	RT #	AREA #	RT #
	12 HOUR STD	437085	7.21	360505	10.47	188592	13.84
	UPPER LIMIT	874170	7.71	721010	10.97	377184	14.34
	LOWER LIMIT	218543	6.71	180253	9.97	94296	13.34
	SAMPLE ID						
1	VSTD010	507459	7.22	411195	10.47	226757	13.84
2	MBLK1W	516413	7.22	401562	10.47	236124	13.84
3	LCS1W	525586	7.22	424430	10.47	233099	13.84
4	LCD1W	520018	7.21	425171	10.47	230850	13.84
5	TRIP01-05052009	507617	7.22	396523	10.47	232631	13.84
6	TRIP02-05062009	472644	7.22	364071	10.47	210029	13.84
7	45MW13-05062009	499453	7.22	394036	10.47	231414	13.84
8	45MW13-05062009MS	504742	7.21	417810	10.47	234683	13.84
9	45MW13-05062009MSD	519198	7.22	424344	10.47	241377	13.84
10	45MW08-05052009	524027	7.22	400210	10.47	231882	13.84
11	45MW10-05052009	512150	7.22	407314	10.47	221461	13.84
12	45MW10D-05052009	543481	7.22	434322	10.47	229178	13.84
13	45MW11-05052009	612985	7.22	459226	10.48	234255	13.84
14	45MW12-05052009	509816	7.22	418635	10.48	240019	13.84

IS1 (DFB) = 1,4-Difluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,2-Dichlorobenzene-d4

AREA UPPER LIMIT = + 100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
AREA UPPER LIMIT = + 50% of surrogate area
AREA LOWER LIMIT = - 50% of surrogate area

Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.
page 1 of 1

FORM VIII VOA-8260 1/2000

Figure 6: **TYPICAL SAMPLE RESULT SUMMARY REPORT**

SW 5030B/8260B
VOLATILE ORGANICS BY GC/MS

Client	: XYZ, INC.	Date Collected:	05/06/09
Project	: CLEAN WATER PROJECT	Date Received:	05/08/09
Batch No.	: 09E108	Date Extracted:	05/08/09 22:51
Sample ID:	45MW13-05062009	Date Analyzed:	05/08/09 22:51
Lab Samp ID:	E108-07	Dilution Factor:	1
Lab File ID:	REG230	Matrix :	WATER
Ext Btch ID:	VOE2E11	% Moisture :	NA
Calib. Ref.:	REG208	Instrument ID :	T-OE2

RESULTS PARAMETERS	RL (ug/L)	MDL (ug/L)	(ug/L)
1,1,1,2-TETRACHLOROETHANE	ND	1.0	0.20
1,1,1-TCA	3.0	1.0	0.20
1,1,2,2-TETRACHLOROETHANE	ND	1.0	0.20
1,1,2-TCA	ND	1.0	0.20
1,1-DCA	0.88F	1.0	0.20
1,1-DCE	1.5	1.0	0.20
1,1-DICHLOROPROPENE	ND	1.0	0.20
1,2,3-TRICHLOROBENZENE	ND	1.0	0.20
1,2,3-TRICHLOROPROPANE	ND	1.0	0.50
1,2,4-TRICHLOROBENZENE	ND	1.0	0.20
1,2,4-TRIMETHYLBENZENE	5.5	1.0	0.20
1,2-DIBROMO-3-CHLOROPROPANE	ND	2.0	0.50
1,2-DCB	ND	1.0	0.20
1,2-DCA	ND	1.0	0.20
1,2-DICHLOROPROPANE	ND	1.0	0.20
1,2-DIBROMOETHANE (EDB)	ND	1.0	0.20
1,3,5-TRIMETHYLBENZENE	1.3	1.0	0.20
1,3-DCB	ND	1.0	0.20
1,3-DICHLOROPROPANE	ND	1.0	0.20
1,4-DCB	ND	1.0	0.20
1-CHLOROHEXANE	ND	1.0	0.20
2,2-DICHLOROPROPANE	ND	1.0	0.20
2-CHLOROTOLUENE	ND	1.0	0.20
4-CHLOROTOLUENE	ND	1.0	0.20
BENZENE	0.56F	1.0	0.20
BROMOBENZENE	ND	1.0	0.20
BROMOCHLOROMETHANE	ND	1.0	0.20
BROMODICHLOROMETHANE	ND	1.0	0.20
BROMOFORM	ND	1.0	0.30
BROMOMETHANE	ND	3.0	0.20
CARBON TETRACHLORIDE	ND	1.0	0.20
CHLOROBENZENE	ND	1.0	0.20
CHLOROETHANE	ND	1.0	0.20
CHLOROFORM	0.83F	1.0	0.20
CHLOROMETHANE	ND	1.0	0.20
CIS-1,2-DCE	62	1.0	0.20
CIS-1,3-DICHLOROPROPENE	ND	1.0	0.20
DIBROMOCHLOROMETHANE	ND	1.0	0.20
DIBROMOMETHANE	ND	1.0	0.20
DICHLORODIFLUOROMETHANE	ND	1.0	0.30
ETHYLBENZENE	5.3	1.0	0.20
HEXACHLOROBUTADIENE	ND	1.0	0.20
ISOPROPYL BENZENE	0.65F	1.0	0.20
M/P-XYLENE	30	2.0	0.50
METHYLENE CHLORIDE	ND	1.0	0.50
N-BUTYLBENZENE	0.34F	1.0	0.20
N-PROPYLBENZENE	0.62F	1.0	0.20
NAPHTHALENE	2.6	1.0	0.50
O-XYLENE	9.8	1.0	0.20
P-ISOPROPYLTOLUENE	0.37F	1.0	0.20
SEC-BUTYLBENZENE	0.26F	1.0	0.20
STYRENE	ND	1.0	0.20
TERT-BUTYLBENZENE	ND	1.0	0.20
TETRACHLOROETHENE	0.22F	1.0	0.20
TOLUENE	26	1.0	0.20
TRANS-1,2-DCE	0.40F	1.0	0.20
TRANS-1,3-DICHLOROPROPENE	ND	1.0	0.20
TCE	740J	1.0	0.20
TRICHLOROFLUOROMETHANE	ND	1.0	0.20
VINYL CHLORIDE	ND	1.0	0.20

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	101	70-140
TOLUENE-D8	107	70-140
4-BROMOFLUOROBENZENE	94	70-130

Figure 7: **TYPICAL LCS SUMMARY REPORT**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: 09E108
METHOD: SW5030B/8260B

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	MBLK1W				
LAB SAMP ID:	VOE2E11Q	VOE2E11L	VOE2E11C		
LAB FILE ID:	REG226	REG222	REG223		
DATE EXTRACTED:	05/08/0921:17	05/08/0919:44	05/08/0920:09	DATE COLLECTED:	NA
DATE ANALYZED:	05/08/0921:17	05/08/0919:44	05/08/0920:09	DATE RECEIVED:	05/08/09
PREP. BATCH:	VOE2E11	VOE2E11	VOE2E11		
CALIB. REF:	REG208	REG208	REG208		

ACCESSION:

PARAMETER	BLNK RSLT (ug/L)	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
1,1,1,2-Tetrachloroethane	ND	10.0	10.8	108	10.0	10.2	102	6	81-129	20
1,1,1-TCA	ND	10.0	10.2	102	10.0	9.64	96	6	67-132	20
1,1,2,2-Tetrachloroethane	ND	10.0	9.47	95	10.0	9.23	92	3	63-128	20
1,1,2-TCA	ND	10.0	10.7	107	10.0	10.3	103	4	75-125	20
1,1-DCA	ND	10.0	10.3	103	10.0	9.94	99	4	69-133	20
1,1-DCE	ND	10.0	10.5	105	10.0	9.92	99	5	68-130	20
1,1-Dichloropropene	ND	10.0	11.4	114	10.0	10.9	109	4	73-132	20
1,2,3-Trichlorobenzene	ND	10.0	10.2	102	10.0	9.96	100	3	67-137	20
1,2,3-Trichloropropane	ND	10.0	8.95	89	10.0	9.15	92	2	73-124	20
1,2,4-Trichlorobenzene	ND	10.0	10.3	103	10.0	10.0	100	3	66-134	20
1,2,4-Trimethylbenzene	ND	10.0	10.2	102	10.0	9.89	99	3	74-132	20
1,2-Dibromo-3-chloropropane	ND	10.0	10.4	104	10.0	10.1	101	3	50-132	20
1,2-DCB	ND	10.0	10.1	101	10.0	9.81	98	2	71-122	20
1,2-DCA	ND	10.0	10.4	104	10.0	9.96	100	5	69-132	20
1,2-Dichloropropane	ND	10.0	10.7	107	10.0	10.2	102	5	75-125	20
1,2-Dibromoethane (EDB)	ND	10.0	10.4	104	10.0	9.72	97	7	80-121	20
1,3,5-Trimethylbenzene	ND	10.0	10.3	103	10.0	9.99	100	3	74-131	20
1,3-DCB	ND	10.0	10.0	100	10.0	9.59	96	4	75-124	20
1,3-Dichloropropane	ND	10.0	10.4	104	10.0	9.87	99	5	73-126	20
1,4-DCB	ND	10.0	9.83	98	10.0	9.57	96	3	74-123	20
1-Chlorohexane	ND	10.0	10.8	108	10.0	10.2	102	6	70-125	20
2,2-Dichloropropane	ND	10.0	9.81	98	10.0	9.62	96	2	69-137	20
2-Chlorotoluene	ND	10.0	9.48	95	10.0	9.30	93	2	73-126	20
4-Chlorotoluene	ND	10.0	9.63	96	10.0	9.37	94	3	74-128	20
Benzene	ND	10.0	10.3	103	10.0	9.71	97	6	81-122	20
Bromobenzene	ND	10.0	9.70	97	10.0	9.53	95	2	76-124	20
Bromochloromethane	ND	10.0	9.55	95	10.0	9.13	91	4	65-129	20
Bromodichloromethane	ND	10.0	10.3	103	10.0	10.1	101	1	76-121	20
Bromoform	ND	10.0	9.90	99	10.0	9.89	99	0	69-128	20
Bromomethane	ND	10.0	9.66	97	10.0	9.42	94	3	30-141	20
Carbon Tetrachloride	ND	10.0	11.0	110	10.0	10.2	102	8	66-138	20
Chlorobenzene	ND	10.0	10.6	106	10.0	10.1	101	5	81-122	20
Chloroethane	ND	10.0	9.91	99	10.0	10.0	100	1	58-133	20
Chloroform	ND	10.0	10.1	101	10.0	9.60	96	5	69-128	20
Chloromethane	ND	10.0	9.14	91	10.0	9.31	93	2	56-131	20
cis-1,2-DCE	ND	10.0	9.81	98	10.0	9.50	95	3	72-126	20
cis-1,3-Dichloropropene	ND	10.0	10.7	107	10.0	10.3	103	4	69-131	20
Dibromochloromethane	ND	10.0	10.6	106	10.0	10.3	103	3	66-133	20
Dibromomethane	ND	10.0	10.7	107	10.0	10.2	102	5	76-125	20
Dichlorodifluoromethane	ND	10.0	9.80	98	10.0	9.73	97	1	30-153	20
Ethylbenzene	ND	10.0	10.3	103	10.0	9.89	99	4	73-127	20
Hexachlorobutadiene	ND	10.0	10.5	105	10.0	9.96	100	5	67-131	20
Isopropyl Benzene	ND	10.0	10.2	102	10.0	9.80	98	4	75-127	20
m/p-Xylene	ND	20.0	20.8	104	20.0	19.9	100	4	76-128	20
Methylene Chloride	ND	10.0	9.70	97	10.0	9.50	95	2	63-137	20
n-Butylbenzene	ND	10.0	9.98	100	10.0	9.80	98	2	69-137	20
n-Propylbenzene	ND	10.0	9.77	98	10.0	9.47	95	3	72-129	20
Naphthalene	ND	10.0	10.1	101	10.0	9.52	95	5	54-138	20
o-Xylene	ND	10.0	10.5	105	10.0	10.0	100	5	80-121	20
p-Isopropyltoluene	ND	10.0	10.5	105	10.0	10.0	100	4	73-130	20
Sec-Butylbenzene	ND	10.0	10.3	103	10.0	9.89	99	4	72-127	20
Styrene	ND	10.0	10.7	107	10.0	10.1	101	5	65-134	20
Tert-Butylbenzene	ND	10.0	10.7	107	10.0	10.1	101	6	70-129	20
Tetrachloroethene	ND	10.0	11.3	113	10.0	10.4	104	8	66-128	20
Toluene	ND	10.0	10.6	106	10.0	10.2	102	4	77-122	20
Trans-1,2-DCE	ND	10.0	10.1	101	10.0	9.67	97	4	63-137	20
Trans-1,3-Dichloropropene	ND	10.0	10.6	106	10.0	10.4	104	2	59-135	20
TCE	ND	10.0	10.8	108	10.0	10.3	103	5	70-127	20
Trichlorofluoromethane	ND	10.0	9.36	94	10.0	9.47	95	1	57-129	20
Vinyl Chloride	ND	10.0	9.04	90	10.0	8.98	90	1	50-134	20

SURROGATE PARAMETER	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	QC LIMIT (%)
1,2-Dichloroethane-d4	10.0	9.30	93	10.0	9.34	93	70-140
Toluene-d8	10.0	10.4	104	10.0	10.2	102	70-130

Figure 8: **TYPICAL MS/MSD REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: 09E108
METHOD: SW5030B/8260B

MATRIX: WATER % MOISTURE: NA

DILUTION FACTOR:	1	1	1		
SAMPLE ID:	45MW13-05062009				
LAB SAMP ID:	E108-07	E108-07M	E108-07S		
LAB FILE ID:	REG230	REG231	REG232		
DATE EXTRACTED:	05/08/0922:51	05/08/0923:16	05/08/0923:39	DATE COLLECTED:	05/06/09
DATE ANALYZED:	05/08/0922:51	05/08/0923:16	05/08/0923:39	DATE RECEIVED:	05/08/09
PREP. BATCH:	VOE2E11	VOE2E11	VOE2E11		
CALIB. REF:	REG208	REG208	REG208		

ACCESSION:

PARAMETER	SMPL RSLT (ug/L)	SPIKE AMT (ug/L)	MS RSLT (ug/L)	MS % REC	SPIKE AMT (ug/L)	MSD RSLT (ug/L)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
1,1,1,2-Tetrachloroethane	ND	10.0	10.4	104	10.0	10.3	103	1	81-129	20
1,1,1-TCA	2.95	10.0	13.0	100	10.0	12.4	95	5	67-132	20
1,1,2,2-Tetrachloroethane	ND	10.0	9.16	92	10.0	9.70	97	6	63-128	20
1,1,2-TCA	ND	10.0	10.7	107	10.0	10.5	105	3	75-125	20
1,1-DCA	0.882F	10.0	10.9	100	10.0	10.6	97	3	69-133	20
1,1-DCE	1.46	10.0	11.1	96	10.0	10.6	91	4	68-130	20
1,1-Dichloropropene	ND	10.0	10.9	109	10.0	10.7	107	2	73-132	20
1,2,3-Trichlorobenzene	ND	10.0	10.3	103	10.0	10.4	104	2	67-137	20
1,2,3-Trichloropropane	ND	10.0	8.65	87	10.0	8.71	87	1	73-124	20
1,2,4-Trichlorobenzene	ND	10.0	10.3	103	10.0	10.2	102	1	66-134	20
1,2,4-Trimethylbenzene	5.47	10.0	15.9	104	10.0	15.4	99	3	74-132	20
1,2-Dibromo-3-chloropropane	ND	10.0	10.1	101	10.0	10.9	109	8	50-132	20
1,2-DCB	ND	10.0	9.62	96	10.0	9.43	94	2	71-122	20
1,2-DCA	ND	10.0	9.93	99	10.0	9.76	98	2	69-132	20
1,2-Dichloropropane	ND	10.0	10.5	105	10.0	10.3	103	1	75-125	20
1,2-Dibromoethane (EDB)	ND	10.0	9.94	99	10.0	10.1	101	2	80-121	20
1,3,5-Trimethylbenzene	1.28	10.0	11.4	101	10.0	11.0	97	4	74-131	20
1,3-DCB	ND	10.0	9.56	96	10.0	9.50	95	1	75-124	20
1,3-Dichloropropane	ND	10.0	9.95	99	10.0	10.1	101	2	73-126	20
1,4-DCB	ND	10.0	9.57	96	10.0	9.50	95	1	74-123	20
1-Chlorohexane	ND	10.0	11.0	110	10.0	10.8	108	2	70-125	20
2,2-Dichloropropane	ND	10.0	9.33	93	10.0	8.82	88	6	69-137	20
2-Chlorotoluene	ND	10.0	9.11	91	10.0	8.91	89	2	73-126	20
4-Chlorotoluene	ND	10.0	9.22	92	10.0	8.98	90	3	74-128	20
Benzene	0.564F	10.0	10.2	96	10.0	9.83	93	4	81-122	20
Bromobenzene	ND	10.0	9.20	92	10.0	9.20	92	0	76-124	20
Bromochloromethane	ND	10.0	9.27	93	10.0	8.82	88	5	65-129	20
Bromodichloromethane	ND	10.0	10.3	103	10.0	10.2	102	1	76-121	20
Bromoform	ND	10.0	9.42	94	10.0	9.61	96	2	69-128	20
Bromomethane	ND	10.0	10.2	102	10.0	9.80	98	4	30-141	20
Carbon Tetrachloride	ND	10.0	10.5	105	10.0	10.2	102	3	66-138	20
Chlorobenzene	ND	10.0	10.2	102	10.0	10.1	101	1	81-122	20
Chloroethane	ND	10.0	10.3	103	10.0	9.90	99	4	58-133	20
Chloroform	0.826F	10.0	10.5	97	10.0	10.1	93	4	69-128	20
Chloromethane	ND	10.0	9.91	99	10.0	9.44	94	5	56-131	20
cis-1,2-DCE	61.5	10.0	56.6	-49*	10.0	54.4	-71*	4	72-126	20
cis-1,3-Dichloropropene	ND	10.0	10.1	101	10.0	10.1	101	0	69-131	20
Dibromochloromethane	ND	10.0	10.3	103	10.0	10.4	104	1	66-133	20
Dibromomethane	ND	10.0	9.70	97	10.0	9.77	98	1	76-125	20
Dichlorodifluoromethane	ND	10.0	10.3	103	10.0	9.12	91	12	30-153	20
Ethylbenzene	5.32	10.0	15.5	102	10.0	15.3	99	1	73-127	20
Hexachlorobutadiene	ND	10.0	10.2	102	10.0	10.1	101	1	67-131	20
Isopropyl Benzene	0.650F	10.0	10.2	96	10.0	9.98	93	3	75-127	20
m/p-Xylene	30.2	20.0	50.3	100	20.0	49.6	97	1	76-128	20
Methylene Chloride	ND	10.0	9.60	96	10.0	9.27	93	4	63-137	20
n-Butylbenzene	0.343F	10.0	10.2	98	10.0	9.93	96	2	69-137	20
n-Propylbenzene	0.617F	10.0	10.1	95	10.0	9.65	90	4	72-129	20
Naphthalene	2.57	10.0	13.3	108	10.0	13.7	111	2	54-138	20
o-Xylene	9.84	10.0	20.1	102	10.0	19.8	99	1	80-121	20
p-Isopropyltoluene	0.369F	10.0	10.8	104	10.0	10.4	101	3	73-130	20
Sec-Butylbenzene	0.258F	10.0	10.3	101	10.0	10.1	99	2	72-127	20
Styrene	ND	10.0	10.9	109	10.0	10.8	108	1	65-134	20
Tert-Butylbenzene	ND	10.0	11.0	110	10.0	10.6	106	4	70-129	20
Tetrachloroethene	0.223F	10.0	10.8	106	10.0	10.8	106	0	66-128	20
Toluene	25.7	10.0	35.5	99	10.0	34.9	93	2	77-122	20
Trans-1,2-DCE	0.398F	10.0	10.3	99	10.0	9.66	93	6	63-137	20
Trans-1,3-Dichloropropene	ND	10.0	10.3	103	10.0	10.2	102	0	59-135	20
TCE	737J	10.0	717J	-203*	10.0	702J	-349*	2	70-127	20
Trichlorofluoromethane	ND	10.0	9.48	95	10.0	9.32	93	2	57-129	20
Vinyl Chloride	ND	10.0	9.31	93	10.0	8.75	88	6	50-134	20

SURROGATE PARAMETER	SPIKE AMT (ug/L)	MS RSLT (ug/L)	MS % REC	SPIKE AMT (ug/L)	MSD RSLT (ug/L)	MSD % REC	QC LIMIT (%)
1,2-Dichloroethane-d4	10.0	9.74	97	10.0	9.45	94	70-140
Toluene-d8	10.0	10.2	102	10.0	10.3	103	70-140
4-Bromofluorobenzene	10.0	9.45	94	10.0	9.38	94	70-130

Figure 9: **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN WATER PROJECT

SDG : 09E108

SW 5030B/8260B
VOLATILE ORGANICS BY GC/MS

A total of ten (10) water samples were received on 05/08/09 for Volatile Organics by GC/MS analysis, Method SW 5030B/8260B in accordance with AFCEE QAPP, Version 4.0

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument tune check was performed prior to calibration. Instrument mass ratios were within specification. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source. Continuing calibration was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms for ICAL, ICV and CCV for details.

Method Blank
Method blanks were analyzed at the frequency required by the project. For this SDG, two (2) method blanks were analyzed with the samples. All results were compliant to project requirement. Refer to QC result summary form for details.

Lab Control Sample
Two (2) sets of LCS/LCD were analyzed with the samples in this SDG.
Percent recoveries for VOE2E11L/C were all within QC limits.
Percent recoveries for VOE2E13L/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries were within project QC limits except for results qualified with [*] in E108-07 M/S summary form, most likely due to matrix interference. Check QC summaries form for details.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within projects QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.
One analyte in samples E108-01,-02,-03,-05T,-07 and three analytes in samples 09E108-04,-05 were manually integrated to correct improper integration. Chromatograms of before and after manual integrations were retained with the initialed and corrected chromatograms.

Table 1: INITIAL CALIBRATION INTERMEDIATE STANDARD PREPARATION

ICAL/DCC Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µL)	Final Vol. (mL)	
I	1-Chlorohexane	AccuStandard	2000	50	2	50
	2-Chloroethylvinylether	CPI	2000	50	2	50
	Oxygenate Gasoline Additive	AccuStandard	2000-10000	50	2	50 - 250
	Custom VOA Mix	CPI	2000, 20000, 40000	50	2	50, 500, 1000
II	VOC Gas Mix	Ultra Scientific	2000	250	2	250
	Vinyl Acetate	CPI	2500	200	2	250
III	Carbon Disulfide	CPI	5000	100	2	250
IV	VOA Calibration Mix 1	Restek	5000	100	2	250
	Acrolein / Acrylonitrile	AccuStandard	5000	100	2	250

Table 2: INITIAL CALIBRATION VERIFICATION INTERMEDIATE STANDARD PREPARATION

ICV / LCS / MS Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µL)	Final Vol. (mL)	
I	1-Chlorohexane	Ultra Scientific	1000	100	2	50
	2-Chloroethylvinylether	AccuStandard	2000	50	2	50
	Chlorophenol	Restek	5000	20	2	50
	California Oxygenate Mix	Restek	2000 - 10000	50	2	50 - 250
	Custom 8260 Mega Mix	Restek	2000, 20000, 40000	50	2	50, 500, 1000
II	Volatile Organic Cpds Mix 6	Supelco	2000	250	2	250
	Vinyl Acetate	Restek	2000	250	2	250
III	TCL Volatile Mix 1	Supelco	2000	250	2	250
	Acrolein / Acrylonitrile	Ultra Scientific	2000	250	2	250

Table 3: SURROGATE / INTERNAL STANDARD PREPARATION

Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µL)	Final Vol. (mL)	
Surrogate	8260 Surrogate Mix	Restek	2500	200	2	250
Internal Standard	Custom 8260 Internal Standard Mix, 3-30	CPI	2500	200	2	250

Table 4: TUNING SOLUTION TANDARD PREPARATION

BFB Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µL)	Final Vol. (mL)	
Tuning Compound	BFB	Restek	5000	20	2	50

Table 5: TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS

ANALYTES	ICAL ANALYTE CONCENTRATIONS (µg/L) 25-ml Purge									ICV/DCC	LCS/MS
	1	2	3	4	5	6	7	8	9		
1,1,1,2-Tetrachloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1,1-Trichloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1,2,2-Tetrachloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1,2-Trichloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1-Dichloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1-Dichloroethene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,1-Dichloropropene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2,3-Trichlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2,3-Trichloropropane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2,4-Trichlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2,4-Trimethylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dibromo-3-chloropropane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dibromoethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dichlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dichloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dichloropropane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,3,5-Trimethylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,3-Dichlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1,3-Dichloropropane	0.3	0.5	1	2	5	10	20	30	40	10	10
1,4-Dichlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
1-Chlorohexane	0.3	0.5	1	2	5	10	20	30	40	10	10
2,2-Dichloropropane	0.3	0.5	1	2	5	10	20	30	40	10	10
2-Butanone (MEK)	1.5	2.5	5	10	25	50	100	150	200	50	50
2-Chloroethyl vinyl ether	0.3	0.5	1	2	5	10	20	30	40	10	10
2-Chlorotoluene	0.3	0.5	1	2	5	10	20	30	40	10	10
2-Hexanone	1.5	2.5	5	10	25	50	100	150	200	50	50
4-Chlorotoluene	0.3	0.5	1	2	5	10	20	30	40	10	10
4-Methyl-2-pentanone (MIBK)	1.5	2.5	5	10	25	50	100	150	200	50	50
Acetone	1.5	2.5	5	10	25	50	100	150	200	50	50
Acrolein	1.5	2.5	5	10	25	50	100	150	200	50	50
Acrylonitrile	1.5	2.5	5	10	25	50	100	150	200	50	50
Benzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromochloromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromodichloromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromoform	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromomethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Carbon disulfide	0.3	0.5	1	2	5	10	20	30	40	10	10
Carbon tetrachloride	0.3	0.5	1	2	5	10	20	30	40	10	10
Chlorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Chloroethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Chloroform	0.3	0.5	1	2	5	10	20	30	40	10	10
Chloromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
cis-1,2-Dichloroethene	0.3	0.5	1	2	5	10	20	30	40	10	10
cis-1,3-Dichloropropene	0.3	0.5	1	2	5	10	20	30	40	10	10
Dibromochloromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Dibromomethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Dichlorodifluoromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Diisopropyl ether (DIPE)	0.3	0.5	1	2	5	10	20	30	40	10	10
Ethyl Methacrylate	0.3	0.5	1	2	5	10	20	30	40	10	10
Ethylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Ethyl-tert-butyl ether (ETBE)	0.3	0.5	1	2	5	10	20	30	40	10	10
Freon 113	0.3	0.5	1	2	5	10	20	30	40	10	10
Hexachlorobutadiene	0.3	0.5	1	2	5	10	20	30	40	10	10
Iodomethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Isopropylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10

Table 5 (cont.) TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS

ANALYTES	ICAL ANALYTE CONCENTRATIONS (µg/L) 25-ml Purge									ICV/DCC	LCS/MS
	1	2	3	4	5	6	7	8	9		
m/p-Xylene	0.6	1	2	4	10	20	40	60	80	20	20
Methylene chloride	0.3	0.5	1	2	5	10	20	30	40	10	10
Methyl-t-butyl ether (MTBE)	0.3	0.5	1	2	5	10	20	30	40	10	10
Naphthalene	0.3	0.5	1	2	5	10	20	30	40	10	10
n-Butylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
n-Propylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
o-Xylene	0.3	0.5	1	2	5	10	20	30	40	10	10
p-Isopropyltoluene	0.3	0.5	1	2	5	10	20	30	40	10	10
sec-Butylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Styrene	0.3	0.5	1	2	5	10	20	30	40	10	10
tert-Amylmethyl ether (TAME)	0.3	0.5	1	2	5	10	20	30	40	10	10
tert-Butanol	1.5	2.5	5	10	25	50	100	150	200	50	50
tert-Butylbenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Tetrachloroethene	0.3	0.5	1	2	5	10	20	30	40	10	10
Toluene	0.3	0.5	1	2	5	10	20	30	40	10	10
trans-1,2-Dichloroethene	0.3	0.5	1	2	5	10	20	30	40	10	10
trans-1,3-Dichloropropene	0.3	0.5	1	2	5	10	20	30	40	10	10
trans-1,4-Dichloro-2-butene	0.3	0.5	1	2	5	10	20	30	40	10	10
Trichloroethene	0.3	0.5	1	2	5	10	20	30	40	10	10
Trichlorofluoromethane	0.3	0.5	1	2	5	10	20	30	40	10	10
Vinyl acetate	0.3	0.5	1	2	5	10	20	30	40	10	10
Vinyl chloride	0.3	0.5	1	2	5	10	20	30	40	10	10
1,2-Dichloroethane-d4	0.3	0.5	1	2	5	10	20	30	40	10	10
Bromofluorobenzene	0.3	0.5	1	2	5	10	20	30	40	10	10
Chlorobenzene-d5	0.3	0.5	1	2	5	10	20	30	40	10	10
Toluene-d8	0.3	0.5	1	2	5	10	20	30	40	10	10

Table 5 (cont.) TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS

Analytes	ICAL ANALYTE CONCENTRATIONS (µg/L) 5-ml Purge								ICV/DCC	LCS/MS
	1	2	3	4	5	6	7	8		
1,1,1,2-Tetrachloroethane	2	5	10	20	50	80	100	200	50	50
1,1,1-Trichloroethane	2	5	10	20	50	80	100	200	50	50
1,1,2,2-Tetrachloroethane	2	5	10	20	50	80	100	200	50	50
1,1,2-Trichloro-1,2,2-trifluoroethane	2	5	10	20	50	80	100	200	50	50
1,1,2-Trichloroethane	2	5	10	20	50	80	100	200	50	50
1,1-Dichloroethane	2	5	10	20	50	80	100	200	50	50
1,1-Dichloroethene	2	5	10	20	50	80	100	200	50	50
1,1-Dichloropropene	2	5	10	20	50	80	100	200	50	50
1,2,3-Trichlorobenzene	2	5	10	20	50	80	100	200	50	50
1,2,3-Trichloropropane	2	5	10	20	50	80	100	200	50	50
1,2,4-Trichlorobenzene	2	5	10	20	50	80	100	200	50	50
1,2,4-Trimethylbenzene	2	5	10	20	50	80	100	200	50	50
1,2-Dibromo-3-chloropropane	2	5	10	20	50	80	100	200	50	50
1,2-Dibromoethane	2	5	10	20	50	80	100	200	50	50
1,2-Dichlorobenzene	2	5	10	20	50	80	100	200	50	50
1,2-Dichloroethane	2	5	10	20	50	80	100	200	50	50
1,2-Dichloropropane	2	5	10	20	50	80	100	200	50	50
1,3,5-Trimethylbenzene	2	5	10	20	50	80	100	200	50	50
1,3-Dichlorobenzene	2	5	10	20	50	80	100	200	50	50
1,3-Dichloropropane	2	5	10	20	50	80	100	200	50	50
1,4-Dichlorobenzene	2	5	10	20	50	80	100	200	50	50
1-Chlorohexane	2	5	10	20	50	80	100	200	50	50
2,2-Dichloropropane	2	5	10	20	50	80	100	200	50	50
2-Butanone (MEK)	10	25	50	100	250	400	500	1000	250	250
2-Chloroethyl vinyl ether	2	5	10	20	50	80	100	200	50	50
2-Chlorotoluene	2	5	10	20	50	80	100	200	50	50
2-Hexanone	10	25	50	100	250	400	500	1000	250	250
4-Chlorotoluene	2	5	10	20	50	80	100	200	50	50
4-Methyl-2-pentanone (MIBK)	10	25	50	100	250	400	500	1000	250	250
Acetone	10	25	50	100	250	400	500	1000	250	250
Acrolein	10	25	50	100	250	400	500	1000	250	250
Acrylonitrile	10	25	50	100	250	400	500	1000	250	250
Benzene	2	5	10	20	50	80	100	200	50	50
Bromobenzene	2	5	10	20	50	80	100	200	50	50
Bromochloromethane	2	5	10	20	50	80	100	200	50	50
Bromodichloromethane	2	5	10	20	50	80	100	200	50	50
Bromoform	2	5	10	20	50	80	100	200	50	50
Bromomethane	2	5	10	20	50	80	100	200	50	50
Carbon disulfide	2	5	10	20	50	80	100	200	50	50
Carbon tetrachloride	2	5	10	20	50	80	100	200	50	50
Chlorobenzene	2	5	10	20	50	80	100	200	50	50
Chloroethane	2	5	10	20	50	80	100	200	50	50
Chloroform	2	5	10	20	50	80	100	200	50	50
Chloromethane	2	5	10	20	50	80	100	200	50	50
cis-1,2-Dichloroethene	2	5	10	20	50	80	100	200	50	50
cis-1,3-Dichloropropene	2	5	10	20	50	80	100	200	50	50
Dibromochloromethane	2	5	10	20	50	80	100	200	50	50
Dibromomethane	2	5	10	20	50	80	100	200	50	50
Dichlorodifluoromethane	2	5	10	20	50	80	100	200	50	50
Diisopropyl ether (DIPE)	2	5	10	20	50	80	100	200	50	50
Ethyl Methacrylate	2	5	10	20	50	80	100	200	50	50
Ethylbenzene	2	5	10	20	50	80	100	200	50	50
Ethyl-tert-butyl ether (ETBE)	2	5	10	20	50	80	100	200	50	50
Hexachlorobutadiene	2	5	10	20	50	80	100	200	50	50
Iodomethane	2	5	10	20	50	80	100	200	50	50
Isopropylbenzene	2	5	10	20	50	80	100	200	50	50

Table 5 (cont.) **TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS**

	ICAL ANALYTE CONCENTRATIONS (µg/L) 5-ml Purge									
Analytes	1	2	3	4	5	6	7	8	ICV/DCC	LCS/MS
m/p-Xylene	4	10	20	40	100	160	200	400	100	100
Methylene chloride	2	5	10	20	50	80	100	200	50	50
Methyl-t-butyl ether (MTBE)	2	5	10	20	50	80	100	200	50	50
Naphthalene	2	5	10	20	50	80	100	200	50	50
n-Butylbenzene	2	5	10	20	50	80	100	200	50	50
n-Propylbenzene	2	5	10	20	50	80	100	200	50	50
o-Xylene	2	5	10	20	50	80	100	200	50	50
p-Isopropyltoluene	2	5	10	20	50	80	100	200	50	50
sec-Butylbenzene	2	5	10	20	50	80	100	200	50	50
Styrene	2	5	10	20	50	80	100	200	50	50
tert-Amylmethyl ether (TAME)	2	5	10	20	50	80	100	200	50	50
tert-Butanol	10	25	50	100	250	400	500	1000	250	250
tert-Butylbenzene	2	5	10	20	50	80	100	200	50	50
Tetrachloroethene	2	5	10	20	50	80	100	200	50	50
Toluene	2	5	10	20	50	80	100	200	50	50
trans-1,2-Dichloroethene	2	5	10	20	50	80	100	200	50	50
trans-1,3-Dichloropropene	2	5	10	20	50	80	100	200	50	50
trans-1,4-Dichloro-2-butene	2	5	10	20	50	80	100	200	50	50
Trichloroethene	2	5	10	20	50	80	100	200	50	50
Trichlorofluoromethane	2	5	10	20	50	80	100	200	50	50
Vinyl acetate	2	5	10	20	50	80	100	200	50	50
Vinyl chloride	2	5	10	20	50	80	100	200	50	50
1,2-Dichloroethane-d4	2	5	10	20	50	80	100	200	50	50
Bromofluorobenzene	2	5	10	20	50	80	100	200	50	50
Toluene-d8	2	5	10	20	50	80	100	200	50	50

Table 6: BFB KEY ION ABUNDANCE CRITERIA

M/z	Required Intensity (relative abundance)
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	Less than 2% of m/z 174
174	Greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	Greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

Table 7: ESTABLISHED DL, LOD AND LOQ

PARAMETER	Water (5mL Purge)			Water (25mL Purge)			Soil		
	DL	LOD	LOQ	DL	LOD	LOQ	DL	LOD	LOQ
Acetone	2.5	5	10	2.6	5	10	3	5	10
Acrolein	2.5	5	10	2.5	5	10	2.5	5	10
Acrylonitrile	2.5	5	10	2.5	5	10	2.5	5	10
Benzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Bromobenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Bromochloromethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Bromodichloromethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Bromoform	0.5	1	5	0.2	0.3	0.5	1	2	5
Bromomethane	1.1	2	5	0.2	0.3	0.5	1.8	2	5
tert-Butyl alcohol	7	10	25	2.5	5	10	9	10	20
2-Butanone (MEK)	2.5	5	10	2	4	10	2.5	5	10
n-Butylbenzene	0.7	1	5	0.2	0.2	0.5	0.7	1	5
sec-Butylbenzene	0.5	1	5	0.1	0.2	0.5	0.7	1	5
tert-Butylbenzene	0.5	1	5	0.1	0.2	0.5	0.6	1	5
Carbon disulfide	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Carbon tetrachloride	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Chlorobenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
2-Chloroethyl vinyl ether	1	2	5	0.5	1	2	1	2	5
Chloroethane	1	2	5	0.3	0.3	0.5	1	2	5
Chloroform	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1-Chlorohexane	0.5	1	5	0.1	0.2	0.5	0.6	1	5
Chloromethane	1	2	5	0.2	0.3	0.5	1	2	5
2-Chlorotoluene	0.5	1	5	0.1	0.2	0.5	0.8	1	5
4-Chlorotoluene	0.6	1	5	0.1	0.2	0.5	0.7	1	5
Isopropyl ether (DIPE)	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Dibromochloromethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2-Dibromo-3-chloropropane	1	2	5	0.25	0.5	1	1	2	5
1,2-Dibromoethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Dibromomethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1-Dichloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2-Dichloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2-Dichlorobenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,3-Dichlorobenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
trans-1,4-Dichloro-2-Butene	1	2	5	0.5	1	2	1	2	5
1,4-Dichlorobenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Dichlorodifluoromethane	1.3	2	5	0.2	0.3	0.5	1.2	2	5
1,1-Dichloroethene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
cis-1,2-Dichloroethene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
trans-1,2-Dichloroethene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Dichlorofluoromethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1-Dichloropropene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2-Dichloropropane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,3-Dichloropropane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
2,2-Dichloropropane	1	2	5	0.2	0.2	0.5	1	2	5
cis-1,3-Dichloropropene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
trans-1,3-Dichloropropene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
tert-Butyl ethyl ether (ETBE)	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Ethyl Methacrylate	1	2	5	0.25	0.5	1	1	2	5
Ethylbenzene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
2-Hexanone (MBK)	2.5	5	10	2	4	5	2.9	5	10

Table 7 (cont): **ESTABLISHED DL, LOD AND LOQ**

PARAMETER	Water (5mL Purge)			Water (25mL Purge)			Soil		
	DL	LOD	LOQ	DL	LOD	LOQ	DL	LOD	LOQ
Hexachlorobutadiene	0.5	1	5	0.2	0.3	0.5	1	2	5
Iodomethane	0.5	1	5	0.15	0.3	0.5	1	2	5
Isopropylbenzene	0.5	1	5	0.1	0.2	0.5	0.6	1	5
p-Isopropyltoluene	0.6	1	5	0.1	0.2	0.5	0.6	1	5
Methylene Chloride	0.5	1	5	0.3	0.5	1	1	2	5
4-Methyl-2-pentanone (MIBK)	2.5	5	10	2	4	5	2.8	5	10
tert-Butyl methyl ether	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Naphthalene	1	2	5	0.25	0.5	1	1	2	5
n-Propylbenzene	0.5	1	5	0.1	0.2	0.5	0.65	1	5
Styrene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
tert-Amyl methyl ether (TAME)	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1,1,2-Tetrachloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1,2,2-Tetrachloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Tetrachloroethene	0.5	1	5	0.15	0.2	0.5	0.5	1	5
Toluene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1,1-Trichloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,1,2-Trichloroethane	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2,3-Trichlorobenzene	0.5	1	5	0.15	0.3	0.5	1	2	5
1,2,4-Trichlorobenzene	0.5	1	5	0.15	0.3	0.5	1	2	5
Trichloroethene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
Trichlorofluoromethane	0.9	1	5	0.2	0.3	0.5	1.1	2	5
1,2,3-Trichloropropane	1	2	5	0.25	0.5	1	1	2	5
1,1,2-Trichloro1,2,2-trifluoroethane	1	2	5	0.2	0.3	0.5	1	2	5
1,2,4-Trimethylbenzene	0.5	1	5	0.1	0.2	0.5	0.6	1	5
1,3,5-Trimethylbenzene	0.5	1	5	0.1	0.2	0.5	0.6	1	5
Vinyl Acetate	1	2	5	0.25	0.5	1	1	2	5
Vinyl Chloride	0.6	1	5	0.1	0.2	0.5	1	2	5
m-Xylene & p-xylene	1	2	10	0.2	0.4	1	1	2	10
o-Xylene	0.5	1	5	0.1	0.2	0.5	0.5	1	5
1,2-Dichloroethane-d4	1	2	5	0.5	1	2	1	2	5
Toluene-d8	1	2	5	0.5	1	2	1	2	5
4-Bromofluorobenzene	1	2	5	0.5	1	2	1	2	5
Dibromofluoromethane	1	2	5	0.5	1	2	0.5	1	5

Table 8: CHARACTERISTIC IONS

ANALYTE	PRIMARY CHARACTERISTIC ION(S)	SECONDARY CHARACTERISTIC ION(S)
Acetone	43	58
Acetonitrile	41	40,39
Acrolein	56	55
Acrylonitrile	53	52, 51
Benzene	78	77, 52
Benzyl Chloride	91	126, 65, 125
Bromobenzene	156	51, 158
Bromochloromethane	49	128, 130
Bromoform	173	171, 175
Bromomethane	94	96
n-Butylbenzene	91	92, 134
sec-Butylbenzene	105	134
tert-Butylbenzene	119	91, 134
Carbon Disulfide	76	78
Carbon Tetrachloride[6]	119	117
Chlorobenzene	112	51, 77, 114
Chloroethane	64	49, 66
2-Chloroethyl vinyl ether	63	65, 106
Chloroform	83	85, 47
Chloromethane	50	52
2-Chlorotoluene	91	126
4-Chlorotoluene	91	126
1,2-Dibromo-3-chloropropane	157	155, 175
Dibromochloromethane	129	127. 131
1,2-Dibromoethane	107	109
Dibromomethane	93	95, 174
1,2-Dichlorobenzene	146	111, 148
1,3-Dichlorobenzene	146	111, 148
1,4-Dichlorobenzene	146	111, 148
cis-1,4-Dichloro-2-butene	75	53, 77, 124, 89
trans-1,4-Dichloro-2-butene	53	88
Dichlorodifluoromethane	85	87, 50
1,1-Dichloroethane	63	65, 83
1,2-Dichloroethane	62	98, 64
1,1-Dichloroethene	61	63, 96
cis-1,2-Dichloroethene	96	61, 98
trans-1,2-Dichloroethene	61	96, 98
1,2-Dichloropropane	63	41, 76
1,3-Dichloropropane	76	63, 78
2,2-Dichloropropane	77	97, 79, 41

[6] Quantitation ion was changed due to co-elution (Carbon tetrachloride – 117 to 119)

Table 8 (cont): CHARACTERISTIC IONS

ANALYTE	PRIMARY CHARACTERISTIC ION(S)	SECONDARY CHARACTERISTIC ION(S)
1,1-Dichloropropene[7]	77	110, 75
cis-1,3-Dichloropropene	75	77, 39, 110
trans-1,3-Dichloropropene	75	77, 39, 110
Ethylbenzene	91	106
Hexachlorobutadiene	225	223, 227
Hexachloroethane	201	166, 199, 203
2-Hexanone	43	58, 100
Iodomethane	142	127, 141
Isopropyltoluene	105	120, 79, 103
Methyl-t-butyl ether	73	57
Methylene chloride	49	84, 86
Methyl ethyl ketone	43	72
4-Methyl-2-pentanone	43	58, 85, 100
Naphthalene	128	127
n-Propylbenzene	91	65, 120
Styrene	104	78, 103
1,2,3-Trichlorobenzene	180	182, 145
1,2,4-Trichlorobenzene	180	182, 145
1,1,1,2-Tetrachloroethane	131	133, 119, 117
1,1,2,2-Tetrachloroethane	83	131, 85
Tetrachloroethene	164	129, 131, 166
Toluene	92	91
1,1,1 -Trichloroethane	97	99, 61
1,1,2 -Trichloroethane	97	83, 85, 99
Trichloroethene	130	97, 132, 95
Trichlorofluoromethane	101	103
1,2,3-Trichloropropane	75	61, 77
1,2,4-Trimethylbenzene	105	120
1,3,5-Trimethylbenzene	105	120, 119
Vinyl acetate	43	86
Vinyl chloride	62	64
o-Xylene	91	106
m-Xylene	91	106
p-Xylene	91	106
INTERNAL STANDARDS / SURROGATES		
1,4-Difluorobenzene	114	88
Chlorobenzene-d5	117	82, 119
1,2-Dichlorobenzene-d4	152	150
4-Bromofluorobenzene	95	174, 176
1,2-Dichloroethane-d4	65	102
Toluene-d8	98	100

[7] Quantitation ion was changed due to co-elution (1,1-Dichloropropene – 75 to 77)

Table 9: INTERNAL STANDARDS WITH CORRESPONDING TARGET COMPOUNDS AND SURROGATES ASSIGNED FOR QUANTITATION

1,4-DIFLUOROBENZENE	**CHLOROBENZENE-D_5**	**1,2-DICHLOROBENZENE-D_4**
Dichlorodifluoromethane	1,1-Dichloropropene	Bromoform
Chloromethane	Carbon Tetrachloride	Isopropyl Benzene
Vinyl Chloride	Benzene	Bromofluorobenzene
Bromomethane	1,2-Dichloroethane	Bromobenzene
Chloroethane	Trichloroethene	1,1,2,2-Tetrachloroethane
Trichlorofluorometh	1,2-Dichloropropane	1,2,3-Trichloropropane
1,1-Dichloroethene	Bromodichloromethane	1,4-Dichloro-2-butene
1,1,2-Trichloro-1,2,2-trifluoroethane	Dibromomethane	n-Propylbenzene
Acetone	2-Chloroethyl Vinyl Ether	2-Chlorotoluene
Iodomethane	cis-1,3-Dichloropropene	4-Chlorotoluene
Carbon Disulfide	4-Methyl-2-Pentanone	1,3,5-Trimethylbenzene
Methylene Chloride	Toluene-d_8	tert-Butylbenzene
Acrylonitrile	Toluene	124-Trimethylbenzen
trans-1,2-Dichloroe	trans-1,3-Dichloropropene	Sec-Butylbenzene
Acrolein	Ethyl Methacrylate	1,3-Dichlorobenzene
MTBE	1,1,2-trichloroethane	1,4-Dichlorobenzene
1,1-Dichloroethane	Tetrachloroethene	p-Isopropyltoluene
Vinyl Acetate	1,3-Dichloropropane	1,2-Dichlorobenzene
2,2-Dichloropropane	2-Hexanone	n-Butylbenzene
cis-1,2-Dichloroeth	Dibromochloromethane	1,2-Dibromo-3-Chlorpropane
2-Butanone	1,2-Dibromoethane	1,2,4-Trichlorobenzene
Bromochloromethane	Chlorobenzene	Hexachlorobutadiene
Chloroform	1-Chlorohexane	Naphthalene
1,1,1-Trichloroetha	1,1,1,2-Tetrachloroethane	1,2,3-Trichlorobenzene
1,2-Dichloroethane-d_4	Ethylbenzene	
	m/p-Xylenes	
	o-Xylene	
	Styrene	

Appendix 1: **SUMMARY OF QUALITY CONTROL PROCEDURES**

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in Table 6	Retune instrument and verify		
Minimum of 6-point initial calibration(ICAL)	Initially; as needed	SPCCs : RF ≥ 0.1 for Bromoform, Chloromethane and 1,1-Dichloroethane RF ≥ 0.3 for Chlorobenzene and 1,1,2,2-Tetrachloroethane CCCs: Chloroform, 1,1-DCE, 1,2-DCP, Ethylbenzene, Toluene and Vinyl Chloride. RFs for CCCs: RSD≤30% and one option below: 1). For analytes with RSD ≤ 15%, use RRFm 2). For analytes with RSD>15% and r ≥0..995, use either Inverse Weighting Factor or Linear Least Squares 3). For analytes with RSD>15% and COD ≥0.99, use non-linear regression (6 pts for second order, 7 pts for third order).	Check for outliers. Otherwise, optimize the instrument then repeat initial calibration.		
Initial calibration verification (ICV)	After initial calibration	In the absence of PSR All analytes within ± 20% of expected value except for the following compounds due to erratic chromatographic behavior: Bromomethane, Chloroethane, Chloromethane, Dichlorodifluoromethane within ± 35% of expected value.	Verify second source standard. Prepare fresh standard and rerun ICV. If that fails, Optimize instrument and repeat ICAL.		
Evaluation of relative retention times (RRT)	Each sample	Within ± 0.06 RRT units	Correct the problem then reanalyze all samples analyzed since the last retention time check		
Continuing Calibration verification (CCV)	Daily, before sample analysis and every 12 hours of analysis time	SPCCs: Min. RF same as ICAL CCC : %Diff ≤ 20% (when using RFs) or drift (when using least squares regression or non-linear calibration)	Correct the problem then repeat initial calibration		
Internal Standard (IS)	All samples	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning		
Method blank (MB)	One per preparation batch	No analytes detected >½ LOQ	Determine the source of contamination and correct the problem. Re-prep and re-analyze MB and all associated samples. Otherwise, apply "B" to specific analyte(s) on associated samples		
LCS	One LCS per preparation	Within project QC Limits	Re-prep and re-analyze the LCS and all associated samples		
MS/MSD	One MS/MSD per every 20 project samples per matrix	Within project QC Limits	Check if sample was properly spiked. If indicative of matrix interference, discuss in case narrative, otherwise re-prep and re-analyze the sample		
Surrogate	Every Sample, MB, LCS, MS/MSD, DCC	Within project QC Limits	Correct the problem then re-analyze		
Comments: Refer to PSR for Flagging Criteria. Report values between LOD and LOQ.			Reviewed by:		
			Date:		

Appendix 2: **DEMONSTRATION OF CAPABILITY**

Final Report - Soil / Hazardous Waste PT

Study: HW0110

Opening Date: January 18, 2010 - Closing Date: March 4, 2010

Laboratory: EMAX Laboratories
1825 205th Street
Torrance, CA 90501

Contact: Kenette Pimentel, Quality Assurance Manager
310-618-8889 ext. 205

EPA Lab ID: CA00291

Volatiles (PT-VOA-SOIL)								Lot #: 7039-12
NELAC Code	Analyte	Method Code	Method Description	Units	Assigned Value	Result	Acceptance Limits	Evaluation
4315	Acetone	10184802	SW 5035/SW 8260 B	µg/kg	303	240	103 - 495	Acceptable
4375	Benzene	10184802	SW 5035/SW 8260 B	µg/kg	105	94.4	62.6 - 144	Acceptable
4395	Bromodichloromethane	10184802	SW 5035/SW 8260 B	µg/kg	111	104	72.1 - 153	Acceptable
4400	Bromoform	10184802	SW 5035/SW 8260 B	µg/kg	<9.3	<5		Acceptable
4410	2-Butanone (MEK)	10184802	SW 5035/SW 8260 B	µg/kg	255	213	51.9 - 397	Acceptable
4455	Carbon tetrachloride	10184802	SW 5035/SW 8260 B	µg/kg	<9.9	<5		Acceptable
4475	Chlorobenzene	10184802	SW 5035/SW 8260 B	µg/kg	179	176	102 - 248	Acceptable
4575	Chlorodibromomethane	10184802	SW 5035/SW 8260 B	µg/kg	58.8	55.8	34.3 - 82.2	Acceptable
4505	Chloroform	10184802	SW 5035/SW 8260 B	µg/kg	110	111	66.4 - 153	Acceptable
4610	1,2-Dichlorobenzene	10184802	SW 5035/SW 8260 B	µg/kg	131	129	63.4 - 185	Acceptable
4615	1,3-Dichlorobenzene	10184802	SW 5035/SW 8260 B	µg/kg	50.5	48	17.6 - 74.7	Acceptable
4620	1,4-Dichlorobenzene	10184802	SW 5035/SW 8260 B	µg/kg	97.0	95	33.5 - 138	Acceptable
4630	1,1-Dichloroethane	10184802	SW 5035/SW 8260 B	µg/kg	44.0	43.9	24.4 - 64.2	Acceptable
4635	1,2-Dichloroethane	10184802	SW 5035/SW 8260 B	µg/kg	45.0	54	26.7 - 63.9	Acceptable
4655	1,2-Dichloropropane	10184802	SW 5035/SW 8260 B	µg/kg	80.8	79.9	47.5 - 109	Acceptable
4765	Ethylbenzene	10184802	SW 5035/SW 8260 B	µg/kg	<9.0	<5		Acceptable
4975	Methylene chloride	10184802	SW 5035/SW 8260 B	µg/kg	108	100	50.4 - 157	Acceptable
5000	Methyl-tert-butyl ether (MTBE)	10184802	SW 5035/SW 8260 B	µg/kg	144	142	60.9 - 213	Acceptable
4995	4-Methyl-2-pentanone (MIBK)	10184802	SW 5035/SW 8260 B	µg/kg	232	176	102 - 337	Acceptable
5005	Naphthalene	10184802	SW 5035/SW 8260 B	µg/kg	93.3	78.3	52.8 - 134	Acceptable
5105	1,1,1,2-Tetrachloroethane	10184802	SW 5035/SW 8260 B	µg/kg	52.5	52.5	33.7 - 73.7	Acceptable
5110	1,1,2,2-Tetrachloroethane	10184802	SW 5035/SW 8260 B	µg/kg	152	133	78.9 - 220	Acceptable
5115	Tetrachloroethene	10184802	SW 5035/SW 8260 B	µg/kg	51.5	47.5	22.7 - 74.1	Acceptable
5140	Toluene	10184802	SW 5035/SW 8260 B	µg/kg	47.4	44.5	26.7 - 67.1	Acceptable
5155	1,2,4-Trichlorobenzene	10184802	SW 5035/SW 8260 B	µg/kg	151	133	75.2 - 190	Acceptable
5160	1,1,1-Trichloroethane	10184802	SW 5035/SW 8260 B	µg/kg	44.8	44.9	23.6 - 63.5	Acceptable
5165	1,1,2-Trichloroethane	10184802	SW 5035/SW 8260 B	µg/kg	32.2	29.9	20.1 - 47.2	Acceptable
5170	Trichloroethene	10184802	SW 5035/SW 8260 B	µg/kg	113	99.6	58.1 - 162	Acceptable
5180	1,2,3-Trichloropropane	10184802	SW 5035/SW 8260 B	µg/kg	61.0	53.9	42.5 - 72.3	Acceptable
5260	Xylenes, total	10184802	SW 5035/SW 8260 B	µg/kg	157	155	76.8 - 233	Acceptable
NELAC Experimental Analytes								
4385	Bromobenzene	10184802	SW 5035/SW 8260 B	µg/kg	68.7	69.1	48.2 - 85.0	Acceptable
4950	Bromomethane	10184802	SW 5035/SW 8260 B	µg/kg	100	74.7	20.0 - 137	Acceptable
4485	Chloroethane	10184802	SW 5035/SW 8260 B	µg/kg	100	88.5	20.0 - 149	Acceptable
4960	Chloromethane	10184802	SW 5035/SW 8260 B	µg/kg	<20	7.35		Acceptable
4570	1,2-Dibromo-3-chloropropane (DBCP)	10184802	SW 5035/SW 8260 B	µg/kg	124	97.6	71.2 - 161	Acceptable
4585	1,2-Dibromoethane (EDB)	10184802	SW 5035/SW 8260 B	µg/kg	181	163	121 - 219	Acceptable
4625	Dichlorodifluoromethane	10184802	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4640	1,1-Dichloroethene	10184802	SW 5035/SW 8260 B	µg/kg	110	98.2	63.3 - 161	Acceptable
4645	cis-1,2-Dichloroethene	10184802	SW 5035/SW 8260 B	µg/kg	<10	<5		Acceptable
4700	trans-1,2-Dichloroethene	10184802	SW 5035/SW 8260 B	µg/kg	74.7	69.1	41.4 - 102	Acceptable
4680	cis-1,3-Dichloropropene	10184802	SW 5035/SW 8260 B	µg/kg	60.5	60.2	40.6 - 78.9	Acceptable
4685	trans-1,3-Dichloropropene	10184802	SW 5035/SW 8260 B	µg/kg	<10	<5		Acceptable
4860	2-Hexanone	10184802	SW 5035/SW 8260 B	µg/kg	177	145	67.6 - 257	Acceptable
4900	Isopropylbenzene	10184802	SW 5035/SW 8260 B	µg/kg	88.0	85.6	45.5 - 124	Acceptable
5100	Styrene	10184802	SW 5035/SW 8260 B	µg/kg	83.2	82	54.1 - 111	Acceptable
5175	Trichlorofluoromethane	10184802	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
5235	Vinyl chloride	10184802	SW 5035/SW 8260 B	µg/kg	140	85.6	60.9 - 181	Acceptable
Additional State Specific Analytes								
4320	Acetonitrile	10184802	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4325	Acrolein	10184802	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4340	Acrylonitrile	10184802	SW 5035/SW 8260 B	µg/kg	76.0	70	22.7 - 129	Acceptable
4390	Bromochloromethane	10184802	SW 5035/SW 8260 B	µg/kg	136	135	40.9 - 232	Acceptable

Appendix 2 (Cont.): **DEMONSTRATION OF CAPABILITY**

Volatiles (PT-VOA-SOIL) cont'd								Lot #: 7039-12
NELAC Code	Analyte	Method Code	Method Description	Units	Assigned Value	Result	Acceptance Limits	Evaluation
Additional State Specific Analytes cont'd								
4435	n-Butylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	65.9	62	19.8 - 112	Acceptable
4440	sec-Butylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	144	137	43.3 - 245	Acceptable
4445	tert-Butylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	180	172	54.0 - 306	Acceptable
4450	Carbon disulfide	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4465	Chloroacetaldehyde	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
5765	bis(2-Chloroethyl)ether	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
5760	bis(2-Chloroethoxy)methane	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
5780	bis(2-Chloroisopropyl)ether	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4500	2-Chloroethylvinylether	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4535	2-Chlorotoluene	10184902	SW 5035/SW 8260 B	µg/kg	40.8	51	12.2 - 69.4	Acceptable
4540	4-Chlorotoluene	10184902	SW 5035/SW 8260 B	µg/kg	153	151	45.9 - 260	Acceptable
4595	Dibromomethane	10184902	SW 5035/SW 8260 B	µg/kg	52.5	50.7	16.2 - 91.8	Acceptable
4660	1,3-Dichloropropane	10184902	SW 5035/SW 8260 B	µg/kg	147	137	44.1 - 250	Acceptable
4665	2,2-Dichloropropane	10184902	SW 5035/SW 8260 B	µg/kg	84.7	85.1	25.4 - 144	Acceptable
4670	1,1-Dichloropropene	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
9375	DIPE	10184902	SW 5035/SW 8260 B	µg/kg	113	108	34.0 - 193	Acceptable
4840	Hexachloroethane	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4835	Hexachlorobutadiene	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4835	Hexachlorobutadiene	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
4910	p-Isopropyltoluene	10184902	SW 5035/SW 8260 B	µg/kg	40.4	39	12.1 - 68.7	Acceptable
5090	n-Propylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	36.4	34.9	10.9 - 61.9	Acceptable
4370	TAME	10184902	SW 5035/SW 8260 B	µg/kg	56.1	54.8	16.8 - 95.4	Acceptable
5150	1,2,3-Trichlorobenzene	10184902	SW 5035/SW 8260 B	µg/kg	99.1	91.1	29.7 - 168	Acceptable
5210	1,2,4-Trimethylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	155	149	46.4 - 263	Acceptable
5215	1,3,5-Trimethylbenzene	10184902	SW 5035/SW 8260 B	µg/kg	42.8	42	12.9 - 72.8	Acceptable
5225	Vinyl acetate	10184902	SW 5035/SW 8260 B	µg/kg	<20	<5		Acceptable
5250	o-Xylene	10174908	SW 5035/SW 8021 B	µg/kg	62.6	67.8	18.8 - 106	Acceptable
5250	o-Xylene	10184902	SW 5035/SW 8260 B	µg/kg	62.6	61.1	18.8 - 106	Acceptable
5240	m+p-Xylene	10184902	SW 5035/SW 8260 B	µg/kg	94.8	93.6	28.4 - 161	Acceptable

Final Report - Water Pollution Proficiency Testing

Study: WP0110

Opening Date: January 4, 2010 - Closing Date: February 18, 2010

Laboratory: EMAX Laboratories
1825 205th Street
Torrance, CA 90501

Contact: Kenette Pimentel, Quality Assurance Manager
310-618-8889 ext. 205

EPA Lab ID: CA00291

Volatiles (PT-VOA-WP) **Lot #: 8094-26**

NELAC Code	Analyte	Method Code	Method Description	Units	Assigned Value	Result	Acceptance Limits	Evaluation
4375	Benzene	10184902	SW 5030 C/SW 8260 B	µg/L	17.1	16	11.4 - 22.8	Acceptable
4395	Bromodichloromethane	10184902	SW 5030 C/SW 8260 B	µg/L	61.1	67	43.2 - 82.5	Acceptable
4400	Bromoform	10184902	SW 5030 C/SW 8260 B	µg/L	88.1	82.4	56.1 - 119	Acceptable
4950	Bromomethane	10184902	SW 5030 C/SW 8260 B	µg/L	30.0	21.4	12.0 - 48.0	Acceptable
4455	Carbon tetrachloride	10184902	SW 5030 C/SW 8260 B	µg/L	22.4	25.5	12.7 - 31.0	Acceptable
4475	Chlorobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	64.7	63.2	46.6 - 81.0	Acceptable
4485	Chloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	90.5	80.3	36.2 - 145	Acceptable
4505	Chloroform	10184902	SW 5030 C/SW 8260 B	µg/L	80.8	82.4	56.0 - 104	Acceptable
4960	Chloromethane	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
4575	Dibromochloromethane	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
4610	1,2 Dichlorobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	85.9	82.1	59.8 - 111	Acceptable
4615	1,3 Dichlorobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	62.1	60.2	42.0 - 79.2	Acceptable
4620	1,4 Dichlorobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	25.0	24.9	16.5 - 32.4	Acceptable
4635	1,2 Dichloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	21.5	21.8	14.9 - 29.2	Acceptable
4640	1,1-Dichloroethene	10184902	SW 5030 C/SW 8260 B	µg/L	25.3	26.1	13.4 - 37.0	Acceptable
4700	trans-1,2-Dichloroethene	10184902	SW 5030 C/SW 8260 B	µg/L	23.2	22.1	12.3 - 34.6	Acceptable
4655	1,2-Dichloropropane	10184902	SW 5030 C/SW 8260 B	µg/L	61.1	59.2	40.0 - 80.7	Acceptable
4685	trans-1,3-Dichloropropene	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
4765	Ethylbenzene	10174908	SW 5030 C/SW 8021 B	µg/L	12.6	12.8	8.31 - 16.8	Acceptable
4765	Ethylbenzene	10184902	SW 5030 C/SW 8260 B	µg/L	12.6	12.1	8.31 - 16.8	Acceptable
4835	Hexachlorobutadiene	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
4975	Methylene Chloride	10184902	SW 5030 C/SW 8260 B	µg/L	106	110	65.0 - 148	Acceptable
4995	4-Methyl-2-pentanone (MIBK)	10184902	SW 5030 C/SW 8260 B	µg/L	36.9	31.9	13.5 - 58.0	Acceptable
5005	Naphthalene	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
5100	Styrene	10184902	SW 5030 C/SW 8260 B	µg/L	35.4	36.1	23.2 - 47.9	Acceptable
5110	1,1,2,2-Tetrachloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	140	120	83.3 - 202	Acceptable
5115	Tetrachloroethene	10184902	SW 5030 C/SW 8260 B	µg/L	19.1	19.1	9.61 - 25.3	Acceptable
5140	Toluene	10184902	SW 5030 C/SW 8260 B	µg/L	38.6	37.3	26.8 - 48.7	Acceptable
5155	1,2,4-Trichlorobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
5160	1,1,1-Trichloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	77.3	85.4	48.1 - 101	Acceptable
5165	1,1,2-Trichloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	32.9	31.2	23.0 - 43.5	Acceptable
5170	Trichloroethene	10184902	SW 5030 C/SW 8260 B	µg/L	0.00	<5		Acceptable
5175	Trichlorofluoromethane	10184902	SW 5030 C/SW 8260 B	µg/L	60.6	75.4	24.2 - 96.9	Acceptable
5235	Vinyl chloride	10184902	SW 5030 C/SW 8260 B	µg/L	36.5	31.2	14.6 - 58.4	Acceptable
5260	Xylenes, total	10184902	SW 5030 C/SW 8260 B	µg/L	204	204	117 - 272	Acceptable
NELAC Experimental Analytes								
4630	1,1-Dichloroethane	10184902	SW 5030 C/SW 8260 B	µg/L	73.7	72.9	50.7 - 101	Acceptable
4645	cis-1,2-Dichloroethene	10184902	SW 5030 C/SW 8260 B	µg/L	110	93.9	80.8 - 145	Acceptable
4680	cis-1,3-Dichloropropylene	10184902	SW 5030 C/SW 8260 B	µg/L	67.2	69.1	47.0 - 87.4	Acceptable
4860	2-Hexanone	10184902	SW 5030 C/SW 8260 B	µg/L	154	203	79.7 - 226	Acceptable
5000	Methyl tert-butyl ether (MTBE)	10184902	SW 5030 C/SW 8260 B	µg/L	89.4	87.5	57.2 - 125	Acceptable
Additional State Specific Analytes								
4315	Acetone	10184902	SW 5030 C/SW 8260 B	µg/L	295	358	110 - 575	Acceptable
4320	Acetonitrile	10184902	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4325	Acrolein	10184902	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4340	Acrylonitrile	10184902	SW 5030 C/SW 8260 B	µg/L	108	101	43.2 - 173	Acceptable
4385	Bromobenzene	10184902	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4390	Bromochloromethane	10184902	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4410	2-Butanone (MEK)	10184902	SW 5030 C/SW 8260 B	µg/L	18.3	21.5	3.36 - 36.6	Acceptable
4435	n-Butylbenzene	10184902	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable

Appendix 2 (Cont.): **DEMONSTRATION OF CAPABILITY**

Volatiles (PT-VOA-WP) cont'd								Lot #: 8094-26
NELAC Code	Analyte	Method Code	Method Description	Units	Assigned Value	Result	Acceptance Limits	Evaluation
Additional State Specific Analytes cont'd								
4440	sec-Butylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4445	tert-Butylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4450	Carbon disulfide	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4500	2-Chloroethylvinylether	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4535	2-Chlorotoluene	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4540	4-Chlorotoluene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4570	1,2-Dibromo-3-chloropropane (DBCP)	10184802	SW 5030 C/SW 8260 B	µg/L	102	96.7	40.8 - 163	Acceptable
4585	1,2-Dibromoethane (EDB)	10184802	SW 5030 C/SW 8260 B	µg/L	110	103	44.0 - 176	Acceptable
4595	Dibromomethane	10184802	SW 5030 C/SW 8260 B	µg/L	119	114	47.6 - 190	Acceptable
4625	Dichlorodifluoromethane	10184802	SW 5030 C/SW 8260 B	µg/L	6.00	<5	0.00 - 10.8	Acceptable
-	Dichlorofluoromethane	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4660	1,3-Dichloropropane	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4665	2,2-Dichloropropane	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4670	1,1-Dichloropropene	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
4900	Isopropylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
4910	p-Isopropyltoluene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
5090	n-Propylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<10	<5		Acceptable
5105	1,1,1,2-Tetrachloroethane	10184802	SW 5030 C/SW 8260 B	µg/L	43.1	46.9	17.2 - 69.0	Acceptable
5150	1,2,3-Trichlorobenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
5180	1,2,3-Trichloropropane	10184802	SW 5030 C/SW 8260 B	µg/L	62.4	59.6	25.0 - 99.8	Acceptable
5210	1,2,4-Trimethylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<20	<5		Acceptable
5215	1,3,5-Trimethylbenzene	10184802	SW 5030 C/SW 8260 B	µg/L	<20	<5		Acceptable
5225	Vinyl acetate	10184802	SW 5030 C/SW 8260 B	µg/L	<5	<5		Acceptable
5240	m+p-Xylene	10184802	SW 5030 C/SW 8260 B	µg/L	136	137	54.4 - 218	Acceptable
5250	o-Xylene	10184802	SW 5030 C/SW 8260 B	µg/L	67.5	66.9	27.0 - 108	Acceptable

EMAX LABORATORIES, INC.

Page 1

ANALYSIS LOG FOR VOLATILES

SOP ☐ EMAX-8260 Rev.No. 4 ☐ EMAX-524.2 Rev.No. 4 ☐ EMAX-CLP-VOA ☐ EMAX 624 Rev.No. 2 ☐

Start Date: ☐ 5-ml Purge ☐ 25-ml Purge Book # AD3 -019

BATCH _____

Sample Prep. ID	Data File Name	Lab Sample ID	Sample Amount	DF	Matrix W pH	Matrix W Cl_2	Matrix S	Notes
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Instrument No.		D3
INITIAL CALIBRATION REFERENCE		
DATE		
ICAL ID		
STANDARDS		
NAME	ID	CONC. (mg/L)
DCC		
DCC		
DCC		
BFB		
IS/SURR.		
LCS		
LCS		
LCS		
SOLVENT	ID	
METHANOL		
DATA FILE		
Electronic Data Archival		
Location		Date
HPCHEM_VOA/TOD3		

Comments:

Analyzed By:

Date Disposed:

Disposed By:

8260FM: **INSTRUMENT MAINTENANCE LOG**

EMAX LABORATORIES, INC.

Page 1

INSTRUMENT MAINTENANCE LOG

Instrument No: 05 Month: Year: 201_ Book # : MD3-005

DATE						
Bake Trap (210°C-260°C)						
Column Head Pressure (2-60 psi)						
Injector Port Temperature (160°C-220°C)						
Interface Temperature (250°C-280°C)						
Verify Computer Date and Time						
Check Gas Pressure (Daily)						
Check IS/Surrogate auto injection vial as appropriate (Daily)						
Check the foreline pump oil level (Weekly)						
AutoTune the MSD (As needed)						
Analyst's initial						
Trouble Shooting						
Problem(s) Encountered						
Return-to-Control (Analyst Initial)						

Code	Problems Encountered	Code	Corrrective Action

STANDARD OPERATING PROCEDURES

SEMIVOLATILE ORGANICS BY GC/MS

SOP No.:	EMAX-8270	Revision No.	4	Date:	15-May-10
Prepared By:	Khoa Vu			Date:	15 May 10
Approved By:	Kenette Pimentel QA Manager			Date:	05.15.10
Approved By:	Caspar Pang Laboratory Director			Date:	15-May 2010.

Control Number: **8270-04-**

1.0 SCOPE AND APPLICATION

1.1. This method is used to determine the concentration of semivolatile organic compounds extracted from many types of solid waste matrices, soils, air sampling media and water samples. Analytes that are listed in Table 7 were determined when this SOP was established. Additional analytes may be added upon completion of similar validation as the analytes that are listed in Table 7. This SOP is an adaptation of method SW846 8270D. Since 8270D is an update and enhancement of 8270C, this SOP is also applicable to 8270C.

2.0 SUMMARY OF METHOD

2.1. Samples are extracted with methylene chloride. Extracts are concentrated and appropriate cleanup procedure is applied if necessary.

2.2. Internal standards are added to an aliquot of the final extract and are qualitatively and quantitatively analyzed by gas chromatography equipped with mass spectrometry (GC/MS).

2.3. **Interference**

2.3.1. Solvents, reagents, glassware, and other sample processing devices are all possible sources of artifacts and/or interferences to sample analysis. Hence, quality control of chemicals and proper decontamination of reusable glassware and proofing the analytical instrument to be free from contamination shall be observed.

2.3.2. Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interference. Determine source of interference in the preparation and/or cleanup of the samples and Perform corrective action to eliminate the problem.

2.3.3. Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, rinse the sample syringe with solvent between sample injections. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross-contamination.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point. All samples analyzed above this concentration are considered "over-range" and shall require dilution for proper quantitation.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required for proper quantitation.

4.3. The dynamic range established for this method are:

Water (µg/L)	Soil (µg/kg)
10 - 160 µg/L	330 - 5300 µg/kg

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Sample Preservation**

5.1.1. Store water and soil samples at ≤6°C away from light.

5.1.2. Store all extracts at ≤6°C.

5.2. **Holding Time**

5.2.1. Extract water samples within 7 days from sampling date.

5.2.2. Extract soil samples within 14 days from sampling date.

5.2.3. Analyze all extracts within 40 days from extraction completion date.

6.0 ASSOCIATED SOPs

6.1. EMAX-1311 TCLP for Organic and Inorganic Analysis

6.2. EMAX-3510 Extraction of Organic Compounds by Separatory Funnel

6.3. EMAX-3520 Extraction of Organic Compounds by Continuous Liquid/Liquid Extraction

6.4. EMAX-3540 Soxhlet Extraction

6.5. EMAX-3550 Extraction of Organic Compounds from Solid Samples by Pulse Sonication

6.6. EMAX-3580 Waste Dilution

6.7. EMAX-3640 Clean Up, GPC

6.8. EMAX-DM01 Data Flow and Review

6.9. EMAX-QA04 Detection Limit Study

6.10. EMAX-QA08 Corrective Action

6.11. EMAX-QC01 Quality Control for Chemicals

6.12. EMAX-QC02 Analytical Standard Preparation

6.13. EMAX-QC07 Glassware Cleaning

6.14. EMAX-SM03 Waste Management

6.15. EMAX-SM04 Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all MSDS for all chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure. Perform all sample and standard handling in the fume hood.

7.3. Place all wastes generated during analytical process in the designated satellite waste containers. Endorse these wastes to the waste disposal section for proper disposal.

7.4. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatography	Agilent Technologies 7890A with split/splitless injection, Shimadzu GC-17A, or equivalent
Mass Spectrometer	Agilent Technologies 5975C MSD or Shimadzu GCMS – GP 5000 capable of scanning from 1.6 to 1050 amu every 1 second using 70 volts electrode energy in the electron impact ionization mode or equivalent
GC/MS Interface	Capillary-direct into the mass spectrometer source or equivalent
Chromatographic Column	ZB-5MS (20m x 0.18mm x 0.32 μm) or equivalent
Data System	MS-ChemStation with Enviroquant software or equivalent
GC Autosampler	Agilent Technologies 7683B series injector or Shimadzu AOC-20i capable of direct injection of 1 μl and 10 μl of extract.
Gases	Ultra high purity helium
Syringes	10 μl, 25 μl, 50 μl , 100 μl, 250 μl, 500 μl and 1000 μl syringe Hamilton 202N or equivalent
Vials	Autosampler vials with teflon lined septa

8.2. **Chemicals and Reagents**

Solvents	Methylene chloride pesticides grade, high purity methanol
Reagents	Na_2SO_4 reagent grade

9.0 STANDARDS

9.1. Standard Preparation

9.1.1. Follow procedures for all standard preparations and labeling as described in EMAX-QC02 and EMAX-SM04, respectively.

9.1.2. Other concentration levels may be prepared to meet the data quality objective of a project.

9.2. Stock Standard

9.2.1. Purchase stock standards as certified solutions from Accustandard or other reputable vendor (refer to Table 1 for the listing of all certified solutions). The standard is expected to be at 96% purity. Read vendor's note if correction has been applied to certified values otherwise corrections must be applied.

9.2.2. Transfer the stock standard solutions into 2-ml amber vial with Teflon lined screw caps and store at -10°C to -20°C.

9.3. Intermediate Standard

9.3.1. Prepare a 10-ml 200 µg/mL intermediate standard (refer to Table 1 for details). Transfer the solution in a properly labeled 10-ml amber vial and store at -10°C to -20°C.

9.4. Internal Standard

9.4.1. The internal standard shall include 1,4-Dichlorobenzene-d_4, Naphthalene-d_8, Acenaphthalene-d_{10}, Phenanthrene-d_{10}, Chrysene-d_{12} and Perylene-d_{12} in methylene chloride solution.

9.4.2. Purchase internal standard solutions as certified solution from AccuStandard or other reputable vendor at 4,000 µg/ml.

9.4.3. Prepare a 10-ml of 2,000 µg/ml of working internal standard from 9.4.2. Transfer the solution in a properly labeled 10-ml amber vial and store in -10°C to -20°C.

9.5. GC/MS Tuning

9.5.1. The tuning standard shall include decafluorotriphenylphosphine (DFTPP), 4,4-DDT, Pentachlorophenol, and Benzidine.

9.5.2. Purchase tuning standard solution as certified standard at 1000 µg/ml.

9.5.3. Prepare a 10-ml of 50,000 µg/L of working standard tuning solution. Transfer the solution in a properly labeled 10-ml amber vial and store in -10°C to -20°C.

9.6. Surrogate Standard

9.6.1. Purchase surrogate stock standards as certified standard.

9.6.1.1. The acid surrogate mixture includes Phenol-d_5, 2-Fluorophenol, and 2,4,6-Tribromophenol at 150 µg/ml.

9.6.1.2. The basic neutral surrogate mixture includes Nitrobenzene-d_5, 2-Fluorobiphenyl, Terphenyl-d_{14}, and 1,2-Dichlorobenzene-d_4 at 50 µg/ml.

9.6.2. For typical extraction [soil: 30g-2ml or water: 1000ml-2ml], add 0.4 ml of surrogate spiking standard to the sample prior to extraction. Spike volume may be adjusted to normalize with

the final extract and yield the same concentration.

9.7. **Calibration Standard**

9.7.1. Prepare working standard solutions for initial calibration and daily calibration (refer to Table 2 for details). Transfer the solutions in 1-ml amber vial and store them at ≤6°C.

9.8. **ICAL Verification Standard (Second Source Verification) (ICV)**

9.8.1. Purchase a certified ICV standard from a different vendor. The ICV standard contains the same list of compounds as the stock standard (refer to Table 1-B for the standard mix and the corresponding vendors).

9.8.2. Prepare a 10-ml of 200-mg/L check standard solution. Transfer the solution in a properly labeled 10-ml amber vial and store at ≤6°C.

9.9. **LCS/MS Spiking Standards**

9.9.1. Purchase spiking standards as certified solutions. The spiking solution may be from the same source as the initial calibration standard[1].

9.9.2. Spike MS/MSD/LCS/LCD samples with 0.4 ml of full spiking solution prior to sample extraction.

9.9.3. Spike volume may be adjusted to normalize with the final extract volume and yield the same concentration.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. For aqueous samples (including TCLP leachates), refer to EMAX-3510 or EMAX-3520 or EMAX-1311. Check the extraction log for presence of residual chlorine.

10.1.2. For solid samples, refer to EMAX-3550 or EMAX-3540.

10.1.3. For waste samples, refer to EMAX-3580.

10.1.4. After extraction, examine the color and consistency of the extract. If the extract appears to be opaque and/or viscous, it is advisable to perform extract cleanup preferably GPC. Refer to EMAX-3640.

10.2. **Instrument Parameters**

10.2.1. Set the instrument parameters as suggested in Table 3. Fine tune the instrument to obtain optimum instrument condition.

10.2.2. Print and display current condition on the instrument for easy access when performing daily instrument routine check.

10.2.3. In the event that instruments parameters necessitate a changed, replace the instrument parameter printout with the new parameter setup and archive the previous instrument parameters in the instrument maintenance log.

[1] SW846 Method 8270D, Section 7.9

10.2.4. Set injection volume to 1 µl to 2 µl.

10.3. **Calibration**

10.3.1. Set GC/MS operating condition as described in Section 10.2.

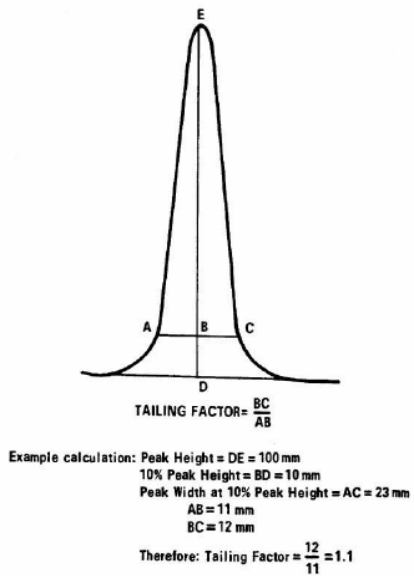
10.3.2. Perform Tune Check

10.3.2.1. Analyze a solution containing 50-µg/ml of tuning standard working solution, DDT , benzidine and pentachlorophenol.

10.3.2.2. Evaluate the tune check by averaging of three scans (the peak apex scan and the scan immediately preceding and the scan immediately following the apex). Apply a background subtraction using a single scan no more than 20 scans prior to the elution of DFTPP. Do not subtract part of the DFTPP peak or any other discrete peak that does not coelute with DFTPP. Use the DFTPP mass intensity criteria in the manufacturer's instructions as primary tuning acceptance criteria otherwise refer to Table 4 for acceptance criteria.

10.3.2.3. Evaluate column performance and injection port inertness using the data acquisition software.

- Degradation of DDT to DDE and DDD must be less than 20% based on area obtained from the total ion chromatogram.
- Benzidine and Pentachlorophenol must be present at their normal responses. Evaluate the tailing factor of benzidine and pentachlorophenol. Tailing factor should not be >2. Refer to Figure-2 for peak evaluation.



10.3.2.4. If tune check is non-compliant, refer to Section 12 for corrective action.

10.3.3. Initial Calibration (ICAL)

10.3.3.1. Perform ICAL when one of the conditions occurs.

- Instrument is new
- Instrument undergoes a major repair
- DCC failed to meet the acceptance criteria

10.3.3.2. Optimize the instrument condition prior to ICAL.

- Ensure that instrument parameters are set up properly
- Ensure that there is no evidence of leak
- Ensure that instrument maintenance as scheduled is performed

- Ensure that instrument tune check and column performance is not indicative that it is at the threshold of failing the acceptance criteria.

10.3.3.3. Analyze a 5 to 9-point initial calibration curve as suggested in Figure 4 after a valid tune check.

10.3.3.4. Generate a summary of Relative Response Factors for each analyte at each concentration. Calculate the Average Relative Response Factor (RRFm), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to Eq-10.6.1.1, Eq-10.6.1.2, Eq-10.6.1.5 and Eq-10.6.1.6, respectively.

10.3.3.5. Evaluate the ICAL Acceptance

10.3.3.5.1. Check for completeness of target compound list. If there is/are missing compound(s), perform the following:

- Check the established retention time window
- Check the relative intensity of major ions
- Adjust accordingly if necessary.

10.3.3.5.2. Evaluate retention time of each analyte with respect to the nearest internal standard. The relative retention time (RRT) of each analyte should agree within $\pm$0.06 RRT units.

10.3.3.5.3. Check the response factors for each analyte as suggested in Table 6. Meeting the minimum response factor is indicative that the analytes are behaving as expected.

10.3.3.5.4. Check RSD and correlation coefficient. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit and do not meet the minimum correlation coefficient (0.99) for alternate curve fits, then the chromatographic system is considered too reactive for analysis to begin. Perform necessary instrument maintenance and repeat calibration. Refer to 10.3.3.2., Section 12 for corrective action.

10.3.3.6. Application of ICAL Curve for Quantitation

10.3.3.6.1. If RSD is $\leq$20% average response factor may be applied.

10.3.3.6.2. Apply Inverse Weighting Factor (1/y or $1/y^2$; y being the instrument response) if it is determined to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of $\leq$20% and correlation coefficient of $\geq$0.99.

10.3.3.6.3. Apply linear least squares regression if past experience or priori knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of $\leq$20% and correlation coefficient of $\geq$0.99.

10.3.3.6.4. It may be appropriate to force the regression through zero for specific analytes.[2] When exercising this option [as included in the data acquisition

[2] SW846 Method 8000B, Section 7.5.3

software], make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.3.6.5. Requant the calibration point near or at LOQ and calculate for percent recovery. Percent recovery within ±30%[3] of their expected values is indicative that calibration accuracy at the lower calibration range is good.

10.3.3.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.4. Initial Calibration Verification (ICV)

10.3.4.1. Verify the concentration of the ICAL by analyzing the ICV from a second source (See Table 2 for standard preparation). Result should be within ±30% of expected value unless otherwise specified by the project.

10.3.4.2. Evaluate the ICV for minimum response factor, internal standard retention time and internal standard response as described in 10.3.5.2.

10.3.5. Daily Continuing Calibration (DCC)

10.3.5.1. Analyze DCC (See Table 2 for standard preparation) to check the validity of the ICAL every 12 hour shift unless otherwise specified by the project.

10.3.5.2. DCC Evaluation

- Check that RF is ≥ minimum response factor listed in Table 6.
- Check that all analytes are ≤20 %D (% Difference for ARF and %Drift for other quantitation technique) unless otherwise specified by the project.
- Check Internal Standard Retention time. Expected retention time is within 30 sec from that of the midpoint of the ICAL.
- Check Internal Standard Response. Expected response of extracted ion current profile (EICP) is no greater that a factor of two (-50% to +100%).
- If any of the above criteria is non-compliant, refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. **Extract Preparation**

10.4.1.1. Allow extracts to equilibrate with room temperature.

10.4.1.2. Measure 300 µL of extract, transfer into an autosampler vial.

10.4.1.3. Add 6 µL of 2000-ng/µL of internal standard (refer to 9.4.3).

10.4.1.4. Seal the vial with Teflon-lined septa cap.

10.4.2. **Analytical Sequence**

10.4.2.1. Analyze instrument blank.

[3] SW846 Method 8270D, Section 11.4.5.6

10.4.2.2. Analyze DFTPP and evaluate tuning.

10.4.2.3. Analyze DCC and check ICAL validity.

10.4.2.4. Analyze Method Blank.

10.4.2.5. Analyze Lab Control Sample and Lab Control Sample Duplicate (optional).

10.4.2.6. Analyze matrix spikes (MS/MSD) as per project requirement.

10.4.2.7. Analyze samples to a maximum number of 12-hour from the time of DFTPP injection.

10.4.3. **Sample Result Evaluation**

10.4.3.1. Check QC criteria

- Check surrogate recoveries against PSR. In the absence of PSR, default to EMAX QC limits.
- Check concentration of target analytes. Dilute and re-analyze samples having result(s) exceeding calibration range unless otherwise specified by the project. Maintain IS concentration on diluted samples.
- Check Internal Standard Response. Expected response of EICP is no greater that a factor of two (-50% to +100%).
- Check Internal Standard Retention Time. Expected retention time is within 30 seconds of the ICAL midpoint.
- If any of the above checkpoints indicate a problem, re-analysis is required.

10.4.3.2. Qualitative Identification

- The intensities of the characteristic ions must maximize in the same scan or within one scan of each other.
- The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
- The relative intensity of the characteristic ions agrees within 30% of the relative intensity of these ions in the reference spectrum.
- Check the chromatogram for possible misidentified analytes. Manually integrate the peak if necessary in accordance to EMAX-DM01, Section 4.4.3.
- Investigate visible peaks in the chromatogram that were not identified in the data output. For samples containing components not associated with the calibration standards, perform a library search for purposes of tentative identification[4] (TIC).
- Visually inspect each extracted mass ion chromatograph to determine the identification of the unknown before final reporting.

10.4.3.3. Quantitation

[4] Library search is performed only when indicated in the PSR.

- Apply the appropriate quantitation method (Section 10.6.3) to calculate the concentration of any positively identified target analyte. Apply the sample preparation and dilution factor to calculate for the final concentration of the sample.

10.4.3.4. Manual Integration

10.4.3.4.1. Refer to EMAX-DM01 for details of manual integration.

10.4.3.5. Dealing with Carryover

- Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.
- If there was no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction. Otherwise, clean up the system and re-analyze the sample suspected to contain carryover.

10.5. **Data Reduction**

10.5.1. Make a copy of the analytical run log and highlight the data to be reported.

10.5.2. Collate the reportable raw data separating the QC results from the sample results.

10.5.3. Keep all other data generated with the analytical folder marked with “For Record Only”.

10.5.4. Proceed to report generation.

10.6. **Calculations**

10.6.1. Initial Calibration

10.6.1.1. Calculate for Relative Response Factor (RRF)

$$RRF = \frac{(AX)(CIS)}{(AIS)(CX)} \qquad \textit{Eq.-10.6.1.1}$$

where:

AX – Area of characteristic ion for the compound being measured

AIS – Area of characteristic ion for the specific internal standard

CX – Concentration of the compound being measured

CIS – Concentration of the specific internal standard

10.6.1.2. Calculate for Average Relative Response Factor (RRFm).

$$RRFm = \frac{\sum RRF}{n} \qquad \textit{Eq-10.6.1.2}$$

where:

RRFm – average response factor

$\sum RRF$ – summation of response factors

n – number of measurements

10.6.1.3. Calculate for Least Square Linear Regression

$$y = ax + b \qquad \textit{Eq.-10.6.1.3}$$

where:

y = Response Ratio *(AX/AIS)*

x = Amount Ratio (CX/CIS)

a = x1 = slope of the line

$$a = \frac{\sum (x - \bar{x})(y - \bar{y})}{(x - \bar{x})^2}$$

where:

$\bar{x}$ = Average of amount ratios

$\bar{y}$ = Average of response ratios

b = x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.6.1.4. Calculate for Inverse Weighting Factor

$$y = ax + b \qquad \textit{Eq.-10.6.1.4}$$

where:

y = Response Ratio *(AX/AIS)*

x = Amount Ratio *(CX/CIS)*

a = x1 = slope of the line

$$a = \frac{\sum [(x - x_a)(y - y_a)]}{\sum (x - x_a)^2}$$

where:

$x_a = \Sigma\ [x(1/x)/\ \Sigma(1/x)]$

$y_a = \Sigma\ [y(1/x)/\ \Sigma(1/x)]$ or

$x_a = \Sigma\ [x(1/x^2)/\ \Sigma(1/x^2)]$

$y_a = \Sigma\ [y(1/x^2)/\ \Sigma(1/x^2)]$

b = x0 = intercept of the line

$$b = y_a - a * x_a$$

10.6.1.5. Calculate for Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n - 1}} \qquad \textit{Eq.-10.6.1.5}$$

where:

SD – standard deviation

x_i – result at i^{th} measurement

$\bar{x}$ – mean

n – number of measurements

10.6.1.6. Calculate for % relative standard deviation (%RSD).

$$\%RSD = \frac{SD}{RRF_m} * 100\% \qquad \textit{Eq-10.6.1.6}$$

where:

SD – standard deviation

RRFm – average response factor

10.6.2. Calibration Check/Continuing Calibration

10.6.2.1. Calculate Percent Difference (%D) when RRFm is used for quantitation

$$\%D = \frac{[RRF_c - RRF_m]}{RRF_m} * 100\% \qquad \textit{Eq-10.6.2.1}$$

where:

RRFc – response factor from continuing calibration standard

RRFm – average response factor

10.6.2.2. Calculate Percent Deviation ($\%D_t$) when applied calculation is other than ARF

$$\%D_t = \frac{|T_t - T_f|}{T_t} * 100\% \qquad \textit{Eq-10.6.2.2}$$

where:

T_t – true value of standard in µg/L

T_f – found value of standard in µg/L

10.6.3. Calculation of Sample Concentration (Water and Soil/Sediment Samples). When a compound is identified, the quantitation of that compound shall be based on the integrated abundance from the EICP of the primary characteristic ion.

10.6.3.1. Water Samples

$$Concentration\ (ug/L) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(V_t)} \qquad \textit{Eq-10.6.3.1}$$

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard added

V_e – extract final volume from sample extraction, usually 1-ml

DF – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

A_{is} – area of characteristic ion for the internal standard

RRF_m – average response factor

V_i – volume of extract injected in µl, usually 1-µL

V_t – volume of water extracted in ml, usually 1000-ml

10.6.3.2. Soil/Sediment Samples (Dry weight basis)

$$Concentration(\mu g/Kg) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(W_s)(DW)} \quad Eq\text{-}10.6.3.2$$

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard injected in ng

V_e – volume of extract in ml, usually 1-ml[5]

DF – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

A_{is} – area of characteristic ion for the internal standard

RRF_m – average response factor

V_i – volume of extract injected in µl, usually 1-µL

W_s – wet soil weight in kg

DW – % solid = $\frac{100 - \%moisture}{100}$

10.6.3.3. Calculation for results subjected to cleanup by GPC

$$Concentration(\mu g/Kg) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(W_s)(DW)} * \frac{V_{bg}}{V_{ig}} \quad Eq\text{-}10.6.3.3$$

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard injected in ng

V_e – volume of extract in ml

DF – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

A_{is} – area of characteristic ion for the internal standard

RF_m – average response factor

[5] For extracts subjected to GPC V_i=0.5-ml

V_i – volume of extract injected in µl, usually 1-µL

W_s – wet soil weight in kg

DW – % solid = $\frac{100 - \%moisture}{100}$

V_{bg} – total volume of extract before GPC clean-up in mL

V_{ig} – injected volume of extract to GPC in mL

10.6.4. Base all sample result calculations on the ICAL curve, e.g., area ratio of Ax/Ais versus concentration using inverse weighting factor fitted to the initial calibration is also used for determination of sample concentration.

10.6.5. Concentration of TIC is estimated by the same method as target compounds with the following assumptions:

10.6.5.1. The area "Ax" and "Ais" are derived from total ion chromatogram. "Ais" refers to the closest internal standard (IS) free of interference.

10.6.5.2. RRF of the TIC is 1.

10.6.6. Accuracy and Precision

10.6.6.1. Percent Recovery

$$\%\ Recovery = \frac{Cf - C}{Cs} * 100 \qquad Eq\text{-}10.6.6.1$$

where:

Cf – concentration found

C – concentration of sample

Cs – concentration of spike

10.6.6.2. Relative Percent Difference (%RPD)

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad Eq\text{-}10.6.6.2$$

where:

RPD – Relative Percent Difference

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.6.7. DDT Degradation

$$\%B = \frac{A_{DDD} + A_{DDE}}{A_{DDT} + A_{DDD} + A_{DDE}}(100) \qquad \textit{Eq-10.6.7}$$

where:

%B	- percent breakdown
ADDD	- area of DDD
ADDE	- area of DDE
ADDT	- area of DDT

10.7. **Report Generation And Data Reduction & Review**

10.7.1. Generate the method.txt file using WDB1C.exe

10.7.2. Generate Lab Chronicle using Labchron1.exe

10.7.3. Generate the sample results using F1V3C.exe

10.7.4. Generate the QC summary using QCV3C.exe

10.7.5. Generate the Case Narrative using CN1.exe

10.7.6. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration and re-analyses.

- Case Narrative
- Lab Chronicle
- Sample Results
- LCS Summary
- MS/MSD Summary
- DCC Summary
- ICV Summary
- ICAL Summary

10.7.7. Perform a 100% data review in accordance to EMAX-DM01 and the PSR. Review the case narrative and edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.7.8. Submit the analysis package for secondary review.

10.8. **Preventive Maintenance**

10.8.1. Refer to form 8270FM for daily routine maintenance check points.

10.8.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back to control.

10.8.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating

under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

Maintenance Activity	Description	Frequency
Autosampler	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis
Vacuum System Verification	Verify pressure. Perform system tune check	Daily prior to analysis
Verification	Check instrument parameters to ensure normal operating conditions. Check instrument performance (e.g., Daily calibration check, instrument blank, DDT/Endrin breakdown).	Daily prior to analysis
Source Cleaning	Remove and clean the Mass Spec ion source	Every 6 months or as necessary
Vacuum System Maintenance	Inspect vacuum pumps, and replace mechanical/diffusion pump oil	Every 6 months
Documentation	Record maintenance in instrument service logs	Daily prior to analysis to include services done by third party.

11.0 QUALITY CONTROL

11.1. Preparative Batch

11.1.1. A preparative batch shall consist of a method blank, LCS, MS/MSD (when required by the project) and a maximum of 20 field samples of similar matrix.

11.1.2. In the absence of MS/MSD, prepare LCS/LCD to check for precision.

11.2. Analytical Batch QC

11.2.1. The GC/MS tuning standard must be analyzed at the beginning of every 12-hour shift. GC/MS tuning criteria is listed in Table 4 and Section 10.3.2.

11.2.2. A continuing calibration shall be performed before any other analysis is done, and after analysis of tuning standard. The continuing calibration procedure and the acceptance criteria are discussed in Section 10.3.5.

11.3. Method QC

11.3.1. Analyst demonstration of proficiency is a must prior to performing this analysis.

11.3.2. A valid MDL must exist prior to sample analysis.

11.3.3. A valid ICAL must exist prior to sample analysis.

11.3.4. Instrument performance must be checked prior to sample analysis.

11.3.5. Check Appendix 1 for acceptance criteria.

11.3.6. Prepare and analyze QC samples, to include, method blank, LCS (LCD), and MS/MSD. QC

Control Limits shall follow the Project Specific Requirement (PSR) in each analytical folder.

11.3.7. Surrogate standard shall be added to all samples, including method blank LCS/LCD and MS/MSD. Check PSR for QC Control Limits.

12.0 CORRECTIVE ACTIONS

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures in Appendix 1. Document out-of-control event and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. If the tune is non-compliant, consider the following suggestions to correct the problem:

- Check the instrument settings and make sure that the instrument parameters are properly set up.
- Check gas flow.
- Perform autotune or visual optimization.
- If the problem persists, inform the supervisor.

12.3. If instrument performance is non-compliant, consider the following suggestions to correct the problem:

- Excessive degradation of DDT and/or poor chromatography demonstrated by too much tailing are indications of dirty injection port. Clean or replace the injection port. If problem persist, cut off the first 6-12 inches of the capillary column.

12.4. If initial calibration is non-compliant, consider the following suggestions to correct the problem:

12.4.1. If %RSD is out of acceptance criteria, review result and identify presence of an outlier.

12.4.2. If one of the standard returns a bias-low or bias-high on all of the analytes, then that point is considered an outlier, prepare a standard at that ICAL point and reanalyze.

12.4.3. If the highest ICAL point appears to be saturated, drop the highest point.

12.4.4. If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

Note: The lowest calibration point identifies the reporting limit (RL). Therefore, check that the RL is in conformance to the current projects where the ICAL will be used.

12.4.5. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

12.4.5.1. Check the connections and make sure they are air-tight and perform maintenance as needed.

12.4.5.2. Check the gas flow

12.4.5.3. Retune the MS

12.4.5.4. Prepare a fresh standard and repeat calibration

12.4.5.5. Clean the MS source and repeat the calibration

12.4.6. If the problem persists, inform the supervisor.

12.5. If the ICV is non-compliant, consider the following suggestions to correct the problem:

12.5.1. Reanalyze ICV (to rule out poor injection)

12.5.2. If ICV is still out of acceptance criteria, prepare a fresh standard and reanalyze to rule out any preparation error

12.5.3. If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration

12.5.4. If the problem persists, inform the supervisor

12.6. If the instrument blank is non-compliant, consider the following suggestions to correct problem:

12.6.1. Rule out instrument contamination by performing the instrument daily maintenance , such as changing septum, cleaning liner, cleaning or using new autosampler syringe.

12.6.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.6.3. Rule out preparation contamination by preparing a new instrument blank

12.6.4. If the problem persists, inform the supervisor.

12.7. If Continuing Calibration is non-compliant, consider the following suggestions to correct the problem:

12.7.1. Change the liner

12.7.2. Clean injection port

12.7.3. Prepare new standard

12.7.4. Cut or replace column

12.7.5. Rule out leaks by checking all connections

12.7.6. If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL

12.8. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

12.8.1. Rule out instrument contamination by checking instrument blank

12.8.2. Rule out reagent contamination by testing each reagent used for extraction as described in EMAX-QC01

12.8.3. Rule out glassware contamination used for extraction as described in EMAX-QC07

12.8.4. Re-extract MB and the associated samples with reagents free of contamination or with newly opened reagents

12.8.5. If the problem persists, inform the supervisor

12.9. If LCS is non-compliant, perform the following suggestions to correct the problem:

12.9.1. If result is bias-high or bias-low, check the LCS Standard by analyzing at the spike level

12.9.2. If LCS check is within 80-120% of expected value, check calibration of the micropipette or syringe used for spiking. Re-extract and reanalyze the LCS and the associated samples.

12.9.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS Standard, re-extract and re-analyze LCS and the associated samples.

12.10. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.10.1. If corrective action needs the function of other department; eg, if the sample needs to be re-extracted, refer to EMAX-QA08 for details of completing an NCR.

12.10.2. If corrective action needs the assistance of the project manager; eg. If the sample is non-compliant to the technical holding time requirement, insufficient amount of sample, or other non-conforming issues.

12.11. For other problems encountered, inform the supervisor immediately for further instructions.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other wastes generated during the analytical process, endorsed to WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents. **Preparation batch** is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate. **Analytical batch** is compose of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Duplicate Sample – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.4. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.5. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.6. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to

the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.7. Lab Control Sample Duplicate (LSD) – is a replicate of LCS analyzed to monitor precision when MS/MSD samples are not analyzed.

15.1.8. Matrix – is a component or form of a sample.

15.1.9. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.10. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.11. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.12. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.13. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing semivolatile analysis by GC/MS unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluation of Solid Wastes", EPA SW846, Methods 8000B and 8270D.

16.2. EMAX Quality Systems Manual (EMAX-QS00), as updated.

17.0 FIGURES, TABLES AND APPENDICES

17.1. **Figures**

17.1.1. Figure 1 Peak Evaluation Technique

17.1.2. Figure 2 Typical Chromatogram

17.1.3. Figure 3 Typical ICAL Summary

17.1.4. Figure 4 Typical DFTPP Tune Summary

17.1.5. Figure 5 Typical Continuing Summary

17.1.6. Figure 6 Typical Sample Result Summary

17.1.7. Figure 7 Typical LCS Report Summary

17.1.8. Figure 8 Typical MS/MSD Report Summary

17.1.9. Figure 9 Typical Case Narrative

17.2. **Tables**

17.2.1. Table 1 Intermediate Standard Preparation

17.2.2. Table 2 Working Standard Preparation

17.2.3. Table 3 Instrument Parameters

17.2.4. Table 4 DFTPP Key Ions and Ion Abundance Criteria

17.2.5. Table 5 Analyte Lists, Quantitation Ions, Internal Standards & Surrogates

17.2.6. Table 6 Minimum Response Factor

17.2.7. Table 7 Established LOD & LOQ

17.3. **Appendices**

17.3.1. Appendix 1 Summary of In-House Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.4. **Forms**

17.4.1. 8270FA Analytical Run Log

17.4.2. 8270FS Sample Preparation Log

17.4.3. 8270FM Instrument Maintenance Log

Figure 1: **PEAK EVALUATION TECHNIQUE**

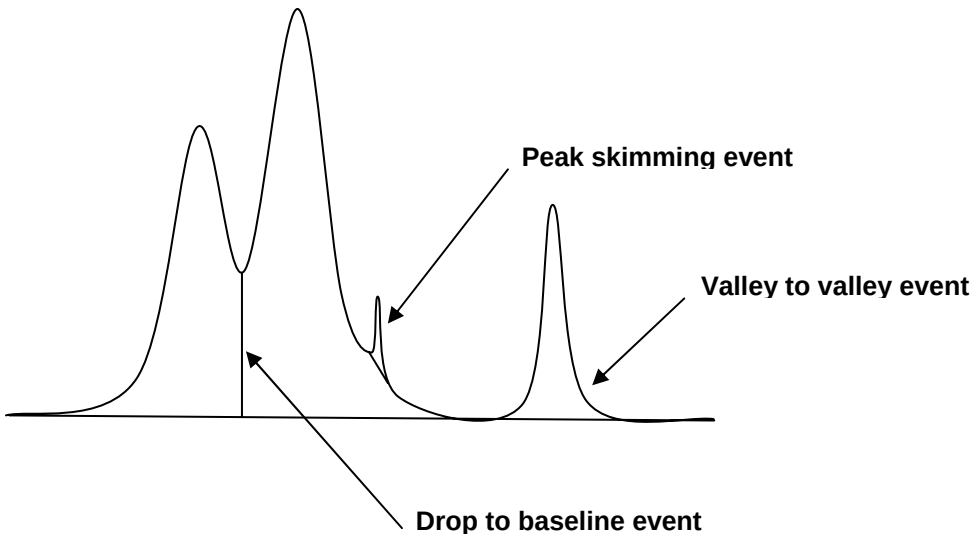
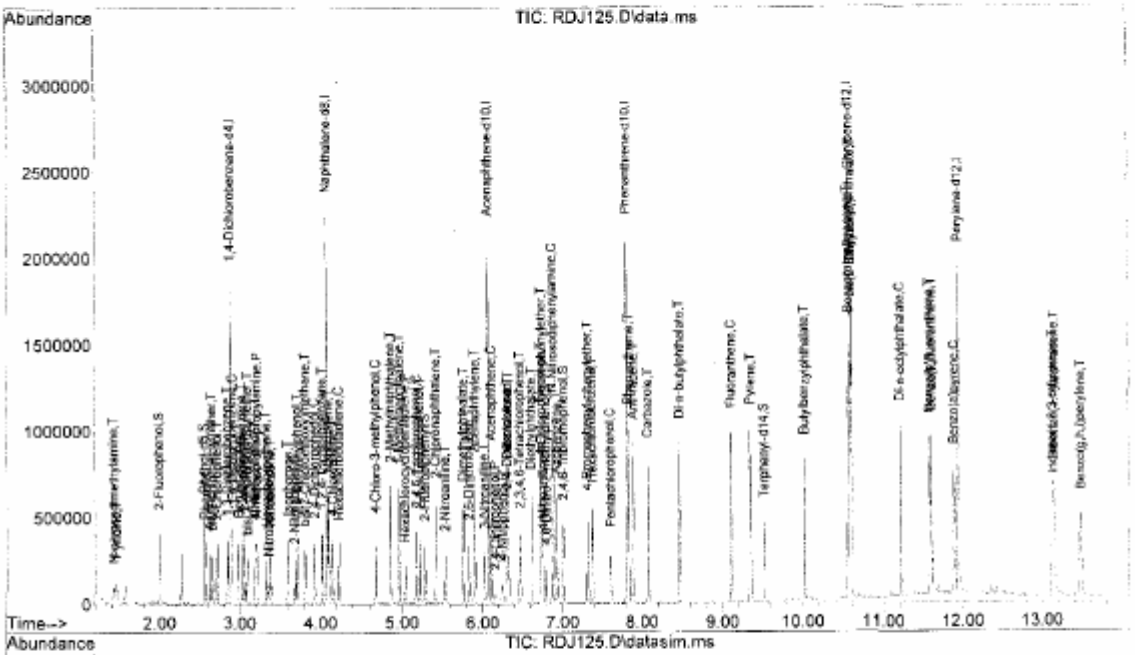


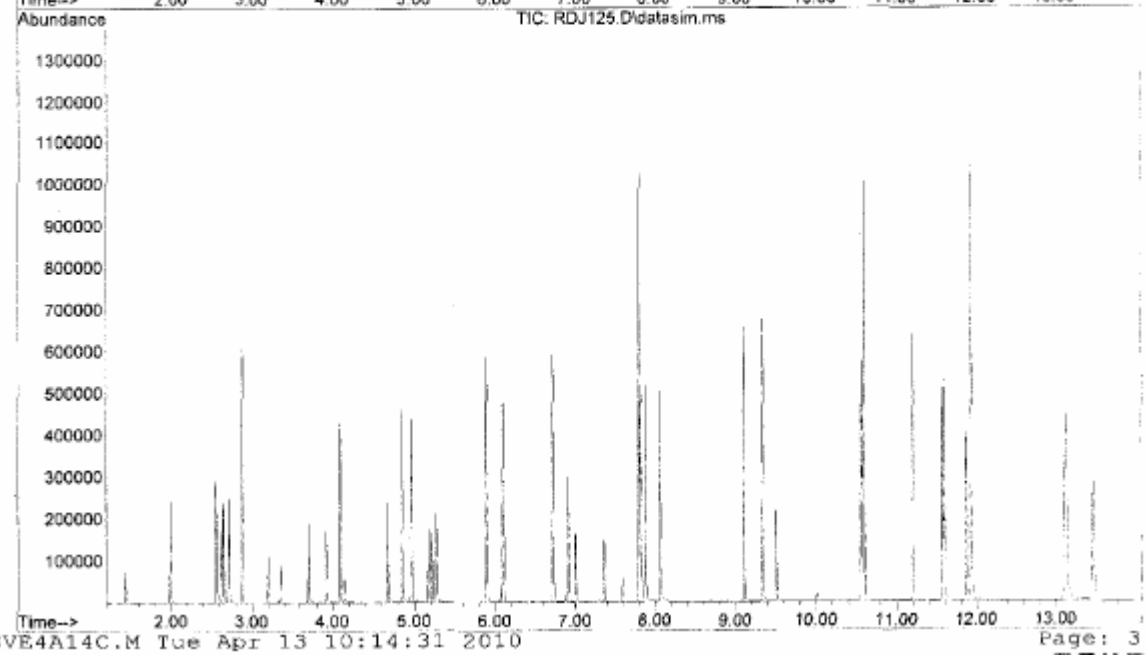
Figure 2: **TYPICAL CHROMATOGRAM**

Quantitation Report (QT Reviewed)

Data File : D:\DATA\10D12\RDJ125.D
Acq On : 12 Apr 2010 15:38
Sample : 10D048-01S
Misc :
Integrator: RTE
Quant Time: Apr 13 10:14:26 2010
Quant Results File: SVE4A14C.RES
Quant Method : C:\msdchem\1\METHODS\SVE4A14C.M
Quant Title : SEMIVOLATILES 8270D
QLast Update : Fri Jan 15 10:17:54 2010
Response via : Initial Calibration
DataAcq Meth:SVE4A08S.M

Vial: 10
Operator: KV
Inst : E4
Multiplr: 1.00





SVE4A14C.M Tue Apr 13 10:14:31 2010 Page: 3

Figure 3: TYPICAL ICAL SUMMARY

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E4
Beginning DateTime :01/14/10 15:00
Spike Units :PPM
IC File :RAJ049

Column Spec :ZB-5MS ID :0.18MM
Ending DateTime :01/14/10 17:43
HPChem Method :SVE4A14C

IDX	Parameters	5 / 15:00 RAJ045	10 / 15:18 RAJ046	20 / 15:36 RAJ047	30 / 15:54 RAJ048	50 / 16:13 RAJ049	60 / 16:31 RAJ050	80 / 16:49 RAJ051	100 / 17:07 RAJ052	120 / 17:25 RAJ053	160 / 17:43 RAJ054	Av_RRF	%_RSD	Av_Rt_M
1	1,4-Dichlorobenzene-d4	1	1	1	1	1	1	1	1	1	1	1	0	2.8745
2	N-nitrosodimethylamine	0.473	0.500	0.513	0.496	0.500	0.508	0.523	0.506	------	------	0.503	2.92	1.3867
3	Pyridine	0.835	0.903	1.010	0.982	0.986	0.998	1.024	1.007	------	------	0.968	6.71	1.4174
4	2-Fluorophenol	1.002	1.034	1.051	1.054	1.055	1.061	1.085	1.066	1.006	1.029	1.044	2.53	1.9654
5	Phenol-d5	1.122	1.164	1.188	1.172	1.188	1.205	1.230	1.200	1.147	1.175	1.179	2.61	2.5351
6	Phenol	1.158	1.198	1.208	1.200	1.204	1.216	1.227	1.204	------	------	1.202	1.66	2.5459
7	Aniline	1.421	1.481	1.505	1.510	1.492	1.519	1.555	1.510	------	------	1.499	2.56	2.6123
8	bis(2-chloroethyl)ether	0.937	0.951	0.948	0.934	0.929	0.947	0.957	0.924	------	------	0.941	1.22	2.6418
9	2-Chlorophenol	1.253	1.261	1.296	1.291	1.421	1.412	1.437	1.412	------	------	1.348	5.88	2.7030
10	1,3-Dichlorobenzene	1.426	1.498	1.457	1.452	1.442	1.454	1.476	1.428	------	------	1.454	1.65	2.8310
11	1,2-Dichlorobenzene-d4	0.933	0.970	0.943	0.931	0.924	0.924	0.932	0.904	0.886	0.886	0.923	2.78	3.0055
12	1,4-Dichlorobenzene	1.466	1.512	1.484	1.496	1.469	1.490	1.494	1.456	------	------	1.483	1.24	2.8884
13	Benzyl alcohol	0.628	0.667	0.685	0.686	0.698	0.709	0.717	0.700	------	------	0.686	4.10	2.9672
14	1,2-Dichlorobenzene	1.367	1.412	1.404	1.382	1.368	1.382	1.403	1.348	------	------	1.383	1.59	3.0185
15	2-Methylphenol	0.814	0.875	0.888	0.898	0.897	0.892	0.907	0.880	------	------	0.881	3.31	3.0418
16	bis(2-chloroisopropyl)ether	2.052	2.122	2.088	2.349	2.329	2.392	2.419	2.338	------	------	2.261	6.54	3.0824
17	4-Methylphenol	1.058	1.112	1.152	1.150	1.157	1.180	1.185	1.172	------	------	1.146	3.68	3.1792
18	N-Nitroso-di-n-propylamine	0.535	0.595	0.600	0.598	0.596	0.609	0.619	0.600	------	------	0.594	4.21	3.2031
19	Hexachloroethane	0.533	0.548	0.543	0.541	0.539	0.551	0.562	0.543	------	------	0.545	1.61	3.3203
20	Naphthalene-d8	1	1	1	1	1	1	1	1	1	1	1	0	4.0727
21	Nitrobenzene-d5	0.243	0.262	0.272	0.272	0.276	0.281	0.287	0.278	0.276	0.278	0.273	4.46	3.3542
22	Nitrobenzene	0.245	0.261	0.266	0.260	0.263	0.269	0.272	0.263	------	------	0.262	3.10	3.3721
23	Isophorone	0.440	0.471	0.484	0.476	0.479	0.493	0.496	0.477	------	------	0.477	3.58	3.5968
24	2-Nitrophenol	0.125	0.146	0.159	0.167	0.171	0.176	0.180	0.176	------	------	0.162	11.59	3.6769
25	2,4-Dimethylphenol	0.288	0.298	0.303	0.297	0.300	0.309	0.307	0.298	------	------	0.300	2.20	3.6964
26	Benzoic acid	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
27	bis(2-Chloroethoxy)methane	0.319	0.329	0.324	0.323	0.323	0.330	0.331	0.320	------	------	0.325	1.44	3.8049
28	2,4-Dichlorophenol	0.250	0.279	0.283	0.287	0.284	0.297	0.295	0.286	------	------	0.283	5.17	3.9096
29	1,2,4-Trichlorobenzene	0.339	0.344	0.339	0.335	0.327	0.335	0.335	0.321	------	------	0.334	2.18	4.0094
30	3,4-Dimethylphenol	0.337	0.365	0.366	0.364	0.364	0.369	0.371	0.357	------	------	0.361	2.97	4.0078
31	Naphthalene	1.026	1.029	1.005	0.992	0.977	1.000	0.994	0.959	------	------	0.998	2.33	4.0964
32	4-Chloroaniline	0.377	0.414	0.416	0.419	0.413	0.426	0.426	0.409	------	------	0.412	3.75	4.1434
33	Hexachlorobutadiene	0.196	0.201	0.196	0.192	0.192	0.197	0.199	0.189	------	------	0.195	1.94	4.2212
34	Hydroquinone	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
35	4-Chloro-3-methylphenol	0.206	0.243	0.246	0.243	0.246	0.254	0.260	0.246	------	------	0.243	6.56	4.6627
36	2-Methylnaphthalene	0.633	0.645	0.654	0.641	0.635	0.648	0.649	0.617	------	------	0.640	1.83	4.8538
37	1-Methylnaphthalene	0.640	0.649	0.641	0.635	0.631	0.636	0.638	0.606	------	------	0.634	1.97	4.9656
38	Acenaphthene-d10	1	1	1	1	1	1	1	1	1	1	1	0	6.0693
39	Hexachlorocyclopentadiene	0.404	0.443	0.453	0.468	0.492	0.510	0.510	0.517	------	------	0.475	8.38	5.0305
40	2,3,5-Trichlorophenol	0.346	0.408	0.417	0.469	0.490	0.499	0.502	0.497	------	------	0.454	12.57	5.0382
41	2,4,6-Trichlorophenol	0.385	0.434	0.441	0.445	0.455	0.467	0.472	0.458	------	------	0.445	6.14	5.1686
42	2,4,5-Trichlorophenol	0.401	0.459	0.462	0.468	0.481	0.490	0.488	0.484	------	------	0.467	6.23	5.2047
43	2,3,4-Trichlorophenol	0.338	0.396	0.376	0.383	0.391	0.390	0.394	0.380	------	------	0.381	4.90	5.2798
44	2-Fluorobiphenyl	1.573	1.588	1.578	1.561	1.544	1.562	1.521	1.496	1.501	1.549	1.547	2.07	5.2785
45	Biphenyl	1.707	1.732	1.690	1.675	1.701	1.711	1.685	1.660	------	------	1.695	1.34	5.3938
46	2-Chloronaphthalene	1.343	1.342	1.337	1.324	1.344	1.353	1.331	1.306	------	------	1.335	1.11	5.4136
47	2-Nitroaniline	0.208	0.269	0.275	0.286	0.302	0.314	0.327	0.317	------	------	0.287	13.30	5.5339
48	2,6-Dimethylnaphthalene	1.177	1.195	1.198	1.189	1.190	1.206	1.177	1.162	------	------	1.187	1.19	5.5768
49	1,4-Dinitrobenzene	0.111	0.138	0.160	0.169	0.184	0.195	0.208	0.199	------	------	0.171	19.51	5.7039
50	Dimethylphthalate	1.423	1.517	1.473	1.461	1.462	1.493	1.536	1.468	------	------	1.479	2.40	5.7654
51	1,3-Dinitrobenzene	0.136	0.194	0.194	0.204	0.216	0.222	0.236	0.223	------	------	0.203	15.18	5.7890
52	2,6-Dinitrotoluene	0.244	0.297	0.305	0.308	0.321	0.322	0.338	0.325	------	------	0.308	9.38	5.8289
53	1,2-Dinitrobenzene	0.107	0.131	0.132	0.134	0.139	0.143	0.147	0.139	------	------	0.134	9.01	5.8857
54	Acenaphthylene	2.094	2.184	2.173	2.172	2.167	2.213	2.183	2.118	------	------	2.163	1.78	5.9015
55	3-Nitroaniline	0.264	0.332	0.328	0.335	0.349	0.362	0.381	0.361	------	------	0.339	10.42	6.0218
56	Acenaphthene	1.379	1.408	1.398	1.375	1.381	1.388	1.393	1.344	------	------	1.383	1.38	6.1090
57	2,4-Dinitrophenol	------	0.098	0.120	0.140	0.170	0.184	0.207	0.199	------	------	0.160	25.81	6.1465
58	4-Nitrophenol	------	0.143	0.143	0.149	0.158	0.168	0.184	0.172	------	------	0.160	9.81	6.2191
59	2,4-Dinitrotoluene	0.290	0.378	0.375	0.389	0.408	0.416	0.436	0.409	------	------	0.388	11.48	6.3066
60	Dibenzofuran	1.849	1.943	1.874	1.863	1.857	1.885	1.884	1.815	------	------	1.871	1.95	6.3160
61	2,3,5,6-Tetrachlorophenol	0.236	0.284	0.288	0.295	0.305	0.315	0.327	0.314	------	------	0.295	9.55	6.4071
62	2,3,4,6-Tetrachlorophenol	0.321	0.384	0.367	0.367	0.442	0.390	0.472	0.472	------	------	0.402	13.59	6.4586
63	2,3,5-Trimethylnaphthalene	1.080	1.116	1.089	1.079	1.076	1.095	1.094	1.052	------	------	1.085	1.71	6.5713
64	Diethylphthalate	1.444	1.605	1.545	1.519	1.539	1.569	1.622	1.535	------	------	1.547	3.55	6.6153
65	Fluorene	1.467	1.539	1.480	1.463	1.469	1.476	1.506	1.423	------	------	1.478	2.28	6.7289
66	4-Chlorophenyl-phenylether	0.694	0.732	0.704	0.684	0.684	0.697	0.696	0.662	------	------	0.694	2.88	6.7402
67	4-Nitroaniline	0.238	0.319	0.312	0.328	0.341	0.357	0.388	0.356	------	------	0.330	13.49	6.7551

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E4
Beginning DateTime :01/14/10 15:00
Spike Units :PPM
IC File :RAJ049

Column Spec :ZB-5MS ID :0.18MM
Ending DateTime :01/14/10 17:43
HPChem Method :SVE4A14C

IDX	Parameters	5 15:00 RAJ045	10 15:18 RAJ046	20 15:36 RAJ047	30 15:54 RAJ048	50 16:13 RAJ049	60 16:31 RAJ050	80 16:49 RAJ051	100 17:07 RAJ052	120 17:25 RAJ053	160 17:43 RAJ054	Av_RRF	%_RSD	Av_Rt_M
68	Phenanthrene-d10	1	1	1	1	1	1	1	1	1	1	1	0	7.8077
69	4,6-Dinitro-2-methylphenol	------	0.090	0.107	0.114	0.142	0.136	0.155	0.154	------	------	0.128	19.54	6.7937
70	N-Nitrosodiphenylamine	0.810	0.824	0.801	0.798	0.787	0.777	0.760	0.756	------	------	0.789	3.00	6.8825
71	Azobenzene	0.594	0.602	0.626	0.619	0.616	0.632	0.631	0.623	------	------	0.618	2.20	6.9287
72	2,4,6-Tribromophenol	0.093	0.105	0.108	0.111	0.116	0.118	0.120	0.118	0.110	0.112	0.111	7.13	7.0115
73	4-Bromophenyl-phenylether	0.219	0.223	0.223	0.226	0.226	0.231	0.231	0.228	------	------	0.226	1.83	7.3132
74	Hexachlorobenzene	0.257	0.258	0.252	0.253	0.251	0.254	0.256	0.251	------	------	0.254	1.12	7.3660
75	Pentachlorophenol	0.094	0.128	0.139	0.146	0.152	0.157	0.165	0.162	------	------	0.143	16.37	7.5907
76	Phenanthrene	1.240	1.256	1.222	1.209	1.201	1.231	1.225	1.198	------	------	1.223	1.61	7.8349
77	Dinoseb	0.068	0.107	0.134	0.158	0.181	0.193	0.211	0.211	------	------	0.158	32.65	7.8141
78	Anthracene	1.181	1.237	1.223	1.216	1.217	1.248	1.238	1.213	------	------	1.222	1.70	7.8921
79	Carbazole	1.068	1.159	1.118	1.109	1.116	1.157	1.178	1.139	------	------	1.130	3.09	8.0743
80	Di-n-butylphthalate	1.105	1.290	1.346	1.359	1.403	1.429	1.467	1.423	------	------	1.353	8.46	8.4765
81	1-Methylphenanthrene	0.831	0.863	0.852	0.832	0.841	0.849	0.863	0.838	------	------	0.846	1.49	8.5061
82	Fluoranthene	1.173	1.242	1.224	1.230	1.322	1.258	1.309	1.246	------	------	1.251	3.79	9.1128
83	Chrysene-d12	1	1	1	1	1	1	1	1	1	1	1	0	10.5840
84	Benzidine	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
85	Pyrene	1.173	1.242	1.239	1.246	1.268	1.274	1.248	1.228	------	------	1.240	2.49	9.3489
86	Terphenyl-d14	0.642	0.678	0.698	0.699	0.707	0.707	0.696	0.685	0.678	0.701	0.689	2.85	9.5214
87	Butylbenzylphthalate	0.301	0.408	0.465	0.496	0.526	0.554	0.561	0.554	------	------	0.483	18.74	10.0306
88	bis(2-ethylhexyl)adipate	0.258	0.361	0.420	0.441	0.467	0.483	0.492	0.484	------	------	0.426	18.88	10.1126
89	3,3'-Dichlorobenzidine	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
90	Benzo(a)anthracene	0.963	1.045	1.067	1.064	1.086	1.111	1.127	1.093	------	------	1.069	4.72	10.5738
91	Chrysene	1.054	1.116	1.078	1.067	1.055	1.072	1.061	1.025	------	------	1.066	2.43	10.6108
92	bis(2-Ethylhexyl)phthalate	0.512	0.654	0.722	0.748	0.765	0.793	0.793	0.776	------	------	0.720	13.28	10.6096
93	Perylene-d12	1	1	1	1	1	1	1	1	1	1	1	0	11.9556
94	Di-n-octylphthalate	0.679	1.042	1.201	1.312	1.405	1.443	1.483	1.465	------	------	1.254	22.10	11.2310
95	Benzo(b)fluoranthene	0.992	1.053	1.074	1.075	1.070	1.121	1.131	1.087	------	------	1.075	3.96	11.5883
96	Benzo(k)fluoranthene	1.295	1.361	1.364	1.411	1.424	1.411	1.422	1.417	------	------	1.388	3.25	11.6150
97	Benzo(e)pyrene	0.987	1.033	1.018	1.039	1.034	1.056	1.047	1.032	------	------	1.031	2.02	11.8481
98	Benzo(a)pyrene	0.946	1.029	1.040	1.071	1.068	1.084	1.090	1.060	------	------	1.048	4.41	11.9013
99	Perylene	1.099	1.087	1.074	1.083	1.084	1.117	1.104	1.088	------	------	1.092	1.26	11.9832
100	Indeno(1,2,3-cd)pyrene	0.953	1.039	1.100	1.113	1.146	1.173	1.189	1.167	------	------	1.110	7.19	13.1623
101	Dibenzo(a,h)anthracene	0.799	0.876	0.909	0.928	0.947	0.957	0.968	0.945	------	------	0.916	6.08	13.1841
102	Benzo(g,h,i)perylene	0.858	0.927	0.955	0.965	0.986	0.996	1.003	0.986	------	------	0.959	4.97	13.5220

Ave_%RSD : 6.1 Max_%RSD : 32.7

Use Least Square Linear Regression with weighting factor of inverse concentration for comps with %_RSD > 15
Resp_Ratio = xo + x1 * Amt_Ratio

IDX	Parameter	x0	x1	CCF
49	1,4-Dinitrobenzene	-0.01528	0.20439	0.9984
51	1,3-Dinitrobenzene	-0.01247	0.23069	0.9990
57	2,4-Dinitrophenol	-0.03744	0.21167	0.9957
69	4,6-Dinitro-2-methylphenol	-0.02259	0.15949	0.9971
75	Pentachlorophenol	-0.00998	0.16486	0.9995
77	Dinoseb	-0.02447	0.21189	0.9963
87	Butylbenzylphthalate	-0.03887	0.56916	0.9995
88	bis(2-ethylhexyl)adipate	-0.03317	0.49913	0.9998
94	Di-n-octylphthalate	-0.11621	1.51085	0.9997

Figure 4: **TYPICAL DFTPP TUNE SUMMARY**

5B
SEMIVOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: RAJ030
Instrument ID: TOE4

Project: GARDEN GROVE PROJECT
SDG No.: 10D048
DFTPP Injection Date: 01/14/10
DFTPP Injection Time: 10:33

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	10.0 - 80.0% of mass 198	43.62
68	Less than 2% of mass 69	0.54(1.6)1
69	Relative abundance of mass 198	34.08
70	Less than 2.0% of mass 69	0.17(0.5)1
127	10.0 - 80.0% of mass 198	51.93
197	Less than 2.0% of mass 198	0.48
198	Base Peak, 100% relative abundance	100.00
199	5.0 - 9.0% of mass 198	6.91
275	10.0 - 30.0% of mass 198	21.02
365	Greater than 1.00% of mass 198	2.44
441	Present, but less than 24% of mass 442	13.07
442	Greater than 50.0% of mass 198	77.57
443	15.0 - 24.0% of mass 442	16.39(21.1)2

1-Value is % mass 69 2-Value is % mass 442

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD,BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
1	SSTD005	SVE4A14B6	RAJ045	01/14/10	15:00
2	SSTD010	SVE4A14B7	RAJ046	01/14/10	15:18
3	SSTD020	SVE4A14B8	RAJ047	01/14/10	15:36
4	SSTD030	SVE4A14B9	RAJ048	01/14/10	15:54
5	SSTD050	SVE4A14B10	RAJ049	01/14/10	16:13
6	SSTD060	SVE4A14B11	RAJ050	01/14/10	16:31
7	SSTD080	SVE4A14B12	RAJ051	01/14/10	16:49
8	SSTD100	SVE4A14B13	RAJ052	01/14/10	17:07
9	SSTD120	SVE4A14B14	RAJ053	01/14/10	17:25
10	SSTD160	SVE4A14B15	RAJ054	01/14/10	17:43
11	SSTD050	ISVE4A14B1	RAJ055	01/14/10	18:01

Figure 5: **TYPICAL CONTINUING CALIBRATION SUMMARY**

CONTINUE_CALIBRATION - CALIBRATION VERIFICATION

Instrument ID :E4
IC_Beginning DateTime :01/14/10 15:00
Spike Amount :50 PPM
CC/CV File :RAJ055
IC File :RAJ049

Column Spec :ZB-5MS ID :0.18MM
IC_Ending DateTime :01/14/10 17:43
HPChem Method :SVE4A14C
Date_Time :01/14/10 18:01

M IDX	Parameters	CC_Con	CC%_D	CC_Resp	CCRRF	AvRRF	CC_Rtm	AvRtm	%_RSD	Co_X0	Co_X1	Co_X2	Co_Cor
1	1,4-Dichlorobenzene-d4	40.000	0	224421	1	1	2.872	2.875	0				
2	N-nitrosodimethylamine	53.207	6.4	150014	0.535	0.503	1.384	1.387	2.92				
3	Pyridine	51.294	2.6	278646	0.993	0.968	1.414	1.417	6.71				
4	2-Fluorophenol												
5	Phenol-d5												
6	Phenol	51.462	2.9	347033	1.237	1.202	2.544	2.546	1.66				
7	Aniline	46.952	-6.1	394893	1.408	1.499	2.610	2.612	2.56				
8	bis(2-chloroethyl)ether	50.403	0.8	266120	0.949	0.941	2.639	2.642	1.22				
9	2-Chlorophenol	54.013	8.0	408505	1.456	1.348	2.701	2.703	5.88				
10	1,3-Dichlorobenzene	51.425	2.9	419498	1.495	1.454	2.830	2.831	1.65				
11	1,2-Dichlorobenzene-d4												
12	1,4-Dichlorobenzene	50.775	1.5	422565	1.506	1.483	2.886	2.888	1.24				
13	Benzyl alcohol	55.201	10.4	212543	0.758	0.686	2.968	2.967	4.10				
14	1,2-Dichlorobenzene	51.344	2.7	398485	1.420	1.383	3.017	3.019	1.59				
15	2-Methylphenol	50.691	1.4	250607	0.893	0.881	3.043	3.042	3.31				
16	bis(2-chloroisopropyl)ether	52.760	5.5	669332	2.386	2.261	3.080	3.082	6.54				
17	4-Methylphenol	52.478	5.0	337328	1.202	1.146	3.178	3.179	3.68				
18	N-Nitroso-di-n-propylamine	52.372	4.7	174518	0.622	0.594	3.202	3.203	4.21				
19	Hexachloroethane	51.207	2.4	156549	0.558	0.545	3.321	3.320	1.61				
20	Naphthalene-d8	40.000	0	827811	1	1	4.074	4.073	0				
21	Nitrobenzene-d5												
22	Nitrobenzene	50.988	2.0	276687	0.267	0.262	3.373	3.372	3.10				
23	Isophorone	51.605	3.2	509585	0.492	0.477	3.597	3.597	3.58				
24	2-Nitrophenol	53.676	7.4	180386	0.174	0.162	3.675	3.677	11.59				
25	2,4-Dimethylphenol	51.363	2.7	318920	0.308	0.300	3.697	3.696	2.20				
26	Benzoic acid												
27	bis(2-Chloroethoxy)methane	49.750	-0.5	334530	0.323	0.325	3.805	3.805	1.44				
28	2,4-Dichlorophenol	52.698	5.4	308288	0.298	0.283	3.910	3.910	5.17				
29	1,2,4-Trichlorobenzene	49.053	-1.9	339475	0.328	0.334	4.009	4.009	2.18				
30	3,4-Dimethylphenol	48.331	-3.3	361478	0.349	0.361	4.009	4.008	2.97				
31	Naphthalene	49.931	-0.1	1031149	0.997	0.998	4.095	4.096	2.33				
32	4-Chloroaniline	50.416	0.8	430247	0.416	0.412	4.144	4.143	3.75				
33	Hexachlorobutadiene	50.926	1.9	205720	0.199	0.195	4.221	4.221	1.94				
34	Hydroquinone												
35	4-Chloro-3-methylphenol	52.065	4.1	261757	0.253	0.243	4.662	4.663	6.56				
36	2-Methylnaphthalene	53.135	6.3	703866	0.680	0.640	4.852	4.854	1.83				
37	1-Methylnaphthalene	49.729	-0.5	652965	0.631	0.634	4.966	4.966	1.97				
38	Acenaphthene-d10	40.000	0	387443	1	1	6.071	6.069	0				
39	Hexachlorocyclopentadiene	41.702	-16.6	191718	0.396	0.475	5.028	5.030	8.38				
40	2,3,5-Trichlorophenol	50.971	1.9	223897	0.462	0.454	5.038	5.038	12.57				
41	2,4,6-Trichlorophenol	51.339	2.7	221068	0.456	0.445	5.169	5.169	6.14				
42	2,4,5-Trichlorophenol	53.361	6.7	241133	0.498	0.467	5.202	5.205	6.23				
43	2,3,4-Trichlorophenol	50.777	1.6	187444	0.387	0.381	5.279	5.280	4.90				
44	2-Fluorobiphenyl												
45	Biphenyl	47.391	-5.2	778058	1.607	1.695	5.393	5.394	1.34				
46	2-Chloronaphthalene	51.238	2.5	662540	1.368	1.335	5.415	5.414	1.11				
47	2-Nitroaniline	53.751	7.5	149496	0.309	0.287	5.535	5.534	13.30				
48	2,6-Dimethylnaphthalene	47.922	-4.2	550918	1.138	1.187	5.576	5.577	1.19				
49	1,4-Dinitrobenzene	50.911	1.8	94871	0.196	0.171	5.789	5.704	19.51	-0.0153	0.2044		0.9984
50	Dimethylphthalate	50.265	0.5	720098	1.487	1.479	5.765	5.765	2.40				
51	1,3-Dinitrobenzene	44.620	-10.8	94871	0.196	0.203	5.789	5.789	15.18	-0.0125	0.2307		0.9990
52	2,6-Dinitrotoluene	53.228	6.5	158635	0.328	0.308	5.830	5.829	9.38				
53	1,2-Dinitrobenzene												
54	Acenaphthylene	51.234	2.5	1073327	2.216	2.163	5.899	5.902	1.78				
55	3-Nitroaniline	53.026	6.1	174011	0.359	0.339	6.023	6.022	10.42				
56	Acenaphthene	49.793	-0.4	667209	1.378	1.383	6.109	6.109	1.38				
57	2,4-Dinitrophenol	47.855	-4.3	83611	0.173	0.160	6.146	6.147	25.81	-0.0374	0.2117		0.9957
58	4-Nitrophenol	52.866	5.7	81818	0.169	0.160	6.219	6.219	9.81				
59	2,4-Dinitrotoluene	53.319	6.6	200192	0.413	0.388	6.305	6.307	11.48				
60	Dibenzofuran	49.172	-1.7	891276	1.840	1.871	6.315	6.316	1.95				
61	2,3,5,6-Tetrachlorophenol	52.312	4.6	149677	0.309	0.295	6.459	6.407	9.55				
62	2,3,4,6-Tetrachlorophenol	47.577	-4.8	185187	0.382	0.402	6.459	6.459	13.59				
63	2,3,5-Trimethylnaphthalene	48.542	-2.9	510258	1.054	1.085	6.568	6.571	1.71				
64	Diethylphthalate	50.218	0.4	752564	1.554	1.547	6.615	6.615	3.55				
65	Fluorene	50.318	0.6	720268	1.487	1.478	6.730	6.729	2.28				
66	4-Chlorophenyl-phenylether	49.077	-1.8	329931	0.681	0.694	6.739	6.740	2.88				
67	4-Nitroaniline	52.172	4.3	166692	0.344	0.330	6.758	6.755	13.49				

CONTINUE_CALIBRATION - CALIBRATION VERIFICATION

Instrument ID :E4
IC_Beginning DateTime :01/14/10 15:00
Spike Amount :50 PPM
CC/CV File :RAJ055
IC File :RAJ049

Column Spec :ZB-5MS ID :0.18MM
IC_Ending DateTime :01/14/10 17:43
HPChem Method :SVE4A14C
Date_Time :01/14/10 18:01

M IDX	Parameters	CC_Con	CC%_D	CC_Resp	CCRRF	AvRRF	CC_Rtm	AvRtm	%_RSD	Co_X0	Co_X1	Co_X2	Co_Cor
68	Phenanthrene-d10	40.000	0	671822	1	1	7.806	7.808	0				
69	4,6-Dinitro-2-methylphenol	58.659	17.3	141952	0.169	0.128	6.792	6.794	19.54	-0.0226	0.1595		0.9971
70	N-Nitrosodiphenylamine	37.979	-24.0	503304	0.599	0.789	6.879	6.883	3.00				
71	Azobenzene	52.948	5.9	549299	0.654	0.618	6.929	6.929	2.20				
72	2,4,6-Tribromophenol												
73	4-Bromophenyl-phenylether	50.804	1.6	192821	0.230	0.226	7.315	7.313	1.83				
74	Hexachlorobenzene	50.713	1.4	216280	0.258	0.254	7.368	7.366	1.12				
75	Pentachlorophenol	52.350	4.7	138247	0.165	0.143	7.593	7.591	16.37	-0.0100	0.1649		0.9995
76	Phenanthrene	49.067	-1.9	1007658	1.200	1.223	7.835	7.835	1.61				
77	Dinoseb	45.794	-8.4	146532	0.174	0.158	7.814	7.814	32.65	-0.0245	0.2119		0.9963
78	Anthracene	50.528	1.1	1036803	1.235	1.222	7.894	7.892	1.70				
79	Carbazole	51.479	3.0	977399	1.164	1.130	8.073	8.074	3.09				
80	Di-n-butylphthalate	53.153	6.3	1207669	1.438	1.353	8.476	8.476	8.46				
81	1-Methylphenanthrene	47.750	-4.5	678612	0.808	0.846	8.505	8.506	1.49				
82	Fluoranthene	51.041	2.1	1072114	1.277	1.251	9.112	9.113	3.79				
83	Chrysene-d12	40.000	0	722068	1	1	10.583	10.584	0				
84	Benzidine												
85	Pyrene	50.728	1.5	1135206	1.258	1.240	9.348	9.349	2.49				
86	Terphenyl-d14												
87	Butylbenzylphthalate	51.682	3.4	502925	0.557	0.483	10.028	10.031	18.74	-0.0389	0.5692		0.9995
88	bis(2-ethylhexyl)adipate	45.706	-8.6	387872	0.430	0.426	10.110	10.113	18.88	-0.0332	0.4991		0.9998
89	3,3'-Dichlorobenzidine												
90	Benzo(a)anthracene	52.331	4.7	1010275	1.119	1.069	10.573	10.574	4.72				
91	Chrysene	49.476	-1.0	952228	1.055	1.066	10.610	10.611	2.43				
92	bis(2-Ethylhexyl)phthalate	56.317	12.6	732413	0.811	0.720	10.610	10.610	13.28				
93	Perylene-d12	40.000	0	670682	1	1	11.955	11.956	0				
94	Di-n-octylphthalate	49.956	-0.1	1187566	1.417	1.254	11.231	11.231	22.10	-0.1162	1.5108		0.9997
95	Benzo(b)fluoranthene	51.469	2.9	927967	1.107	1.075	11.587	11.588	3.96				
96	Benzo(k)fluoranthene	50.550	1.1	1176470	1.403	1.388	11.611	11.615	3.25				
97	Benzo(e)pyrene	47.989	-4.0	829383	0.989	1.031	11.846	11.848	2.02				
98	Benzo(a)pyrene	51.114	2.2	898599	1.072	1.048	11.900	11.901	4.41				
99	Perylene	46.161	-7.7	845189	1.008	1.092	11.982	11.983	1.26				
100	Indeno(1,2,3-cd)pyrene	51.986	4.0	967418	1.154	1.110	13.161	13.162	7.19				
101	Dibenzo(a,h)anthracene	52.414	4.8	805107	0.960	0.916	13.183	13.184	6.08				
102	Benzo(g,h,i)perylene	51.722	3.4	831961	0.992	0.959	13.522	13.522	4.97				

Figure 6: **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 3550B/8270D
SEMI VOLATILE ORGANICS BY GC/MS

Client	: BEST SERVICES, INC.	Date Collected:	04/05/10
Project	: GARDEN GROVE PROJECT	Date Received:	04/05/10
Batch No.	: 10D048	Date Extracted:	04/09/10 10:45
Sample ID:	DSW-G2-B3	Date Analyzed:	04/12/10 15:57
Lab Samp ID:	D048-01	Dilution Factor:	.97
Lab File ID:	RDJ126	Matrix :	SOIL
Ext Btch ID:	SVD013S	% Moisture :	3.2
Calib. Ref.:	RAJ049	Instrument ID :	T-OE4

PARAMETERS	RESULTS (mg/kg)	RL (mg/kg)	MDL (mg/kg)
1,2,4-TRICHLOROBENZENE	ND	0.33	0.17
1,2-DICHLOROBENZENE	ND	0.33	0.17
1,3-DICHLOROBENZENE	ND	0.33	0.17
1,4-DICHLOROBENZENE	ND	0.33	0.17
2,4,5-TRICHLOROPHENOL	ND	0.33	0.17
2,4,6-TRICHLOROPHENOL	ND	0.33	0.18
2,4-DICHLOROPHENOL	ND	0.33	0.17
2,4-DIMETHYLPHENOL	ND	0.33	0.17
2,4-DINITROPHENOL	ND	0.66	0.17
2,4-DINITROTOLUENE	ND	0.33	0.17
2,6-DINITROTOLUENE	ND	0.33	0.17
2-CHLORONAPHTHALENE	ND	0.33	0.17
2-CHLOROPHENOL	ND	0.33	0.17
2-METHYLNAPHTHALENE	ND	0.33	0.17
2-METHYLPHENOL	ND	0.33	0.17
2-NITROANILINE	ND	0.33	0.17
2-NITROPHENOL	ND	0.33	0.17
3,3'-DICHLOROBENZIDINE	ND	0.33	0.17
3-NITROANILINE	ND	0.33	0.17
4,6-DINITRO-2-METHYLPHENOL	ND	0.66	0.17
4-BROMOPHENYL-PHENYL ETHER	ND	0.33	0.17
4-CHLORO-3-METHYLPHENOL	ND	0.33	0.17
4-CHLOROANILINE	ND	0.33	0.17
4-CHLOROPHENYL-PHENYL ETHER	ND	0.33	0.17
4-METHYLPHENOL (1)	ND	0.33	0.17
4-NITROANILINE	ND	0.33	0.17
4-NITROPHENOL	ND	0.66	0.17
ACENAPHTHENE	ND	0.33	0.17
ACENAPHTHYLENE	ND	0.33	0.17
ANTHRACENE	ND	0.33	0.17
BENZO(A)ANTHRACENE	ND	0.33	0.17
BENZO(A)PYRENE	ND	0.33	0.17
BENZO(B)FLUORANTHENE	ND	0.33	0.17
BENZO(K)FLUORANTHENE	ND	0.33	0.17
BENZO(G,H,I)PERYLENE	ND	0.33	0.17
BIS(2-CHLOROETHOXY)METHANE	ND	0.33	0.17
BIS(2-CHLOROETHYL)ETHER	ND	0.33	0.17
BIS(2-CHLOROISOPROPYL)ETHER	ND	0.33	0.17
BIS(2-ETHYLHEXYL)PHTHALATE	ND	0.33	0.17
BUTYLBENZYLPHTHALATE	ND	0.33	0.17
CHRYSENE	ND	0.33	0.17
DI-N-BUTYLPHTHALATE	ND	0.33	0.17
DI-N-OCTYLPHTHALATE	ND	0.33	0.17
DIBENZO(A,H)ANTHRACENE	ND	0.33	0.17
DIBENZOFURAN	ND	0.33	0.17
DIETHYLPHTHALATE	ND	0.33	0.17
DIMETHYLPHTHALATE	ND	0.33	0.17
FLUORANTHENE	ND	0.33	0.17
FLUORENE	ND	0.33	0.17
HEXACHLOROBENZENE	ND	0.33	0.17
HEXACHLOROBUTADIENE	ND	0.33	0.19
HEXACHLOROCYCLOPENTADIENE	ND	0.33	0.17
HEXACHLOROETHANE	ND	0.33	0.17
INDENO(1,2,3-CD)PYRENE	ND	0.33	0.17
ISOPHORONE	ND	0.33	0.17
N-NITROSO-DI-N-PROPYLAMINE	ND	0.33	0.17
N-NITROSODIPHENYLAMINE (2)	ND	0.33	0.17
NAPHTHALENE	ND	0.33	0.17
NITROBENZENE	ND	0.33	0.17
PENTACHLOROPHENOL	ND	0.66	0.18
PHENANTHRENE	ND	0.33	0.17
PHENOL	ND	0.33	0.17
PYRENE	ND	0.33	0.17

SURROGATE PARAMETERS	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	76	20-140
2-FLUOROBIPHENYL	52	30-130
2-FLUOROPHENOL	52	20-130
NITROBENZENE-D5	46	20-130
PHENOL-D5	58	20-130
TERPHENYL-D14	101	40-130

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

Figure 7: **TYPICAL LCS REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: BEST SERVICES, INC.
PROJECT: GARDEN GROVE PROJECT
BATCH NO.: 10D048
METHOD: METHOD 3550B/8270D

MATRIX:	SOIL			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	MBLK1S				
LAB SAMP ID:	SVD013SB	SVD013SL	SVD013SC		
LAB FILE ID:	RDJ121	RDJ122	RDJ123		
DATE EXTRACTED:	04/09/1010:45	04/09/1010:45	04/09/1010:45	DATE COLLECTED:	NA
DATE ANALYZED:	04/12/1014:24	04/12/1014:43	04/12/1015:01	DATE RECEIVED:	04/09/10
PREP. BATCH:	SVD013S	SVD013S	SVD013S		
CALIB. REF:	RAJ049	RAJ049	RAJ049		

ACCESSION:

PARAMETER	BLNK RSLT (mg/kg)	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	SPIKE AMT (mg/kg)	BSD RSLT (mg/kg)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
1,2,4-Trichlorobenzene	ND	1.33	0.991	74	1.33	0.928	70	7	30-130	50
1,2-Dichlorobenzene	ND	1.33	1.01	76	1.33	0.934	70	8	40-130	50
1,3-Dichlorobenzene	ND	1.33	1.01	76	1.33	0.914	69	10	40-130	50
1,4-Dichlorobenzene	ND	1.33	1.01	76	1.33	0.905	68	11	30-130	50
2,4,5-Trichlorophenol	ND	1.33	1.06	79	1.33	1.05	79	1	50-130	50
2,4,6-Trichlorophenol	ND	1.33	0.997	75	1.33	0.949	71	5	50-130	50
2,4-Dichlorophenol	ND	1.33	1.01	75	1.33	0.953	71	5	50-130	50
2,4-Dimethylphenol	ND	1.33	1.01	76	1.33	0.962	72	5	40-130	50
2,4-Dinitrophenol	ND	1.33	1.01	76	1.33	1.06	80	5	40-130	50
2,4-Dinitrotoluene	ND	1.33	1.22	91	1.33	1.21	90	1	30-130	50
2,6-Dinitrotoluene	ND	1.33	1.10	83	1.33	1.09	82	1	60-130	50
2-Chloronaphthalene	ND	1.33	1.07	81	1.33	1.04	78	3	50-130	50
2-Chlorophenol	ND	1.33	1.11	83	1.33	0.964	72	14	30-130	50
2-Methylnaphthalene	ND	1.33	1.11	83	1.33	1.05	79	5	40-130	50
2-Methylphenol	ND	1.33	1.08	81	1.33	0.985	74	9	40-130	50
2-Nitroaniline	ND	1.33	1.10	82	1.33	1.11	83	1	50-130	50
2-Nitrophenol	ND	1.33	1.08	81	1.33	1.03	77	5	50-130	50
3,3'-Dichlorobenzidine	ND	1.33	1.30	98	1.33	1.31	99	1	60-130	50
3-Nitroaniline	ND	1.33	1.17	88	1.33	1.15	87	2	60-130	50
4,6-Dinitro-2-Methylphenol	ND	1.33	1.34	100	1.33	1.42	106	6	50-130	50
4-Bromophenyl-phenyl ether	ND	1.33	1.17	88	1.33	1.13	84	4	50-130	50
4-Chloro-3-Methylphenol	ND	1.33	1.03	78	1.33	1.00	75	3	30-130	50
4-Chloroaniline	ND	1.33	1.05	79	1.33	1.01	76	4	40-130	50
4-Chlorophenyl-phenyl ether	ND	1.33	1.07	81	1.33	1.04	78	3	50-130	50
4-Methylphenol	ND	1.33	1.14	86	1.33	1.04	78	9	40-130	50
4-Nitroaniline	ND	1.33	1.29	96	1.33	1.27	95	1	60-130	50
4-Nitrophenol	ND	1.33	0.824	62	1.33	0.841	63	2	20-130	50
Acenaphthene	ND	1.33	1.08	81	1.33	1.05	79	2	30-130	50
Acenaphthylene	ND	1.33	1.09	82	1.33	1.05	79	4	30-130	50
Anthracene	ND	1.33	1.14	86	1.33	1.14	85	1	30-130	50
Benzo(a)anthracene	ND	1.33	1.25	93	1.33	1.24	93	1	40-130	50
Benzo(a)pyrene	ND	1.33	1.21	91	1.33	1.20	90	1	40-130	50
Benzo(b)fluoranthene	ND	1.33	1.26	95	1.33	1.25	94	1	50-130	50
Benzo(k)fluoranthene	ND	1.33	1.21	91	1.33	1.12	84	8	40-130	50
Benzo(g,h,i)perylene	ND	1.33	1.29	96	1.33	1.28	96	0	40-140	50
bis(2-Chloroethoxy)methane	ND	1.33	1.22	91	1.33	1.03	78	16	40-130	50
bis(2-Chloroethyl)ether	ND	1.33	1.12	84	1.33	1.03	77	9	40-130	50
bis(2-Chloroisopropyl)ether	ND	1.33	1.06	79	1.33	0.973	73	8	40-130	50
bis(2-Ethylhexyl)phthalate	ND	1.33	1.42	106	1.33	1.43	107	1	50-130	50
Butylbenzylphthalate	ND	1.33	1.33	100	1.33	1.35	101	2	60-130	50
Chrysene	ND	1.33	1.23	92	1.33	1.24	93	1	40-130	50
Di-n-butylphthalate	ND	1.33	1.28	96	1.33	1.28	96	0	50-130	50
Di-n-octylphthalate	ND	1.33	1.33	100	1.33	1.31	98	1	50-130	50
Dibenzo(a,h)anthracene	ND	1.33	1.31	98	1.33	1.30	97	1	40-130	50
Dibenzofuran	ND	1.33	1.07	80	1.33	1.04	78	3	50-130	50
Diethylphthalate	ND	1.33	1.08	81	1.33	1.09	82	1	60-130	50
Dimethylphthalate	ND	1.33	1.13	85	1.33	1.11	83	2	60-130	50
Fluoranthene	ND	1.33	1.25	94	1.33	1.21	91	4	40-130	50
Fluorene	ND	1.33	1.08	81	1.33	1.07	80	1	30-130	50
Hexachlorobenzene	ND	1.33	1.19	89	1.33	1.13	85	5	30-130	50
Hexachlorobutadiene	ND	1.33	0.893	67	1.33	0.824	62	8	40-130	50
Hexachlorocyclopentadiene	ND	1.33	0.574	43	1.33	0.545	41	5	10-130	50
Hexachloroethane	ND	1.33	0.959	72	1.33	0.872	65	9	40-130	50
Indeno(1,2,3-cd)pyrene	ND	1.33	1.29	97	1.33	1.29	96	0	30-140	50
Isophorone	ND	1.33	1.06	80	1.33	1.00	75	6	50-130	50
n-Nitroso-di-n-propylamine	ND	1.33	1.12	84	1.33	1.04	78	8	30-130	50
n-Nitrosodiphenylamine	ND	1.33	0.845	63	1.33	0.823	62	3	30-140	50
Naphthalene	ND	1.33	1.03	77	1.33	0.955	72	8	30-130	50
Nitrobenzene	ND	1.33	1.01	76	1.33	0.952	71	6	40-130	50
Pentachlorophenol	ND	1.33	1.04	78	1.33	1.06	79	2	20-130	50
Phenanthrene	ND	1.33	1.15	86	1.33	1.13	85	1	30-130	50
Phenol	ND	1.33	1.12	84	1.33	1.00	75	11	30-130	50
Pyrene	ND	1.33	1.20	90	1.33	1.21	91	1	30-130	50

SURROGATE PARAMETER	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	SPIKE AMT (mg/kg)	BSD RSLT (mg/kg)	BSD % REC	QC LIMIT (%)
2,4,6-Tribromophenol	2.00	1.87	94	2.00	1.79	90	40-130
2-Fluorobiphenyl	0.667	0.526	79	0.667	0.491	74	30-130
2-Fluorophenol	2.00	1.58	79	2.00	1.35	67	30-130
Nitrobenzene-d5	0.667	0.479	72	0.667	0.434	65	30-130
Phenol-d5	2.00	1.67	83	2.00	1.48	74	30-130
Terphenyl-d14	0.667	0.710	107	0.667	0.709	106	40-130

Figure 8: **TYPICAL MS/MSD REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: BEST SERVICES, INC.
PROJECT: GARDEN GROVE PROJECT
BATCH NO.: 10D048
METHOD: METHOD 3550B/8270D

MATRIX: SOIL % MOISTURE: 3.2

DILUTION FACTOR:	.97	.97	.98
SAMPLE ID:	DSW-G2-B3		
LAB SAMP ID:	D048-01	D048-01M	D048-01S
LAB FILE ID:	RDJ126	RDJ124	RDJ125
DATE EXTRACTED:	04/09/1010:45	04/09/1010:45	04/09/1010:45
DATE ANALYZED:	04/12/1015:57	04/12/1015:20	04/12/1015:38
PREP. BATCH:	SVD013S	SVD013S	SVD013S
CALIB. REF:	RAJ049	RAJ049	RAJ049

DATE COLLECTED: 04/05/10
DATE RECEIVED: 04/05/10

ACCESSION:

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
1,2,4-Trichlorobenzene	ND	1.34	0.679	51	1.35	0.647	48	6	10-130	50
1,2-Dichlorobenzene	ND	1.34	0.657	49	1.35	0.646	48	2	30-130	50
1,3-Dichlorobenzene	ND	1.34	0.628	47	1.35	0.612	45	4	30-130	50
1,4-Dichlorobenzene	ND	1.34	0.634	47	1.35	0.627	46	2	10-130	50
2,4,5-Trichlorophenol	ND	1.34	0.999	75	1.35	0.931	69	8	40-130	50
2,4,6-Trichlorophenol	ND	1.34	0.839	63	1.35	0.803	59	7	40-130	50
2,4-Dichlorophenol	ND	1.34	0.754	56	1.35	0.746	55	2	30-130	50
2,4-Dimethylphenol	ND	1.34	0.602	45	1.35	0.615	46	2	30-130	50
2,4-Dinitrophenol	ND	1.34	0.839	63	1.35	0.781	58	8	20-130	50
2,4-Dinitrotoluene	ND	1.34	1.23	92	1.35	1.09	80	14	20-130	50
2,6-Dinitrotoluene	ND	1.34	1.06	80	1.35	0.974	72	11	50-130	50
2-Chloronaphthalene	ND	1.34	0.825	62	1.35	0.826	61	2	40-130	50
2-Chlorophenol	ND	1.34	0.745	56	1.35	0.745	55	2	20-130	50
2-Methylnaphthalene	ND	1.34	0.816	61	1.35	0.800	59	3	30-130	50
2-Methylphenol	ND	1.34	0.722	54	1.35	0.744	55	2	30-130	50
2-Nitroaniline	ND	1.34	1.10	82	1.35	1.00	74	10	40-130	50
2-Nitrophenol	ND	1.34	0.764	57	1.35	0.741	55	4	30-130	50
3,3'-Dichlorobenzidine	ND	1.34	1.03	77	1.35	0.971	72	7	40-130	50
3-Nitroaniline	ND	1.34	1.17	88	1.35	1.04	77	13	50-130	50
4,6-Dinitro-2-Methylphenol	ND	1.34	1.19	89	1.35	1.09	80	11	40-130	50
4-Bromophenyl-phenyl ether	ND	1.34	1.09	82	1.35	1.02	76	8	50-130	50
4-Chloro-3-Methylphenol	ND	1.34	0.944	71	1.35	0.883	65	9	30-130	50
4-Chloroaniline	ND	1.34	0.770	58	1.35	0.772	57	2	30-130	50
4-Chlorophenyl-phenyl ether	ND	1.34	0.991	74	1.35	0.947	70	6	50-130	50
4-Methylphenol	ND	1.34	0.781	58	1.35	0.802	59	2	30-130	50
4-Nitroaniline	ND	1.34	1.32	99	1.35	1.14	85	15	50-130	50
4-Nitrophenol	ND	1.34	0.888	66	1.35	0.747	55	18	20-130	50
Acenaphthene	ND	1.34	0.909	68	1.35	0.909	67	1	20-130	50
Acenaphthylene	ND	1.34	0.892	67	1.35	0.892	66	2	30-130	50
Anthracene	ND	1.34	1.10	82	1.35	1.03	76	8	30-130	50
Benzo(a)anthracene	ND	1.34	1.19	89	1.35	1.10	82	8	40-130	50
Benzo(a)pyrene	ND	1.34	1.12	84	1.35	1.03	76	10	40-130	50
Benzo(b)fluoranthene	ND	1.34	1.15	86	1.35	1.07	80	7	50-130	50
Benzo(k)fluoranthene	ND	1.34	1.15	86	1.35	1.09	81	6	40-130	50
Benzo(g,h,i)perylene	ND	1.34	1.22	92	1.35	1.13	84	9	40-130	50
bis(2-Chloroethoxy)methane	ND	1.34	0.848	63	1.35	0.843	62	2	30-130	50
bis(2-Chloroethyl)ether	ND	1.34	0.757	57	1.35	0.751	56	2	20-130	50
bis(2-Chloroisopropyl)ether	ND	1.34	0.688	51	1.35	0.694	51	0	20-130	50
bis(2-Ethylhexyl)phthalate	ND	1.34	1.40	105	1.35	1.35	100	5	50-130	50
Butylbenzylphthalate	ND	1.34	1.38	103	1.35	1.35	100	3	50-130	50
Chrysene	ND	1.34	1.17	88	1.35	1.10	81	8	40-130	50
Di-n-butylphthalate	ND	1.34	1.25	94	1.35	1.19	88	7	50-130	50
Di-n-octylphthalate	ND	1.34	1.36	102	1.35	1.35	100	2	50-130	50
Dibenzo(a,h)anthracene	ND	1.34	1.23	92	1.35	1.16	86	7	40-130	50
Dibenzofuran	ND	1.34	0.942	71	1.35	0.908	67	6	40-130	50
Diethylphthalate	ND	1.34	1.11	83	1.35	0.998	74	11	50-130	50
Dimethylphthalate	ND	1.34	1.08	81	1.35	1.00	74	9	50-130	50
Fluoranthene	ND	1.34	1.20	90	1.35	1.12	83	8	40-130	50
Fluorene	ND	1.34	1.01	76	1.35	0.953	71	7	30-130	50
Hexachlorobenzene	ND	1.34	1.12	84	1.35	1.06	79	6	10-160	50
Hexachlorobutadiene	ND	1.34	0.594	44	1.35	0.575	43	2	30-130	50
Hexachlorocyclopentadiene	ND	1.34	0.410	31	1.35	0.407	30	3	10-130	50
Hexachloroethane	ND	1.34	0.580	43	1.35	0.570	42	2	30-130	50
Indeno(1,2,3-cd)pyrene	ND	1.34	1.24	93	1.35	1.15	85	9	40-130	50
Isophorone	ND	1.34	0.777	58	1.35	0.784	58	0	40-130	50
n-Nitroso-di-n-propylamine	ND	1.34	0.762	57	1.35	0.768	57	0	20-130	50
n-Nitrosodiphenylamine	ND	1.34	0.765	57	1.35	0.731	54	5	20-140	50
Naphthalene	ND	1.34	0.719	54	1.35	0.705	52	4	20-130	50
Nitrobenzene	ND	1.34	0.700	52	1.35	0.701	52	0	30-130	50
Pentachlorophenol	ND	1.34	0.997	75	1.35	0.930	69	8	20-130	50
Phenanthrene	ND	1.34	1.12	84	1.35	1.04	77	9	30-130	50
Phenol	ND	1.34	0.766	57	1.35	0.795	59	3	20-130	50
Pyrene	ND	1.34	1.15	86	1.35	1.10	81	6	10-160	50

SURROGATE PARAMETER	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	QC LIMIT (%)
2,4,6-Tribromophenol	2.00	1.84	92	2.02	1.79	88	20-140
2-Fluorobiphenyl	0.668	0.397	59	0.675	0.408	60	30-130
2-Fluorophenol	2.00	1.05	52	2.02	1.10	54	20-130
Nitrobenzene-d5	0.668	0.340	51	0.675	0.349	52	20-130
Phenol-d5	2.00	1.14	57	2.02	1.23	61	20-130
Terphenyl-d14	0.668	0.663	99	0.675	0.675	100	40-130

Figure 9: **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : BEST SERVICES, INC.

Project : GARDEN GROVE PROJECT

SDG : 10D048

METHOD 3550B/8270D
SEMI VOLATILE ORGANICS BY GC/MS

A total of nine (9) soil samples were received on 04/05/10 for Semi Volatile Organics by GC/MS analysis, Method 3550B/8270D in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument tune check was performed prior to calibration. Instrument mass ratios as well as DDT breakdown were evaluated. Results were within acceptance criteria. Tailing factor for Benzidine and Pentachlorophenol were also verified and results were ≤ 2. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source (ICV). Continuing calibration (CCV) was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms for ICAL, ICV and CCV for details.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for SVD013SL/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for D048-01M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Table 1: INTERMEDIATE STANDARD PREPARATION

A. Primary Source: AccuStandard, Restek or equivalent

Compound Name	Stock / Internal Soln. Conc. (µg/ml)	Source	Preparation			Final Conc. (mg/L)
			Aliquot (µL)	Dil. Solution	Final Vol. (ml)	
Base/Neutral Composite Mix	2000	Accu Standard	1000	MeCl2	10	200
Toxic Substance Mix #1	2000	Accu Standard	1000	MeCl2	10	200
Phenol Mix	2000	Accu Standard	1000	MeCl2	10	200
Composite Mix 3	2000	Accu Standard	1000	MeCl2	10	200
Benzidine and 3,3'dichlorobenzidine	2000	Accu Standard	1000	MeCl2	10	200
Acid Surrogate Mix	7500	Restek Standard	267	MeCl2	10	200
Base/Neutral Surrogate Mix	5000	Restek Standard	400	MeCl2	10	200

B. Secondary Source: Supelco, Ultra Scientific or equivalent

Compound Name	Stock Soln. Conc. (µg/ml)	Source	Preparation			Final Conc. (mg/L)
			Aliquot (ml)	Solvent	Final Vol. (ml)	
Base/Neutral Mix 1	2000	Ultra Scientific	1	MeCl2	10	200
Base/Neutral Mix 2	2000	Ultra Scientific	1	MeCl2	10	200
Toxic Substance Mix 1	2000	Ultra Scientific	1	MeCl2	10	200
Toxic Substance Mix 2	2000	Ultra Scientific	1	MeCl2	10	200
Phenol Mix	2000	Ultra Scientific	1	MeCl2	10	200
PAH Mixture	2000	Ultra Scientific	1	MeCl2	10	200
Benzidine	2000	Ultra Scientific	1	MeCl2	10	200
Carbazol	2000	Supelco	1	MeCl2	10	200
Pyridine	2000	Supelco	1	MeCl2	10	200

Table 2: **WORKING STANDARD CALIBRATION**

Standard Name	Intermediate Standard µl of 200 mg/L	Internal Standard µl of 2000 mg/L	Amount of $MeCl_2$(µl)	Final Volume (µl)	Final Conc.
Standard 1 5 mg/L Calib. Std	12.5	10	477.5	500	5 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 2 10 mg/L Calib. Std	25	10	465	500	10 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 3 20 mg/L Calib. Std	50	10	440	500	20 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 4 40 mg/L Calib. Std	100	10	390	500	40 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 5 50 mg/L Calib. Std	125	10	365	500	50 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 6 80 mg/L Calib. Std	200	10	290	500	80 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 7 100 mg/L Calib. Std	250	10	240	500	100 mg/L of Cal Std 40mg/L of Internal Std.
Standard 8 120 mg/L Calib. Std	300	10	190	500	120 mg/L of Cal. Std. 40mg/L of Internal Std.
Standard 9 160 mg/L Calib. Std	400	10	90	500	160 mg/L of Cal. Std. 40mg/L of Internal Std.

WORKING SECONDARY SOURCE STANDARD

Standard Name	Intermediate Standard µl of 200 mg/L	Internal Standard µl of 2000 mg/L	Amount of $MeCl_2$(µl)	Final Volume (µl)	Final Conc.
Secondary Source Std. Mix(see Table 1)	125	10	365	500	50 mg/L of Cal. Ver. Std. 40 mg/L of Internal Std.

Table 3: INSTRUMENT PARAMETERS

	Inst. E4 / Inst. E7	Inst. 052
Carrier Gas	Helium at 90 psi at outlet	Helium at 90 psi at outlet
Column head pressure	15 - 35 psi at 40°C	15-35 psi at 50°C
Injection port temperature	280-300°C	280-300°C
Interface	Direct column interference at 280-300°C	Direct column interference at 2 80-300°C
Valve time	Split 0.2 minute	Split 0.2 minutes
Oven Temperature Program		
Initial Temperature	50°C/min; hold for 0min.	50°C/min; hold for 0.2min.
Rate	30°C/min to 100°C; hold for 0.0 min.; 20ºC/min to 200ºC; hold for 0.0 min.; 25ºC/min to 320ºC; hold for 2.53 min.	10°C/min to 100°C; hold for 0 min. 38°C/min to 280°C; hold for 0 min.
Run Time	14 minutes	9.94 minutes
Scan Parameters		
Scan start time	After solvent peak	After solvent peak
Mass range	10 to 1050 AMU	40 to 500 AMU
Multiplier voltage	1000-3000	0.7-3
Number of sampling rate	1	0.4
Threshold	300	500-1500
Tuning File	DFTPP	DFTPP

Table 4: DFTPP KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
51	10 – 80% of mass 198
68	< 2.0% of mass 69
70	< 2.0% of mass 69
127	10 – 80% of mass 198
197	<2% of mass 198
198	Base peak, 100% relative abundance (See Note), or >50% of mass 442
199	5 to 9% of mass 198
275	10 to 60% of mass 198
365	> 1% of mass 198
441	Present but <24% of mass 442
442	Base peak or >50% of mass 198
443	15 to 24% of mass 442

NOTE: All ion abundance MUST be normalized to m/z 198, the nominal base peak.

Table 5: ANALYTE LISTS, QUANTITATION IONS, INTERNAL STANDARDS & SURROGATES

Analyte	Type	Quantitation Ions	
		Primary	Secondary
1,4-Dichlorobenzene-d_4	**IS**	152	150,154
Phenol	T	94	65,66
Bis(2-Chloroethyl)ether	T	93	63,95
2-Chlorophenol	T	128	64,130
1,3-Dichlorobenzene	T	146	148,111
1,4-Dichlorobenzene	T	146	148,111
1,2-Dichlorobenzene	T	146	148,111
2-Methylphenol	T	107	108,77,79,90
4-Methylphenol	T	107	108,77,79,90
N-Nitroso-di-n-propylamine	T	70	42,101,130
Hexachloroethane	T	117	201,199
Aniline	T	93	66,65
Benzyl Alcohol	T	108	79,77
Bis(2-chloroisopropyl)ether	T	45	77,121
N-Nitrosodimethylamine	T	42	74,44
2-Fluorophenol	S	112	64
Phenol-d5	S	99	42,71
1,2-Dichlorobenzene-d4	S	152	150,115
Acenaphthene-d_{10}	**IS**	164	162,160
Hexachlorocyclopentadiene	T	237	235,272
2,4,6-Trichlorophenol	T	196	198,200
2,4,5-Trichlorophenol	T	196	198,97,132,99
2-Chloronaphthalene	T	162	127,164
2-Nitroaniline	T	65	92,138
Dimethylphthalate	T	163	194,164
Acenaphthylene	T	152	151,153
3-Nitroaniline	T	138	108,92
Acenaphthene	T	154	153,152
2,4-Dinitrophenol	T	184	63,154
4-Nitrolphenol	T	139	109,65
Dibenzofuran	T	168	139
2,4-Dinitrotoluene	T	165	63,89
2,6-Dinitrotoluene	T	165	63,89
Diethylphthalate	T	149	177,150
4-Chlorophenylphenylether	T	204	206,141
Fluorene	T	166	165,167
4-Nitroaniline	T	138	65,108,92,80,39
Azobenzene	T	77	105,182
2-Fluorobiphenyl	S	172	171
2,4,6-Tribromophenol	S	330	332, 141

Analyte	Type	Quantitation Ions	
		Primary	Secondary
Naphthalene-d_8	**IS**	136	68
Nitrobenzene	T	77	123,65
Isophorone	T	82	95,138
2-Nitrophenol	T	139	109,65
2,4-Dimethylphenol	T	122	107,121
Bis(2-Chloroethoxy)methane	T	93	95,123
2,4-Dichlorophenol	T	162	164,98
1,2,4-Trichlorobenzene	T	180	182,145
Naphthalene	T	128	129,127
4-Chloroaniline	T	127	129,65,92
Hexachlorobutadiene	T	225	223,227
4-Chloro-3-methylphenol	T	107	144,142
2-Methylnaphthalene	T	142	141
Benzoic Acid	T	122	105,77
Hydroquinone	T	110	81,53,55
Nitrobenzene-d5 (surr)	S	82	128,545
Chrysene-d_{12}	**IS**	240	120,236,
Pyrene	T	202	200,203
Butylbenzylphthalate	T	149	91,206
3,3'-Dichlorobenzidine	T	252	254,126
Benzo(a)anthracene	T	228	229,226
Bis(2-ethylhexyl)phthalate	T	149	167,279
Chrysene	T	228	226,229
Benzidine	T	184	92,185
Terphenyl-d14 (surr)	S	244	122,212
Phenanthrene-d_{10}	**IS**	188	94,80
4,6-Dinitro-2-methylphenol	T	198	51,105
n-Nitrosodiphenylamine	T	169	168, 164
4-Bromophenyl phenyl ether	T	248	250,141
Hexachlorobenzene	T	284	142249
Pentachlorophenol	T	266	264,268
Carbazole	T	167	166,168
Phenanthrene	T	178	179,176
Anthracene	T	178	176,179
Di-n-butylphthalate	T	149	150,104
Fluoranthene	T	202	101,203
Perylene-d_{12}	**IS**	264	260,265
Di-n-octyl-phthalate	T	149	167,43
Benzo(b)fluoranthene	T	252	253,125
Benzo(k)fluoranthene	T	252	253,125
Benzo(a)pyrene	T	252	25,3125
Indeno(1,2,3-cd)pyrene	T	276	138,227
Benzo(g,h,I)perylene	T	276	138,277
Dibenzo(a,h)anthracene	T	278	139,279

Notes: T – target compound

S – surrogate

IS –internal standard

Table 5 con't.: ADDITIONAL ANALYTE LISTS, QUANTITATION IONS, INTERNAL STANDARDS & SURROGATES

Analyte	Type	Quantitation Ions	
		Primary	Secondary
1,4-Dichlorobenzene-d_4	**IS**	152	150,154
Ethyl methanesulfonate	T	79	109,97,45,65
Methyl methanesulfonate	T	80	79,65,95
2-Picoline	T	93	66,92
Naphthalene-d_8	**IS**	136	68
Acetophenone	T	106	71,51,120
2,6-Dichlorophenol	T	162	164,98
a,a-Dimethylphenethylamine	T	58	91,65,134,42
n-Nitrosodi-n-butylamine	T	84	57,41,116,158
N-Nitrosopiperidine	T	114	42,55
Acenaphthene-d_{10}	**IS**	164	162,160
1-Chloronaphthalene	T	162	127,164
2-Chloronaphthalene	T	162	127,164
1-Naphthylamine	T	143	115,89,63
2-Naphthylamine	T	143	115,116
Pentachlorobenzene	T	250	252,108,248
1,2,4,5-Tetrachlorobenzene	T	216	214,179,108
2,3,4,6-Tetrachlorophenol	T	232	131,230,166

Analyte	Type	Quantitation Ions	
		Primary	Secondary
Phenanthrene-d_{10}	**IS**	188	94,80
4-Aminophenyl	T	169	168,170,115
Phenacetin	T	108	180,179,109
Pronamide	T	173	175,145,109
Chrysene-d_{12}	**IS**	240	120,236,
p-Dimethylaminoazobenzene	T	225	120,77,105
Perylene-d_{12}	**IS**	264	260,265
Dibenzo(a,j)acridine	T	279	280,277,250
7,12-Dimethylbenz(a)anthracene	T	256	241,239,120
3-Methylcholanthrene	T	268	252,253,126

Notes: T – target compound

S – surrogate

IS –internal standard

Table 6: RECOMMENDED MINIMUM RESPONSE FACTOR

ANALYTE	Minimum ResponseFactor(RF)	ANALYTE	Minimum ResponseFactor(RF)
Benzaldehyde	0.010	4-Nitrophenol	0.010
Phenol	0.800	Dibenzofuran	0.800
Bis(2-chloroethyl)ether	0.700	2,4-Dinitrotoluene	0.200
2-Chlorophenol	0.800	Diethyl phthalate	0.010
2-Methylphenol	0.700	1,2,4,5-Tetrachlorobenzene	0.010
2,2'-Oxybis-(1-chloropropane)	0.010	4-Chlorophenyl-phenyl ether	0.400
Acetophenone	0.010	Fluorene	0.900
4-Methylphenol	0.600	4-Nitroaniline	0.010
N-Nitroso-di-n-propylamine	0.500	4,6-Dinitro-2-methylphenol	0.010
Hexachloroethane	0.300	4-Bromophenyl-phenyl ether	0.100
Nitrobenzene	0.200	N-Nitrosodiphenylamine	0.010
Isophorone	0.400	Hexachlorobenzene	0.100
2-Nitrophenol	0.100	Atrazine	0.010
2,4-Dimethylphenol	0.200	Pentachlorophenol	0.050
Bis(2-chloroethoxy)methane	0.300	Phenanthrene	0.700
2,4-Dichlorophenol	0.200	Anthracene	0.700
Naphthalene	0.700	Carbazole	0.010
4-Chloroaniline	0.010	Di-n-butyl phthalate	0.010
Hexachlorobutadiene	0.010	Fluoranthene	0.600
Caprolactam	0.010	Pyrene	0.600
4-Chloro-3-methylphenol	0.200	Butyl benzyl phthalate	0.010
2-Methylnaphthalene	0.400	3,3'-Dichlorobenzidine	0.010
Hexachlorocyclopentadiene	0.050	Benzo(a)anthracene	0.800
2,4,6-Trichlorophenol	0.200	Chrysene	0.700
2,4,5-Trichlorophenol	0.200	Bis-(2-ethylhexyl)phthalate	0.010
1,1'-Biphenyl	0.010	Di-n-octyl phthalate	0.010
2-Chloronaphthalene	0.800	Benzo(b)fluoranthene	0.700
2-Nitroaniline	0.010	Benzo(k)fluoranthene	0.700
Dimethyl phthalate	0.010	Benzo(a)pyrene	0.700
2,6-Dinitrotoluene	0.200	Indeno(1,2,3-cd)pyrene	0.500
Acenaphthylene	0.900	Dibenz(a,h)anthracene	0.400
3-Nitroaniline	0.010	Benzo(g,h,i)perylene	0.500
Acenaphthene	0.900	2,3,4,6-Tetrachlorophenol	0.010
2,4-Dinitrophenol	0.010		

Notes:

1. PSR supersedes Table 6.
2. Other analytes not listed above must have a minimum response factor of 0.01.
3. Table 6 is from SW846 Method 8270D, Table 4.

Table 7: ESTABLISHED LIMIT OF DETECTION (LOD) & LIMIT OF QUANTITATION (LOQ)

PARAMETER	DL	LOD	LOQ	Unit
Acenaphthene	1.52	5	10	ug/L
Acenaphthylene	1.42	5	10	ug/L
Aniline	5.26	5	10	ug/L
Anthracene	2.32	5	10	ug/L
Azobenzene	1.52	5	10	ug/L
Benzidine	0.00			ug/L
Benzo(a)anthracene	1.55	5	10	ug/L
benzo(a)pyrene	2.20	5	10	ug/L
Benzo(b)fluoranthene	2.58	5	10	ug/L
Benzo(e)pyrene	1.81	5	10	ug/L
Benzo(g,h,i)perylene	1.61	5	10	ug/L
Benzo(k)fluoranthene	2.00	5	10	ug/L
Benzoic Acid	7.63	20	40	ug/L
Benzyl Alcohol	2.42	5	10	ug/L
Biphenyl	1.34	5	10	ug/L
bis(2-chloroethoxy)methane	1.75	5	10	ug/L
bis(2-chloroethyl)ether	1.81	5	10	ug/L
bis(2-chloroisopropyl)ether	1.98	5	10	ug/L
bis(2-Ethylhexyl)adipate	1.51	5	10	ug/L
bis(2-Ethylhexyl)phthalate	1.60	5	10	ug/L
4-Bromophenyl-phenylether	1.78	5	10	ug/L
Butylbenzylphthalate	1.16	5	10	ug/L
Carbazole	2.05	5	10	ug/L
4-Chloro-3-methylphenol	1.99	5	10	ug/L
4-Chloroaniline	4.20	5	10	ug/L
2-Chloronaphthalene	1.69	5	10	ug/L
2-Chlorophenol	2.10	5	10	ug/L
4-Chlorophenyl-phenylether	1.61	5	10	ug/L
Chrysene	1.64	5	10	ug/L
Dibenzo(a,h)anthracene	1.85	5	10	ug/L
Dibenzofuran	1.40	5	10	ug/L
1,2-Dichlorobenzene	2.12	5	10	ug/L
1,3-Dichlorobenzene	2.09	5	10	ug/L
1,4-Dichlorobenzene	2.28	5	10	ug/L
3,3'-Dichlorobenzidine	1.56	5	10	ug/L
2,4-Dichlorophenol	2.23	5	10	ug/L
Diethylphthalate	2.35	5	10	ug/L
2,6-Dimethylnaphthalene	1.64	5	10	ug/L
2,4-Dimethylphenol	2.58	5	10	ug/L
Dimethylphthalate	2.02	5	10	ug/L
Di-n-butylphthalate	1.44	5	10	ug/L
4,6-Dinitro-2-methylphenol	2.25	5	10	ug/L
2,4-Dinitrophenol	1.32	5	10	ug/L
2,4-Dinitrotoluene	1.59	5	10	ug/L
2-6-Dinitrotoluene	1.34	5	10	ug/L
Di-n-octylphthalate	1.76	5	10	ug/L
1,2-Diphenylhydrazine	0.00	5	10	ug/L
Fluoranthene	1.81	5	10	ug/L
Fluorene	1.60	5	10	ug/L
Hexachlorobenzene	1.59	5	10	ug/L
Hexachlorobutadiene	2.33	5	10	ug/L
Hexachlorocyclopentadiene	1.42	5	10	ug/L
Hexachloroethane	2.40	5	10	ug/L
Indeno(1,2,3-cd)pyrene	1.80	5	10	ug/L
Isophorone	1.77	5	10	ug/L
1-Methylnaphthalene	1.91	5	10	ug/L
2-Methylnaphthalene	2.06	5	10	ug/L
1-Methylphenanthrene	1.38	5	10	ug/L
2-Methylphenol	1.97	5	10	ug/L
4-Methylphenol	1.87	5	10	ug/L
Naphthalene	1.97	5	10	ug/L

PARAMETER	DL	LOD	LOQ	Unit
Acenaphthene	53	167	333	ug/Kg
Acenaphthylene	57	167	333	ug/Kg
Aniline	41	167	333	ug/Kg
Anthracene	60	167	333	ug/Kg
Azobenzene	96	167	333	ug/Kg
Benzidine	863	667	1333	ug/Kg
Benzo(a)anthracene	56	167	333	ug/Kg
benzo(a)pyrene	53	167	333	ug/Kg
Benzo(b)fluoranthene	86	167	333	ug/Kg
Benzo(e)pyrene	59	167	333	ug/Kg
Benzo(g,h,i)perylene	87	167	333	ug/Kg
Benzo(k)fluoranthene	71	167	333	ug/Kg
Benzoic Acid	186	667	1333	ug/Kg
Benzyl Alcohol	72	167	333	ug/Kg
Biphenyl	59	167	333	ug/Kg
bis(2-chloroethoxy)methane	57	167	333	ug/Kg
bis(2-chloroethyl)ether	59	167	333	ug/Kg
bis(2-chloroisopropyl)ether	45	167	333	ug/Kg
bis(2-Ethylhexyl)adipate	87	167	333	ug/Kg
bis(2-Ethylhexyl)phthalate	115	167	333	ug/Kg
4-Bromophenyl-phenylether	90	167	333	ug/Kg
Butylbenzylphthalate	54	167	333	ug/Kg
Carbazole	89	167	333	ug/Kg
4-Chloro-3-methylphenol	83	167	333	ug/Kg
4-Chloroaniline	71	167	333	ug/Kg
2-Chloronaphthalene	54	167	333	ug/Kg
2-Chlorophenol	48	167	333	ug/Kg
4-Chlorophenyl-phenylether	71	167	333	ug/Kg
Chrysene	47	167	333	ug/Kg
Dibenzo(a,h)anthracene	65	167	333	ug/Kg
Dibenzofuran	59	167	333	ug/Kg
1,2-Dichlorobenzene	45	167	333	ug/Kg
1,3-Dichlorobenzene	38	167	333	ug/Kg
1,4-Dichlorobenzene	45	167	333	ug/Kg
3,3'-Dichlorobenzidine	84	167	333	ug/Kg
2,4-Dichlorophenol	52	167	333	ug/Kg
Diethylphthalate	52	167	333	ug/Kg
2,6-Dimethylnaphthalene	54	167	333	ug/Kg
2,4-Dimethylphenol	50	167	333	ug/Kg
Dimethylphthalate	63	167	333	ug/Kg
Di-n-butylphthalate	97	167	333	ug/Kg
4,6-Dinitro-2-methylphenol	64	167	333	ug/Kg
2,4-Dinitrophenol	86	167	333	ug/Kg
2,4-Dinitrotoluene	58	167	333	ug/Kg
2-6-Dinitrotoluene	75	167	333	ug/Kg
Di-n-octylphthalate	97	167	333	ug/Kg
1,2-Diphenylhydrazine	0	167	333	ug/Kg
Fluoranthene	126	167	333	ug/Kg
Fluorene	60	167	333	ug/Kg
Hexachlorobenzene	68	167	333	ug/Kg
Hexachlorobutadiene	52	167	333	ug/Kg
Hexachlorocyclopentadiene	47	167	333	ug/Kg
Hexachloroethane	48	167	333	ug/Kg
Indeno(1,2,3-cd)pyrene	68	167	333	ug/Kg
Isophorone	68	167	333	ug/Kg
1-Methylnaphthalene	62	167	333	ug/Kg
2-Methylnaphthalene	71	167	333	ug/Kg
1-Methylphenanthrene	64	167	333	ug/Kg
2-Methylphenol	61	167	333	ug/Kg
4-Methylphenol	68	167	333	ug/Kg
Naphthalene	43	167	333	ug/Kg

Table 7: ESTABLISHED LIMIT OF DETECTION (LOD) & LIMIT OF QUANTITATION (LOQ)

PARAMETER	DL	LOD	LOQ	Unit	PARAMETER	DL	LOD	LOQ	Unit
2-Nitroaniline	1.36	5	10	ug/L	2-Nitroaniline	56	167	333	ug/Kg
3-Nitroaniline	1.35	5	10	ug/L	3-Nitroaniline	74	167	333	ug/Kg
4-Nitroaniline	2.19	5	10	ug/L	4-Nitroaniline	120	167	333	ug/Kg
Nitrobenzene	2.19	5	10	ug/L	Nitrobenzene	51	167	333	ug/Kg
2-Nitrophenol	2.12	5	10	ug/L	2-Nitrophenol	64	167	333	ug/Kg
4-Nitrophenol	2.03	5	10	ug/L	4-Nitrophenol	106	167	333	ug/Kg
n-Nitrosodimethylamine	1.62	5	10	ug/L	n-Nitrosodimethylamine	47	167	333	ug/Kg
n-Nitroso-di-n-propylamine	2.18	5	10	ug/L	n-Nitroso-di-n-propylamine	70	167	333	ug/Kg
n-Nitrosodiphenylamine	0.98	5	10	ug/L	n-Nitrosodiphenylamine	153	167	333	ug/Kg
Pentachlorophenol	2.33	5	10	ug/L	Pentachlorophenol	62	167	333	ug/Kg
Perylene	2.09	5	10	ug/L	Perylene	86	167	333	ug/Kg
Phenanthrene	1.70	5	10	ug/L	Phenanthrene	49	167	333	ug/Kg
Phenol	1.89	5	10	ug/L	Phenol	39	167	333	ug/Kg
Pyrene	2.22	5	10	ug/L	Pyrene	160	167	333	ug/Kg
Pyridine	11.42	20	40	ug/L	Pyridine	220	667	1333	ug/Kg
2,3,4,6-Tetrachlorophenol	3.61	5	10	ug/L	2,3,4,6-Tetrachlorophenol	104	167	333	ug/Kg
1,2,4-Trichlorobenzene	2.24	5	10	ug/L	1,2,4-Trichlorobenzene	44	167	333	ug/Kg
2,3,4-Trichlorophenol	2.02	5	10	ug/L	2,3,4-Trichlorophenol	64	167	333	ug/Kg
2,3,5-Trichlorophenol	1.66	5	10	ug/L	2,3,5-Trichlorophenol	165	167	333	ug/Kg
2,4,5-Trichlorophenol	1.57	5	10	ug/L	2,4,5-Trichlorophenol	91	167	333	ug/Kg
2,4,6-Trichlorophenol	1.64	5	10	ug/L	2,4,6-Trichlorophenol	61	167	333	ug/Kg
2,3,5-Trimethylnaphthalene	1.36	5	10	ug/L	2,3,5-Trimethylnaphthalene	69	167	333	ug/Kg
2-Fluorophenol	1.52	3	5	ug/L	2-Fluorophenol	37	100	167	ug/Kg
Phenol-d5	1.44	3	5	ug/L	Phenol-d5	45	100	167	ug/Kg
2-Fluorobiphenyl	0.41	1	2	ug/L	2-Fluorobiphenyl	16	33	167	ug/Kg
Nitrobenzene-d5	0.59	1	2	ug/L	Nitrobenzene-d5	22	33	167	ug/Kg
2,4,6-Tribromophenol	1.20	3	5	ug/L	2,4,6-Tribromophenol	60	100	167	ug/Kg
Terphenyl-d14	0.54	1	2	ug/L	Terphenyl-d14	39	33	167	ug/Kg

Note:

1. PSR supersedes Table 7
2. LOD and LOQ were established at the time this SOP is written.

Appendix 1: **SUMMARY OF QUALITY CONTROL PROCEDURES**

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
DFTPP Tune Check	Prior to calibration (ICAL, ICV or CCV)	Refer to criteria listed in the method description (Table 4)	Retune instrument and verify		
Breakdown Check	Prior to calibration (ICAL, ICV or CCV)	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Clean the injection port and repeat breakdown check. If problem persist cut or replace column.		
ICAL: At least 6-point calibration for all analytes	Initially; as needed	Min. RF: Refer to Table 6 %RSD ≤ 20% or r=0.99 with a min. of 6 ICAL points	Rule out outlier(s)/ bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
ICV: Second-source calibration verification	After initial calibration	Min. RF: Refer to Table 6 All analytes within ±30% of expected value	Rule out bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
DCC: Calibration Check	Daily, before sample analysis and every 12 hours of analysis time	Min. RF: Refer to Table 6 All analytes ≤ 20% diff.	Rule out bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
Retention time window calculated for each analyte	Each sample	Relative retention time (RRT) of the analyte within ± 0.06 RRT units of the RRT	Correct the problem then reanalyze all samples analyzed since the last retention time check		
Internal Standard	Every sample, spiked sample, standard, and method blank	Retention time ±30 seconds from retention time of the mid-point std. In the ICAL. EICP area within -50% to +100% of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning		
Method blank	One per preparation batch (≤ 20 samples per matrix)	In the absence of PSR apply No analytes detected > ½ LOQ	Rule out instrument contamination by re-analyzing the MB. If problem persist refer to PSR. In the absence of PSR, report NDs and results >10X of the MB concentration. Otherwise, cure contamination source, reprep and reanalyze method blank and all associated samples.		
LCS	One LCS per preparation (≤ 20 samples per matrix)	In the absence of PSR default to EMAX QC Limits	Cure probable source of LCS failure, reprep and reanalyze the LCS and all associated samples		
MS/MSD	One MS/MSD per every 20 project samples per matrix	In the absence of PSR default to EMAX QC Limits	Ensure that spike concentration and spike addition was accurate. If chromatogram exhibits matrix interference narrate observation in the case narrative.		
Surrogate spike	Every sample, spiked sample, standard, and method blank	In the absence of PSR default to 2 out of 3 Acid and 2 out of 3 BN surrogates should be within EMAX QC Limits.	If non-compliant and no apparent matrix interference is observed, re-extract and analyze sample. Otherwise inform the client for further instruction.		
Comments: Project specific requirements (PSR) supersede EMAX QCP. In the absence of PSR, apply "J" flag to results between LOD and LOQ, "B" flag to results associated with MB contamination. *Analytes known to have erratic chromatographic behavior: Benzidine, 4,6-dinitro-2-methylphenol, 4-chroanaline, benzyl alcohol, n-Nitrosodimethylamine, 4-nitrophenol, 2-nitroaniline, Pyridine, Benzoic Acid, and 3-nitroaniline					

Appendix 2: **DEMONSTRATION OF CAPABILITY**

PT # **WP0110 Water Pollution Proficiency Testing** **PT Study Closing Date: 2/18/2010**

Method: SW 3520 C/SW 8270 D **Analyst:** Vu Khoa

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
1	1,2,4,5-Tetrachlorobenzene	<10 ug/L	<10	-	Acceptable
2	1,2,4-Trichlorobenzene	68.9 ug/L	78.5	16.6-95	Acceptable
3	1,2-Dichlorobenzene	<10 ug/L	0.00	-	Acceptable
4	1,3-Dichlorobenzene	<10 ug/L	0.00	-	Acceptable
5	1,4-Dichlorobenzene	90.2 ug/L	108	10.8-129	Acceptable
6	1-Chloronaphthalene	<10 ug/L	<10	-	Acceptable
7	1-Methylnaphthalene	109 ug/L	119	23.8-214	Acceptable
8	2,3,4,6-Tetrachlorophenol	<20 ug/L	<50	-	Acceptable
9	2,4,5-Trichlorophenol	78.9 ug/L	85.6	31.2-111	Acceptable
10	2,4,6-Trichlorophenol	56.9 ug/L	63.5	20.3-82	Acceptable
11	2,4-Dichlorophenol	82.2 ug/L	95.1	30.2-118	Acceptable
12	2,4-Dimethylphenol	78.3 ug/L	92.9	19.1-122	Acceptable
13	2,4-Dinitrophenol	106 ug/L	137	13.7-189	Acceptable
14	2,4-Dinitrotoluene	73.1 ug/L	83.9	30.6-105	Acceptable
15	2,6-Dichlorophenol	85.1 ug/L	92.8	30.9-117	Acceptable
16	2,6-Dinitrotoluene	<10 ug/L	0.00	-	Acceptable
17	2-Chloronaphthalene	76.5 ug/L	88.0	26.8-107	Acceptable
18	2-Chlorophenol	94.1 ug/L	99.7	29.2-126	Acceptable
19	2-Methyl-4,6-Dinitrophenol	78.6 ug/L	94.7	29.2-132	Acceptable
20	2-Methylnaphthalene	84.9 ug/L	89.0	17-105	Acceptable
21	2-Methylphenol	78.9 ug/L	89.8	17-112	Acceptable
22	2-Nitroaniline	<10 ug/L	<10	-	Acceptable
23	2-Nitrophenol	71.7 ug/L	79.0	21.5-101	Acceptable
24	3,3'-Dichlorobenzidine	<10 ug/L	0.00	-	Acceptable
25	3-Nitroaniline	<10 ug/L	<10	-	Acceptable
26	3-Nitrophenol	<10 ug/L	<10	-	Acceptable
27	4-Bromophenyl-phenylether	87.6 ug/L	88.7	29.2-119	Acceptable
28	4-Chloro-3-methylphenol	78.6 ug/L	83.9	32.1-108	Acceptable
29	4-Chloroaniline	<10 ug/L	<50	-	Acceptable
30	4-Chlorophenyl-phenylether	73.4 ug/L	77.9	29.4-97	Acceptable
31	4-Methylphenol (and/or 3-Methylphenol)	92.2 ug/L	94.3	9.43-123	Acceptable
32	4-Nitroaniline	70.1 ug/L	83.1	16.6-150	Acceptable
33	4-Nitrophenol	122 ug/L	131	13.1-176	Acceptable
34	Acenaphthene	87.2 ug/L	95.1	37.8-113	Acceptable
35	Acenaphthylene	67 ug/L	74.2	29.2-90	Acceptable
36	Aniline	<20 ug/L	<10	-	Acceptable
37	Anthracene	86.3 ug/L	89.1	37.6-111	Acceptable
38	Benzidine	<50 ug/L	0.00	-	Acceptable
39	Benzo(a)anthracene	87.6 ug/L	82.9	37.6-105	Acceptable
40	Benzo(a)pyrene	70.5 ug/L	70.2	20.9-89	Acceptable

Appendix 2 con't.: **DEMONSTRATION OF CAPABILITY**

PT # **WP0110 Water Pollution Proficiency Testing** **PT Study Closing Date: 2/18/2010**

Method: SW 3520 C/SW 8270 D **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
41	Benzo(b)fluoranthene	<10 ug/L	0.00	-	Acceptable
42	Benzo(g,h,i)perylene	<10 ug/L	0.00	-	Acceptable
43	Benzo(k)fluoranthene	56 ug/L	59.0	14.2-86	Acceptable
44	Benzoic acid	78.8 ug/L	76.3	0-130	Acceptable
45	Benzyl alcohol	<10 ug/L	<50	-	Acceptable
46	bis(2-Chloroethoxy)methane	88.3 ug/L	90.9	35.8-108	Acceptable
47	bis(2-Chloroethyl)ether	65.6 ug/L	73.1	20.6-91	Acceptable
48	bis(2-Chloroiospropyl) ether	89.8 ug/L	98.5	24.7-121	Acceptable
49	bis(2-ethylhexyl) phthalate	68.9 ug/L	66.8	20.1-94	Acceptable
50	Butyl benzyl phthalate	65.1 ug/L	71.2	10-105	Acceptable
51	Carbazole	<10 ug/L	<10	-	Acceptable
52	Chrysene	<10 ug/L	0.00	-	Acceptable
53	Dibenzo(a,h)anthracene	58.9 ug/L	59.9	16.5-84	Acceptable
54	Dibenzofuran	108 ug/L	115	39.9-142	Acceptable
55	Diethyl phthalate	85.1 ug/L	93.1	16.6-130	Acceptable
56	Dimethyl phthalate	131 ug/L	138	13.8-199	Acceptable
57	Di-n-butylphthalate	77 ug/L	79.2	26.3-105	Acceptable
58	Di-n-octylphthalate	93.4 ug/L	99.3	22-147	Acceptable
59	Fluoranthene	84.8 ug/L	84.6	37.8-103	Acceptable
60	Fluorene	<10 ug/L	0.00	-	Acceptable
61	Hexachlorobenzene	<10 ug/L	0.00	-	Acceptable
62	Hexachlorobutadiene	94.8 ug/L	96.5	10.8-116	Acceptable
63	Hexachlorocyclopentadiene	<10 ug/L	0.00	-	Acceptable
64	Hexachloroethane	82.8 ug/L	93.3	9.7-110	Acceptable
65	Indeno(1,2,3, cd)pyrene	<10 ug/L	0.00	-	Acceptable
66	Isophorone	94.5 ug/L	103	40.5-133	Acceptable
67	Naphthalene	77.3 ug/L	85.3	23.4-103	Acceptable
68	Nitrobenzene	<10 ug/L	0.00	-	Acceptable
69	N-Nitrosodiethylamine	<10 ug/L	<10	-	Acceptable
70	N-Nitrosodimethylamine	88.2 ug/L	97.0	9.7-115	Acceptable
71	N-Nitroso-di-n-propylamine	83.3 ug/L	92.0	26.8-118	Acceptable
72	N-Nitrosodiphenylamine	51 ug/L	74.0	17.1-102	Acceptable
73	o-Toluidine	<10 ug/L	<10	-	Acceptable
74	p-Dioxane	<10 ug/L	<10	-	Acceptable
75	Pentachlorobenzene	<10 ug/L	<10	-	Acceptable
76	Pentachlorophenol	103 ug/L	108	27.9-149	Acceptable
77	Phenanthrene	<10 ug/L	0.00	-	Acceptable
78	Phenol	112 ug/L	103	10.3-139	Acceptable
79	Pyrene	80.6 ug/L	83.1	27.5-114	Acceptable
80	Pyridine	<40 ug/L	<10	-	Acceptable

Appendix 2 con't.: **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil / Hazardous Waste PT** **PT Study Closing Date: 3/4/2010**

Method: **SW 3550 C/SW 8270 D** **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
1	1,2,3,4-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
2	1,2,3,5-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
3	1,2,3-Trichlorobenzene	<330 ug/kg	<500	-	Acceptable
4	1,2,4,5-Tetrachlorobenzene	<330 ug/kg	<500	-	Acceptable
5	1,2,4-Trichlorobenzene	1000 ug/kg	1790	300-2070	Acceptable
6	1,2-Dichlorobenzene	<330 ug/kg	<300	-	Acceptable
7	1,3,5-Trichlorobenzene	<330 ug/kg	<500	-	Acceptable
8	1,3-Dichlorobenzene	<330 ug/kg	<300	-	Acceptable
9	1,4-Dichlorobenzene	1000 ug/kg	1920	300-2120	Acceptable
10	1-Chloronaphthalene	<330 ug/kg	<500	-	Acceptable
11	2,3,4,5-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
12	2,3,4,6-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
13	2,3,4-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
14	2,3,5,6-Tetrachlorophenol	<330 ug/kg	<500	-	Acceptable
15	2,3,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
16	2,3,6-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
17	2,3-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
18	2,4,5-Trichlorophenol	1130 ug/kg	1900	300-2300	Acceptable
19	2,4,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
20	2,4,6-Trichlorophenol	958 ug/kg	1800	300-2240	Acceptable
21	2,4,6-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
22	2,4-Dibromophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
23	2,4-Dichlorophenol	962 ug/kg	1800	300-2260	Acceptable
24	2,4-Dichlorophenyl-3-methyl-4-nitrophenyle	<330 ug/kg	<500	-	Acceptable
25	2,4-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
26	2,4-Dimethylphenol	1080 ug/kg	3790	505-4170	Acceptable
27	2,4-Dinitrophenol	<660 ug/kg	<600	-	Acceptable
28	2,4-Dinitrotoluene	1240 ug/kg	1820	300-2570	Acceptable
29	2,5-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
30	2,6-Dichlorophenol	1160 ug/kg	2110	523-2330	Acceptable
31	2,6-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
32	2,6-Dinitrotoluene	<330 ug/kg	<300	-	Acceptable
33	2-Amino-1-methylbenzene	<330 ug/kg	<500	-	Acceptable
34	2-Chloronaphthalene	613 ug/kg	1120	200-1350	Acceptable
35	2-Chlorophenol	1190 ug/kg	2300	300-2870	Acceptable
36	2-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
37	2-Methyl-4,6-Dinitrophenol	<660 ug/kg	<600	-	Acceptable
38	2-Methylnaphthalene	961 ug/kg	1620	426-1780	Acceptable
39	2-Methylphenol	2470 ug/kg	5190	600-5710	Acceptable

Appendix 2 con't.: **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil / Hazardous Waste PT** **PT Study Closing Date: 3/4/2010**

Method: SW 3550 C/SW 8270 D **Analyst:** Vu Khoa

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
40	2-Nitroaniline	<330 ug/kg	<500	-	Acceptable
41	2-Nitrophenol	1510 ug/kg	3630	600-3990	Acceptable
42	3,3'-Dichlorobenzidine	<330 ug/kg	<500	-	Acceptable
43	3,4,5-Trichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
44	3,4-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
45	3,5-Dichlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
46	3-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
47	3-Nitroaniline	<330 ug/kg	<500	-	Acceptable
48	3-Nitrophenol	<330 ug/kg	<500	-	Acceptable
49	4-Bromophenyl-phenylether	2300 ug/kg	3040	836-3580	Acceptable
50	4-Chloro-3-methylphenol	<330 ug/kg	<300	-	Acceptable
51	4-Chloroaniline	655 ug/kg	815	0-1960	Acceptable
52	4-Chlorophenyl-4-nitrophenylether	<330 ug/kg	<500	-	Acceptable
53	4-Chlorophenyl-phenylether	2370 ug/kg	3390	842-3930	Acceptable
54	4-Methylphenol (and/or 3-Methylphenol)	2400 ug/kg	4600	1200-5060	Acceptable
55	4-Nitroaniline	1200 ug/kg	1070	107-4210	Acceptable
56	4-Nitrophenol	1830 ug/kg	5500	600-6600	Acceptable
57	4-Nitrophenylphenylether	<330 ug/kg	<500	-	Acceptable
58	Acenaphthene	870 ug/kg	1420	200-1820	Acceptable
59	Acenaphthylene	863 ug/kg	1500	228-1930	Acceptable
60	Aniline	<660 ug/kg	<500	-	Acceptable
61	Anthracene	1380 ug/kg	1850	343-2420	Acceptable
62	Benzidine	<1300 ug/kg	<500	-	Acceptable
63	Benzo(a)anthracene	1240 ug/kg	1400	364-1890	Acceptable
64	Benzo(a)pyrene	1110 ug/kg	1340	319-1840	Acceptable
65	Benzo(b)fluoranthene	<330 ug/kg	<200	-	Acceptable
66	Benzo(g,h,i)perylene	<330 ug/kg	<200	-	Acceptable
67	Benzo(k)fluoranthene	1330 ug/kg	1760	444-2240	Acceptable
68	Benzoic acid	<1300 ug/kg	<500	-	Acceptable
69	Benzotrichloride	<330 ug/kg	<500	-	Acceptable
70	Benzyl alcohol	<330 ug/kg	<500	-	Acceptable
71	Benzyl chloride	<330 ug/kg	<500	-	Acceptable
72	Bis(2-chloroethoxy)methane	993 ug/kg	1710	300-2120	Acceptable
73	bis(2-Chloroethyl)ether	977 ug/kg	1840	229-2020	Acceptable
74	Bis(2-chloroisopropyl) ether	<330 ug/kg	<300	-	Acceptable
75	Bis(2-ethylhexyl)phthalate	1600 ug/kg	1690	300-2660	Acceptable
76	bis(2-methoxyethyl)phthalate	<330 ug/kg	<500	-	Acceptable
77	Butyl benzyl phthalate	1790 ug/kg	2130	446-2840	Acceptable
78	Carbazole	<330 ug/kg	<500	-	Acceptable

Appendix 2 con't.: **DEMONSTRATION OF CAPABILITY**

PT # **HW0110 Soil / Hazardous Waste PT** **PT Study Closing Date: 3/4/2010**

Method: **SW 3550 C/SW 8270 D** **Analyst: Vu Khoa**

#	Analyte	Result	Assigned Value	Acceptance Limits	Comment
79	Chrysene	<330 ug/kg	<200	-	Acceptable
80	Diamylphthalate	<330 ug/kg	<500	-	Acceptable
81	Dibenzo(a,h)anthracene	1110 ug/kg	1260	200-1910	Acceptable
82	Dibenzofuran	1660 ug/kg	2520	648-2990	Acceptable
83	Dicyclohexylphthalate	<330 ug/kg	<500	-	Acceptable
84	Diethylphthalate	1200 ug/kg	1830	300-2420	Acceptable
85	Dimethylphthalate	1270 ug/kg	1970	300-2550	Acceptable
86	Di-n-butylphthalate	1530 ug/kg	1900	300-2730	Acceptable
87	Di-n-octylphthalate	1750 ug/kg	1950	300-2900	Acceptable
88	Dinonylphthalate	<330 ug/kg	<500	-	Acceptable
89	Fluoranthene	2000 ug/kg	2360	720-3040	Acceptable
90	Fluorene	1260 ug/kg	1820	349-2340	Acceptable
91	Hexachlorobenzene	<330 ug/kg	<300	-	Acceptable
92	Hexachlorobutadiene	1140 ug/kg	1900	300-2400	Acceptable
93	Hexachlorocyclohexane	<330 ug/kg	<500	-	Acceptable
94	Hexachlorocyclopentadiene	<330 ug/kg	<300	-	Acceptable
95	Hexachloroethane	895 ug/kg	1840	71.8-2050	Acceptable
96	Hexyl-2-ethylhexylphthalate	<330 ug/kg	<500	-	Acceptable
97	Indeno(1,2,3-cd)pyrene	<330 ug/kg	<200	-	Acceptable
98	Isophorone	814 ug/kg	1740	423-1920	Acceptable
99	Maleic anhydride	<330 ug/kg	<500	-	Acceptable
100	Naphthalene	1050 ug/kg	1830	218-2160	Acceptable
101	Nitrobenzene	1040 ug/kg	1920	300-2430	Acceptable
102	N-Nitrosodiethylamine	<330 ug/kg	<1500	-	Acceptable
103	N-Nitrosodimethylamine	653 ug/kg	1860	0-2040	Acceptable
104	N-Nitroso-di-n-propylamine	<330 ug/kg	<300	-	Acceptable
105	N-Nitrosodiphenylamine	1000 ug/kg	1700	422-1990	Acceptable
106	Pentachlorobenzene	<330 ug/kg	<500	-	Acceptable
107	Pentachlorohexane	<330 ug/kg	<500	-	Acceptable
108	Pentachlorophenol	2550 ug/kg	5790	600-6370	Acceptable
109	Phenanthrene	1360 ug/kg	1810	372-2330	Acceptable
110	Phenol	1930 ug/kg	3800	380-4280	Acceptable
111	Pyrene	1390 ug/kg	1720	497-2270	Acceptable
112	Pyridine	<1300 ug/kg	<500	-	Acceptable

8270FA: **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

Page 1

ANALYSIS LOG FOR SEMIVOLATILES

SOP ☐ EMAX-8270 Rev. No. 4 ☐ EMAX-8270SIM Rev. No. 1 ☐ EMAX-CLPSVOA ☐ EMAX-M8270SIM Rev. No. 1 ☐ Book #AE4 -007

Method File: Tune File: Start Date/Time: End Date/Time:

ANALYTICAL BATCH : _____

Preparative Batch	Data File Name	Run ID	DF	Matrix		Notes
				S	W	

Instrument No:	E4
INITIAL CALIBRATION REFERENCE	
Date	
ICAL ID	

Standards		
Name	ID	Conc. (mg/L)
DFTPP		
INT. STD.		
ICV		
DCC		
BENZIDINE		
APP 9		
APP 9 ADD		

Solvent	ID	
CH_2Cl_2		

DATA FILE	

Electronic Data Archival	
Location	Date
HPCHEM_SVOA/TOE4	

Comments: _____

Analyzed By: _____

Date Disposed: _____

Disposed By: _____

This page is checked during data review.

8270FS: **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

Page 1

EXTRACTION LOG FOR SEMIVOLATILES

SOP ☐ EMAX-3540 Rev. No.: 0 ☐ EMAX-3510 Rev. No.: 1 ☐ EMAX-3550 Rev. No.: 2 ☐ EMAX-3520 Rev. No.: 2 ☐ EMAX-CLP-SVOA ☐ Book # ESV-058

Matrix: Init.Start Date/Time: End Date/Time: Final Start Date/Time: End Date/Time:

PREPARATION BATCH: * _____

Sample Prep ID	Lab Sample ID	Sonicator Number	Sample Amount (g/ml)	pH	Extract Volume (ml)	Clean-up [G] [F] [A] [S]	Notes
*01							
*02							
*03							
*04							
*05							
*06							
*07							
*08							
*09							
*10							
*11							
*12							
*13							
*14							
*15							
*16							
*17							
*18							
*19							
*20							
*21							
*22							
*23							
*24							
*25							
*26							
*27							
*28							

Standards	ID	Amount Added (ml)
Surrogate		
LCS/MS		
Micropipette Check		

Reagent	Lot# / ID
CH_2Cl_2	
Na_2SO_4	
H_2SO_4	
NaOH	
Silica Sand	

TUNING

Sonicator #	Reading

Concentrator	Water Bath Temperature Setting (°C)	Thermometer Reading (°C)
1		
2		
3		
4		
5		
6		

Comments: Thermometer ID = T_1

Prepared By: Witnessed By:

Standard Added By:

Checked By:

Extract Received by: Location:

Disposed by: Disposed on:

Clean-up Legend :[G]=GPC [A]=Acid [F]=Florisil [S]=Silica

8270FM: INSTRUMENT MAINTENANCE LOG

Page 1

EMAX LABORATORIES, INC.

INSTRUMENT MAINTENANCE LOG

Instrument No: E4 Month: Year: 201_ Book #: ME4 -003

Date							
Column Head Pressure: 70 - 100 (KPa)							
Run Instrument Blank							
Column Temperature							
Autosampler							
Calibration curve updated							
Verify computer date & clock							
Check printer paper							
Change Septa							
Clean Linear							
Analyst Initial							
TroubleShooting							
Problems Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

STANDARD OPERATING PROCEDURE
SAMPLE MANAGEMENT

SOP No.:	EMAX-SM01	Revision No.	5	Effective Date:	03-Mar-10
Prepared By:	Jonathan Luna			Date:	03-03-10
Approved By:	Kenette J. Pimentel QA Manager			Date:	03.03.10
Approved By:	Caspar Pang Laboratory Director			Date:	3/3/10
				Control Number:	**SM01-05**

1.0 PURPOSE

1.1. To describe EMAX's sample management, its internal control and work order distribution.

1.2. To ensure that samples and extracts under EMAX's custody shall be traceable at all times.

1.3. To maintain the internal sample custody to stand legally defensible by documenting the history of a sample, assuring that it has always been under the custody of an authorized individual, and that no sample is accidentally or purposely tampered.

2.0 POLICIES

2.1. Any sample processed for analysis must be handled under the chain-of-custody protocol. A sample is under custody when one of the following conditions is met:

- It is in your possession.
- It is in your view after being in your possession.
- It was in your possession and you locked or sealed it up to prevent tampering.
- It is in a designated secure area. The secured area is one, which is accessible only to authorized personnel.
- All EMAX personnel associated with the analytical process should understand the requirements for the chain-of-custody protocol and shall comply with the provisions of this procedure.

2.2. The Sample Custodian or designee shall be responsible for relinquishing the samples from the sample control room and receiving the samples back when returned. The Sample Custodian is also responsible to make sure that the ICOC is properly filled-out.

2.3. Any analyst having a sample in his/her possession is responsible for its custody and integrity. He/she shall be responsible in returning the samples to their designated storage area, under the supervision of the Sample Custodian.

2.4. The Department Supervisor shall be responsible for enforcing the policies set forth in this SOP.

2.5. Change orders shall be initiated by the Project Manager (PM). In the absence of the PM, the Laboratory director or the Operations Manager may act on behalf of the PM and will leave a copy of the change order on the PM's mailbox.

2.6. All discrepancies/anomalies related to sample management shall be forwarded to the PM to obtain proper resolution.

2.7. The QA Manager shall be responsible to ensure that the activities performed in this Section is in compliance to all requirements of the different programs EMAX is currently in participation.

3.0 ASSOCIATED SOP

3.1. EMAX-SM02 - Sample Receiving

3.2. EMAX-QC03 - Refrigerator Control

3.3. EMAX-QC04 - Balance Calibration

3.4. EMAX-RS02 - Receiving Radioactive Material

3.5. EMAX-RS03 - Control of Radioactive Samples

4.0 SAFETY

4.1. All sample compositing and sub-sampling must be done under a fume hood.

4.2. Sample Chain-of-Custody (COC) comment section shall be read prior to starting sample inspection. Any information that may cause hazard to those that will handle, process and/or analyze the sample(s) shall be disseminated in advanced by the Sample Custodian.

4.3. All samples shall be treated as potential hazards. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves, shall be worn at all times when performing this procedure.

5.0 PROCEDURES

5.1. EMAX Control Number (ECN)

5.1.1. Generate an ECN to uniquely identify every group of samples received from one project on the same day (refer to Section 6.1 for definition) using the convention below.

YYMNNN

Where:

YY -Last two digits of the calendar year. (i.e., 00, 01, 03, etc)

M -The month in which the sample is brought in (A-Jan., B-Feb. … L-Dec.)

NNN -The sequential number that resets to 001for the first group of samples received every month

Example: The ECN for the first group of samples received from project XYZ on January of 2008 shall be ***08A001.***

5.2. **Lab Sample ID (LSID) and Lab Sample Container ID (LSCID)**

5.2.1. Assign a LSID to uniquely identify each sample received using the ECN followed by a two digit sequential number that resets to "01" in every ECN. This number corresponds with each client sample ID.

5.2.2. Assign a LSCID to uniquely identify each sample container received using the LSID followed by a three digit sequential number that resets to "001" in every ECN.

Example: The first group of sample received for the month of January 2008 were two vials for volatile bearing the same ID and two other samples bearing different IDs for metals analysis. The control numbers and sample labels shall read as follows:

ECN	*LSID*	*LSCID*	*Sample Containers*
08A001	*A001-01*	*A001-01-001* *A001-01-002*	*2*
08A001	*A001-02*	*A001-02-003*	*1*
08A001	*A001-03*	*A001-03-004*	*1*

5.3. **Sample Delivery Group1 (SDG)**

5.3.1. Group samples received within 14 days or less not to exceed 20 per analysis, per matrix.

5.3.2. If an SDG is composed of more than one delivery, assign the first ECN as the SDG number. The ECN number is the SDG number if SDG is completed in one delivery.

5.4. **Sample Receiving**

[1] This system of sample grouping shall only be applicable when it is specified by the project. Refer to 6.1 for definition.

5.4.1. Check that samples received have Project Specific Requirement (PSR) ready. If not, check with the Operations Manager for further advice. For samples from DOE refer to EMAX-RS01 and EMAX-RS03.

5.4.2. Login every group of samples received in the ECN Log (see Appendix 1).

5.4.3. Follow the procedures detailed in SOP EMAX-SM02 – Sample Receiving.

5.4.4. Drop a copy of the COC on each box mounted in front of the Sample Login Office.

5.4.5. The PM scans the COC, and drops it at: EMAX Network/ScanJobsonScanstation/SampleReceivingDocument, using the SDG as its filename (e.g. 08D129.pdf).

5.4.6. If discrepancies are found at this stage, the PM resolves the issue(s) and provides a copy of the resolution where applicable.

5.5. **Processing Work Orders**

5.5.1. Prepare Master Folder to contain the following:

- Original COC
- Airbill (if any)
- Original Sample Receipt Forms (SRF1 & SRF2)
- Copy of the Project Specific Requirement (PSR)

5.5.2. Prepare Analytical Folders for each analysis requested in the COC.

5.5.2.1. Choose the type of folder to be used.

- Use Manila folders for samples with regular turn around time (more than five working days).
- Use green folders for all samples with RUSH (seven working days or less) turn around time.
- Use specified folder color for projects with designated color code.

5.5.2.2. The folder tab shall contain the following information:

- Analysis
- Client/Project
- EMAX Control Number (ECN)

5.5.2.3. The analytical folders shall contain the following:

- Copy of the Work Order

- Copy of the PSR
- Summary of QC Procedures (PSR)
- RL & QC Limits
- Other pertinent instructions/information for the analytical and/or reporting process, e.g. SRFs with discrepancies/corrective actions, change orders, etc.

5.5.3. Routing the Work Order

5.5.3.1. Endorse the Master Folder and the analytical folders to the Project Manager (PM) for review.

5.5.3.2. The PM reviews the Master Folder

5.5.3.3. After which the PM drops the analytical folders to the supervisor's work order boxes and the master folder to Data Processing.

5.5.3.4. Department Supervisors distributes the workload to analysts.

5.6. **Project Management**

5.6.1. Review of SRF

5.6.1.1. Sample Management reviews the SRFs to make sure that the form is properly filled and discrepancies (if any) are described properly and accurately.

5.6.1.2. The Project Manager reviews the SRF and resolves discrepancies (if any) contained in the SRF. Resolutions shall be documented/attached in the SRF and the PM shall inform all parties affected.

5.6.2. Electronic Sample Login

5.6.2.1. Using LabWorks LIMS, login the following:

- Client Information [name, project, address, recipient of report]
- Sample Information [client sample ID, collection date / time, receiving / due dates, EMAX control number]

5.6.2.2. Refer to LabWorks User's Manual for software operation procedures.

5.6.2.3. Generate review sheet and submit the review sheet to the PM.

5.6.2.4. The PM reviews the login and initials and dates the review sheet. If corrections are necessary, the review sheet with corrections is returned to the LIMS login for correction. Repeat the process until all information is correctly logged-in.

5.6.2.5. The PM attaches the review sheet(s) in the Master Folder and all pertinent records to the Master Folder and forwards the Master Folder to the LIMS login.

5.6.2.6. LIMS login generates the Analytical Record, attach it to the Master Folder and drops it to the Data Processing Master Folder box.

5.7. **Sample Storage**

5.7.1. Place the water samples for volatile analysis in refrigerators designated for volatile water sample storage only.

5.7.2. Place the soil samples for volatile analysis in refrigerators designated for volatile samples only, if the samples are received with separate container for volatiles.

5.7.3. Whenever possible, place the samples from the same project in one refrigerator.

5.7.4. Samples known to have high concentrations, pure products, and samples for leaching (TCLP, WET, etc.) shall be placed in double zipped locked bags before placing them inside the refrigerator.

5.7.5. Store samples for metal analysis in the same condition as they are received. Samples for Mercury must be stored at $\leq 6^{o}C$.

5.7.6. Place samples from overseas in refrigerator designated for overseas samples only.

5.7.7. Record the sample location on the ECN log, COC and Internal COC (ICOC).

5.8. **Internal Chain-of-Custody (ICOC)**

5.8.1. Fill-out the ICOC (see Appendix 2) and request for the sample release from the Sample Custodian.

5.8.2. When returning samples in the Sample Control Room, fill-out the return portion of the ICOC and endorse the samples to the Sample Custodian.

5.8.3. After the Sample Custodian has verified the returned samples, place the samples to its original location.

5.9. **Processing Change Orders**

5.9.1. Fill-out change order form (see Appendix 3)

5.9.2. Attach the information re-change order (i.e. written correspondence from the client, telephone log, etc.)

5.9.3. Endorse to Sample Custodian.

- If change order happens prior to release of Master Folder and analytical folders, incorporate the change order into the routing of work order.
- If change order involves additional analysis request after the original report has been generated, add a suffix letter to the ECN, sequential to the change orders (i.e. 00A001A, 00A001B...), then process the change order as a regular work order.
- If the change order involves cancellation of work order, make copies of the cancellation order and distribute to the Sections listed in COC Receipt form. Obtain the recipients' initials on the original change order form. File the original form with the Master Folder.

5.9.4. Recipients of change orders direct the implementation change order.

5.10. **Extract Storage and Custody**

5.10.1. Store the extracts in the designated extract refrigerator sequentially, in the order of the preparation batch, separating each batch by an empty slot.

5.10.2. Custody of extracts shall remain on the recipient until endorse for disposal.

5.11. **Sample Shipping**

5.11.1. Provide a COC and shipping instruction (PM or designee) to the Sample Custodian for the samples to be shipped.

5.11.2. Withdraw the samples from the storage and line them up according to the COC order.

5.11.3. Have the Sample Custodian or the alternate Sample Custodian to countercheck for completeness of the samples requested for shipping.

5.11.4. Wrap each sample with bubble pack and place it in a zip-locked bag. Make sure that it is properly sealed.

5.11.5. Pack the samples in a cooler and place adequate ice to maintain $\leq 6\ ^{o}C$ for at least 48 hours.

5.11.6. Label the cooler(s) and if it shall be shipped through a third party courier (FEDEX, UPS, etc.) weigh the cooler(s). Labels shall, at a minimum contain:

- Name of Company/Project
- Attention Line
- Street Address
- City, State, Zip Code
- Telephone Number of Contact Person/Recipient

5.11.7. Inform the Supervisor or a designee that the sample shipment is ready for checking. The Supervisor or a designee shall check for the following:

- Verify that all samples were checked for completeness.
- Check that each sample was properly packed.
- Check that it is going to where it is intended.

5.11.8. Give a copy of the signed/dated COC to the PM.

5.12. **Composite Samples**

5.12.1. For soil samples, discard the top half-inch and any artifacts (e.g., vegetation, rocks, wood, etc) of each sample to be composited.

5.12.2. Place a clean 32-oz jar in a balance and tare-off.

5.12.3. Transfer 30-g to the jar from the first sample, then tare-off. Repeat this process until all samples to be composited is aliquoted.

Note: Sample amount may be adjusted to conform to the required analyses, as long as equal amounts shall be taken from each sample.

5.12.4. Using a clean stainless steel spatula, thoroughly mix the sample contained in the composite jar.

5.12.5. Label the jar using EMAX labeling convention corresponding to client composite sample ID.

5.12.6. Document the activity done on the COC comment section, sign and date it.

5.13. **Sub-Sampling**

5.13.1. The sub-sample procedure detailed below is applicable to all samples received at EMAX unless otherwise other specific sub-sampling instruction is stipulated in the project specific requirement (PSR).

5.13.2. Solid Samples

5.13.2.1. For soil samples, discard the top half-inch of the sample and any artifacts (e.g., vegetations, rocks, wood, etc.). Homogenize the sample and bring to room temperature.

5.13.2.2. For other solid matrices (e.g., concrete, roofing material, building debris, etc.), refer to project specific instruction. In the absence of project specific instruction, perform particle size reduction to pass through #10 sieve.

5.13.2.3. Check that the balance to be used was check for the days use.

5.13.2.4. Place the labeled subsample container on the balance and tare it off.

5.13.2.5. Scoop subsample and transfer the entire content of the scoop into subsample container. Repeat this process until the approximate weight is achieved (e.g., if subsample needed is 30g and the sample weighs is 29.67g or 32.24g after the last scoop was added, then you have achieved the desired weight). Record the reading as it appears on the balance display screen.

Note: Do not target exact weights (e.g., 30.00 ± 0.01g).

5.13.3. For projects requiring sectorial splitting or multi-incremental subsampling, perform sectorial splitting procedure for soil samples.

5.13.4. Sectorial Splitting[2]

5.13.4.1. If the sample is relatively wet (unworkable to sieve through #10 sieve), spread the soil sample into a pan and air dry until it appears to be surface dry and manageable to pass through #10 sieve. Otherwise proceed to the next step.

5.13.4.2. Note presence of vegetation, rocks, wood or any other artifacts in the internal chain of custody and discard them.

5.13.4.3. Pass the sample through #10 sieve.

- Store the sample passing through the sieve on clean properly labeled sample jar where further subsampling is obtained.
- Put the sample retained in the sieve back to the original container. When possible return this portion to the client.

5.13.4.4. Obtain subsample following the steps below.

5.13.4.4.1. Position a subsample receptacle on each valley of paper cone sectorial splitter.

5.13.4.4.2. Pour the sample on funnel situated above the sectorial splitter.

5.13.4.4.3. Open the funnel so that the sample will freely fall above the sectorial splitter approximately distributing the same amount of sample on each receptacle.

[2] EPA's Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples (EPA/600/R-03/027)

5.13.4.4.4. If there is a need for smaller quantity of sample then repeat the process using one of the subsamples collected until the approximate desired amount is obtained. Record the balance reading as observed.

Note: Do not target exact weights (e.g., 30.00 ± 0.01g).

5.13.5. Aqueous Samples

5.13.5.1. Bring the sample to equilibrate with the room temperature.

5.13.5.2. For samples requiring chemical preservatives to be maintained at a certain pH level, shake the container and verify the pH (refer to EMAX-SM02, Section 5.2.8, 4th check mark.) and record the observation in the sample preparation or analytical log (e.g., pH<2 or pH>12).

5.13.5.3. Shake the sample container to obtain matrix homogeneity (unless the analytical procedure prevents sample agitation during sub-sampling), measure the representative sub-sample using a Class A or verified volumetric measuring device and transfer to a properly labeled sub-sample container.

5.13.6. Uniquely identify the sub-sample with the sample preparation ID.

5.14. **Sample Disposal**

5.14.1. Endorse all unused samples that are stored in the sample control room to Waste Management Unit upon getting an approval from the PM.

5.14.2. Samples from overseas have to be identified properly when endorsing to ensure proper treatment prior to disposal.

5.14.3. Endorse all unused extracts/digestates to Waste Management Unit after 60 days from date of extraction/digestion unless otherwise specified by the project.

6.0 QUALITY CONTROL

6.1. Storage refrigerators for volatile samples shall be monitored to ensure that no cross contamination happens during the storage period.

6.2. Electronic login shall be reviewed by the PM or his/her designee, for correctness and completeness.

6.3. All samples withdrawn/returned shall be acknowledged with initials of both the receiver and the Sample Custodian or his/her designee.

6.4. All extracts received shall be acknowledged with the initial and date of receipt.

6.5. All samples/extracts, except leachates for metals analyses, shall be stored at $\leq 6\ ^{o}C$, unless otherwise specified by the project.

6.6. All samples shall be traceable from the time it is received to the date it is disposed. Records shall be maintained at all stations.

6.7. Labels used for samples to extracts shall be durable.

6.8. All label markings shall be legible and only indelible ink shall be used.

6.9. Refrigerators used to store samples must be maintained and monitored as described in EMAX-QC03– Refrigerator Control.

6.10. In case of power failure, maintain all refrigerators closed for a maximum of two hours to maintain the temperature $\leq 6\ ^{o}C$. If power does not come back within two hours, place ice bags in the refrigerators sufficient enough to maintain the required temperature. Monitor the refrigerators every two hours until the power is restored. Record the readings in the temperature/freezer log.

7.0 SUPPLEMENTARY NOTES

7.1. Definition of Terms

7.1.1. Chain-of-Custody (COC) – is a record where sample custody transfer is documented. At a minimum the COC shall contain the project ID, sample ID, sampling location, date/time of collection, chemical preservatives (if any) dated signatures of individuals involved in the sample transfer.

7.1.2. Composite Sample – is an equal amount of sample aliquot combined together from specified sample containers.

7.1.3. Corrective Action - Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

7.1.4. EMAX Control Number (ECN) – is an identification given to a group of samples received from a project that arrived on the same day accompanied by a chain-of-custody (COC). Grouping of samples is determined by either the project or the Project Manager's discretion.

7.1.5. Internal COC (ICOC) – is a record used by the laboratory to document when samples are withdrawn from the sample control room. This record shall contain the Lab Sample IDs and Lab Sample Container IDs of samples withdrawn, the intended analysis, the initials of the custodian and recipients, and the date and time of sample turn over.

7.1.6. Lab Sample ID (LSID) – is EMAX sample identification to uniquely identify each sample.

7.1.7. Lab Sample Container ID (LSCID) – is EMAX sample container identification to uniquely identify each sample container.

7.1.8. Sample Receipt Form 1 (SRF1)- is a record where to logged-in the type of delivery, who delivered the samples, the packaging condition, temperature upon receipt and the conditions or any discrepancies of samples during receiving.

7.1.9. Sample Receipt Form 2 (SRF2)- is a record where to logged-in the container type, any chemical preservative and conditions per container of samples upon receipt.

7.1.10. Non-conformance - An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

7.1.11. Preservative – is a chemical added to a sample to maintain its integrity prior to analysis.

7.1.12. Project Specific Requirement (PSR) – is a document containing the summary of project requirements, the QC references and other information needed to complete the work order.

7.1.13. Sample – is a specimen received in the laboratory bearing a unique client sample ID traceable to the accompanying COC. Each unique client sample ID shall have a corresponding unique Lab Sample ID, unless otherwise specified by the project. Hence, samples collected in different containers having the same client sample ID are labeled with the same corresponding Lab Sample ID.

7.1.14. Sample Delivery Group (SDG) – is a group of samples received over a period of 14 days or less, not exceeding 20 samples per analysis per matrix.

7.1.15. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

7.1.16. Trip Blank – is a target-analyte-free sample, which travels with the sample to monitor possible contamination during sample transport. This sample is analyzed for volatiles.

7.2. Sample management described in this SOP shall be applicable to all projects. In instances where there is project or program specific requirement, the project specification shall take precedence over this SOP.

8.0 FIGURES & FORMS

8.1. Figures

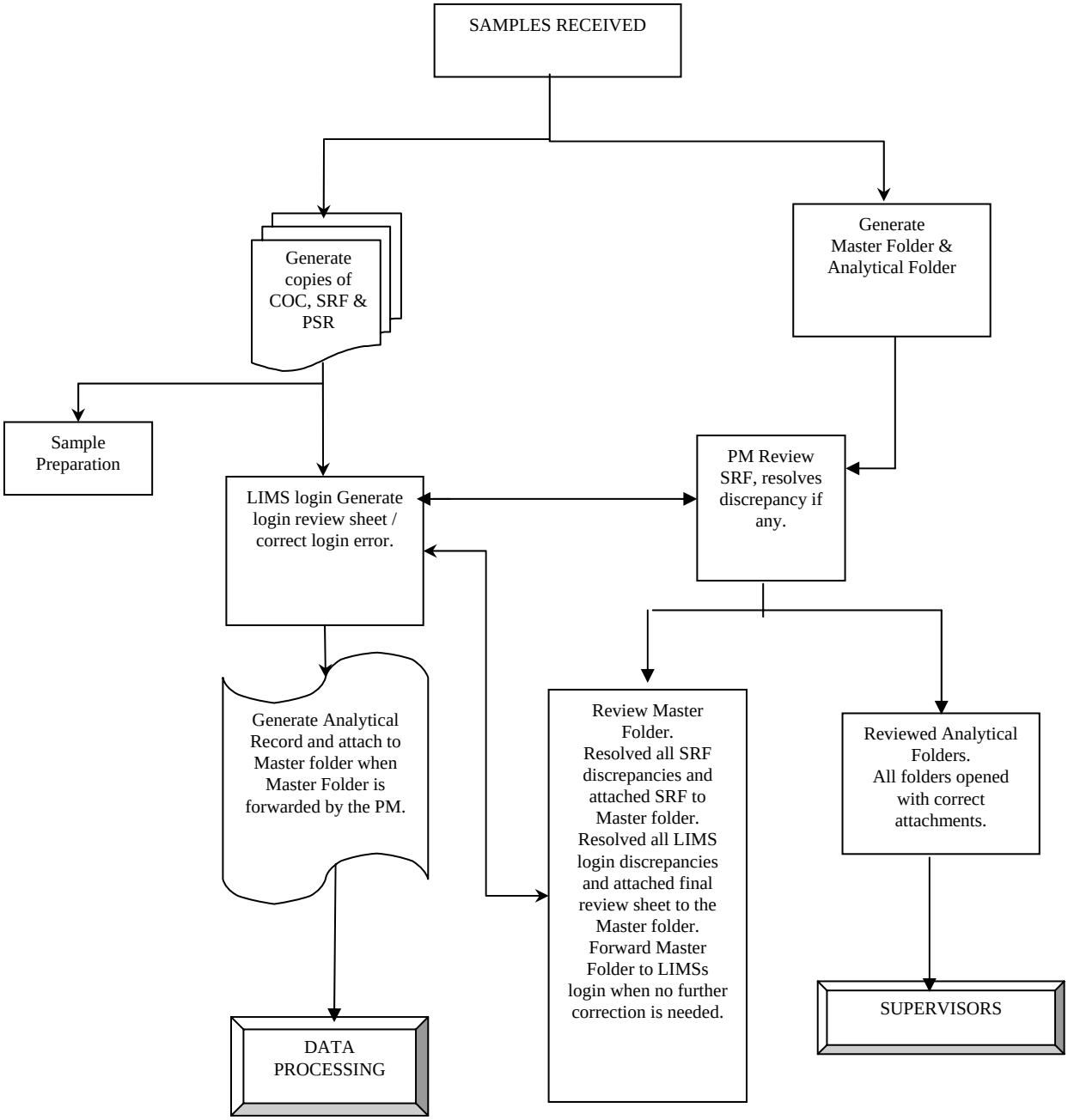
8.1.1. Figure 1 - Work Order System Flow

8.2. Forms

8.2.1. SM01F1 – EMAX Control Number Log

8.2.2. SM01F2 – Internal Chain-of-Custody

FIGURE I: **WORK ORDER SYSTEM FLOW**



SM01F1:

EMAX LABORATORIES, INC.

EMAX CONTROL NUMBER LOG

Book # ECNL-2010 A-F

YEAR 2010 MONTH JANUARY CODE A

Date		Batch	Client	Project	Delivery /	Sample Location					Recipient	
MM	DD	Number			Pick-up	S	W	Vs	Vw	O	Initials	COMMENTS
01		10A001										
01		10A002										
01		10A003										
01		10A004										
01		10A005										
01		10A006										
01		10A007										
01		10A008										
01		10A009										
01		10A010										
01		10A011										
01		10A012										
01		10A013										
01		10A014										
01		10A015										
01		10A016										
01		10A017										
01		10A018										
01		10A019										
01		10A020										
01		10A021										
01		10A022										
01		10A023										
01		10A024										
01		10A025										

S=SOIL W=WATER
V = VOLATILES
O = OTHER

Residual samples disposed by:_____

on:_____

SM01F2:

EMAX LABORATORIES, INC.

Page 1

INTERNAL CHAIN OF CUSTODY

ECN BOOK # ICOC-10-02

SAMPLE LOCATION								
SOIL	WATER WITH NO CHEMICAL PRESERVATIVE		WATER WITH CHEMICAL PRESERVATIVE					OTHERS
	AMBER	PLASTIC	HNO_3	HCl	H_2SO_4	NaOH [+Zn(Ac)$_2$]	O&G	

RELINQUISHED				LSID (*)	LSCID	ANALYSIS	MATRIX			RETURNED				REMARKS
BY	TO	DATE	TIME				S	W	OTHER	BY	TO	DATE	TIME	
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									
					*									

*LSID - Lab Sample ID
LSCID - Lab Sample Container ID

Disposed by: _____
Disposal Date: _____

PRINT DRF

STANDARD OPERATING PROCEDURE

SAMPLE RECEIVING

SOP No.:	EMAX-SM02	Revision No.	5	Effective Date:	2-Mar-09
Prepared By:	Tu Nisamaneepong			Date:	03-02-09
Approved By:	Kenette Pimentel QA Manager			Date:	03.02.09
Approved By:	Caspar Pang Laboratory Director			Date:	3/2/09

Control Number: SM02-05-

1.0 PURPOSE

1.1. To describe sample acceptance policy, sample receiving and sample storage procedures.

2.0 POLICIES

2.1. Any sample received by EMAX Laboratories Inc. must be processed as described in this procedure to ensure that inspection is thorough, the documentation is complete and the chain of custody is maintained.

2.2. The Sample Custodian shall be responsible for implementing the procedures set forth in this SOP and shall adhere to the QC procedures as described in Appendix 1.

2.3. The Department Supervisor shall be responsible for checking and overseeing that the process is properly enforced and are effectively applicable for the functions it is designed for.

2.4. The Project Manager shall be responsible to make sure that the activities performed in this Section are in compliance to project specific requirements. The PM shall also obtain and relay resolution(s) of discrepancies on a timely manner.

2.5. All samples under the custody of EMAX Laboratories shall be stored in a properly maintained and secured Sample Control Room.

2.6. All refrigerators used for sample storage shall be maintained as described in EMAX-QC03.

3.0 ASSOCIATED SOP

3.1. EMAX-SM01 - Sample Management

3.2. EMAX-QC03 - Refrigerator Control

3.3. EMAX-RS02 - Receiving Radioactive Material

3.4. EMAX-RS03 - Control of Radioactive Samples

4.0 SAFETY

4.1. Read all MSDS of preservatives listed in this SOP.

4.2. Post the list of projects from superfund sites and projects requiring leaching procedures in the sample control room. All sample coolers from these projects must be opened under a fume hood.

4.3. Sample Chain of Custody comment section shall be reviewed prior to starting sample inspection. Any information related to proper sample handling should be disseminated in advanced by the Sample Custodian.

4.4. All samples shall be treated as potential hazards. Observe the standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, gloves shall be worn at all times when performing this procedure.

5.0 PROCEDURES

5.1. Accepting Sample Custody

5.1.1. Samples Delivered by a Third Party (FedEx, UPS, etc.)

5.1.1.1. Check for the following:

- ✓ Presence of airbill/delivery receipt.
- ✓ Check if the delivery is for EMAX

5.1.1.2. Sign the third party delivery form and accept the cooler(s).

5.1.1.3. If samples were received from DOE site, refer to EMAX-RS02 and EMAX-RS03.

5.1.1.4. If more than one cooler is received, place a numeric mark on the coolers starting from #1. If coolers are numbered as received, use the existing number. Proceed to 5.2

5.1.2. Samples Delivered by the Client

5.1.2.1. Check the COC for the presence of the following:

- ✓ Client Name
- ✓ Client Address, Telephone #, and Fax #
- ✓ Project Name and Contact Person
- ✓ Turn Around Time
- ✓ Sampler Name and Signature
- ✓ Sample ID Number for Each Sample
- ✓ Sampling Time and Date
- ✓ Sample Container Type/Size

- ✓ Sample Matrix
- ✓ Analysis Required/Requested
- ✓ Signature of the courier with date and time

5.1.2.2. If discrepancies are found, notify the PM to resolve the issue with the client representative. If it can not be resolved, note it in the SRF.

5.1.2.3. Sign the COC, and write the date and time of receipt.

5.1.2.4. If more than one cooler is received, place a numeric mark on the coolers. Proceed to 5.2.

5.1.3. Samples Picked-up by EMAX Courier

5.1.3.1. Check that the coolers are intact.

5.1.3.2. If coolers are not sealed, check that samples are packed properly to prevent any breakage during transport

5.1.3.3. If coolers are sealed prior to accepting the COC, note on COC comments section that coolers are sealed.

5.1.3.4. Follow steps 5.1.2

5.1.3.5. Sign the COC with date and time upon arrival at the laboratory

5.1.3.6. Endorse the coolers and the COC to the Laboratory Sample Custodian. If more than one cooler is received, place a numeric mark on the coolers.

5.1.3.7. Sample Custodian shall inspect/accept the custody of the COC and the coolers as described by 5.1.2. Proceed to 5.2

5.2. Sample Inspection

5.2.1. Bring the cooler(s) to the fume hood. Turn on the fume hood.

5.2.2. Check the COC for any warning regarding safety issues.

5.2.3. Open the coolers and check presence of cooler thermometer[1] or temperature blank. If both are not present proceed to 5.2.4

5.2.3.1. If cooler thermometer is present, proceed to 5.2.5.

5.2.3.2. If a temperature blank is present, open the container and submerge the thermometer into the liquid. Proceed to 5.2.5.

5.2.4. Place the thermometer in between or near the sample(s).

5.2.5. Close the cooler and let it stand by for at least 5 minutes.

5.2.6. Read the thermometer and record the temperature for each cooler, in the

[1] Clients providing cooler thermometers are expected to have valid calibration prior to use.

COC(s) and SRF. ADD

5.2.6.1. If all coolers are received with designated COC, record the temperature of each cooler in the associated COC.

5.2.6.2. If COC is not specific to each cooler, identify which samples are contained in each cooler in the comment section of the COC and correspondingly record the temperatures of each cooler.

Example: Three coolers were received accompanied by one COC. Cooler number one temperature reading is 3 ^{o}C, and contains samples, 1,3, 7 and 12. Cooler number two temperature reading is 4 ^{o}C and contains 2,4,5 and 6. Cooler number three-temperature reading is 4 ^{o}C and contains 8, 9, 10 and 11. The comment section of the COC should read:

1 - 3 ^{o}C – samples 1, 3, 7, 12

2 - 4 ^{o}C – samples 2, 4, 5, 6

3 - 4 ^{o}C –samples 8 to 11

5.2.7. Line-up the samples according to the COC sequence and check for agreement with the sample tag. At a minimum check for the following information:

- ✓ Client Sample ID
- ✓ Sampling Date/Time
- ✓ Analysis Requested
- ✓ Preservative
- ✓ Sample Container
- ✓ Matrix

5.2.8. Check for the sample integrity.

- ✓ Custody seal and sample container is intact
- ✓ Initial of sampler is present
- ✓ Check for sample holding time/preservation. Refer to Table 1.
- ✓ Check for pH if required
  - Ensure that the sample cap is sealed properly.
  - Shake the sample, open the cap and pour a small amount of sample into the cap. Trickle the transferred sample into an appropriate pH strip indicator.
  - Compare the pH strip with the pH indicator table. Where readings are not distinguishable between the increments of pH readings, use a

narrow pH strip (0-3 or 9-12 pH strips) to distinctively identify sufficiency of sample preservation.

- Record the pH and any discrepancy on the SRF.

✓ Check for Sample Adequacy

5.2.9. Check for sample sufficiency (refer to Table 1)

✓ Sample(s) received is enough for all the analyses requested.

✓ Sample(s) for MS/MSD is enough for all analyses requested and if more than one container is sent, check visually the consistency of samples and label of containers; e.g. do all container labels agree, do the samples contained look the same.

5.3. **Assigning EMAX Control Number (ECN)**

5.3.1. Write the next available ECN[2] into the COC. Record the date, the project and sample location into the ECN log corresponding to the ECN taken.

5.3.2. Assign a unique Lab Sample ID (LSID) and Lab Sample Container ID (LSCID) to each sample received as described in EMAX-SM01.

5.4. **Labeling the Samples**

5.4.1. Line-up the samples according to the COC sequence.

5.4.2. Using the labeling gun, position the characters of the first line to agree with the LSID and the second line to agree with the LSCID.

5.4.3. Counter-check the COC sample label and ensure agreement with the sample tag.

5.4.4. Press the labeler trigger and attach the printed label on a free space of the sample label. Press the trigger again and attach on the sample cover.

5.4.5. Repeat steps 5.4.2 to 5.4.4 until all samples are labeled.

5.4.6. Have the sample labeling reviewed by the Supervisor or his/her designee and document review in the SRF.

5.4.7. Store samples as described in EMAX-SM01- Sample Management.

5.5. **Sample Receipt Form (SRF)**

5.5.1. Complete the SRF1 and SRF2 to have all the information pertinent to the sample(s) received (see Appendix 2).

5.5.2. For conformance to requirement of sample condition, refer to Table 1.

5.5.3. Write all discrepancies found in the SRF1.

[2] Refer to EMAX-SM01 for generating ECN.

5.5.4. Have the SRFs reviewed by the supervisor or his/her designee.

5.5.5. Make three copies of the SRFs and the COC(s) and distribute one set of copies to the PM, the Sample Preparation Dept. and the Operations Manager. The PM shall provide one set of copies of the SRF and COCs to the log-in after checking.

5.5.6. The PM resolves discrepancies with the Client.

6.0 QUALITY CONTROL

6.1. All samples shall be counter checked by a second person after labeling prior to sample storage.

6.2. All SRFs shall be reviewed by the Sample Management Supervisor or his/her designee.

6.3. All anomalies reported shall require closures before work orders commence.

6.4. All reviews shall be initialed and dated.

6.5. Where sample preservatives are added in the lab as instructed by the client, observed preservation requirements prior to sample analysis. For aqueous samples requested for metals analysis preserved with HNO3 to pH $\leq$ 2, allow a minimum of 24 hours to dissolved metals adsorb into the walls of the sample container prior to sample analysis.

7.0 CORRECTIVE ACTION

7.1. The requirements for sample containers, preservations, holding time and minimum amount of sample is listed in Table 1. Acceptance criteria and corrective actions for samples are listed in Appendix 1.

7.2. The PM shall follow-up all resolutions to issues and discrepancies in a timely manner and shall document all correspondence.

7.3. The PM shall then relay the resolutions in writing [resolution on SRF1 and/or email/fax attached to the SRF1], to the Sample Management Dept. and all other affected departments for appropriate action.

8.0 SUPPLEMENTARY NOTES

8.1. **Definition Of Terms**

8.1.1. Chain-of-Custody (COC) – is a record where sample custody transfer is documented. At a minimum the COC shall contain the project ID, sample ID, sampling location, date/time of collection, chemical preservatives (if any) dated signatures of individuals involved in the sample transfer.

8.1.2. Composite Sample – is an equal amount of sample aliquot combined together from specified sample containers.

8.1.3. Corrective Action - Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

8.1.4. EMAX Control Number (ECN) – is an identification given to a group of samples received from a project that arrived on the same day accompanied by a chain-of-custody (COC). Grouping of samples is determined by either the project or the Project Manager's discretion.

8.1.5. Internal COC (ICOC) – is a record used by the laboratory to document when samples are withdrawn from the sample control room. This record shall contain the Lab Sample IDs of samples withdrawn, the intended analysis, the initials of the custodian and recipients, and the date and time of sample turn over.

8.1.6. Lab Sample ID – is EMAX sample identification to uniquely identify each sample.

8.1.7. Lab Sample Container ID (LSCID) – is EMAX sample container identification to uniquely identify each sample container.

8.1.8. Sample Receipt Form 1 (SRF1)- is a record where to logged-in the type of delivery, who delivered the samples, the packaging condition, temperature upon receipt and the conditions or any discrepancies of samples during receiving.

8.1.9. Sample Receipt Form 2 (SRF2)- is a record where to logged-in the container type, any chemical preservative and conditions per container of samples upon receipt.

8.1.10. Nonconformance - An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

8.1.11. Preservative – is a chemical added to a sample to maintain its integrity prior to analysis.

8.1.12. Project Specific Requirement (PSR) – is a document containing the summary of project requirements, the QC references and other information needed to complete the work order.

8.1.13. Sample – is a specimen received in the laboratory bearing a unique client sample ID traceable to the accompanying COC. Each unique client sample ID shall have a corresponding unique Lab Sample ID, unless otherwise specified by the project. Hence, samples collected in different containers having the same client sample ID are labeled with the same corresponding Lab Sample ID.

8.1.14. Sample Delivery Group (SDG) – is a group of samples received over a period of 14 days or less, not exceeding 20 samples per analysis per matrix.

8.1.15. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

8.1.16. Trip Blank – is a target-analyte-free sample, which travels with the sample to monitor possible contamination during sample transport. This sample is analyzed for volatiles.

9.0 APPENDICES, TABLES & FORMS

9.1. Table 1 - Required Sample Condition

9.2. Appendix 1 - Summary of Quality Control Procedures

9.3. Forms - Sample Receipt Forms (SRF1 & SRF2)

TABLE 1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Parameter	Applicable Methods	Container[3]	Preservation[4]	Maximum holding time	Min. Sample Amount (ml)
Acidity	SM 2310B 4(a) 18th , 20th , Online	P, FP, G	Cool, ≤6 °C	14 days	50
Alkalinity	SM 2320B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	14 days	50
Ammonia	EPA 350.1, Rev. 2.0 (1993) SM 4500–NH3 C 18th (Neslerization) SM 4500-NH3 C 20th (Titration) SM 4500–NH3 F/G 18th (Electrode) SM 4500–NH3 D/E 20th (Electrode)	P, FP, G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	25
Anions (Bromide, Chloride, Fluoride, Sulfate)	EPA 300.0 SM 4110B 18th, 20th, Online SW 9056	P, FP, G	Cool, ≤6 °C	28 days	25
Biochemical oxygen demand	SM 5210 B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	1000
Chemical oxygen demand	EPA 410.4 Rev. 2 1993 SM 5220 D 18th, 20th, Online	P, FP, G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	5
Chloride	SM 44500-Cl B 18th, 20th, Online (Titrimetric – Silver Nitrate)	P, FP, G	None required	28 days	25
Chlorine, total residual	SM 4500-Cl B 18th, 20th, Online	P, G	None required	Analyze within 15 minutes	200
Color	SM 2120 B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	50
Cyanide, total	SM 4500-CN E 18th, 20th, Online	P, FP, G	Cool, ≤6 °C, NaOH to pH>12, reducing agent	14 days	25
Cyanide, available	SM 4500-CN G 18th, 20th, Online	P, FP, G	Cool, ≤6 °C, NaOH to pH>12, reducing agent	14 days	25
Fluoride	SM 4500-F B 18th, 20th, Online (Electrode) SM 4500-F D 18th, 20th, Online (Colorimetric - SPADNS)	P	None required	28 days	25
Hardness	SM 2340 B/C 18th, 20th, Online	P, FP, G	HNO_3 or H_2SO_4 to pH<2	6 months	50
Hydrogen ion (pH)	SM 4500-H^+ B 18th, 20th, Online SW 9040B, SW9045C	P, FP, G	None required	Analyze within 15 minutes	20

[3] ‘‘P’’ is polyethylene; ‘‘FP’’ is fluoropolymer (polytetrafluoroethylene (PTFE; Teflon), or other fluoropolymer, unless stated otherwise in this Table 1; ‘‘G’’ is glass; ‘‘PA’’ is any plastic that is made of a sterilizable material (polypropylene or other autoclavable plastic); ‘‘LDPE’’ is low density polyethylene.

[4] Samples received are expected to have been properly preserved by the field samplers. Checking of sample preservation is only based on Temperature reading and/or pH measurements specified in this SOP. Cool, ≤6 °C – means cooled at ≤6 °C but samples must not be frozen.

TABLE 1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Parameter	Applicable Methods	Container[3]	Preservation[4]	Maximum holding time	Min. Sample Amount (ml)
Kjeldahl and Organic N	SM 4500-N_{org} C 18th, 20th, Online	P, FP, G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	50
Chromium VI	EPA 218.6, SW 7199 SM 3500-Cr E 18th, C 20th, Online (Ion Chromatography) SW 7196A SM 3500-Cr D 18th, 20th, Online (Colorimetric)	P, FP, G	Cool, ≤6 °C, Ammonium Sulfate pH = 9.3–9.7	28 days (Preserved) 24 hours (Unpreserved)	20
Mercury (CVAA)	EPA 245.2 SM 3112B 18th, Online SW 7470A	P, FP, G	HNO_3 to pH<2	28 days	50
Metals, [5] except chromium VI, and mercury	EPA 200.7 EPA 200.8 SW 6010B SW6020A	P, FP	HNO_3 to pH<2	6 months	50
Nitrate	EPA 352.1 (Brucine sulfate) EPA 300.0 SM 4110B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	25
Nitrate-nitrite	EPA 353.2 (Cadmium Reduction) SM 4500-NO_3 E 18th, 20th, Online EPA 300.0 SM 4110B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	25
Nitrite	EPA 300.0 SM 4110B 18th, 20th, Online SM 4500-NO_2 B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	25
Oil and grease	SW 1664A SM 5520 B 20th, Online	G	Cool to ≤6 °C, HCl or H_2SO_4 to pH<2	28 days	25
Organic Carbon , total	SM 5310 B/C/D 18th, 20th, Online SW 9060A	P, FP, G	Cool to ≤6 °C, HCl, H_2SO_4, or H_3PO_4 to pH<2	28 days	25
Orthophosphate	EPA 365.1 Rev. 2 1993 EPA 356.3 1978 EPA 300.0 SM 4110B 18th, 20th, Online SM 4500-P E 18th, 20th	P, FP, G	Cool, ≤6 °C	Filter within 15 minutes; Analyze within 48 hours	25

[5] Aqueous sample received without acid preservation may be preserve in the lab upon client instruction. When acid is added allow at least 24 hours before sample analysis to dissolve any metals that adsorb to the container walls.

TABLE 1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Parameter	Applicable Methods	Container[3]	Preservation[4]	Maximum holding time	Min. Sample Amount (ml)
Oxygen, Dissolved	SM 4500-O C 18th, 20th, Online	G	None required	Analyze within 15 minutes after filtration	25
Phenols	EPA 420.1 1978 SW 9065	G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	25
Phosphorous, total	EPA 365.3 SM 4500-P E 18th, 20th	P, FP, G	Cool, ≤6 °C, H_2SO_4 to pH<2	28 days	50
Residue, total	SM 2540 B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	7 days	100
Residue, Filterable	SM 2540 C 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	7 days	100
Residue, Nonfilterable (TSS)	SM 2540 D 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	7 days	100
Residue, Settleable	SM 2540 F 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	1000
Silica, Dissolved	SM 4500-Si C 18th SM 4500-SiO_2 D 20th, Online	P or Quartz	Cool, ≤6 °C	28 days	50
Specific conductance	EPA 120.1 1982 SM 2510B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	28 days	20
Sulfate	EPA 300.0 SM 4110B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	28 days	50
Sulfide	SM 4500-S^2 D 18th, 20th, Online SM 4500-S^2 E 18th, F 20th, Online SW 9034	P, FP, G	Cool, ≤6 °C, add zinc acetate plus NaOH to pH>9	7 days	100
Sulfite	SM 4500-SO_3 B 18th, 20th, Online	P, FP, G	None required	Analyze within 15 minutes	
Surfactants	SM 5540 C 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	100
Turbidity	EPA 180.1 Rev. 2 1993 SM 2130 B 18th, 20th, Online	P, FP, G	Cool, ≤6 °C	48 hours	40
Purgeables VOCs	EPA 524 EPA 624 SW 8260B	G, FP-lined septum	Cool, ≤6 °C, 0.008% $Na_2S_2O_3$, HCl to pH ≤2	14 days (Preserved) 7 days (Unpreserved)	40
Purgeable Hydrocarbons	SW 8015B AK101	G, FP-lined septum	Cool, ≤6 °C, 0.008% $Na_2S_2O_3$, HCl to pH ≤2	14 days (Preserved) 7 days (Unpreserved)	40
Acrolein and acrylonitrile	EPA 624 SW 8260B	G, FP-lined septum	Cool, ≤6 °C, 0.008% $Na_2S_2O_3$, pH to 4-5	14 days (Preserved) 3 days (Unpreserved)	40
Extractable BNAs	EPA 625 SW 8270C	G, FP-lined cap	Cool, ≤6 °C, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction	1000

TABLE 1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Parameter	Applicable Methods	Container[3]	Preservation[4]	Maximum holding time	Min. Sample Amount (ml)
Extractable Hydrocarbons	SW 8015B LUFT AK102 AK 103	G, FP-lined cap	Cool, ≤6 °C, store in dark, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction	1000
PCBs	EPA 608 SW 8082	G, FP-lined cap	Cool, ≤6 °C	1 year until extraction, 1 year after extraction	1000
Pesticides	EPA 608 SW 8081A	G, FP-lined cap	Cool, ≤6 °C, pH 5–9	7 days until extraction, 40 days after extraction	1000
Extractable Organics	SW 8141A SW 8151A	G, FP-lined cap	Cool, ≤6 °C	7 days until extraction, 40 days after extraction	1000

TABLE 2
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR SOLID SAMPLES

Parameters	Applicable Methods	Sample Container	Preservative	Holding Time	Min. Sample Amount (g)
Volatile Organics	SW 8260B	Encore Tube (or equivalent)	Cool, ≤6 °C	48 hours	5
Volatile Organics	SW8260B	Encore Tube (or equivalent)	Cool, ≤6 °C $Na_2S_2O_3$ solution or Methanol	14 days	5
Purgeable TPH	SW 8015B	Encore Tube 2-4 oz Jar/ Shelby Tube	Cool, ≤6 °C	14 days	5

TABLE 2
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR SOLID SAMPLES

Parameters	Applicable Methods	Sample Container	Preservative	Holding Time	Min. Sample Amount (g)
Extractable Organics	SW 8015B SW 8081A SW 8082 SW 8141A SW 8151A SW 8270B	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	14 days (extract 40 days)	30
Ignitability	SW 1010	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	ASAP (24 hours from receipt)	100
Perchlorate	EPA 314.0	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	28 days	10
Metals	SW6010B SW 6020A	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	180 days	5
Chromium VI	EPA 218.6 SW 9076A SW 7199	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	24 hours	10
Mercury	SW 7471A	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	28 days	5
Cyanide	SW 9010B/9014	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	14 days	10
Sulfide	SW 9030 SW9034	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	7 days	10
pH	SW 9040C SW 9045C	4-8 oz Jar/Shelby Tube	None	ASAP (24 hours from receipt)	10
Anions (Br, Cl, F, NO_3/NO_2, SO_4)	SW 9056	4-8 oz Jar/Shelby Tube	None	28 days	10

TABLE 2
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR SOLID SAMPLES

Parameters	Applicable Methods	Sample Container	Preservative	Holding Time	Min. Sample Amount (g)
Nitrate-N	SW 9056	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	48 hours	10
TOC	SW 9060A	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	28 days	10
Phenols	SW 9065	4-8 oz Jar/Shelby Tube	Cool, ≤6 °C	28 days	10

APPENDIX 1: **SUMMARY OF QUALITY CONTROL PROCEDURES**

Parameter	Acceptance Criteria	Corrective Action
Cooler/Sample Custody Seal	To maintain sample integrity at all time, custody seal must be intact when samples are received.	• Take cooler temperature reading • Inform the client immediately. • Wait for the client response before proceeding.
Integrity Of Sample Container	All samples shall be protected from any form of contamination. Samples received must be intact.	• Place sample(s) in a double zipped locked bag. • Inform the client immediately • Wait for Client response before proceeding
Cooler Temperature	Samples must be received at required temperature. Refer to Table 1	• Take the cooler temperature reading. • Inform the client immediately • Wait for Client response before proceeding
Sample Holding Time	Samples must be analyzed within holding time. Refer to Table 1	• Check COC if special instruction is present. • Inform the client immediately. • Wait for Client response before proceeding.
Preservation	Samples must be received with proper and adequate preservative. Refer to Table 1.	• Inform the client immediately • Wait for Client response before proceeding
Volatile Samples	Water samples for volatile analyses requires zero headspace Presence of air bubble must not to exceed 6mm. Samples must be accompanied with Trip Blank in the same cooler.	• Check the number of sample containers. If more than one is submitted, and the other sample is okay, note the discrepancy on the SRF and proceed with sample receiving. • Corresponding to the sample container ID, write "Bubble >6mm" as discrepancy in the SRF. If all vials for a sample have bubble >6mm, inform the PM immediately so that client can be notified promptly. • If there is only one sample container received, inform the client immediately. • If Trip Blank is misplaced or lacking, inform the client immediately.
Sample Amount	Refer to Table 1 for appropriate sample container for specific analysis.	• Inform the Client immediately • Wait for the response before proceeding.
Sample Label	COC and sample tag must agree.	• Document the discrepancy following the convention below: Sample Control #XXXXXX-XX Client sample ID XXXXXXXXX COC reads …… Field sample tag reads …….. • Submit copy to SRFs and COCs to PM for proper action.
Others (any other parameters observed that is not listed above.)	Must be verified.	• Report to the Supervisor

SRF1

EMAX LABORATORIES, INC.

SAMPLE RECEIPT FORM 1

Type of Delivery	Delivered By/Airbill	ECN
☐ EMAX Courier		Receipient
☐ Client Delivery		Date
☐ Third Party		Time

COC Inspection

☐ Client Name	☐ Client PM/FC	☐ Sampler Name	☐ Sampling Date/Time/Location	☐ Sample ID	☐ Matrix
☐ Address	☐ Tel # / Fax #	☐ Courier Signature	☐ Analysis Required	☐ Preservative (if any)	☐ TAT
Safety Issues	☐ None	☐ High concentrations expected	☐ Superfund Site samples	☐ Rad screening required	

Comments:

Packaging Inspection

Container	☐ Cooler	☐ Box	☐ Other		
Condition	☐ Custody Seal	☐ Intact	☐ Damaged		
Packaging	☐ Bubble Pack	☐ Styrofoam	☐ Popcorn	☐ Sufficient	☐ _____
Temperatures (Cool, ≤6 °C but not frozen)	☐ Cooler 1_____ °C	☐ Cooler 2_____ °C	☐ Cooler 3_____ °C	☐ Cooler 4_____ °C	☐ Cooler 5_____ °C
	☐ Cooler 6_____ °C	☐ Cooler 7_____ °C	☐ Cooler 8_____ °C	☐ Cooler 9_____ °C	☐ Cooler 10_____ °C

Thermometer: *A - S/N 101541371* *B - S/N 101541382*

Comments: ☐ **PM was informed on non-compliant coolers immediately.**

DISCREPANCIES

LSID	LSCID	Sample Label ID/COC ID	Discrepancy Code	Corrective Action Code

REVIEWS

Sample Labeling _____ SRF _____ PM _____

Date _____ Date _____ Date _____

LEGEND:

Code	Description- Sample Management	Code	Description-Sample Management	Code	Description-Project Management
A1	Analysis is not indicated in COC	D1	Date and/or time is not indicated in COC	R1	Hold sample(s); wait for further instructions
A2	Analysis is not indicated in label	D2	Date and/or time is not indicated in label	R2	Proceed as indicated in COC
A3	Analysis is inconsistent in COC vis-à-vis label	D3	Date and/or time is inconsistent in COC vis-à-vis label	R3	Refer to attached instruction
A4	_____	E1	Insufficient preservative	R4	Cancel the analysis
B1	Sample ID is not indicated in COC	E2	Improper preservation	R5	_____
B2	Sample ID is not indicated in label	F1	Insufficient Sample	R6	_____
B3	Sample ID is inconsistent in COC vis-à-vis label	F2	Bubble is> 6mm		_____
B4	_____	G1	Temperature is out of range		_____
C1	Wrong container	G2	Out of Holding Time		_____
C2	Broken container	G3	>20 % solid particle		_____
C3	Leaking container	H1	_____		_____
C4	_____	H2	_____		_____

SRF2

EMAX LABORATORIES, INC.

EMAX-SM02
Rev.5

SAMPLE RECEIPT FORM 2

SAMPLES RECEIVED FOR ECN:

ECN (*)	SAMPLE CONTAINER ID	COOLER#	CONTAINER TYPE								CHEMICAL PRESERVATIVE											Filtered	
			Jar	Amber	HDPE	Encore	Vial	Tube	Bag	Other	NONE	HCl (pH<2)	HNO_3 (pH<2)	H_2SO_4 (pH<2)	Zn(Ac)+NaOH (pH>12)	NaOH (pH>12)	$Na_2S_2O_3$	Methanol	NaHSO4	Other	Other	Yes	No
	* 1																						
	* 2																						
	* 3																						
	* 4																						
	* 5																						
	* 6																						
	* 7																						
	* 8																						
	* 9																						
	* 0																						
	* 1																						
	* 2																						
	* 3																						
	* 4																						
	* 5																						
	* 6																						
	* 7																						
	* 8																						
	* 9																						
	* 0																						
	* 1																						
	* 2																						
	* 3																						
	* 4																						
	* 5																						
	* 6																						
	* 7																						
	* 8																						
	* 9																						
	* 0																						

WASTE DISPOSAL

SOP No.:	EMAX-SM03	Revision No.	4	Effective Date:	09/10/07
Prepared By:	Richard Beauvil			Date:	09/10/07
Approved By:	Kenette Pimentel QA Manager			Date:	09.10.07
Approved By:	Sing Pang RSO			Date:	09/10/07

Control Number: SM03-03-

1.0 PURPOSE

1.1. To establish waste disposal policies in accordance to all applicable Local, State and Federal requirements.

1.2. To describe the specific steps required to assure compliance to the requirements for disposing laboratory generated waste.

2.0 POLICIES

2.1. All wastes shall be disposed in accordance to all applicable Local, State and Federal requirements.

2.2. All wastes shall be separated according to different waste streams as described in this SOP.

2.3. The Safety Officer shall be responsible to make sure that waste streams are analyzed or waste process history is used prior to disposal and all analytical results shall be maintained accordingly.

2.4. The Waste Management Unit shall be responsible for waste disposal handling and all members shall be duly trained and certified to perform this activity. They shall also be responsible for ensuring that all wastes streams are properly labeled in all laboratory areas and be responsible for maintaining orderliness in the waste storage area.

2.5. Satellite waste disposal units will be maintained in all laboratory areas, and will be clearly labeled in accordance to labeling requirements.

2.6. The waste storage area shall bear the caution sign:

"HAZARDOUS WASTE STORAGE AREA"

"UNAUTHORIZED PERSONS KEEP OUT"

2.7. The Safety Officer shall be responsible for conducting weekly inspection of the waste storage area (See appendix 2) to ensure that:

- The area is safe and clean.
- There is no evidence of container leakage and/or deterioration.
- There are no substance incompatibilities.
- There are no other related issues that may cause a danger to any personnel.

2.8. All hazardous waste will only be stored on-site for no more than 90 days, from the accumulation start date of the waste stream.

3.0 ASSOCIATED SOP

3.1. EMAX-SM01 Sample Management

4.0 SAFETY

4.1. Employees performing any waste disposal activity shall be done under the direct supervision of a certified waste disposal employee.

4.2. Safety goggles, gloves and protective clothing shall be worn at all times during the entire course of waste disposal. Respirators shall be worn when disposing solvent waste.

4.3. Incompatible wastes shall not be mixed together or stored on the same secondary container.

5.0 INSTRUMENTS, CHEMICALS AND MATERIALS

5.1. Hazardous waste containers - DOT approved containers

5.2. Non-hazardous waste containers - Non-reactive material to waste stored

6.0 PROCEDURES

6.1. Identify waste streams and handle each independently.

Waste Stream	EPA Waste No.	State Waste Code	Disposal Sites
1. Mixed Flammable Liquid	D001	214/741	CAD 044429835 (Clean Harbor)
2. Soil and Debris	None	181	NVT330010000 (US Ecology)
3. Acid Waste pH < 2	D002	791	CAT 080033681 (Phibro Tech)
4. Cyanide Waste pH > 10	P030	711	CAD 044429835 (Clean Harbor)
5. Methylene Chloride Waste	F001	211	CAD 008302903 (Veolia)
6. Wastewater w/ trace of Methylene Chloride	F001	135	CAD 008302903 (Veolia)
7. Waste Flammable Solids; PCB < 50 ppm	D001,F003 F005	214/741	ARD981057870 (Rineco.)
8. Wastewater; PCB ≥ 5	F005	741	CAD 044429835

mg/L			(Clean Harbor)
9. Non-RCRA Wastewater pH 4 – 10	None	135	CAT 080033681 (Phibro Tech)
10. Chromium VI Waste	D002, D007	171	CAD 044429835 (Clean Harbor)
11. Universal Waste (Electronic Devices, Monitors, Empty Printer Cartridges)	None	None	Offlease Clearinghouse
12. Universal Waste (Batteries, Fluorescent tubes, Mercury wastes, Aerosal cans)	None	None	AZD 982434185 (EPSI, AZ) CAD088504881 (Kinsbursky, CA)

6.2. Handling Satellite Waste

6.2.1. Collect all analytical waste generated in a satellite waste container.

Note: ***Residual samples, digestates or extracts incorporated in the analytical wastes are traceable through the analytical run log.***

6.2.2. Place satellite waste containers in a cart and move them to the 90-day waste storage area.

6.2.3. Transfer satellite waste into the appropriate 55 gallons waste stream drum as identified in section 6.1.

6.2.4. Record the activity into the satellite waste disposal logbook. (See Appendix 1).

6.2.5. Return the satellite containers to their appropriate location. Affix a label with the accumulation start date on the containers.

6.3. Digestates and extracts Disposal

6.3.1. Dispose digestates and extracts once the holding time is past or by approval of the client.

6.3.2. Place digestates and extracts in a cart and move them to the 90-day waste storage area.

6.3.3. Transfer the satellite waste into the appropriate 55 gallons waste stream drum as identified in section 6.1.

6.3.4. Record their disposal in the digestion or extraction logbook.

6.4. Sample Residue disposal

6.4.1. Dispose samples after three (3) months and/or with the client consent.

6.4.2. Dispose samples past holding time unless directed otherwise by the client.

6.4.3. Transfer the samples into a 5 gallon pal and check the pH before placing it into the appropriate 55 gallons waste stream drum as identified in section 6.1.

6.4.4. Record the activity into the corresponding SDG pages of the internal chain of custody (ICOC).

6.4.5. Glass containers remaining after disposal of the water and soil waste will be broken or crushed whenever possible. Place glass containers in a strong cardboard box, cover and brake them with a heavy long metal rod.

6.5. Other Waste Streams

6.5.1. Separate soil samples having concentrations higher than 50 ppm of Polychlorinated Biphenyls (PCBs) and dispose as PCB contaminated soil.

6.5.2. Separate water samples having concentration higher than 5 ppm of Polychlorinated Biphenyls (PCBs) and dispose as PCB contaminated wastewater.

6.5.3. Dilute all PCB standards > 50 ppm and dispose into the mixed flammable liquid waste stream drum.

6.5.4. Separate all oil samples and product samples and dispose them into the mixed flammable liquid waste stream drum.

6.5.5. Collect all Chemical Oxygen Demand (COD) vials and bulk into a 5 gallon drum for disposal as Chromium VI waste Stream.

6.6. Waste Stream Records

6.6.1. Create and maintain a file for each waste stream to include:

- Description of waste stream and/or generating process.
- Classification of waste stream based on DOT and EPA regulations.
- Profile reports from TSD facility where the waste is shipped.
- And other pertinent information.

6.7. Management of Containers

6.7.1. Fill the waste containers to a maximum of 95% of their capacity to allow for expansion within the container.

6.7.2. For wastes characterized as hazardous wastes:

- Use containers approved by DOT only.
- Use DOT approved labels only
- Labels shall include “HAZARDOUS WASTE” in addition to other information required to be in the label.

6.7.3. For wastes characterized as non-hazardous, use a container that will not react with the substance stored.

6.7.4. Maintain the containers closed except when wastes are being added or removed from them.

6.7.5. Maintain the exteriors of waste containers free from dirt, sludge or liquids.

6.8 Universal Waste

6.8.1 Universal waste will be collected in 55 gallon drum and will be disposed as identified in section 6.1.

7.0 REFERENCES

7.1. California Title 22

7.2. 40 CFR 261 Subpart C

8.0 APPENDICES

8.1. Appendix 1 - Satellite Waste Disposal Log

8.2. Appendix 2 - Weekly Satellite Inspection Checklist

9.0 SUPPLEMENTARY NOTES

9.1 Satellite wastes are wastes generated from the instruments or various analytical processes.

9.2 Digestates or extracts are stored aliquot of liquid or solvent generated from analytical digestion or extraction processes.

9.3 Sample residues are stored samples aliquot remaining after its use from analyses.

SATELLITE WASTE DISPOSAL LOG

DATE	SIGNATURE	DESCRIPTION	VOLUME	REMARKS

SATELLITE WASTE DISPOSAL LOG

WEEKLY

SATELLITE/WASTE ACCUMULATION AREA

INSPECTION CHECKLIST

INVESTIGATOR:_____

Date	Lab Area	Container Closed? Y/N	Container Labeled? Y/N	Container in Good Condition? Y/N	Signs of Spills/Leaks? Y/N	Secondary Containment? Y/N	Accumulation Start Date? Y/N	Date of Correction?	Initials
	EXTRACTION								
	DOE METALS								
	STD ROOM								
	FUEL/WETCHEM								
	METALS								
	WEIGHING ROOM								

UNCONTROLLED WHEN PRINTED

Columbia Analytical Services

SOP CHANGE FORM

SOP Title: Method 8290: Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans by High Resolution Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS)
SOP Code: HMS-8290
SOP Revision No.: 9
SOP Date: 08/12/2010
SOP Section(s) Affected by Change:

Description of Change:

13.2.3.3 – *Current language is replaced by the following:*
When the laboratory operates the instrument during a single 12-hour shift, the beginning of the shift is defined by the GC Performance (Window Define) Solution. Beginning and ending calibration checks must be analyzed within this 12-hour shift. Mass resolution checks are required prior to, and immediately following the 12-hour shift. Refer to figure 2a for further details.

13.2.3.4 – *Current language is replaced by the following:*
When the laboratory operates the instrument during consecutive 12-hour shifts, the initial shift must follow the sequence scheme outlined in section13.2.3.3. The second shift begins at the injection of the ending calibration check, which is immediately followed by a mass resolution check and a GC Performance (Window Define) Solution. The closing calibration check must be analyzed within 12 hours of the previous calibration check, and must be followed by a mass resolution check. Refer to figure 2b for further details.

13.2.3.5 – *The following changes apply*
The analysis of at least one analysis of the GC column performance (Window Define) solution and of two routine calibration checks must be performed *and reported* within the 12-hour period. *A mass resolution check must also be performed immediately before and after the 12-hour period. Failure to meet these frequency criteria requires reinjection of the sequence.*

Figure 2 – *Current figure is replaced by Figures 2a and 2b, attached.*

Reason(s) for Change(s):
Change is in response to NCAR20110412, requiring a more definitive discussion of the 12-hour period.

Change(s) Submitted by: R. Pierrot	Date: 4/26/2011

Approvals:

Technical Reviewer Signature: Xiangqi Liang	Date: 4/26/11
QA PM Signature: Rebecca Pierrot	Date: 4/26/11

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

Uncontrolled Copy
Will not be updated

Department Supervisor/Manager Signature:	Date:

Change(s) Effective Date: 4/28/2011

Uncontrolled Copy
Will not be updated

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

FIGURE 2a

ANALYTICAL SEQUENCE FOR A TYPICAL 12-HOUR SHIFT

Time	Analysis
Hour 0	PFK HRMS Tune
Beginning of 12-hr shift	GC Performance (Window Define) Solution
	Beginning HRCC3
	Method Blank
	Samples and Batch QC
End of 12-hr shift	Closing HRCC3
	PFK HRMS Tune

*Note: The PFK Tune must be performed immediately before, and immediately following the 12-hour shift, but does not define the beginning or end of the shift.

Uncontrolled Copy
Will not be updated

FIGURE 2b

ANALYTICAL SEQUENCE FOR A TYPICAL 12-HOUR SHIFT

Time	**Analysis**
Hour 0	PFK HRMS Tune
Beginning of 1st 12-hr shift	GC Performance (Window Define) Solution
	Beginning HRCC3
	Method Blank
	Samples and Batch QC
End of 1st 12-hr shift/Beginning of 2nd 12-hr shift	Closing HRCC3
	PFK HRMS Tune
	GC Performance (Window Define) Solution
	Method Blank
	Samples and Batch QC
End of 2nd 12-hour shift	Closing HRCC3
	PFK HRMS Tune

*Note: The PFK Tune must be performed immediately before, and immediately following the 12-hour shift, but does not define the beginning or end of the shift.

Uncontrolled Copy
Will not be updated

Columbia Analytical Services

SOP CHANGE FORM

SOP Title: Analysis of Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans by High Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)
SOP Code: HMS-8290
SOP Revision No.: 9
SOP Date: 09-Aug-10 (Effective 20-Aug-2010)
SOP Section(s) Affected by Change: 1.2; 2.7; 3.5; 8.16; 12.2.3; 12.2.5; 12.2.10; 12.3.1

Description of Change:

1.2 (Paragraph 2) The sensitivy of this method is dependant on the level of interferences within a given matrix (see Table 1). The calibration range of the method for a 1L water sample is 10 to *20,000 ppq* for TCDD/TCDF and PeCDD/PeCDF, and 1.0 to *2,000 ppt* for a 10-g soil, sediment, ash, or tissue sample. Analysis of a one tenth aliquot of the sample permits measurement of concentrations up to 10 times the upper MCL

2.7 Quantitation of the individual congeners, total PCDDs, and total PCDFs, is achieved in conjunction with the establishment of a multipoint (seven point) calibration curve for each homolog, during which each calibration solution is analyzed once.

3.5 **Calibration Solutions** – solutions containing known amounts of unlabeled PCDDs/PCDFs and labeled standards (Table 4). The set of *7* solutions is used to determine the instrument response of the unlabeled analytes relative to the C13 labeled standard

8.16 **High-Resolution Concentration Calibration *Stock* Solutions** – *7* nonane solutions containing unlabeled and carbon-labeled PCDDs and PCDFs at known concentrations are used to calibrate the instrument. The concentrations ranges are homolog dependent (Table 4). These solutions are *prepared from a purchased certified stock solution.*

12.2.3 Initial Calibration – Initial calibration is required before any samples may be analyzed for PCDDs and PCDFs. Initial calibration is also required if any routine calibration does not meet the required criteria. All *seven* high-resolution concentration calibration solutions must be used for the initial calibration. Tune the instrument with PFK.

12.2.5 By using the same GC and MS conditions that produced acceptable results with the Window Define solution, analyze a 1 µL portion of each of the *seven* concentration calibration solutions once with the ~~*following*~~ mass spepectometer operating procedures *outlined in section 12.1.*

12.2.10 Calculate the mean response factors for the *seven* calibration solutions:… $\overline{RF_m}$ = calculated mean relative response factor of a particular labeled standard (m) relative to an appropriate recovery standard as determined from the *seven* initial calibration injections (j)

Uncontrolled Copy
Will not be updated

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

Columbia Analytical Services™

SOP CHANGE FORM

SOP Title: Analysis of Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)
SOP Code: HMS-8290
SOP Revision No.: 9
SOP Date: 08/09/10 (effective 2/4/2010)
SOP Section(s) Affected by Change: 11.3.2.10 and 12.3.1

Description of Change:
11.3.2.10. *Deleted*

12.3.1 "Remove the sample or QC extract from storage. Add 10 µL of recovery standard at 50 ng/mL (Table 9) to the final extract.

Reason(s) for Change(s):
The final extract volume for this procedure is being updated so as not to elevate the MRL.

Change(s) Submitted by: R. Pierrot	Date: 1/31/2011

Approvals:

Technical Reviewer Signature:	Date:
QA PM Signature: Rebecca Pierrot	Date: 1/31/11
Department Supervisor/Manager Signature: [illegible]	Date: 1/31/11

Change(s) Effective Date: 2/4/2011

Uncontrolled Copy
Will not be updated

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

Columbia Analytical Services™

SOP CHANGE FORM

SOP Title: Analysis of Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)
SOP Code: HMS-8290
SOP Revision No.: 9
SOP Date: 08/09/10 (effective 08/20/10)
SOP Section(s) Affected by Change: 13.2.3.8

Description of Change: 13.2.3.8 If either one of the criteria in Section 13.2.3.7 is not satisfied, the end of sequence routine calibration should be injected once more. If these criteria are still not satisfied, reanalysis of all positive sample extracts is required. It is realized that it may not always be possible to achieve all RF criteria. For example, it has occurred that the RF criteria for 13C-HpCDD and 13C-OCDD were not met, however, the RF values for the corresponding unlabeled compounds were routinely within the criteria established in the method. In these cases, 24 of the 26 RF parameters have met the QC criteria, and the data quality for the unlabeled HpCDD and OCDD values were not compromised as a result of the calibration event.

In these situations, the analyst must assess the effect on overall data quality as required for the data quality objectives and decide on appropriate action. Corrective action would be in order, for example, if the compounds for which the RF criteria were not met included both the unlabeled and corresponding internal standard compounds. However, the ion abundance ratio must meet acceptance criteria.

13.2.3.9 A new initial calibration (new RFs) is required immediately following the analysis of the samples, whenever the RPD from the next routine calibration exceeds 25% or 35%, respectively. Failure to perform a new initial calibration immediately following the analysis of the samples will automatically require reanalysis of all positive sample extracts analyzed before the failed end-of-shift continuing calibration check.

Reason(s) for Change(s):
EPA Method 8290 allows for this change, as most of the language is taken directly from Section 7.7.4.4. This is standard practice and the SOP needed to be updated to match this practice.

Change(s) Submitted by: Xiaoqi Liang	Date: 11/19/10

Approvals:

Technical Reviewer Signature:	Date: 11/19/10
QA PM Signature:	Date: 11/19/10
Department Supervisor/Manager Signature: Xiaoqi Liang	Date: 11/19/10

Change(s) Effective Date: 11/19/10

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

Uncontrolled Copy
Will not be updated

Columbia Analytical Services™

SOP CHANGE FORM

SOP Title: Analysis of Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)
SOP Code: HMS-8290
SOP Revision No.: 9
SOP Date: 08/09/20 (effective 08/20/10)
SOP Section(s) Affected by Change: 11.2.2.1-11.2.2.3, 11.2.3.2, 11.2.4.1-11.2.4.3

Description of Change:
Spiking will now occur prior to mixing solid and tissue samples with sodium sulfate.

11.2.2.1 Add 10-20g anhydrous sodium sulfate to each thimble containing the sample and mix thoroughly to evenly distribute the sodium sulfate. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained.

11.2.2.2 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet. Allow the samples to equilibrate for 1 to 2 hours.

11.2.2.3 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2.3.2 Rather than adding sample/spiking solution to a clean thimble, instead add sample to a clean beaker to record weight. Add 10-20g sodium sulfate and mix thoroughly to evenly distribute the sodium sulfate. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained. Spike with 100µL internal standard spiking solution at 10-50ng/mL (Table 9). Record the standard addition on the bench sheet. Transfer sample to ASE cell. Top with sodium sulfate.

11.2.4.1 Add 20-30g anhydrous sodium sulfate to each thimble containing the sample and mix thoroughly to evenly distribute the sodium sulfate. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained.

Uncontrolled Copy
Will not be updated

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

11.2.4.2 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet. If lipid determination is to be performed on a sample, spike 200µL of the internal standard spiking solution. 11.2.4.3 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

Reason(s) for Change(s): After some recent investigation, the EPA ORCR released a memo recommending that the recently updated language in some EPA 3500 series methods regarding standard addition should not be followed, and that addition of internal standards to solid samples should occur following mixture with sodium sulfate to minimize potential low percent recovery issues.

Change(s) Submitted by: Andrew Biddle	Date: 08/17/10

Approvals:

Technical Reviewer Signature:	Date: 8/17/10
QA PM Signature:	Date: 08/17/10
Department Supervisor/Manager Signature:	Date: 8/17/10

Change(s) Effective Date: 08/17/10

Uncontrolled Copy
Will not be updated

Distribution: Original filed with original SOP Photocopy attached to each controlled copy

Uncontrolled Copy
Will not be updated

STANDARD OPERATING PROCEDURE

ANALYSIS OF POLYCHLORINATED DIBENZO-*p*-DIOXINS AND POLYCHLORINATED DIBENZOFURANS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)

SOP Code: HMS-8290

Revision: 9

Effective: 08/20/10

Approved by: _____ 8/9/10
Xiangqiu 'Sam' Liang, Laboratory Director Date

_____ 08/09/10
Dr. Lan Le, Technical Director Date

_____ 08/09/10
Andrew Biddle, Quality Assurance Program Manager Date

© Columbia Analytical Services, Inc., 2010
19408 Park Row, Suite 320
Houston, TX 77084

Annual review of this SOP has been performed; this SOP reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

DOCUMENT CONTROL

NUMBER: _____

Initials: _____ Date: _____

TABLE OF CONTENTS

Section		Page Number
1.	SCOPE AND APPLICATION	3
2.	METHOD SUMMARY	4
3.	DEFINITIONS	5
4.	INTERFERENCES	6
5.	SAFETY	7
6.	SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE	8
7.	APPARATUS AND EQUIPMENT	8
8.	STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS	11
9.	PREVENTIVE MAINTENANCE	16
10.	RESPONSIBILITIES	17
11.	PROCEDURE FOR SAMPLE PREPARATION, EXTRACTION, CONCENTRATION AND CLEAN UP	17
12.	PROCEDURE FOR HRGC/HRMS ANALYSIS AND CALIBRATION	26
13.	QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS	33
14.	DATA REDUCTION AND REPORTING	40
15.	METHOD PERFORMANCE	45
16.	POLLUTION PREVENTION AND WASTE MANAGEMENT	45
17.	CORRECTIVE ACTIONS FOR OUT-OF-CONTROL DATA	45
18.	CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA	47
19.	REFERENCES	47
20.	TRAINING PLAN	47
21.	METHOD MODIFICATIONS	48
22.	INSTRUMENT SPECIFIC ADDENDUM	49
23.	CHANGES FROM PREVIOUS REVISION	49
24.	ATTACHMENTS	49

Uncontrolled Copy
Will not be updated

Standard Operating Procedure

ANALYSIS OF POLYCHLORINATED DIBENZO-*p*-DIOXINS AND POLYCHLORINATED DIBENZOFURANS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)

Uncontrolled Copy
Will not be updated

1.0 SCOPE AND APPLICATION

1.1 This standard operating procedure (SOP) provides the procedures for the detection and quantitative measurement of polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in a variety of environmental matrices and at part-per-trillion to part-per-quadrillion concentrations and applies to EPA SW-846 Method 8290. The following compounds can be determined by this method:

Analyte	CAS Registry No
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD)	1746-01-6
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin (PeCDD)	40321-76-4
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin (HxCDD)	39227-28-6
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin (HxCDD)	57653-85-7
1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin (HxCDD)	19408-74-3
1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin (HpCDD)	35822-46-9
1,2,3,4,6,7,8,9-Octachlorodibenzo-*p*-dioxin (OCDD)	3268-87-9
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	70648-26-9
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	72918-21-9
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-0
Total Tetrachlorodibenzo-*p*-dioxin (TCDD)	41902-57-5
Total Pentachlorodibenzo-*p*-dioxin (PeCDD)	36088-22-9
Total Hexachlorodibenzo-*p*-dioxin (HxCDD)	34465-46-8
Total Heptachlorodibenzo-*p*-dioxin (HpCDD)	37871-00-4
Total Tetrachlorodibenzofuran (TCDF)	55722-27-5
Total Pentachlorodibenzofuran (PeCDF)	30402-15-4
Total Hexachlorodibenzofuran (HxCDF)	55684-94-1
Total Heptachlorodibenzofuran (HpCDF)	38998-75-3

1.2 The analytical method calls for the use of high-resolution gas chromatography and high-resolution mass spectrometry (HRGC/HRMS) on purified sample extracts. Table 1 lists the various sample types covered by this analytical protocol, the 2,3,7,8-TCDD-based

method calibration limits (MCLs), and other pertinent information. A calculation for reporting the analytical results using a 2,3,7,8-TCDD toxicity equivalency factor (TEF) to obtain a total toxicity equivalence quotient (Total TEQ) is described.

The sensitivity of this method is dependent upon the level of interferences within a given matrix (see Table 1.) The calibration range of the method for a 1L water sample is 10 to 2000ppq for TCDD/TCDF and PeCDD/PeCDF, and 1.0 to 200ppt for a 10g soil, sediment, ash, or tissue sample. Analysis of a one tenth aliquot of the sample permits measurement of concentrations up to 10 times the upper MCL.

2.0 METHOD SUMMARY

2.1 This procedure uses matrix specific extraction, analyte specific clean up, and HRGC/HRMS analysis techniques. If interferences are encountered, the method provides selected clean up procedures to aid the analyst in their elimination.

2.2 A specified amount of soil, sediment, ash, water, sludge, paper pulp, fuel oil, chemical reactor residue, fish or plant tissue is spiked with a solution containing specified amounts of each of the nine isotopically labeled PCDDs/PCDFs. The sample is then extracted according to a matrix specific extraction procedure. Aqueous samples that are judged to contain 1% or more solids are filtered. The solid phase (including the filter) and the aqueous phase are extracted separately. The extracts are then combined before clean up.

The extraction procedures are:

2.2.1 Toluene: Soxhlet and ASE extractions for soil, ash, and paper pulp samples;
2.2.2 Dichloromethane: Jar/Separatory Funnel extraction for water samples;
2.2.3 Toluene: Soxhlet for sediment and sludge samples; and
2.2.4 Hexane/Dichloromethane: Soxhlet extraction for tissue samples.

2.3 The extracts may be submitted to a sulfuric acid washing treatment and dried. Following a solvent exchange step, compounds that interfere are removed by column chromatography using silica gel and activated carbon.

2.4 The preparation of the final extract for HRGC/HRMS analysis is accomplished by adding 20µL of a nonane solution containing 50pg/µL of the recovery standards C13-1,2,3,4-TCDD and C13-1,2,3,7,8,9-HxCDD. The former is used to determine the percent recoveries of tetra- and pentachlorinated PCDD/PCDF congeners, while the latter is used to determine the percent recoveries of the hexa-, hepta- and octachlorinated PCDD/PCDF congeners.

2.5 One µL of the concentrated extract is injected into a HRGC/HRMS system capable of performing selected ion monitoring at resolving powers of at least 10,000 (10 percent valley definition).

Uncontrolled Copy
Will not be updated

2.6 The congeners associated directly with C13 labeled standards are identified based on the elution of the congeners at the same retention times as their respective labeled standards. The remaining congeners for which C13 labeled standards are not present are identified when their retention times fall within the windows established during routine calibration. All congeners are also identified based on the simultaneous detection of the two most abundant ions as well as the comparison of the ratio of these two ions with theoretical ion abundance ratios.

2.7 Quantitation of the individual congeners, total PCDDs, and total PCDFs is achieved in conjunction with the establishment of a multipoint (five point) calibration curve for each homolog, during which each calibration solution is analyzed once.

3.0 DEFINITIONS

3.1 Abbreviations

PCDD	=	Polychlorinated dibenzo-*p*-dioxin
PCDF	=	Polychlorinated dibenzofuran
TCDD	=	Tetrachlorodibenzo-*p*-dioxin
PeCDD	=	Pentachlorodibenzo-*p*-dioxin
HxCDD	=	Hexachlorodibenzo-*p*-dioxin
HpCDD	=	Heptachlorodibenzo-*p*-dioxin
OCDD	=	Octachlorodibenzo-*p*-dioxin
TCDF	=	Tetrachlorodibenzofuran
PeCDF	=	Pentachlorodibenzofuran
HxCDF	=	Hexachlorodibenzofuran
HpCDF	=	Heptachlorodibenzofuran
OCDF	=	Octachlorodibenzofuran
PFK	=	Perfluorokerosene
CS	=	Clean up standard
IS	=	Internal standard
RS	=	Recovery standard
HRGC	=	High-resolution gas chromatography
HRMS	=	High-resolution mass spectrometry
TEF	=	Toxicity equivalence factor
TEQ	=	Toxicity equivalent

3.2 Polychlorinated dibenzo-p-dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) – compounds that contain from 1 to 8 chlorine atoms, resulting in a total of 75 PCDDs and 135 PCDFs. The structures are shown in Figure 1. The fifteen 2,3,7,8-

Uncontrolled Copy
Will not be updated

substituted PCDDs/PCDFs are shown in Table 2. The number of isomers at different chlorination levels are shown in Table 3.

3.3 **Isomer –** compounds having the same number and type of chlorine atoms, but substituted in different positions.

3.4 **Internal Standard Solution–** a solution containing the isotopically labeled analogs that is added to all samples, including method blanks and quality control samples, before extraction. The labeled standards are used along with response factors to measure the concentrations of the analytes. Nine PCDD/PCDF internal standards are used in this method (Table 9).

3.5 **Calibration Solutions** – solutions containing known amounts of unlabeled PCDDs/PCDFs and labeled standards (Table 4). The set of 5 solutions is used to determine the instrument response of the unlabeled analytes relative to the C13 labeled standards.

3.6 **Recovery Standard Solution** – a solution containing the recovery standards that are added to the extract after final concentration for HRGC/HRMS analysis to determine the recovery efficiencies achieved for the C13 labeled standards (Table 9).

3.7 **Clean Up Standard Solution** – a solution containing one Cl37 labeled standard that is to be spiked to the sample extract prior to performing any clean up procedures (Table 9).

3.8 **Matrix Spike Solution –** a solution of native (unlabeled) PCDDs and PCDFs that are spiked into the laboratory control samples or matrix spike samples prior to extraction (Table 9).

3.9 **Method Blank (MB)** – represents the background contributions from glassware, extraction and clean up solvents. An MB is spiked with a solution of C13 labeled internal standards, extracted, cleaned up, and analyzed by HRGC/HRMS in exactly the same manner as the test samples.

4.0 INTERFERENCES

4.1 Solvents, reagents, glassware and other sample processing hardware may yield discrete artifacts or elevated baselines that may cause misinterpretation of the chromatographic data. All materials used during the extraction procedure must be demonstrated to be free from interferences under the conditions of analysis by performing laboratory method blanks. Analysts should avoid using polyvinylchloride gloves.

4.2 The use of high purity reagents and solvents helps minimize interference problems. Solvent lots are tested for the absence of PCDDs and PCDFs prior to use by the laboratory.

Uncontrolled Copy
Will not be updated

4.3 Interferences co-extracted from the sample will vary considerably from matrix to matrix. PCDDs and PCDFs are often associated with other interfering chlorinated substances such as polychlorinated biphenyls (PCBs), polychlorinated diphenyl ethers (PCDPEs), polychlorinated naphthalenes, and polychlorinated alkyldibenzofurans that may be found at concentrations several orders of magnitude higher than the analytes of interest. Retention times of target analytes must be verified using reference standards. These values must correspond to the established retention time windows. While clean up techniques are provided as part of this method, unique samples may require additional clean up steps to achieve lower detection limits.

4.4 A high-resolution capillary column (60m DB-5, J&W Scientific) is used in this method. However, no single column is known to resolve all isomers. The 60m DB-5 GC column is capable of 2,3,7,8-TCDD isomer specificity. In order to determine the concentration of the 2,3,7,8-TCDF (if detected on the DB-5 column), the sample extract must be reanalyzed on a column capable of 2,3,7,8-TCDF isomer specificity (30m DB-225).

5.0 SAFETY

5.1 The 2,3,7,8-TCDD and other 2,3,7,8-chlorine substituted isomers are toxic and can pose health hazards if handled improperly. Only highly trained individuals who are thoroughly versed in appropriate laboratory procedures and familiar with the hazards of dioxins should handle these substances.

5.2 The laboratory will ensure that all analysts receive adequate safety training prior to working with the chemicals and compounds associated with this method.

5.3 The solvents and acids in use in the laboratory may be hazardous and should be treated as such. See the *Environmental Health and Safety Manual*, ***CHP*** (Chemical Hygiene Plan), Section 5, for more information.

5.4 Finely divided dry soils contaminated with PCDDs and PCDFs are particularly hazardous due to the potential for inhalation and ingestion. Samples of this nature should be processed under a fume hood. Additionally, particulate masks should be worn to further protect these routes of entry.

5.5 The toxicity or carcinogenicity of each reagent used in this method is not precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be kept to a minimum.

5.6 A useful method for determining cleanliness of work surfaces and tools is to wipe the surface with a piece of filter paper, extract the filter paper and analyze the extract.

5.7 Thorough washing of hands and forearms after each handling of samples or extracts and before breaks (coffee, lunch, and shift) is recommended. Workers must be trained in the

Uncontrolled Copy
Will not be updated

proper method of removing contaminated gloves and clothing without contacting the exterior surfaces. Gloves must be one time use only.

5.8 Care must be taken when handling compressed gas tanks in the laboratory. All cylinders must be properly secured at all times. See Section 6 of the ***CHP*** for more information.

5.9 Plastic backed absorbent paper must be used on all bench tops.

5.10 Low-level contamination is always a possibility for HRGC/HRMS analysis due to the chemical properties of dioxins/furans and the low detection limits of the instruments.

6.0 SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1 Samples are typically delivered by a standard shipping service or by the client.

6.2 Samples are logged in to CAS LIMS and labeled for tracking through the laboratory. A cooler receipt form is filled out, cataloging any non-conformances associated with the receipt of the sample containers. See the SOP for *Sample Receiving*, ***SMO-WET,*** for a more detailed explanation.

6.3 **Storage and Holding Times -** All samples, except tissue samples, must be stored at 4°C in the dark, extracted within 30 days and completely analyzed within 45 days of extraction. Tissue samples must be stored at -20 to -10°C in the dark, extracted within 30 days and completely analyzed within 45 days of collection. Whenever samples are analyzed after the holding time expiration date, the results should be considered to be minimum concentrations and should be identified as such.

NOTE: The holding times listed in this method are recommendations. PCDDs and PCDFs are very stable in a variety of matrices, and holding times may be as high as a year for certain matrices. Sample extracts, however, should always be analyzed within 45 days of extraction.

6.4 Tissue samples must be shipped on dry ice and arrive at <0°C.

6.5 Before extraction, a visual inspection of a sample is done. Aqueous samples deemed to have greater than 1% solids are filtered unless otherwise specified by the client. Solid samples are homogenized thoroughly prior to aliquotting. See the SOP for *Subsampling and Compositing Aqueous and Soil Samples*, ***WET-SSMP***, for more information.

7.0 APPARATUS AND EQUIPMENT

7.1 **High-Resolution Gas Chromatograph/High-Resolution Mass Spectrometer/Data System (HRGC/HRMS/DS) –** The GC must be equipped for temperature programming, and all required accessories must be available, such as syringes, gases, and capillary columns.

Uncontrolled Copy
Will not be updated

7.1.1 GC Injection Port – The GC injection port must be designed for capillary columns. The use of splitless injection techniques is recommended. On column 1µL injections can be used on the 60m DB-5 column. The use of a moving needle injection port is also acceptable. When using the method described in this protocol, a 1µL injection volume is used consistently (i.e., the injection volumes for all extracts, blanks, calibration solutions and the performance check samples are 1µL).

7.1.2 Gas Chromatograph/Mass Spectrometer (GC/MS) Interface – The GC/MS interface components should withstand 350°C. The interface must be designed so that the separation of 2,3,7,8-TCDD from the other TCDD isomers achieved in the gas chromatographic column is not appreciably degraded. Cold spots or active surfaces (adsorption sites) in the GC/MS interface can cause peak tailing and peak broadening. It is recommended that the GC column be fitted directly into the mass spectrometer ion source without being exposed to the ionizing electron beam.

7.1.3 Mass Spectrometer – The static resolving power of the instrument must be maintained at a minimum of 10,000 (10 percent valley).

7.1.4 Data System – A dedicated data system is employed to control the rapid multiple-ion monitoring process and to acquire the data. Quantitation data (peak areas or peak heights) and selected ion monitoring (SIM) traces (displays of intensities of each ion signal being monitored including the lock-mass ion as a function of time) must be acquired during the analyses and stored. Quantitations may be reported based upon computer generated peak areas or upon measured peak heights (chart recording). The data system must be capable of acquiring data at a minimum of 10 ions in a single scan. It is also recommended to have a data system capable of switching to different sets of ions (descriptors) at specified times during an HRGC/HRMS acquisition. The data system should be able to provide hard copies of individual ion chromatograms for selected gas chromatographic time intervals. It should also be able to acquire mass spectral peak profiles and provide hard copies of peak profiles to demonstrate the required resolving power. The data system should permit the measurement of noise on the base line.

7.1.5 Micromass MassLynx (Version 4.1) is used to obtain all data from the HRMS system. CAS/Houston employs the following HRGC/HRMS systems:

7.1.5.1 An Agilent 6890N Gas Chromatograph with a CTC A200S Autosampler interfaced to a Micromass Autospec Ultima High Resolution Mass Spectrometer.

7.1.5.2 An Agilent 6890N GC with a CTC A200S Autosampler interfaced to a Micromass Autospec Ultima HRMS.

Uncontrolled Copy
Will not be updated.

7.1.5.3 An Agilent 7890A GC with a CTC A200S Autosampler interfaced to a Micromass Autospec Premier HRMS.

7.1.5.4 An Agilent 7890A GC with a CTC A200S Autosampler interfaced to a Micromass Autospec Premier HRMS.

7.2 GC Columns

7.2.1 In order to have an isomer specific determination for 2,3,7,8-TCDD and to allow the detection of OCDD/OCDF within a reasonable time interval in one HRGC/HRMS analysis, use of the 60m DB-5 fused silica capillary column is recommended (J&W Scientific, Agilent 122-5062 or equivalent). Minimum acceptance criteria must be demonstrated and documented. At the beginning of each 12 hour period (after mass resolution and GC resolution are demonstrated) during which sample extracts or concentration calibration solutions will be analyzed, column operating conditions must be attained for the required separation on the column to be used for samples. Isomer specificity for all 2,3,7,8-substituted PCDDs/PCDFs cannot be achieved on the 60m DB-5 GC column alone. In order to determine the proper concentrations of the individual 2,3,7,8-substituted congeners, the sample extract must be reanalyzed on another GC column that resolves the isomers (30m DB-225 fused silica capillary column, J&W Scientific, Agilent 122-2232 or equivalent).

7.3 Soxhlet/ASE Apparatus – The laboratory will be equipped with a macro and/or micro soxhlet apparatus. CAS/Houston uses a series of four (4) Combo Mantles (Glas-Col, 100D RJ30012, with Glas-Col, 104A RL3612 controllers) and a series of twenty-four (24) individual mantles (Glas-Col, TM106, with Glas-Col 104A PL120 PowrTrol and PL-312 and PL-3122 MiniTrol controllers) for the soxhlet apparatus. The combination mantles are designed for 250mL flasks (24/40, VWR, 89000-330), soxhlets (24/40 and 45/50, HGF Scientific), and condensers (45/50, HGF Scientific). The individual mantles are designed for 500mL flasks (24/40, VWR, 89000-334), soxhlets (24/40 and 55/50, HGF Scientific), and condensers (55/50, HGF Scientific). The condensers are connected to a chiller capable of maintaining a chilled temperature to ensure proper solvent reflux. Additionally, if an ASE apparatus (Dionex, ASE200) is to be employed, it must be capable of being pre-programmed to allow for automatic sample extraction at temperature and pressure settings unique to the extraction solvent. Other EPA approved extractors may be used instead.

7.4 Miscellaneous Equipment and Materials – The following list of items does not necessarily constitute an exhaustive compendium of the equipment needed for this analytical method (CAS/Houston equipment in parentheses).

7.4.1 Balances capable of accurately weighing to 0.001g (Denver, XE Series 300, Mettler, AJ100, and Mettler Toledo, PG603-S)
7.4.2 Centrifuge (Clay Adams Dynac, 0101)

Uncontrolled Copy
Will not be updated

7.4.3 Drying oven (VWR Utility Oven, Model 1305U and Blue M Electric, C4855Q)
7.4.4 250mL polypropylene beaker (Fisher, 01-291-5)
7.4.5 20mL scintillation vials (VWR, 66022-004)
7.4.6 Laboratory fume hoods
7.4.7 Pipets, disposable, Pasteur, 150mm long x 5mm ID (VWR, 14673-010)
7.4.8 Pipets, disposable, serological, 10mL (Fisher, 13-676-34D)
7.4.9 Pipet tips, 2-200uL and 10-1000uL (Eppendorf, 022492039 and 022492055, respectively)
7.4.10 Commercial food preparation machine (Hobart, HCM62)
7.4.11 PTFE boiling chips (VWR, 36397-103)

NOTE: Teflon boiling chips may float in methylene chloride, may not work in the presence of any water phase, and may be penetrated by nonpolar organic compounds.

7.4.12 Glass fiber filters, Whatman filter grade (Whatman Grade 1 90mm, 1001 090, VWR 110mm, 28310-081, and other varying sizes and particle retentions)
7.4.13 2-liter screw top clear jars (C&G Containers, LFW0642000)
7.4.14 Rotary evaporator with a temperature controlled water bath (Buchi, Rotavapor R-200 with Heating Bath B-490 and Rotavapor 201 with Heating Bath B-491)
7.4.15 Glass wool (EMD, EM-GX0090-2)
7.4.16 Jars, clear glass, 250mL, with Teflon lined screw caps (C&G, LFA0082000)
7.4.17 Volumetric flasks, Class A – 5mL to 10mL
7.4.18 Auto sampler vials with 150µL inserts (Restek, 24653)
7.4.19 Glass columns – 12mm diameter x 12in long (HGF Scientific specialty product)
7.4.20 Glass columns – 20mm diameter x 12in long with one tapered end (HGF Scientific specialty product)
7.4.21 Shaker (for 2L jar, Eberbach Model 6000)
7.4.22 GC Gooseneck Splitless Liners, 2mm inner diameter (Restek, 20797)
7.4.23 Thermogreen™ LB-2 11mm Septa (Supelco, 20654)
7.4.24 Autosampler Vial Caps, Seal with PTFE Liner, 11mm (Supelco, 27102-U)
7.4.25 Carrier Gas, Ultra High Purity Helium (Airgas)
7.4.26 Perfluorokerosene (PFK) (SynQuest, SpectraSynQ PKF-H, PN 1200-2-20)
7.4.27 Tumbler
7.4.28 Ultrasonicator (Bransonic Ultrasonic Cleaner, 5510R-MT)
7.4.29 Supeltex™ M-2A Ferrules 0.4mm ID (Supelco, 22474)
7.4.30 Nitrogen Evaporator with a temperature controlled heating mantle (Zanntek, ZipVap #109A Custom)
7.4.31 OASIS HLB 3cc (60mg) SPE Cartridges (Waters, WAT094226)
7.4.32 Vacuum Manifold Apparatus
7.4.33 Muffle Furnace (Blue-M/Lindberg, LGO Element Box Furnace, BF51842-P-BC)

8.0 STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

Uncontrolled Copy
Will not be updated

8.1 All standards, reagents, and consumable materials must be logged in and numbered when delivered. Details of all dilutions of standards must also be entered in the Dioxin Standards Logbook. Store standards in the dark at room temperature.

8.2 **Organic-free reagent water** – All references to water in this method refer to organic-free reagent water. CAS/Houston uses the water supplied from our bottled water supplier as the source of the organic-free reagent water used in the preparation of quality control samples and standards.

8.3 **Carbon 120-440 mesh (Supelco Envi-Carb, 57210-U, or equivalent)** – weigh 0.400 – 0.425g into 20mL scintillation vials and activate by heating at or above 140°C for three hours.

8.4 **Silica gel, high purity grade, type 60, 70-230 mesh (JT Baker, JT3405-05)** – Activate overnight at a minimum temperature of 120°C. Store in a glass bottle sealed with Teflon lined screw cap.

8.5 **Silica gel impregnated with Sodium Hydroxide** – Add one part (by weight) of 1M NaOH solution to two parts (by weight) activated silica gel in a Teflon lined screw cap bottle and mix with a glass rod until free of lumps.

8.6 **Silica gel impregnated with Sulfuric Acid** – Add one part (by weight) concentrated sulfuric acid to two parts (by weight) activated silica gel in a Teflon lined screw cap bottle and mix with a glass rod until free of lumps.

8.7 **Extraction thimbles, 43mm x 123mm and 33mm x 80mm (VWR, 28320-510 and 27730-128, respectively)**

8.8 **Sulfuric Acid, concentrated, ACS grade (EMD, EM-SX1244-75)**

8.9 **Sand, quartz (VWR, BDH0274-2.5kg)**

8.10 **Sodium Sulfate, granular, anhydrous (EMD, EM-SX0760E-20) –** Activate for four hours at a temperature of 400°C. Store in a glass bottle sealed with a Teflon lined screw cap.

8.10.1 Fill ceramic crucibles with sodium sulfate and place in the muffle furnace. Add 5-10g sand to an empty crucible and place in the muffle furnace.

8.10.2 The temperature program is set to ramp up to 400°C then hold that temperature for four hours. Start the program by holding the "**P**" button until "**Pnr 4**" appears on the controller. Press "**Run/Hold**." To cancel a program, press the up and down arrows simultaneously. At the end of the program the furnace will cool by convection.

Uncontrolled Copy
Will not be updated

8.10.3 When the sodium sulfate is ready to remove, transfer it to 2-liter jars and label them with the preparation date, analyst name, and lot number of the sodium sulfate. Make an entry into the Semi-Volatile Na_2SO_4 Preparation Logbook containing the preparation date, analyst name, quantity prepared, sodium sulfate lot number, and whether the run passed or failed (as indicated by a color change in the sand from gray to pink/orange).

8.10.4 If the sodium sulfate has a noticeable grayish cast, it must be discarded.

8.11 Sodium Chloride, analytical reagent grade, 5 percent (w/v) in water (VWR, VW6430-5)

8.12 Sodium Hydroxide, 1N (VWR, 3222-4)

8.13 Solvents

8.13.1 Methylene Chloride – 99.9% minimum Assay (HPLC Grade, EMD, TXEMDX0831-1CA)
8.13.2 Hexane – 99.9% minimum Assay (HPLC Grade, EMD, TXEMH0296-1CA)
8.13.3 Methanol – 99.9% minimum Assay (HPLC Grade, EMD, MX0488P-1)
8.13.4 Nonane – 99.9% minimum Assay (HPLC Grade, Sigma, N29406-500mL)
8.13.5 Toluene – 99.9% minimum Assay (HPLC Grade, EMD, TX0737-1)
8.13.6 Tridecane – 99.9% minimum Assay (HPLC Grade, Sigma, T57401-100g)
8.13.7 Ethyl Acetate – 99.9% minimum Assay (HPLC Grade, EMD, EX0241-1)
8.13.8 Acetone – 99.9% minimum Assay (HPLC Grade, EMD, AX0116-1)

8.14 Standards Suppliers

8.14.1 Cambridge Isotope Laboratories (CIL) – Primary standards supplier

8.14.2 Wellington Laboratories – Secondary standards supplier

8.15 Purchase, Receipt, and Handling of Standards

8.15.1 All standards purchased from CAS/Houston must have an appropriate purchase request form filled out and have approval from the Laboratory Director or other qualified individual. They must then go through the CAS/Corporate Purchasing Department. Standards are considered consumable and do not need an Expenditure Authorization Request (EAR) even if the cost exceeds the threshold. See the SOP for *Purchasing and Approval of Vendors*, ***ADM-PUR***, for more information

8.15.2 Upon arrival, all packages containing high concentrations must be checked for damage. If any damage is present, consult with CAS/Houston Health and Safety

Uncontrolled Copy
Will not be updated

Officer before further steps are taken. Proper safety practices should be followed when handling received standards.

8.15.3 All received standards must be assigned a Dioxin Standards Logbook identification number. Copy the solution description from the certificate of analysis and attach to the space provided for the next entry in the logbook. The following format is applied: D(ioxin)[Logbook number]-[page number]-[entry number][method descriptor]. An example would be D11-32-1A, where the A indicates 8290.

8.15.4 Assign each standard an expiration date as noted by the supplier. This is usually ten years after the manufacture date. Record this in the standards logbook. A standard must be disposed of after this date unless its validity can be verified (Section 8.24.)

8.15.5 Record the identification number on the received vial label. Transfer the standard from the received ampoule to a 2mL amber vial, keeping the supplier label intact. Seal the vial with Teflon tape. This will ensure no deterioration will occur.

8.15.6 Record the identification number on the certificate of analysis received from the supplier and store this documentation in the "Standards" binder for future reference. Certificates of analysis are also available through the Cerilliant website, CIL's manufacturer.

8.15.7 All solutions must be adequately labeled with the logbook identification code, method, short solution description, preparation date, initials of person performing preparation, expiration date, volume and concentration. Logbook entries shall include all of the above with the addition of the list of components, the components' logbook identification code, description and concentration, plus the initials of the person witnessing the dilution steps.

8.16 High-Resolution Concentration Calibration Solutions – Five nonane solutions containing unlabeled and carbon-labeled PCDDs and PCDFs at known concentrations are used to calibrate the instrument. The concentration ranges are homolog dependent (Table 4). These are purchased pre-made and are assigned the manufacturer's expiration dates.

8.17 Window Defining/GC Column Performance Mix Solution – This solution contains the first and last eluting isomers for each homologous series from tetra- through heptachlorinated congeners. The solution also contains a series of other TCDD isomers for the purpose of documenting the chromatographic resolution. The labeled 2,3,7,8-TCDD and TCDF are also present (Table 6). This is purchased pre-made at 200ng/mL and is assigned the manufacturer's expiration date.

Uncontrolled Copy
Will not be updated

8.18 **Internal Standard Solution** – Individual labeled analytes are combined to make an internal standard stock solution. This stock solution is diluted with nonane to make the internal standard spiking solution (Table 9). Store at room temperature in the dark.

8.18.1 For making a stock solution; use an appropriately sized volumetric flask specific for the target compounds and add nonane. Add each individual analyte in succession, making sure to not cross-contaminate analytes or affect analyte concentrations. Assign the solution a logbook identification code and label the solution according to Section 8.15.7. When done, vortex for homogeneity and submit a 20µL aliquot to HRGC/HRMS for analysis. All analytes must be validated against an acceptance requirement of 20% of the target value. Document this analysis in the "Stock Solution Analysis" binder for future reference.

8.18.2 After stock solution verification, perform an additional dilution on the stock solution to create the working solution. This can be performed in a properly labeled 20mL amber vial. Use a certified Eppendorf pipet for volume measurements requiring precision below 0.1mL. No verification of the working solution is necessary. Document all steps in the standards logbook. Since dioxin and furan compounds are highly stable in controlled environments, it is acceptable to assign a five (5) year expiration date to all created stock solutions and a one (1) year expiration date to all created working standard solutions.

8.19 **Recovery Standard Solution** – Individual labeled analytes are combined to make a recovery standard stock solution. Perform an additional dilution on the stock solution to make a recovery standard working solution (Table 9). Store at room temperature in the dark.

8.20 **Clean Up Standard Solution** – The individual labeled analyte is used to make the clean up standard stock solution. Perform an additional dilution on the stock solution to make a clean up standard working solution (Table 9). Store at room temperature in the dark.

8.21 **Matrix Spiking Solution (target compounds)** – Individual target compounds are combined to make a matrix compound stock solution. Perform an additional dilution on the stock solution to make a matrix standard working solution (Table 9). Store at room temperature in the dark.

8.22 Reference Standards are to be purchased from a supplier other than the primary standard supplier. All reference standards must be segregated from primary standards during storage. Reference standards can only be used to verify primary standards and must not be used for samples. All reference standards must be documented in the standards logbook following Sections 8.15.3 – 8.15.7.

8.23 Research standards must be adequately labeled as such. In addition to Sec. 8.15.7, all labels for standards designated for research must also state specifically the intended

Uncontrolled Copy
Will not be updated

research to be done, along with an appropriate qualifier, such as "For research purposes only."

8.24 Standards approaching expiration can be verified for validity by following the requirements in the CAS *Policy for Standards and Reagents Expiration Dates*, (Sept. 28th, 2009).

9.0 PREVENTIVE MAINTENANCE

9.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument.

9.2 **Carrier gas -** Inline purifiers or scrubbers must be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.

9.3 Gas Chromatograph

9.3.1 Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, o-ring, septum, column ferrule, and auto sampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. Liners and seals may be cleaned and re-used.

9.3.2 Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column-cutting tool.

9.3.3 Over time, the column will exhibit poorer overall performance. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

9.4 Mass Spectrometer

9.4.1 Tune the MS as needed to result in consistent and acceptable performance.

9.4.2 The source should be cleaned, as needed, depending on the performance of the instrument.

9.5 Preventive maintenance is performed annually by the service engineer for instruments under a service contract.

Uncontrolled Copy
Will not be updated

10.0 RESPONSIBILITIES

It is the responsibility of the analyst to perform the analysis according to the instructions in this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are only to be performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data. Problems that require corrective action are to be documented by the analyst, and brought to the attention of the Operations Manager.

11.0 PROCEDURE FOR SAMPLE PREPARATION, EXTRACTION, CONCENTRATION AND CLEAN UP

11.1 Sample Preparation

11.1.1 Sample preparation involves modifying the physical form of the sample so that the dioxins/furans can be extracted efficiently. In general, the samples must be in a liquid form or in the form of finely divided solids in order for efficient extractions to take place. Table 1 lists the phases and suggested quantities for extraction of various sample matrices.

For all samples, the blank, Ongoing Precision and Recovery (OPR), and other QC sample aliquots must be processed through the same steps as the sample to check for contamination and losses in the preparation process.

11.1.2 Aqueous Sample Preparation – Preparation of samples assigned to the aqueous matrix class.

11.1.2.1 Aqueous samples are prepared using the procedure below and extracted using the extraction techniques in Section 11.2.1. This procedure is applicable for samples and QC aliquots.

11.1.2.2 Transfer the sample to the ½ gal. extraction vessel. Mark the original level of the sample on the sample container for reference.

11.1.2.3 For each batch of up to 20 samples to be extracted in the same shift, place three 1L aliquots of reagent water into clean ½ gal. extraction vessels. One of these will serve as the Method Blank, and the other two will serve as the Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS, if applicable).

11.1.3 Solid (Soil, Sediment, Paper Pulp) Sample Preparation – Preparation of samples assigned to the solid matrix class.

Uncontrolled Copy
Will not be updated

11.1.3.1 Solid samples are prepared using the procedure below and extracted using the extraction techniques in Section 11.2.2-3. This procedure is applicable for samples and QC aliquots.

11.1.3.2 Weigh a well-mixed aliquot of each sample sufficient to provide 10g of dry solids into a clean thimble.

11.1.3.3 For each batch of up to 20 samples to be extracted in the same shift, weigh three 10g aliquots of the reagent grade quartz sand (or sodium sulfate, if no sand is available) into clean thimbles. One of these will serve as the Method Blank, and the other two will serve as the Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS, if applicable).

11.1.3.4 Total Solids Determination. Record the weight of an empty, labeled scintillation vial on the bench sheet. Add 5-10g (wet weight) of the solid sample to the scintillation vial and record the new, combined weight. Place the vial in an oven at or above 110±5°C for a minimum of 24 hours. Finally, record the dry weight of the combination on the bench sheet. Calculate the percent solids using the following formula:

$$\%solids = \frac{w_a}{w_b} \times 100$$

Where: w_a = combined weight after drying, in g, minus the empty vial weight.
w_b = combined weight before drying, in g, minus the empty vial weight.

11.1.4 <u>Fish and Other Tissues</u> – Most tissue samples are received previously homogenized. If a sample is received that is not, however, the portion of the sample to be used for dioxin/furan determination must be established and the following procedure used for homogenization.

11.1.4.1 Tissue samples are prepared using the procedure below and extracted using the extraction techniques in Section 11.2.4. This procedure is applicable for samples and QC aliquots.

11.1.4.2 A minimum of 30g of tissue must be homogenized to ensure there is enough sample for dioxin/furan and lipid determination (with enough left over in case re-extraction is necessary). Additionally, the weight should be increased for samples requiring additional analyses.

11.1.4.3 Homogenize the sample according to the procedures in the SOP for *Tissue Preparation*, ***WET-TISP***. Transfer to a new, labeled sample

Uncontrolled Copy
Will not be updated

container with a Teflon-lined cap. Store at -20 to -10°C and in the dark until analysis.

11.1.4.4 Weigh approximately 10g (20g if lipid analysis is requested) of the homogenized tissue into a clean thimble.

11.1.4.5 For each batch of up to 20 samples to be extracted in the same shift, weigh three 10g aliquots of contaminant free tissue or corn oil into clean thimbles. One of these will serve as the Method Blank, and the other two will serve as the Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS, if applicable).

To ensure the material used for QC samples is free of target compounds, homogenize and extract the material following the steps in Sections 11.1.4.1-11.1.4.4 and 11.2.4. Analyze the extracts on the HRGC/HRMS machines to verify no dioxins/furans are present. Once determined, the blank material can be used for QC samples. If contamination is present, however, the entire lot of material must be properly disposed of and another lot obtained.

11.1.5 Fuel Oil/Chemical

11.1.5.1 Fuel Oil/Chemical samples are prepared using the procedure below and cleaned up using the techniques in Section 11.3. This procedure is applicable for samples and QC aliquots.

11.1.5.2 Extract sample by weighing 1g of sample into a tared 250mL jar and combining with 60mL hexane. Sample is ready for clean up.

11.1.5.3 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet.

11.1.5.4 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2 Extraction and Concentration

11.2.1 Extraction of Aqueous Samples – Aqueous samples are to be extracted using a modified separatory funnel procedure. The primary difference is that the vessel is a glass jar with a Teflon-lined cap that is disposable. This greatly reduces cross-contamination.

Uncontrolled Copy
Will not be updated

11.2.1.1 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet.

11.2.1.2 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS or MS/DMS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2.1.3 If the sample contains greater than 1% suspended solids, it must be filtered using a Buchner funnel and vacuum apparatus. The filter and solids must be extracted following Sections 11.2.2.4-11.2.2.5 and combined with the filtrate extraction from Sections 11.2.1.4-11.2.1.5.

11.2.1.4 Add 100mL dichloromethane to the spiked sample in the ½ gal. extraction vessel. Vent the vapors under a fume hood by shaking for a few seconds then unsealing the cap. Repeat this process until pressure no longer builds in the vessel. Extract the sample by shaking the jar manually or on an automatic shaker for 3 minutes. Allow the layers to separate for 10 minutes and transfer the dichloromethane layer (bottom) into an appropriately labeled 250mL jar. If an emulsion layer forms, employ mechanical techniques (ultrasonic bath, centrifugation) to complete the phase separation.

11.2.1.5 Extract the sample with an additional 50mL aliquot of dichloromethane. Following extraction, remove any excess water from the dichloromethane portion by swirling the sample extract and removing the water that collects on top.

11.2.1.6 Add 750µL of tridecane and let evaporate until near dryness under a fume hood utilizing a fan. An alternate evaporation technique is to transfer the extract to a 500mL boiling flask, add boiling chips and 750µL of tridecane, and concentrate the extract using a rotary evaporator (with heating bath at 45-50°C) to near dryness. Add 60mL hexane. Sample is now ready for clean up.

11.2.1.7 Sample Volume Determination. Following extraction, using tap water, refill the sample container to the line marked in Section 11.1.2.2. Measure the volume of this water using a calibrated graduated cylinder and record on the extraction bench sheet.

11.2.2 <u>Soxhlet Extraction of Solid Samples</u> – Solid samples are to be extracted using either a soxhlet extraction apparatus or an Accelerated Solvent Extractor (ASE). Choosing which apparatus to use is at the discretion of the analyst; however, the ASE should only be used for low percent moisture samples.

Uncontrolled Copy
Will not be updated

11.2.2.1 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet. Allow the samples to equilibrate for 1 to 2 hours.

11.2.2.2 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2.2.3 Add 10-20g anhydrous sodium sulfate to each thimble containing the sample and mix thoroughly to evenly distribute the sodium sulfate. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained.

11.2.2.4 Transfer thimble to soxhlet extractor fitted with a 500mL boiling flask containing 240mL toluene and boiling chips. Alternatively, the micro-soxhlet apparatus utilizes a smaller set up, thus requiring only 125mL toluene and boiling chips to be added to a 250mL boiling flask.

11.2.2.5 Place the soxhlet apparatus onto a boiling mantle/condenser combination and reflux overnight (16-24 hours). Solvent must cycle 5 times per hour minimum (controller set at “6” or “60%”).

11.2.2.6 Cool the extraction apparatus. Transfer to a 250mL jar, add 750µL of tridecane, and let evaporate until near dryness under a fume hood utilizing a fan. An alternate evaporation technique is to keep the extract in the 500mL boiling flask, add boiling chips and 750µL of tridecane, and concentrate the extract using a rotary evaporator (with heating bath at 65°C) to near dryness. Add 60mL hexane. Sample is now ready for clean up.

11.2.3 <u>ASE Extraction of Solid Samples</u> – Solid samples are to be extracted using either a soxhlet extraction apparatus or an Accelerated Solvent Extractor (ASE). Choosing which apparatus to use is at the discretion of the analyst; however, the ASE should only be used for low percent moisture samples.

CAS/Houston uses a Dionex ASE200 Extractor. Other EPA approved extractors may be used instead.

11.2.3.1 Label stainless steel ASE cells accordingly. Add a frit to each cell and cover with a small amount of sodium sulfate.

11.2.3.2 Rather than adding sample/spiking solution to a clean thimble, instead add sample to a clean beaker to record weight. Add 10-20g sodium

Uncontrolled Copy
Will not be updated

sulfate, spike with 100µL internal standard spiking solution at 10-50ng/mL (Table 9), and mix thoroughly to evenly distribute the sodium sulfate. Record the standard addition on the bench sheet. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained. Transfer sample to ASE cell. Top with sodium sulfate.

11.2.3.3 Label 60mL collection vials and position both the cell and 60mL collection vial in corresponding locations on the trays. Double check to ensure each cell position matches their respective vial position.

11.2.3.4 Check the toluene reservoir and fill if low. Check the nitrogen tank level. If low, replace the tank. Use safety precautions when handling the gas tanks.

11.2.3.5 To start the ASE: Press "Menu," "Load Method," "Number 1," and "Start" on the screen. All methods and schedules are pre-programmed based on Dionex recommendations for the solvents used, and can be found in the appropriate maintenance logbook.

11.2.3.6 Transfer to a 250mL jar, add 750µL of tridecane and let evaporate until near dryness under a fume hood utilizing a fan. An alternate evaporation technique is to transfer the extract to a 500mL boiling flask, add boiling chips and 750µL of tridecane, and concentrate the extract using a rotary evaporator (with heating bath at 65°C) to near dryness. Add 60mL hexane. Sample is now ready for clean up.

11.2.4 Soxhlet Extraction of Tissue Samples – Tissue samples are to be extracted using a soxhlet extraction apparatus.

11.2.4.1 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet. If lipid determination is to be performed on a sample, spike 200µL of the internal standard spiking solution.

11.2.4.2 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2.4.3 Add 20-30g anhydrous sodium sulfate to each thimble containing the sample and mix thoroughly to evenly distribute the sodium sulfate. If the mixture is not free-flowing, continue to mix in sodium sulfate until a free-flowing consistency can be obtained.

Uncontrolled Copy
Will not be updated

11.2.4.4 Transfer thimble to soxhlet extractor fitted with a 500mL boiling flask containing boiling chips and 300mL of a 1:1 mixture of hexane/dichloromethane. Alternatively, the micro-soxhlet apparatus utilizes a smaller set up, thus requiring only 150mL of the 1:1 mixture to be added to a 250mL boiling flask.

11.2.4.5 Place the soxhlet apparatus onto a boiling mantle/condenser combination and reflux overnight (16-24 hours). Solvent must cycle 5 times per hour minimum (controller set at “4” or “40%”).

11.2.4.6 Cool the extraction apparatus. If lipid determination is to be performed, follow these steps, else, continue to Section 11.2.4.7. Weigh one 250mL jar and record on the bench sheet. Split the extract into two 250mL jars (with the extract for lipids determination added to the pre-weighed jar). Be sure to split the extracts evenly so as to ensure one half of the final extract is in each container. Dry the extract in the pre-weighed jar to complete dryness and record the weight on the bench sheet. Calculate the percent lipids using the following equation:

$$\%lipid = \frac{w_r}{w_t} \times 100$$

Where: w_r = weight of residue, in g, measured as the difference in the jar prior to adding the sample and following concentration.
w_t = weight of tissue, in g.

The un-weighed jar and extract is to be used for target compound determination and should be concentrated following the procedure in Section 11.2.4.7 below.

11.2.4.7 Cool the extraction apparatus. Transfer to a 250mL jar, add 750µL of tridecane, and let evaporate until near dryness under a fume hood utilizing a fan. An alternate evaporation technique is to keep the extract in the 500mL boiling flask, add boiling chips and 750µL of tridecane, and concentrate the extract using a rotary evaporator (with heating bath at 45-50°C) to near dryness. Add 60mL hexane. Sample is now ready for clean up.

11.2.5 Solid Phase Extraction (SPE) of Blood Serum – Blood serum samples are to be extracted using SPE cartridges. Handle denatured blood only. If blood does not arrive denatured, consult the Health and Safety Officer prior to proceeding.

11.2.5.1 Measure the volume of the sample and record on the bench sheet. For each batch of up to 20 samples to be extracted in the same shift, measure three 45mL aliquots of the reagent grade water into clean 50mL

Uncontrolled Copy
Will not be updated

centrifuge vials. One of these will serve as the Method Blank, and the other two will serve as the Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS, if applicable).

11.2.5.2 Spike 100µL of the internal standard spiking solution at 10-50ng/mL (Table 9) into each sample and each QC aliquot. Record this addition on the bench sheet. If lipid determination is to be performed on a sample, spike 200µL of the internal standard spiking solution.

11.2.5.3 Spike 100µL of the matrix standard spiking solution at 2-10ng/mL (Table 9) into the LCS/DLCS aliquots. Record this addition on the bench sheet. These will serve as both the precision and accuracy for the batch.

11.2.5.4 Assemble the vacuum manifold apparatus and attach one appropriately labeled SPE cartridge per sample. Turn the vacuum on to approximately 5-10psi. Activate the cartridges by filling with methanol twice, then reagent grade water twice. Discard methanol and water rinses, and turn the vacuum off.

11.2.5.5 Pour the samples and QCs into the cartridges and rinse with 5mL reagent grade water. Add rinses to cartridges. Rinse the cartridges two additional times with 5mL reagent grade water.

11.2.5.6 Turn the vacuum on and allow the cartridges to dry for a minimum of sixty minutes. Elute the target compounds and labeled standards with approximately 20mL hexane into scintillation vials. Samples are ready for silica gel clean up (Section 11.3.2).

11.3 Extract Clean Up – For some aqueous samples and all tissue and solid samples, back extraction with sulfuric acid is necessary to remove the presence of interferences. The presence of color in an aqueous sample determines if back extraction is necessary. If it is not, proceed directly to the silica gel clean up procedure in Section 11.3.2. Spike all samples, including QC samples, with 100µL of the labeled clean up standard spiking solution at 8ng/mL (Table 9) prior to performing any extract clean up procedures.

11.3.1 <u>Sulfuric Acid Clean Up</u>

11.3.1.1 Partition the extract against 10mL sulfuric acid. Shake for 30 seconds minimum with periodic venting into a hood. Remove and discard the acid (bottom) layer. Repeat the acid washings until no color is visible in the hexane layer, up to a maximum of four washings.

Uncontrolled Copy
Will not be updated

11.3.1.2 Partition the extract against 10mL sodium chloride solution and shake in the same way as with the acid. Remove and discard the aqueous (bottom) layer.

11.3.1.3 Add 750µL of tridecane and concentrate the extract by air drying under a fume hood to near dryness. Proceed with the silica gel and carbon clean up procedure.

11.3.2 Silica Gel and Carbon Clean Up

11.3.2.1 Pack the 12mm glass column as follows: Insert a ~1cm (approximately 1cm) long glass wool plug to a depth of ~10cm into the column. Remove the pre-weighed, activated carbon from the oven, and add ~5mL toluene. Cool-down is not necessary. Transfer the slurry to the glass column and allow the carbon to settle. Allow the toluene to completely drain. Insert another ~1cm long glass wool plug into the column. Push the carbon/glass wool combination down until there is ~10cm of free space. Elute with ~10mL dichloromethane then ~10mL hexane. Check the column for channeling. If channeling is observed, discard the column. Do not tap a wetted column. Flip the column 180 degrees so that the smaller end is facing down.

11.3.2.2 Pack the tapered glass column as follows: Insert a glass wool plug into the bottom of the column. Place ~2g activated neutral silica gel into the column. Add ~3g activated sodium hydroxide infused silica gel, ~6g activated sulfuric acid infused silica gel, and ~3g anhydrous sodium sulfate. Tap the column gently after each addition to settle the silica gel. Elute with ~30mL hexane. Check the column for channeling. If channeling is observed, discard the column. Do not tap a wetted column.

11.3.2.3 Place the silica gel column in the upper clamp of the clean up apparatus and the carbon column on the lower clamp. Gently connect the two columns, making sure to not create a seal. The column is now ready to load the sample extract. Do not allow the column to go dry at any time throughout this process.

11.3.2.4 Add ~2mL hexane to the sample extract. Transfer the 2mL extract to the silica gel column and allow the solvent to elute until the extract level is at the top of the sodium sulfate.

11.3.2.5 Rinse the 250mL jar containing the extract with ~25mL hexane and load the rinsate onto the silica gel column. Allow the hexane to elute until the solvent level is at the top of the sodium sulfate.

Uncontrolled Copy
Will not be updated

11.3.2.6 Slowly add ~25mL hexane to the silica gel column, allowing the hexane to pass through the column using a gravity feed. Add three more ~25mL portions to each column, as space permits. The total volume of hexane eluant is ~100mL per column clean up.

11.3.2.7 Remove and discard the used silica gel column when the drip from the carbon column stops. Flip the carbon column. Elute the column with ~10mL dichloromethane, then ~10mL of 1:1 ethyl acetate/hexane. Dispose all solvents used up until this point.

11.3.2.8 Place a labeled 20mL scintillation vial in the rack under the carbon column and elute with a total of ~20mL toluene. Be sure to collect the toluene, as this eluant contains the target compounds. Allow the extract to evaporate to complete dryness under the hood.

11.3.2.9 Add 400µL hexane to the scintillation vial. Add 20µL toluene to the auto sampler vial. Shake and transfer the extract to the auto sampler vial. Allow to evaporate halfway to dryness, under the fume hood. Add another 400µL hexane to the scintillation vial. Cap, vortex, and transfer to the respective auto sampler vial. Repeat this process once more, for a total of three rinses. Allow the sample to evaporate to near dryness under the fume hood. An optional evaporation technique is to concentrate using a nitrogen evaporator with the heating mantle set at 55-60°C.

11.3.2.10 The sample extract is ready to be spiked with 20µL of the recovery standard at 50ng/mL (Table 9.)

12.0 PROCEDURE FOR HRGC/HRMS ANALYSIS AND CALIBRATION

12.1 Chromatographic/Mass Spectrometric Conditions and Data Acquisition Parameters

12.1.1 Gas Chromatograph

Column coating: DB-5
Film thickness: 0.25µm
Column dimension: 60 m x 0.25mm
Injector temperature: 300°C
Splitless valve time: 1 min
Interface temperature: 300°C
Temperature program:

Uncontrolled Copy
Will not be updated

DB-5 STAGE	INITIAL TEMP °C	INITIAL HOLD TIME, MIN	TEMPERATURE RAMP, °C/MIN	FINAL TEMP °C	FINAL HOLD TIME, MIN
1	150	5	35	215	5
2			1.5	230	6
3			7	315	5

Column coating: DB-225
Film thickness: 0.25µm
Column dimension: 30 m x 0.25mm
Injector temperature: 290°C
Splitless valve time: 1 min
Interface temperature: 300°C
Temperature program:

DB-225 STAGE	INITIAL TEMP °C	INITIAL HOLD TIME, MIN	TEMPERATURE RAMP, °C/MIN	FINAL TEMP °C	FINAL HOLD TIME, MIN
1	130	2.5	40	170	0
2			5	210	1
3			3	240	13

12.1.2 Mass Spectrometer

12.1.2.1 The mass spectrometer must be operated in a selected ion monitoring (SIM) mode with a total cycle time (including the voltage-reset time) of one second or less. At a minimum, the ions listed in Table 5 for each of the five SIM descriptors must be monitored. Note that with the exception of the last descriptor (OCDD/OCDF), all descriptors contain 10 ions. The selection (Table 5) of the molecular ions M and M+2 for $^{13}C_{12}$-HxCDF and $^{13}C_{12}$-HpCDF rather than ^{13}M+2 and ^{13}M+4 (for consistency) was made to eliminate, even under high-resolution mass spectrometric conditions, interferences occurring in these two ion channels for samples containing high levels of native HxCDDs and HpCDDs. It is important to maintain the same set of ions for both calibration and sample extract analyses. The selection of the lock-mass ion is left to the analyst.

NOTE: At the option of the analyst, the tetra- and pentachlorinated dioxins and furans can be combined into a single descriptor.

12.1.2.2 The recommended mass spectrometer tuning conditions are based on the groups of monitored ions shown in Table 5. By using a PFK molecular leak, tune the instrument to meet the minimum required resolving power of 10,000 (10% valley) at m/z 304.9824 (PFK) or any other reference signal close to m/z 303.9016 (from TCDF). By using peak matching

Uncontrolled Copy
Will not be updated

conditions and the aforementioned PFK reference peak, verify that the exact mass of m/z 380.9760 (PFK) is within 5 ppm of the required value. Note that the selection of the low mass and high mass ions must be such that they provide the largest voltage jump performed in any of the five mass descriptors.

12.2 Data Acquisition/Calibration

12.2.1 The total cycle time for data acquisition must be <1 second. The total cycle time includes the sum of all the dwell times and voltage reset times.

12.2.2 Acquire SIM data for all the ions listed in the five descriptors.

12.2.3 Initial Calibration – Initial calibration is required before any samples may be analyzed for PCDDs and PCDFs. Initial calibration is also required if any routine calibration does not meet the required criteria. All five high-resolution concentration calibration solutions must be used for the initial calibration. Tune the instrument with PFK.

12.2.4 Inject 1µL of the GC Window Define solution and acquire SIM mass spectral data. The laboratory must not perform any further analysis until it is demonstrated and documented that the column performance check criterion was met (Section 13.1.1.2).

12.2.5 By using the same GC and MS conditions that produced acceptable results with the Window Define solution, analyze a 1µL portion of each of the five concentration calibration solutions once with the following mass spectrometer operating parameters.

12.2.6 The ratio of integrated ion current (homologous series quantitation ions) must be within the indicated control limits (set for each homologous series) for all unlabeled calibration standards.

12.2.7 The ratio of integrated ion current for the ions belonging to the carbon-labeled internal and recovery standards must be within the acceptable control limits.

12.2.8 For each selected ion current profile (SICP) and for each GC signal corresponding to the elution of a target analyte and of its labeled standards, the signal-to-noise ratio (S/N) must be better than or equal to 10.0.

12.2.9 Calculate the 17 relative response factors (RF) for the target analytes [RF_n; n = 1-17, Table 10]. The response factors are relative to the target analytes and the RFs for the internal standards [RF_{is}; is = 18 to 26]. The response factors for the clean up standard [RF_{cs}, cs = 29] is also related to the recovery standard using the following equations:

Uncontrolled Copy
Will not be updated

$$RF_n = \frac{(A_n^1 + A_n^2) \times Q_{is}}{(A_{is}^1 + A_{is}^2) \times Q_n} \qquad RF_{is} = \frac{(A_{is}^1 + A_{is}^2) \times Q_{rs}}{(A_{rs}^1 + A_{rs}^2) \times Q_{is}}$$

$$RF_{cs} = \frac{A_{cs} \times Q_{rs}}{(A_{rs}^1 + A_{rs}^2) \times Q_{cs}}$$

Where:

A_n^1 and A_n^2 = sum of the integrated ion abundances of the quantitation ions for unlabeled PCDDs/PCDFs.

A_{is}^1 and A_{is}^2 = sum of the integrated ion abundances of the quantitation ions for the internal standard PCDDs/PCDFs.

A_{rs}^1 and A_{rs}^2 = sum of the integrated ion abundances of the quantitation ions for the labeled recovery standards.

A_{cs} = integrated ion abundance of the quantitation ion for the labeled clean up standard.

Q_{is} = quantity of the internal standard injected (pg).

Q_{rs} = quantity of the recovery standard injected (pg).

Q_{cs} = quantity of the clean up standard injected (pg).

Q_n = quantity of the unlabeled PCDD/PCDF analyte injected (pg).

The RF values are dimensionless quantities; the units used to express Q_{is}, Q_{rs}, Q_{cs} and Q_n must be the same.

12.2.10 Calculate the mean response factors for the five calibration solutions:

$$\overline{RF_n} = \frac{\sum_{j=1}^{5} RF_{n(j)}}{5} \qquad \overline{RF_m} = \frac{\sum_{j=1}^{5} RF_{m(j)}}{5}$$

Where:

n = The particular native congener (*n* = 1 to 17)

m = The particular labeled congener (*m* = 18 to 26)

j = The injection number (or calibration solution number; *j* = 1 to 5)

RF_n = relative response factor of a particular native compound (*n*) relative to an appropriate internal standard, as determined from each injection

$\overline{RF_n}$ = calculated mean relative response factor of a particular native compound (*n*) relative to an appropriate internal standard, as determined from the five initial calibration injections (*j*)

Uncontrolled Copy
Will not be updated

RF_m = relative response factor of a particular internal standard (*m*) relative to an appropriate recovery standard, as determined from each injection

$\overline{RF_m}$ = calculated mean relative response factor of a particular labeled standard (*m*) relative to an appropriate recovery standard, as determined from the five initial calibration injections (*j*)

12.2.12 The relative response factors to be used for the determination of the concentration of total isomers in a homologous series are calculated as follows:

12.2.12.1 For congeners that belong to a homologous series with only one isomer (e.g., OCDD and OCDF) or only one 2,3,7,8-substituted isomer (TCDD, PeCDD, HpCDD, and TCDF), the mean RF used will be the same as the mean RF for that single isomer.

NOTE: The calibration solutions do not contain $^{13}C_{12}$-OCDF as an internal standard. This is because a minimum resolving power of 12,000 is required to resolve the M+6 ion of $^{13}C_{12}$-OCDF from the M+2 ion of OCDD (and M+4 from $^{13}C_{12}$-OCDF with M of OCDD). Therefore, the RF for OCDF is calculated relative to $^{13}C_{12}$-OCDD.

12.2.12.2 For congeners that belong to a homologous series containing more than one 2,3,7,8-substituted isomer, the mean RF used for those homologous series will be the mean of the RFs calculated for all individual 2,3,7,8-substituted congeners using the equation below:

$$\overline{RF_k} = \frac{1}{t}\sum_{n=1}^{t} RFn$$

Where: k=27 to 30; with 27=PeCDF; 28=HxCDF; 29=HxCDD; and 30=HpCDF (Table 11)
t=total number of 2,3,7,8-substituted isomers present in the calibration solutions for each homologous series (e.g., two for PeCDF, four for HxCDF, three for HxCDD, two for HpCDF).

NOTE: Presumably, the HRGC/HRMS response factors of different isomers within a homologous series are different. However, this analytical protocol will make the assumption that the HRGC/HRMS responses of all isomers in a homologous series that do not have the 2,3,7,8-substitution pattern are the same as the responses of one or more of the 2,3,7,8-substituted isomer(s) in that homologous series.

12.2.13 <u>Criteria for Acceptable Calibration</u> – The criteria listed below for acceptable calibration must be met before sample analyses are performed.

Uncontrolled Copy
Will not be updated

12.2.13.1 The percent relative standard deviations for the mean response factors [$\overline{RF_n}$ and $\overline{RF_m}$] from the 17 unlabeled standards must not exceed ±20 percent, and those for the nine labeled reference compounds must not exceed ±30 percent.

12.2.13.2 The S/N for the GC signals present in every SICP (including the ones for the labeled standards) must be $\geq$10.

12.2.13.3 The ion abundance ratios must be within the specified control limits.

NOTE: If the criterion for acceptable calibration is met, the analyte specific RF can then be considered independent of the analyte quantity for the calibration concentration range. The mean *RF* values will be used for all calculations until the routine calibration criteria are no longer met. At such time, new mean *RF* values will be calculated from a new set of injections of the calibration solutions.

12.2.14 Secondary Source Verification – Immediately following the analysis of the five calibration solutions, analyze another standard at the midpoint of the calibration. This standard must be obtained from a secondary vendor. Calculate the response factors of all compounds and verify against the initial calibration results.

12.2.15 Routine Calibration (Continuing Calibration Check) – Routine calibrations must be performed at the beginning of a 12-hour period after successful mass resolution and GC resolution performance checks. A routine calibration is also required at the end of a 12-hour shift. Inject 1µL of the concentration calibration solution HRCC3 standard. By using the same HRGC/HRMS conditions, determine and document an acceptable calibration.

12.2.16 Criteria for Acceptable Routine Calibration - The following criteria must be met before further analysis is performed.

12.2.16.1 The measured response factors obtained during the routine calibration runs must be within the limits specified in Table 12.

12.2.16.2 The measured response factors for the internal and clean up standards obtained during the routine calibration runs must be within the specified limits in Table 12.

12.2.16.3 The ion abundance ratios must be within the allowed control limits (Table 7.)

12.2.16.4 If any one these criteria is not satisfied, perform corrective actions and repeat one more time. Document all maintenance in the instrument

Uncontrolled Copy
Will not be updated

maintenance logbook. If these criteria are still not satisfied, the entire routine calibration process must be reviewed and a root cause analysis must be performed. If the resulting corrective actions produce an acceptable calibration, sample analysis may continue. If the subsequent ending routine calibration passes, calibration is verified, else, all samples must be reanalyzed and further corrective action must be taken. Another initial calibration must be performed.

NOTE: While samples requiring Minnesota Department of Health (MDH) certification are in the laboratory, an HRCC1 must be analyzed monthly at a minimum to verify the reporting limit (Table 12).

Uncontrolled Copy
Will not be updated

12.3 Analysis

12.3.1 Remove the sample or QC extract from storage. Add 20µL of recovery standard at 50ng/mL (Table 9) to the final extract.

12.3.2 Inject a 1µL aliquot of the extract into the GC, operated under the conditions that have been established to produce acceptable results with the performance check solution.

12.3.3 Acquire SIM data – Use the same acquisition and mass spectrometer operating conditions previously used to determine the relative response factors.

NOTE: The acquisition period must at least encompass the PCDD/PCDF overall retention time window previously determined. Selected ion current profiles (SICP) for the lock-mass ions (one per mass descriptor) must also be recorded and included in the data package. These SICPs must be true representations of the evolution of the lock-mass ions amplitudes during the HRGC/HRMS run. The analyst may be required to monitor a PFK ion, not as a lock-mass, but as a regular ion, in order to meet this requirement. It is recommended to examine the lock-mass ion SICP for obvious basic sensitivity and stability changes of the instrument during the HRGC/HRMS run that could affect the measurements. Report any discrepancies in the case narrative.

12.3.4 Identification Criteria – For a gas chromatographic peak to be identified as a PCDD or PCDF, it must meet all of the following criteria:

12.3.4.1 Retention Times.

12.3.4.1.1 For 2,3,7,8-substituted congeners which have an isotopically labeled internal standard present in the sample extract, the retention time (RRT; at maximum peak height) of the sample components must be within -1 to +3 seconds of the internal standard. Congeners without an internal standard are identified

based on their retention time relative to the internal standard for that level of chlorination, within 0.005 retention time units, as determined by the routine calibration.

12.3.4.1.2 Identification of OCDF is based on its retention time relative to $^{13}C_{12}$-OCDD as determined from the daily routine calibration results.

12.3.4.1.3 For non-2,3,7,8-substituted compounds the retention time must be within the corresponding homologous retention time windows established by analyzing the GC Window Define solution.

12.3.4.1.4 The ion current responses for both ions used for quantitative purposes (e.g., for TCDDs: m/z 319.8965 and 321.8936) must reach maximum simultaneously (±2 seconds).

12.3.4.1.5 The ion current responses for both ions used for the labeled standards (e.g., for $^{13}C_{12}$-2,3,7,8-TCDD: m/z 331.9368 and m/z 333.9339) must reach maximum simultaneously (±2 seconds).

NOTE: The analyst is required to verify the presence of 1,2,8,9-TCDD and 1,3,4,6,8-PeCDF in the SICPs in the window defining mix. Should either one compound be missing, the analyst is required to take corrective action as it may indicate a potential problem with the ability to detect all the PCDDs/PCDFs.

12.3.4.2 Abundance Ratios. The integrated ion currents for the two ions used for quantitation purposes must have a ratio between the lower and upper limits established for the homologous series to which the peak is assigned (Table 7.)

12.3.4.3 Signal-to-Noise Ratio. All ion current intensities must be ≥2.5 times noise level for positive identification of a PCDD/PCDF compound or a group of coeluting isomers.

12.3.4.4 Polychlorinated Diphenyl Ether Interferences. In addition to the above criteria, the identification of a GC peak as a PCDF can only be made if no signal having a S/N≥2.5 is detected at the same retention time (±2 seconds) in the corresponding polychlorinated diphenyl ether channel. Compounds associated with a corresponding ether peak are assigned data qualifier flags to indicate the possible interference.

13.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

Uncontrolled Copy
Will not be updated

13.1 System Performance Criteria – System performance criteria are presented below. It must be documented that all applicable system performance criteria were met before analysis of any sample is performed. Figure 2 provides a typical 12-hour analysis sequence, whereby the response factors and mass spectrometer resolving power checks must be performed at the beginning and the end of each 12-hour period of operation. A GC column performance check is only required at the beginning of each 12-hour period during which samples are analyzed. An HRGC/HRMS method blank run is required between a calibration run and the first sample run. The same method blank extract may be analyzed more than once.

13.1.1 GC Column Performance (Window Define)

13.1.1.1 Inject 1µL of the column performance check solution and acquire selected ion monitoring (SIM) data within a total cycle time of ≤1 second.

13.1.1.2 The chromatographic separation between 2,3,7,8-TCDD and the peaks representing any other unlabeled TCDD isomers must be resolved with a valley of ≤25%, where:

$$\text{Valley percent} = \frac{(X)}{(Y)} \times 100$$

Where: X = the trough height measured between 2,3,7,8-TCDD and its closest eluting isomer
Y = the peak height of 2,3,7,8-TCDD

NOTE: It is the responsibility of the laboratory to verify the conditions suitable for the appropriate resolution of 2,3,7,8-TCDD from all other TCDD isomers. The GC column performance check solution (Window Define) also contains the known first and last PCDD/PCDF eluters under the conditions specified in this protocol. Their retention times are used to determine the eight homolog retention time windows that are used for qualitative and quantitative purposes. All peaks (including $^{13}C_{12}$-2,3,7,8-TCDD) should be identified on the chromatograms.

Any individual selected ion current profile (SICP) (for the tetras, this would be the SICP for m/z 322 and m/z 304) or the reconstructed homolog ion current (for the tetras, this would correspond to m/z 320 + m/z 322 + m/z 304 + m/z 306) constitutes an acceptable form of data presentation. An SICP for the labeled compounds (e.g., m/z 334 for labeled TCDD) is also required.

13.1.1.3 The retention times for the switching of SIM ions characteristic of one homologous series to the next higher homologous series must be

Uncontrolled Copy
Will not be updated

indicated in the SICP. Accurate switching at the appropriate times is absolutely necessary for monitoring of these compounds. Allowable tolerance on the daily verification with the GC performance check solution should be better than 10 seconds for the absolute retention times of all the components of the mixture. Particular caution should be exercised for the switching time between the last tetrachlorinated congener (i.e., 1,2,8,9-TCDD) and the first pentachlorinated congener (i.e., 1,3,4,6,8-PeCDF), as these two compounds elute within 15 seconds of each other on the 60m DB-5 column. If the HRGC/HRMS system is not capable of detecting both congeners within one analysis, corrective action must be taken. If the recommended column is not used, then the first and last eluting isomer of each homolog must be determined experimentally on the column which is used, and the appropriate isomers must then be used for window definition and switching times.

13.1.2 Mass Spectrometer Performance

13.1.2.1 Chromatography time for PCDDs and PCDFs exceeds the long term mass stability of the mass spectrometer. Because the instrument is operated in the high-resolution mode, mass drifts of a few ppm (e.g., 5ppm in mass) can have serious adverse effects on instrument performance. Therefore, a mass drift correction is mandatory. To that effect, it is recommended to select a lock-mass ion from the reference compound (PFK is recommended) used for tuning the mass spectrometer. The selection of the lock-mass ion is dependent on the masses of the ions monitored within each descriptor. However, an acceptable lock-mass ion at any mass between the lightest and heaviest ion in each descriptor can be used to monitor and correct mass drifts. The level of the reference compound (PFK) metered into the ion chamber during HRGC/HRMS analyses should be adjusted so that the amplitude of the most intense selected lock-mass ion signal (regardless of the descriptor number) does not exceed 10% of the full scale deflection for a given set of detector parameters. Under those conditions, sensitivity changes that might occur during the analysis can be more effectively monitored.

NOTE: Excessive PFK (or any other reference substance) may cause noise problems and contamination of the ion source resulting in an increase in downtime for source cleaning.

13.1.2.1 Documentation of the instrument resolving power must then be accomplished by recording the peak profile of the high-mass reference signal (m/z 380.9760) obtained during the above peak matching experiment by using the low-mass PFK ion at m/z 304.9824 as a reference. The minimum resolving power of 10,000 must be

Uncontrolled Copy
Will not be updated

demonstrated on the high-mass ion while it is transmitted at a lower accelerating voltage than the low-mass reference ion, which is transmitted at full sensitivity. The format of the peak profile representation must allow manual determination of the resolution, i.e., the horizontal axis must be a calibrated mass scale (amu or ppm per division). The result of the peak width measurement (performed at 5 percent of the maximum, which corresponds to the 10% valley definition) must appear on the hard copy and cannot exceed 100ppm at m/z 380.9760 (or 0.038amu at that particular mass).

13.2 Quality Control Samples

13.2.1 Initial Precision and Recovery (IPR) – Prior to evaluating field samples for the first time, or following any major procedural changes, the analyst shall perform the following operations to establish the ability to generate acceptable precision and recovery:

13.2.1.1 Four identical aliquots of a reference matrix are to be spiked with the internal and matrix standards. All sample processing steps that are to be used for processing samples, including preparation, extraction and cleanup, shall be performed on these aliquots.

13.2.1.2 Using results of the set of four analyses, compute the average concentration of the extracts in ng/mL and the standard deviation of the in ng/mL for each compound.

13.2.1.3 For each native and labeled compound, the average must be within 30% of the expected value and the standard deviation must be within 20%. If the results for all compounds meet the acceptance criteria, system performance is acceptable and analysis of field samples may begin. If, however, any precision limit or accuracy limit is exceeded, system performance is unacceptable for that compound. Perform a root cause analysis, correct the problem, and repeat the test.

13.2.2 Performance Evaluation Samples – Included among the samples in all batches may be samples (blind or double blind) containing known amounts of unlabeled 2,3,7,8-substituted PCDDs/PCDFs or other PCDD/PCDF congeners.

CAS/Houston participates in performance evaluation studies through R.T. Corp (RTC). Solid, aqueous, and tissue studies are performed semiannually. All studies are performed following the guidelines of the SOP for *Proficiency Testing Sample Analysis*, ***ADM-PTS***.

13.2.3 Performance Check Solutions

13.2.3.1 At the beginning of each 12-hour period during which samples are to be analyzed, an aliquot of the GC column performance check (Window

Uncontrolled Copy
Will not be updated

Define) solution and high resolution concentration calibration solution, HRCC3, shall be analyzed to demonstrate adequate GC resolution and sensitivity, response factor reproducibility, and mass range calibration, and to establish the PCDD/PCDF retention time windows. A mass resolution check shall also be performed to demonstrate adequate mass resolution using an appropriate reference compound (PFK is recommended). If the required criteria (Section 12.2.15) are not met, corrective action must be taken before any samples are analyzed.

13.2.3.2 To validate positive sample data, the routine calibration and the mass resolution check must be performed also at the end of each 12-hour period during which samples are analyzed. A method blank must be analyzed following a calibration run and before the first sample run.

13.2.3.3 If the laboratory operates only during one period (shift) each day of 12 hours or less, the GC performance check (Window Define) solution must be analyzed once (at the beginning of the period) to validate the data acquired during the period. However, the mass resolution and continuing calibration checks must be performed at the beginning as well as at the end of the period.

13.2.3.4 If the laboratory operates during consecutive 12-hour periods (shifts), analysis of the GC performance check solution must be performed at the beginning of each 12-hour period. Acceptable mass resolution and continuing calibration checks from the previous period can be used for the beginning of the next period (thus the calibration check is allowed to occur prior to the mass resolution check).

13.2.3.5 Results of at least one analysis of the GC column performance (Window Define) solution and of two mass resolution and routine calibration checks must be reported with the sample data collected during a 12-hour period.

13.2.3.6 Deviations from criteria specified for the GC column performance check or for the mass resolution check invalidate all positive sample data collected between analyses of the performance check solution, and the extracts from those positive samples shall be reanalyzed.

13.2.3.7 If the continuing calibration check performed at the end of a 12-hour period fails by no more than 25% RPD for the 17 unlabeled compounds, and 35% RPD for the 9 labeled internal compounds, use the mean RFs from the two daily routine calibration runs to compute the analyte concentrations, instead of the RFs obtained from the initial calibration.

Uncontrolled Copy
Will not be updated

13.2.3.8 A new initial calibration (new RFs) is required immediately (within two hours) following the analysis of the samples, whenever the RPD from the end-of-shift routine calibration exceeds 25% or 35%, respectively. Failure to perform a new initial calibration immediately following the analysis of the samples will automatically require reanalysis of all positive sample extracts analyzed before the failed end-of-shift continuing calibration check.

13.2.4 Method Blank

13.2.4.1 Add 100µL of the internal standard solution at 10-50ng/mL (Table 9).

13.2.4.2 Extract and analyze according to Sections 11-12.

13.2.4.3 Evaluate the test results according to the acceptance criteria (Table 13).

NOTE: A low or high percent recovery for a blank does not require discarding the analytical data but it may indicate a potential problem with future analytical data.

13.2.5 Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS)

13.2.5.1 These quality control samples are performed in lieu of a matrix spike/matrix spike duplicate (MS/DMS).

13.2.5.2 Add 100µL of the internal standard solution at 10-50ng/mL. Add 100µL of the matrix spike at 2-10ng/mL (Table 9).

13.2.5.3 Extract and analyze according to Sections 11-12. These two measurements provide the batch's accuracy (% recovered in the LCS and DLCS) and the batch's precision (how closely the two results compare.)

13.2.5.4 Evaluate the test results according to the acceptance criteria (Table 13). Results that do not meet the acceptance criteria should be handled according to the procedures in Table 12.

13.2.6 Matrix Spike and Matrix Spike Duplicate (MS/DMS)

13.2.6.1 An MS/DMS combination is performed only at the request of the client. For Department of Defense (DoD), Texas Risk Reduction Program (TRRP), or MDH samples, an MS/DMS is required with each batch of samples.

Uncontrolled Copy
Will not be updated

13.2.6.2 Homogenize the sample and separate three identical aliquots for analysis. Often, for aqueous samples requiring MS/DMS analyses, the client will send a sufficient sample amount to use 1L for each aliquot. Add 100µL of the internal standard solution at 10-50ng/mL (Table 9). Add 100µL of the matrix spike at 2-10ng/mL (Table 9) to the two aliquots indicated for MS/DMS analysis.

13.2.6.3 Extract and analyze according to Sections 11-12. These two measurements provide the batch's accuracy (% recovered in the MS and DMS) and the batch's precision (how closely the two results compare.) The LCS acts as a second accuracy test. No DLCS is required for extraction batches containing an MS/DMS combination.

13.2.6.4 Evaluate the test results according to the acceptance criteria (Table 13).

13.2.7 Field Sample Duplicate (DUP)

13.2.7.1 A field sample duplicate is performed at the request of the client.

13.2.7.2 Homogenize the sample and separate two identical aliquots for analysis. Often, for aqueous samples requiring DUP analyses, the client will send a sufficient sample amount to use 1L for each aliquot. Add 100µL of the internal standard solution at 10-50ng/mL (Table 9). No matrix standard is added to either aliquot.

13.2.7.3 Extract and analyze according to Sections 11-12. This measurement provides the batch's precision (how closely the result compares with the field sample.) The LCS acts as an accuracy test. No DLCS is required for extraction batches containing a DUP analysis.

13.2.7.4 Evaluate the test results according to the acceptance criteria (Table 13).

13.3 Sample Preparation Batching Requirements

13.3.1 Number – The number of field samples in a preparation batch will not exceed twenty (20).

13.3.2 Matrix – The matrix to be used for the quality control samples must be consistent with the matrix of the field samples (i.e. reagent water for aqueous matrices, quartz sand or sodium sulfate for solid matrices, or blank tissue for tissue matrices).

13.3.3 Reagent Lots – A single lot of each reagent used in the analysis will be used to process the batch of samples.

Uncontrolled Copy
Will not be updated

13.3.4 Batch Time Frame – The maximum time between the start of processing of the first and last samples in the batch must be twenty-four (24) hours.

13.3.5 Batch QC Samples – Each preparation batch must contain, at a minimum, a Method Blank (Section 13.2.4) to monitor laboratory introduced contamination, an LCS (Section 13.2.5) to assess analysis performance (i.e. bias, or accuracy), and an additional sample to assess batch precision. This additional sample can be in the form of a DLCS (Section 13.2.5), an MS/DMS pair (Section 13.2.6), or a DUP (Section 13.2.7). Batch QC samples do not count towards the maximum number of sample allowed in a batch (Section 13.3.1).

13.3.6 See Figure 3 for an outline of an example sample preparation batch.

13.4 Percent Recovery of the Internal Standards

13.4.1 For each field and QC sample, calculate the percent recovery of the labeled compounds. The percent recovery must be within the acceptance criteria in Table 13. Acceptance criteria are updated periodically according to the SOP for *Control Limits*, ***ADM-CTRL_LIM***. The acceptance criteria located in Table 13 are interim control limits for when none are available.

NOTE: A low or high percent recovery for a blank does not require discarding the analytical data but it may indicate a potential problem with future analytical data.

13.5 Identification Criteria

13.5.1 If either one of the identification criteria in Sections 12.3.4.1.1 through 12.3.4.1.4 are not met for a homologous series, it is reported that the sample does not contain unlabeled 2,3,7,8-substituted PCDD/PCDF isomers for that homologous series at the calculated detection limit.

13.5.2 If the first initial identification criteria in Sections 12.3.4.1.1 through 12.3.4.1.4 are met, but the criteria appearing in Sections 12.3.4.1.5 or 12.3.4.2 are not met, that sample is presumed to contain interfering contaminants. This must be noted on the analytical report form, and the sample should be rerun or the extract reanalyzed.

13.6 Reuse of glassware is to be minimized to avoid the risk of contamination.

14.0 DATA REDUCTION AND REPORTING

All data reduction steps (integrations, and calculations, etc.) on raw data is performed using the Micromass OPUSQuan Software, Version 3.6 X.

14.1 Calculations

Uncontrolled Copy
Will not be updated

14.1.1 For gas chromatographic peaks that have met the criteria, calculate the concentration of the PCDD or PCDF compounds using the formula:

$$C_x = \frac{A_x \times Q_{is}}{A_{is} \times wv \times \overline{RF_n}}$$

Where:
C_x = amount of unlabeled PCDD/PCDF congeners (or group of coeluting isomers within a homologous series) in pg.
A_x = sum of the integrated ion abundances of the quantitation ions for unlabeled PCDDs/PCDFs.
wv = weight or volume, in g or L, of the sample (solid or liquid).
A_{is} = sum of the integrated ion abundances of the quantitation ions for the internal standards.
Q_{is} = quantity, in pg, of the internal standards added to the sample before extraction.
$\overline{RF_n}$ = calculated mean relative response factor for the analyte RF_n [n = 1 to 17]

14.1.2 For internal standards and the clean up standard, calculate the recovery based on the recovery standards. Calculate the percent recovery measured in the sample extract, using the formula (Table 9):

$$\%\text{Recovery} = \frac{A_{is} \times Q_{rs}}{Q_{is} \times A_{rs} \times \overline{RF}_m} \times 100 \qquad \%\text{Recovery} = \frac{A_{cs} \times Q_{rs}}{Q_{cs} \times A_{rs} \times \overline{RF}_m} \times 100$$

Where:
A_{is}, A_{cs}, A_{rs} = sum of the integrated ion abundances of the quantitation ions for the internal, clean up (one ion), and recovery standards.
Q_{is}, Q_{cs}, Q_{rs} = quantity, in pg, of the internal, clean up, and recovery standards added to the sample prior to extraction.
$\overline{RF_m}$ = calculated mean relative response factor for the labeled internal (or clean up) standard relative to the appropriate recovery standard.

14.1.3 If the concentration in the final extract of any of the 2,3,7,8-substituted PCDD/PCDF compounds exceeds the upper method calibration limits (MCL), the linear range of response versus amount has been exceeded. A second analysis of the sample, a dilution, should be performed. The volumes of the internal and recovery standard solutions should remain the same as described for the sample preparation. For OCDD and OCDF peaks that do not saturate the detector, however, report the measured concentration and indicate that the value exceeds the MCL. All compounds exceeding the upper calibration limit are flagged with an E flag.

Uncontrolled Copy
Will not be updated

14.1.3.1 To prepare a dilution of 1:50 or less, combine a portion of the extract equal to the dilution factor (i.e. 1/10th of the extract for a 1:10 dilution) with an amount of internal and recovery standards equal to the amount added prior to extraction and analysis, respectively. For extracts that may have partially evaporated between the analysis and the dilution, the volume must be brought back up to the extract volume following the most recent analysis prior to removing the portion to be combined with the internal and recovery standards. Additional solvent may be added to allow for the accurate retrieval of the portion removed for combination. For dilutions higher than 1:50, serial dilutions are necessary due to the limited size of the auto sampler vials and the high volume required for the accurate retrieval of the portion removed for combination. For example, to perform a 1:100 dilution, bring the extract volume up to the volume following the previous injection. Transfer 1/10th of the extract to a new auto sampler vial, and bring this volume up to a suitable amount. Transfer 1/10th of this new volume to a final vial, where 1000-5000pg of the internal and 1000pg of the recovery standards are added. The successive 1:10 dilutions result in a 1:100 dilution.

14.1.3.2 Reanalyze the diluted sample using the labeled standard recoveries calculated from the initial analysis to correct the diluted results for losses during the original extraction and clean up. Calculate the results as below:

$$C_x = \frac{A_x \times Q_{is} \times DL}{A_{is} \times \overline{RF_n} \times \%REC}$$

Where:

C_x, A_x, A_{is}, Q_{is}, and $\overline{RF_n}$ are as defined above.

DL = Dilution factor of reanalyzed extract.

%REC = Percent recovery of the labeled internal standard in the original analysis of the extract as calculated above.

14.1.4 If there is significant interference present or if internal standard recoveries are below the acceptance criteria (Section 13.4), a re-extraction with a smaller sample size may be necessary. The analyst must take precautions to ensure a representative aliquot is taken (weights <2g are not recommended).

14.1.5 The total concentration for each homologous series of PCDD and PCDF is calculated by summing up the concentrations of all positively identified isomers of each homologous series. Therefore, the total will also include the 2,3,7,8-substituted congeners.

Uncontrolled Copy
Will not be updated

14.1.6 Sample Specific Estimated Detection Limit - The sample specific estimated detection limit (EDL) is the concentration of a given analyte required to produce a signal with a peak height of at least 2.5 times the background noise level. An EDL is calculated for each 2,3,7,8-substituted congener that is not identified, regardless of whether or not other non-2,3,7,8-substituted isomers are present. Two methods of calculation can be used, as follows, depending on the type of response produced during the analysis of a particular sample.

14.1.6.1 For samples giving a response for both quantitation ions that are less than 2.5 times the background noise level, use the expression for EDL (specific 2,3,7,8-substituted PCDD/PCDF) below. The background level is determined by measuring the range of the noise (peak to peak) for the two quantitation ions of a particular 2,3,7,8-substituted isomer within an homologous series, in the window of the SICP trace corresponding to the elution of the labeled standard (if the congener possesses a labeled standard) or in the window of the SICP where the congener is expected to elute by comparison with the routine calibration data (for those congeners that do not have a C13-labeled standard), multiplying that noise height by 2.5, and relating the product to an estimated concentration that would produce that peak height. Use the formula:

$$EDL = \frac{2.5 \times H_x \times Q_{is}}{H_{is} \times \overline{RF_n}}$$

where:

EDL = estimated detection limit for homologous 2,3,7,8-substituted PCDDs/PCDFs.

H_x = sum of the height of the noise level for each quantitation ion for the unlabeled PCDDs/PCDFs.

Q_{is} = quantity, in pg, of the internal standard added to the sample

H_{is} = sum of the height of the signal level for each quantitation ion for the internal standard.

$\overline{RF_n}$ = calculated mean relative response factor for the analyte [n=1 to 17]

14.1.6.2 For compounds characterized by the response of a signal having the same retention time as a 2,3,7,8-substituted congener, having a S/N in excess of 2.5, and does not meet any of the other qualitative identification criteria, calculate the "Estimated Maximum Possible Concentration" (*EMPC*); with the exception that the variable *A* represents the sum of the area under the smaller peak and of the other peak area calculated using the theoretical chlorine isotope ratio.

Uncontrolled Copy
Will not be updated

$$\frac{A_1}{A_2} = i_c \qquad A_1 = A_2 \times i_t \qquad (i_c > i_t)$$

$$A_2 = \frac{A_1}{i_t} \qquad (i_c < i_t)$$

Where:
A_1 = Area of the first ion used for quantitation.
A_2 = Area of the second ion used for quantitation.
i_c = Calculated ion abundance ratio for the compound.
i_t = Theoretical ion abundance ratio for the compound.

If $i_c > i_t$ then use A_2 and adjust the value for A_1. If $i_c < i_t$ then use A_1 and adjust the value for A_2. Use the second and third equations for this adjustment.

14.1.7 The relative percent difference (*RPD*) of any duplicate sample results are calculated as follows:

$$RPD = \frac{|S_1 - S_2|}{\frac{(S_1 + S_2)}{2}} \times 100$$

where: S_1, S_2 = sample and duplicate sample results.

14.1.8 The 2,3,7,8-TCDD toxicity equivalents (TEQ/TEF) of PCDDs and PCDFs present in the sample are calculated according to the method recommended by the Chlorinated Dioxins Workgroup (CDWG) of the EPA and the Center for Disease Control (CDC). This method assigns a 2,3,7,8-TCDD toxicity equivalency factor (TEF) to each of the 2,3,7,8-substituted PCDDs and PCDFs. The 2,3,7,8-TCDD equivalent of the PCDDs and PCDFs present in the sample is calculated by summing the TEF times their concentration for each of the compounds or groups of compounds. The exclusion of other homologous series such as mono-, di-, and tri- chlorinated dibenzo-p-dioxins and dibenzofurans does not mean that they are non-toxic.

14.1.8.1 The concentration of the 2,3,7,8-TCDF is obtained from the analysis of the sample extract on the 30m DB-225 fused silica capillary column. However, the HRGC/HRMS conditions must be altered so that only the first three descriptors (i.e., tetra-, penta-, and hexachlorinated congeners) are used; and the switching time between descriptor 2 (pentachlorinated congeners) and descriptor 3 (hexachlorinated congeners) takes place following the elution of $^{13}C_{12}$-1,2,3,7,8-PeCDD. The chromatographic separation between the 2,3,7,8-TCDF and its close eluters (2,3,4,7-TCDF and 1,2,3,9-TCDF) must be equal or less than 25 percent valley.

Uncontrolled Copy
Will not be updated

14.2 Data review

14.2.1 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met.

14.2.2 Refer to the SOP for *HRMS Data Review and Reporting*, ***HRMS-DATAREV,*** for general instructions for data review.

15.0 METHOD PERFORMANCE

15.1 There is no need for MDL studies for this method. Method performance is monitored using a sample specific EDL calculation, as shown above. Method reporting limits (MRLs) are determined from the minimum point of linearity as calculated from the lowest calibration point (HRCC1) for each labeled and unlabeled compound. MRLs have no correlation to the EDL.

15.2 Limits of Detection (LOD) and Limits of Quantitation (LOQ) are generated and verified according to the requirements in the Department of Defense Quality Systems Manual (Reference 19.7).

15.3 Method capabilities can be found in appropriate reference method. Training documentation and demonstrations of capability are controlled by the Quality Assurance Program Manager.

16.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat from solvent and reagents used in this method can be minimized when recycled or disposed of properly. All disposable glassware should be recycled as per the laboratory procedures. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the CAS Environmental Health and Safety (EH&S) Manual. Also, see the SOP for *Waste Disposal*, ***SMO-WASTDISP***.

17.0 CORRECTIVE ACTIONS FOR OUT OF CONTROL DATA

Corrective action measures applicable to specific analysis steps are discussed in the applicable section of this SOP. Also, refer to the SOP for *Corrective Action*, ***ADM-CA***, for correct procedures for identifying and documenting such data. Procedures for applying data qualifiers are described in the SOP for *HRMS Data Review and Reporting*, ***HRMS-DATAREV***. See Table 12 for additional example corrective actions and required documentation.

Uncontrolled Copy
Will not be updated

17.1 Contamination problems, if they arise, should be investigated systematically.

17.1.1 Contaminated chemicals (including solvents) should be discarded. If one or more additional containers of the chemical with the same lot number are present in the laboratory, the additional quantity of chemical should be evaluated for contamination prior to use.

17.1.2 Contaminated glassware should be discarded.

17.2 Problems associated with low standard recoveries are usually attributed to one of the following:

17.2.1 Low recoveries of internal standard (for samples where the clean up standard recoveries are normal) indicate that extraction is inefficient. The analysis should be repeated. If the low recoveries of internal standards are still a problem, then the cause may be a matrix effect. Low recoveries of internal standard are frequently a problem if the sample is a charcoal filter or a fly ash.

17.2.2 Low recoveries of both internal standards and clean up standards indicate that losses are taking place during the clean up process. Such losses may simply be due to inefficient transfers, or losses may be taking place during carbon column clean up. Contaminants in the sample extract may interact with the carbon and alter the retention times of analytes on the carbon column.

17.2.3 If any of the standards are completely absent from the selected ion profile, the possibility should be considered that addition of that standard to the sample or extract has not taken place.

17.2.4 If the chromatographic peak area for a standard is approximately double the anticipated area, the possibility should be considered that two aliquots of that standard have been added to the sample or extract.

17.3 Low sensitivity (poor signal-to-noise ratio) may be attributed to a number of causes.

17.3.1 A leaking septum might result in losses of sample during injection. Another consequence of a leaking septum (or any leak in the inlet system of the gas chromatograph) is reduced flow of carrier gas, resulting in increased retention times.

17.3.2 Accumulation of particles of septum or ferrule material in the injection port can lead to adsorptive losses. Similar losses are encountered when the injection port or the injection port liner are contaminated by the residues of ‘dirty’ samples.

17.3.3 A degraded column can cause peak distortion, and may also lead to adsorptive losses. Excessive bleed of stationary phase from the column may result in high background levels and, consequently, elevated noise levels (thus decreasing the signal-to-noise ratio). The problem is commonly restricted to the first few centimeters of the column, and can be corrected by cutting off 10 to 20 cm of the column.

Uncontrolled Copy
Will not be updated

17.3.4 High background levels can also be attributed to bleed from an inappropriate septum. This is a particular problem with the PeCDF channels.

17.3.5 Re-tuning of the mass spectrometer might improve the sensitivity, or the problem may be due to a contaminated ion source. If, over a period of time, continual increases in the electron multiplier voltage are needed to obtain adequate sensitivity, then the photo multiplier may have to be replaced.

18.0 CONTINGENCIES FOR HANDLING OUT OF CONTROL OR UNACCEPTABLE DATA

18.1 See Section 17.0.

19.0 REFERENCES

19.1 "Method 8290: Analytical Procedures and Quality Assurance for Multimedia Analysis of Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry". Y. Tondeur and W.F. Beckert. US Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, NV.

19.2 DoD *Quality Systems Manual*, Final Version 4.1

19.3 2003 NELAC Quality Systems Standard

19.4 USEPA, 2005-09-01; USEPA AOC National Functional Guidelines for Chlorinated Dioxin/Furan Data Review (Sept 2005)

19.5 “Method 8000B: Determinative Chromatographic Separations”, USEPA

19.6 “Laboratory Procedure Manual: PCDDs, PCDFs, cPCBs, and ortho-substituted PCBs.” National Center for Environmental Health, CDC, October 2006.

20.0 TRAINING PLAN

20.1 Refer to the SOP for *Documentation of Training*, ***ADM-TRANDOC***. The SOP describes the training outline and necessary documentation (Figure 7.)

20.2 Review the SOP. Also review safety procedures, any instrument related manuals, and all related SOPs.

20.3 Following these reviews observe the procedure as performed by an experienced analyst at a minimum of three times.

20.4 Once the analyst and trainer are comfortable with the procedure, the analyst must perform the SOP with supervision for an extended period of time. During this period, the analyst is expected to transition from a role of assisting to performing the procedure with minimal oversight from an experienced analyst.

Uncontrolled Copy
Will Not Be Updated

20.5 Independently perform the SOP and complete an Initial Demonstration of Capabilities. This study can be based on either a blind Performance Evaluation sample or four consecutive LCS samples. Document these studies.

21.0 METHOD MODIFICATIONS

The following modifications have been made to the published method (referenced parenthetically). These modifications offer equivalent performance at a reduced cost.

21.1 Reused glassware is not rinsed with solvents (Ref 19.1 Sec 4.3).
21.2 Silica gel is not pre-cleaned with DCM if blanks are contaminated. Gel mixed on a tumbler not with a glass stirring rod (Ref 19.1 Sec 5.2.3).
21.3 Acid impregnated silica gel made at 33% w/w instead of 40% (Ref 19.1 Sec 5.2.5).
21.4 0.400g of Envi-Carb used instead of AX-21/Celite for carbon clean up (Ref 19.1 Secs 5.2.6, 5.2.7, 7.5.3.1).
21.5 Tridecane is used as a keeper solvent to prevent sample from going to dryness (Ref 19.1 Sec 7.2.3-4).
21.6 Oil samples are not filtered through a glass fiber filter following extraction (Ref 19.1 Sec 7.4.2).
21.7 Paper mill effluents are not routinely filtered (Ref 19.1 Sec 7.4.5.2 Note).
21.8 Disposable jars used instead of separatory funnels (Ref 19.1 Secs 7.4.5.4 and 7.4.6.4).
21.9 First aqueous extraction step performed with 100mL instead of 60mL DCM (Ref 19.1 Sec 7.4.5.4).
21.10 Aqueous extraction step repeated only once and with 50mL DCM (Ref 19.1 Sec 7.4.5.7).
21.11 Solvent evaporated with a fan under a fume hood (primarily) instead of using the KD apparatus or rotary evaporator (Ref 19.1 Sec 7.4.5.8-9).
21.12 Sample extract is not filtered through a glass fiber filter following soxhlet extraction (Ref 19.1 Sec 7.4.6.3).
21.13 Rotary evaporator water bath is set at 65°C instead of 50°C (Ref 19.1 Sec 7.4.6.3).
21.14 Volumes for back extraction are 10mL instead of 40mL (Ref 19.1 Sec 7.5.1).
21.15 Samples are shaken with sulfuric acid for 30 seconds instead of 2 minutes (Ref 19.1 Sec 7.5.1.1).
21.16 Samples are shaken with NaCl solution for 30 seconds instead of 2 minutes (Ref 19.1 Sec 7.5.1.2).
21.17 Samples are not exposed to a base clean up (Ref 19.1 Sec 7.5.1.3).
21.18 Glass disposable columns are used for column chromatography to reduce contamination. Top layer of column bed is sodium sulfate instead of neutral silica gel (Ref 19.1 Sec 7.5.2.1).
21.19 No alumina column is used for clean up (Ref 19.1 Sec 7.5.2).
21.20 Solvent rinses performed with DCM and a 1:1 mix of hexane/ethyl acetate (Ref 19.1 Sec 7.5.3.3-4).
21.21 Extracts are concentrated (primarily) using a fan under a fume hood. During final transfer the vials are not rinsed with a 1% toluene:DCM mix, but hexane instead (Ref 19.1 Sec 7.5.3.6).

Uncontrolled Copy
Will not be updated

21.22 Target compounds without respective labeled standards are verified against the CCAL (Ref 19.1 Sec 7.8.4.1.2).

21.23 100ppm peak width not measured when demonstrating instrument resolution (Ref 19.1 Sec 8.2.2.3).

21.24 Samples appearing heterogeneous are not transferred to a larger container and/or mixed with a stainless steel spoon (polypropylene is used) (Ref 19.1 Sec 6.2.1).

21.25 Aqueous volume measured to the accuracy of the graduated cylinder (which depends on the sample size) (Ref 19.1 Sec 7.4.5.11).

22.0 INSTRUMENT SPECIFIC ADDENDUM

None.

23.0 CHANGES FROM PREVIOUS REVISION

23.1	Section 1.1	Added EPA Method reference.
23.2	Sections 1.3-1.4	Deleted.
23.3	Section 5.3	New.
23.4	Section 7.1.5.1	Deleted and all following sections renumbered.
23.5	Section 7.3	Updated.
23.6	Section 8.9	New and all following sections renumbered.
23.7	Section 8.10	Updated for muffle furnace procedure.
23.8	Section 8.17	Updated.
23.9	Section 11.1.4.5	Updated to include corn oil blank matrix.
23.10	Section 11.2.2	Updated.
23.11	Section 11.3	Updated.
23.12	Section 13.2.3.1	Updated.
23.13	Section 13.2.5.4	Updated.
23.14	Section 14.1.3	Updated.

24.0 ATTACHMENTS

24.1 **Tables –** See Appendix 1.

24.2 **Figures –** See Appendix 2.

Uncontrolled Copy
Will not be updated

APPENDIX 1

TABLE 1

MATRICES, SAMPLE SIZES, AND METHOD CALIBRATION LIMITS (PARTS PER TRILLION)

	Water	Soil, Sediment, Paper Pulp[b]	Fly ash	Fish Tissue[c]	Human Adipose Tissue	Sludges Fuel Oil
Lower MCL[a]	0.01	1.0	1.0	1.0	1.0	5.0
Upper MCL[a]	2	200	200	200	200	1000
Weight/Volume (g/mL)	1000	10	10	10	2	1
IS Spiking Levels (ppt)	1	100	100	100	100	500
Final Extract Volume (µL)	20	20	20	20	20	20

[a] For other congeners, multiply the values by 1 for TCDF/TCDD, by 2.5 for PeCDD/PeCDF, HxCDD/HxCDF/HpCDD/HpCDF, and by 5 for OCDD/OCDF.
[b] Sample dewatered prior to analysis.
[c] An additional 10g sample is used for determination of lipid content.

Uncontrolled Copy
Will not be updated

TABLE 2

THE FIFTEEN 2,3,7,8-SUBSTITUTED PCDD AND PCDF CONGENERS

PCDD	PCDF
2,3,7,8-TCDD(*)	2,3,7,8-TCDF(*)
1,2,3,7,8-PeCDD(*)	1,2,3,7,8-PeCDF(*)
1,2,3,6,7,8-HxCDD(*)	2,3,4,7,8-PeCDF
1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDF
1,2,3,7,8,9-HxCDD(+)	1,2,3,7,8,9-HxCDF
1,2,3,4,6,7,8-HpCDD(*)	1,2,3,4,7,8-HxCDF(*)
	2,3,4,6,7,8-HxCDF
	1,2,3,4,6,7,8-HpCDF(*)
	1,2,3,4,7,8,9-HpCDF

* The C13-labeled analogue is used as an internal standard
+ The C13-labeled analogue is used as recovery standard

Uncontrolled Copy
Will not be updated

TABLE 3

ISOMERS OF CHLORINATED DIOXIN AND FURANS AS A FUNCTION OF THE NUMBER OF CHLORINE ATOMS

Number of Chlorine Atoms	Number of Dioxin Isomers	Number of 2378-Dioxin	Number of Furan Isomers	Number of 2378-furans
1	2	-	4	-
2	10	-	16	-
3	14	-	28	-
4	22	1	38	1
5	14	1	28	2
6	10	3	16	4
7	2	1	4	2
8	1	1	1	1
Total	75	7	135	10

Uncontrolled Copy
Will not be updated

TABLE 4

HIGH RESOLUTION CONCENTRATION CALIBRATION SOLUTIONS

Unlabeled Analytes	**Concentrations (pg/uL)** 1	2	3	4	5
2,3,7,8-TCDD	1	2.5	10	50	200
2,3,7,8-TCDF	1	2.5	10	50	200
1,2,3,7,8-PeCDD	2.5	6.25	25	125	500
1,2,3,7,8-PeCDF	2.5	6.25	25	125	500
2,3,4,7,8-PeCDF	2.5	6.25	25	125	500
1,2,3,4,7,8-HxCDD	2.5	6.25	25	125	500
1,2,3,6,7,8-HxCDD	2.5	6.25	25	125	500
1,2,3,7,8,9-HxCDD	2.5	6.25	25	125	500
1,2,3,4,7,8-HxCDF	2.5	6.25	25	125	500
1,2,3,6,7,8-HxCDF	2.5	6.25	25	125	500
1,2,3,7,8,9-HxCDF	2.5	6.25	25	125	500
2,3,4,6,7,8-HxCDF	2.5	6.25	25	125	500
1,2,3,4,6,7,8-HpCDD	2.5	6.25	25	125	500
1,2,3,4,6,7,8-HpCDF	2.5	6.25	25	125	500
1,2,3,4,7,8,9-HpCDF	2.5	6.25	25	125	500
OCDD	5	12.5	50	250	1000
OCDF	5	12.5	50	250	1000
Internal Standards					
C13-2,3,7,8-TCDD	50	50	50	50	50
C13-2,3,7,8-TCDF	50	50	50	50	50
C13-1,2,3,7,8-PeCDD	50	50	50	50	50
C13-1,2,3,7,8-PeCDF	50	50	50	50	50
C13-1,2,3,6,7,8-HxCDD	125	125	125	125	125
C13-1,2,3,4,7,8-HxCDF	125	125	125	125	125
C13-1,2,3,4,6,7,8-HpCDD	125	125	125	125	125
C13-1,2,3,4,6,7,8-HpCDF	125	125	125	125	125
C13-OCDD	250	250	250	250	250
Recovery Standards					
C13-1,2,3,4-TCDD	50	50	50	50	50
C13-1,2,3,7,8,9-HxCDD	125	125	125	125	125

Uncontrolled Copy
Will not be updated

TABLE 5

IONS MONITORED FOR HRGC/HRMS ANALYSIS OF PCDDS/PCDFS

DESCRIPTOR	EXACT M/Z	M/Z TYPE	ELEMENT COMPOSITION	COMPOUND
1	292.9825	LOCK	C_7F_{11}	PFK
	303.9016	M	$C_{12}H_4{}^{35}Cl_4O$	TCDF
	305.8987	M+2	$C_{12}H_4{}^{35}Cl{}^{37}O$	TCDF
	315.9419	M	${}^{13}C_{12}H_4{}^{35}Cl_4O$	TCDF(S)
	317.9389	M+2	${}^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF(S)
	319.8965	M	$C_{12}H_4{}^{35}ClO_2$	TCDD
	321.8936	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD
	327.8847	M	$C_{12}H_4{}^{37}Cl_4O_2$	TCDD(CS)
	330.9792	QC	C_7F_{13}	PFK
	331.9368	M	${}^{13}C_{12}H_4{}^{35}Cl_4O_2$	TCDD(S)
	333.9339	M+2	${}^{13}C_{12}H_4{}^{35}Cl{}^{37}ClO_2$	TCDD(S)
	375.8364	M+2	$C_{12}H_4{}^{35}Cl_5{}^{37}ClO$	HXCDPE
2	339.8597	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PECDF
	341.8567	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PECDF
	351.9000	M+2	${}^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PECDF(S)
	353.8970	M+4	${}^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PECDF(S)
	355.8546	M+2	$C_{12}H_3{}^{35}Cl_3{}^{37}ClO_2$	PECDD
	357.8516	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PECDD
	367.8949	M+2	${}^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PECDD(S)
	369.8919	M+4	${}^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PECDD(S)
	409.7974	M+2	$C_{12}H_3{}^{35}Cl_6{}^{37}ClO$	HPCDPE
3	373.8208	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HXCDF
	375.8178	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O$	HXCDF
	383.8639	M	${}^{13}C_{12}H_2{}^{35}Cl_6O$	HXCDF(S)
	385.8610	M+2	${}^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HXCDF(S)

Uncontrolled Copy
Will not be updated

TABLE 5 (cont.)

DESCRIPTOR	EXACT M/Z	M/Z TYPE	ELEMENT COMPOSITION	COMPOUND
3	389.8157	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HXCDD
	391.8127	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HXCDD
	392.9760	LOCK	C_9F_{15}	PFK
	401.8559	M+2	${}^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HXCDD(S)
	403.8529	M+4	${}^{13}C_{12}H_2{}^{35}Cl_4{}^{37}C_2lO$	HXCDD(S)
	430.9729	QC	C_9F_{17}	PFK
	445.7555	M+4	$C_{12}H_2{}^{35}Cl_5{}^{37}Cl_2O$	OCDPE
4	407.7818	M+2	$C_{12}H{}^{35}Cl_6{}^{37}ClO$	HPCDF
	409.7789	M+4	$C_{12}H{}^{35}Cl_5{}^{37}Cl_2O$	HPCDF
	417.8253	M	${}^{13}C_{12}H{}^{35}Cl_7{}^{37}O$	HPCDF(S)
	419.8220	M+2	${}^{13}C_{12}H{}^{35}Cl_6{}^{37}ClO$	HPCDF(S)
	423.7766	M+2	$C_{12}H{}^{35}Cl_6{}^{37}ClO_2$	HPCDD
	425.7737	M+4	$C_{12}H{}^{35}Cl_5{}^{37}Cl_2O_2$	HPCDD
	430.9729	LOCK	C_9F_{17}	PFK
	435.8169	M+2	${}^{13}C_{12}H{}^{35}Cl_6{}^{37}ClO_2$	HPCDD(S)
	437.8140	M+4	${}^{13}C_{12}H{}^{35}Cl_5{}^{37}Cl_2O_2$	HPCDD(S)
	479.7165	M+4	$C_{12}H{}^{35}Cl_7{}^{37}Cl_2O$	NCDPE
5	441.728	M+2	$C_{12}H{}^{35}Cl_7{}^{37}ClO$	OCDF
	443.7399	M+4	$C_{12}H{}^{35}Cl_6{}^{37}Cl_2O$	OCDF
	457.7377	M+2	$C_{12}H{}^{35}Cl_7{}^{37}ClO_2$	OCDD
	459.7348	M+4	$C_{12}H{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD
	469.7779	M+2	${}^{13}C_{12}H{}^{35}Cl_7{}^{37}ClO_2$	OCDD(IS)
	471.7750	M+4	${}^{13}C_{12}H{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD(IS)
	513.6775	M+4	$C_{12}H{}^{35}Cl_8{}^{37}Cl_2O_2$	DCDPE
	442.9728	QC	$C_{10}F_{17}$	PFK

Nuclidic masses used:

H= 1.007825
C= 12.000000
${}^{13}C$ = 13.003355
F= 18.9984
O= 15.994915
${}^{35}Cl$ = 34.968853
${}^{37}Cl$ = 36.965903

PFK= PERFLUROKEROSENE
SS= INTERNAL STANDARD
CS=CLEANUP STANDARD (only one m/z)

Uncontrolled Copy
Will not be updated

TABLE 6

PCDD AND PCDF CONGENERS PRESENT IN THE GC PERFORMANCE CHECK (WINDOW DEFINE) SOLUTION

	PCDD Positional Isomer		PCDF Positional Isomers	
# Chlorine Atoms	First Eluters	Last Eluters	First Eluters	Last Eluters
4 [a]	1,3,6,8	1,2,8,9	1,3,6,8	1,2,8,9
5	1,2,4,6,8/1,2,4,7,9	1,2,3,8,9	1,3,4,6,8	1,2,3,8,9
6	1,2,4,6,7,9/1,2,4,6,8,9	1,2,3,4,6,7	1,2,3,4,6,8	1,2,3,4,8,9
7	1,2,3,4,6,7,9	1,2,3,4,6,7,8	1,2,3,4,6,7,8	1,2,3,4,7,8,9
8	1,2,3,4,6,7,8,9		1,2,3,4,6,7,8,9	

[a] In addition to these two TCDD isomers, the 1,2,3,4,-, 1,2,3,7-, 1,2,3,8-, 2,3,7,8-, $^{13}C_{12}$ – 2,3,7,8-, and 1,2,3,9-TCDD isomers must be present as a check of column resolution.

Uncontrolled Copy
Will not be updated

TABLE 7

THEORICAL ION ABUNDANCE RATIOS AND THEIR CONTROL LIMITS

# Chlorine Atoms	Ion Type	Theoretical Abundance Ratio	Control Limits Lower	Control Limits Upper
4	M/M+2	0.77	0.65	0.89
5	M+2/M+4	1.55	1.32	1.78
6	M+2/M+4	1.24	1.05	1.43
6 [a]	M/M+2	0.51	0.43	0.59
7 [b]	M/M+2	0.44	0.37	0.51
7	M+2/M+4	1.04	0.88	1.20
8	M+2/M+4	0.89	0.76	1.02

[a] Used only for $^{13}C_{12}$ – HxCDF (IS)
[b] Used only for $^{13}C_{12}$ – HpCDF (IS)

Uncontrolled Copy
Will not be updated

TABLE 8

2,3,7,8-TCDD TOXICITY EQUIVALENCY FACTORS (TEFs) FOR THE POLYCHLORINATED DIBENZO-p-DIOXINS AND DIBENZOFURANS

Analyte	TEF [a]
2,3,7,8-TCDD	1
1,2,3,7,8-PeCDD	0.5
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
1,2,3,4,6,7,8,9-OCDD	0.001
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
1,2,3,4,7,8-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
1,2,3,4,6,7,8,9-OCDF	0.001

[a] Taken from "Interim Procedure for Estimating Risk Associated with Exposures to Mixtures of Chlorinated Dibenzo-*p*-Dioxin and –Dibenzofurans 1989 Update". (EPA/625/3-89/016, March 1989).

Uncontrolled Copy
Will not be updated

TABLE 9

CONCENTRATION OF STOCK AND SPIKING SOLUTIONS CONTAINING PCDDs/PCDFs

PCDDs/PCDFs	Internal Standard Stock Solution (ng/mL)	Internal Standard Spiking Solution (ng/mL)	MS Stock Fortification Solution (ng/mL)	MS Spiking Fortification Solution (ng/mL)
2,3,7,8-TCDD			100	2
2,3,7,8-TCDF			100	2
1,2,3,7,8-PeCDD			250	5
1,2,3,7,8-PeCDF			250	5
2,3,4,7,8-PeCDF			250	5
1,2,3,4,7,8-HxCDD			250	5
1,2,3,6,7,8-HxCDD			250	5
1,2,3,7,8,9-HxCDD			250	5
1,2,3,4,7,8-HxCDF			250	5
1,2,3,6,7,8-HxCDF			250	5
1,2,3,7,8,9-HxCDF			250	5
2,3,4,6,7,8-HxCDF			250	5
1,2,3,4,6,7,8-HpCDD			250	5
1,2,3,4,6,7,8-HpCDF			250	5
1,2,3,4,7,8,9-HpCDF			250	5
OCDD			500	10
OCDF			500	10
Internal Standard				
$^{13}C_{12}$ – 2,3,7,8-TCDD	100	10		
$^{13}C_{12}$ – 2,3,7,8-TCDF	100	10		
$^{13}C_{12}$ – 1,2,3,78-PeCDD	100	10		
$^{13}C_{12}$ – 1,2,3,7,8-PeCDF	100	10		
$^{13}C_{12}$ – 1,2,3,6,7,8-HxCDD	250	25		
$^{13}C_{12}$ – 1,2,3,4,7,8-HxCDF	250	25		
$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpCDD	250	25		
$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpCDF	250	25		
$^{13}C_{12}$ – OCDD	500	50		
Cleanup Standard				
$^{37}Cl_4$ – 2,3,7,8-TCDD		8		
Recovery Standard				
$^{13}C_{12}$ – 1,2,3,4-TCDD		50		
$^{13}C_{12}$ – 1,2,3,7,8,9-HxCDD		50		

Uncontrolled Copy
Cannot be updated

TABLE 10

REFERENCE COMPOUNDS FOR QUANTITATION OF NATIVE AND LABELED PCDDs AND PCDFs

Compound Number	Type	Name	Reference Compound
1	Native	2,3,7,8-TCDD	18
2	Native	1,2,3,7,8-PeCDD	19
3	Native	1,2,3,4,7,8-HxCDD	20
4	Native	1,2,3,6,7,8-HxCDD	20
5	Native	1,2,3,7,8,9-HxCDD	20
6	Native	1,2,3,4,6,7,8-HpCDD	21
7	Native	OCDD	22
8	Native	2,3,7,8-TCDF	23
9	Native	1,2,3,7,8-PeCDF	24
10	Native	2,3,4,7,8-PeCDF	24
11	Native	1,2,3,4,7,8-HxCDF	25
12	Native	1,2,3,6,7,8-HxCDF	25
13	Native	1,2,3,7,8,9-HxCDF	25
14	Native	2,3,4,6,7,8-HxCDF	25
15	Native	1,2,3,4,6,7,8-HpCDF	26
16	Native	1,2,3,4,7,8,9-HpCDF	26
17	Native	OCDF	22
18	Internal Standard	$^{13}C_{12}$ – 2,3,7,8-TCDD	27
19	Internal Standard	$^{13}C_{12}$ – 1,2,3,7,8-PeCDD	27
20	Internal Standard	$^{13}C_{12}$ – 1,2,3,6,7,8-HxCDD	28
21	Internal Standard	$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpCDD	28
22	Internal Standard	$^{13}C_{12}$ – OCDD	28
23	Internal Standard	$^{13}C_{12}$ – 2,3,7,8-TCDF	27
24	Internal Standard	$^{13}C_{12}$ – 1,2,3,7,8-PeCDF	27
25	Internal Standard	$^{13}C_{12}$ – 1,2,3,4,7,8-HxCDF	28
26	Internal Standard	$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpCDF	28
27	Recovery Standard	$^{13}C_{12}$ – 1,2,3,4-TCDD	
28	Recovery Standard	$^{13}C_{12}$ – 1,2,3,7,8,9-HxCDD	
29	Cleanup Standard	$^{37}Cl_4$ – 1,2,3,7,8-TCDD	27

Uncontrolled Copy
Will not be updated

TABLE 11

RELATIVE RESPONSE FACTOR [RF (NUMBER)] ATTRIBUTIONS

Number	Specific Congener Name
1	2,3,7,8-TCDD (and total TCDDs)
2	2,3,7,8-TCDF (and total TCDFs)
3	1,2,3,7,8-PeCDD (and total PeCDDs)
4	1,2,3,7,8-PeCDF
5	2,3,4,7,8-PeCDF
6	1,2,3,4,7,8-HxCDD
7	1,2,3,6,7,8-HxCDD
8	1,2,3,7,8,9-HxCDD
9	1,2,3,4,7,8-HxCDF
10	1,2,3,6,7,8-HxCDF
11	1,2,3,7,8,9-HxCDF
12	2,3,4,6,7,8-HxCDF
13	1,2,3,4,6,7,8-HpCDD (and totals HpCDD)
14	1,2,3,4,6,7,8-HpCDF
15	1,2,3,4,7,8,9-HpCDF
16	OCDD
17	OCDF
18	$^{13}C_{12}$ – 2,3,7,8-TCDD
19	$^{13}C_{12}$ – 2,3,7,8-TCDF
20	$^{13}C_{12}$ – 1,2,3,7,8-PeCDD
21	$^{13}C_{12}$ – 1,2,3,7,8-PeCDF
22	$^{13}C_{12}$ – 1,2,3,6,7,8-HxCDD
23	$^{13}C_{12}$ – 1,2,3,4,7,8-HxCDF
24	$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpCDD
25	$^{13}C_{12}$ – 1,2,3,4,6,7,8-HpDF
26	$^{13}C_{12}$ – OCDD
27	Total PeCDFs
28	Total HxCDFs
29	Total HxCDDs
30	Total HpCDFs

Uncontrolled Copy
Will not be updated

TABLE 12

CORRECTIVE ACTION SUMMARY TABLE

QC Activity	Unacceptable Criteria	Recommended Corrective Action	Documentation
Method Blank	Tetra through Hepta>MRL or Octa>3xMRL	Analyze an instrument blank to demonstrate instrument is free of possible contamination. Evaluate whether entire sample batch must be re-extracted.	Compounds associated with a value in the method blank are flagged with 'B' on Form 1s.
DoD QSM Requirement - Method Blank	>½MRL and >1/10 amount in any sample	Analyze an instrument blank to demonstrate instrument is free of possible contamination. Evaluate whether affected samples must be re-extracted.	If re-extraction is not done, compounds associated with a value in the method blank are flagged with 'B' on Form 1s.
Instrument Blank	>MRL	Determine cause of contamination. Analyze an acceptable instrument blank prior to analyzing analytical sequence.	Resolve blank issue before proceeding.
Initial Calibration Standards	±20% native standards ±30% labeled standards	Reanalyze standards. If still unacceptable, remake standards and reanalyze.	Resolve ICAL standards issue before proceeding.
Continuing Calibration Verification Standard (CCV/HRCC3)	>RRF; ±20% native and ±30% labeled for beginning cal and ±25% native and ±30% labeled for ending cal	Reanalyze standard. If still unacceptable, recalibrate and reanalyze samples from last acceptable CCV/HRCC3.	Comment in case narrative.
Laboratory Control Sample (LCS) & Laboratory Control Sample Duplicate (DLCS)	Value outside acceptance criteria; >20% RSD	If LCS or DLCS out, evaluate the labeled standard(s) associated with the compound(s). If out, evaluate the associated labeled standard(s) in the sample(s). If out, re-extract the samples. If labeled standard(s) meet the acceptance criteria, release the test results.	Comment in case narrative.
DoD Requirement – LCS/DLCS	Exceedance of any control limit, marginal exceedance of any control limit by more than allowable number, exceedance of ME limits by any analyte	LCS/DLCS fails. Evaluate whether affected samples must be re-extracted.	Where samples cannot be re-extracted, note in case narrative.
MS & DMS	Value outside acceptance criteria; >20% RSD	Evaluate parent sample. If necessary, re-extract sample and MS/DMS pair.	Comment in case narrative.

Uncontrolled Copy
Will not be updated

TABLE 12

CORRECTIVE ACTION SUMMARY TABLE (cont.)

QC Activity	Unacceptable Criteria	Recommended Corrective Action	Documentation
Duplicate (DUP)	>25% RSD	Evaluate parent samples. If necessary, re-extract sample and DUP.	Comment in case narrative
Labeled Standard Recovery(ies)	Outside acceptance criteria for all labeled standards or if any labeled standard recovery is <10%	Complete an NCAR form and re-extract the sample using a smaller sample size.	Add an 'RE' suffix to the end of the Lab Sample ID, indicating 'Re-extraction'
Recovery of labeled standard for compounds	Outside acceptance criteria	Report values and flag results.	Flag associated results with 'Y' on Form 1s.
2378-TCDF result	Quantitated value on DB-5 column	Reanalyze 2378-TCDF on DB-225 column. Report value obtained from DB-225 column.	2378-TCDF result associated with a value from the DB-5 column flagged with 'C' on Form 1s.
Sample Results	Quantitated value >5x upper calibration limit. (OCDD/OCDF are exceptions to this rule)	Report values; dilute sample and report both undiluted and diluted test results. If only OCDD and/or OCDF are over-range, do not dilute extract – report OCDD and/or OCDF as over-range.	Flag associated results with 'E' on Form 1s.
Sample Results	Quantitated value <lower end of linear calibration range and >EDL.	Report values and flag results.	Flag associated results with 'J' on Form 1s.
Sample Results	Compound not detected.	Report and flag results.	Flag associated compounds with 'U' on Form 1s.
Native ions	Outside ion abundance ratio QC limit	Report as EMPC	Flag associated results with 'K' on Form 1s.
MDH Requirement - Analyze HRCC1 monthly at minimum	%Recovery falls outside ±40% acceptance criteria	Elevate MRL to lowest point meeting acceptance criteria. Reanalyze standard.	Report all samples using elevated MRL until passing HRCC1 can be analyzed.

Uncontrolled Copy
Will not be updated

TABLE 13

METHOD ACCEPTANCE CRITERIA[a]

Compounds	LCS & DLCS		MS & DMS		DUP
	Accuracy (%Rec)	Precision (%Diff)	Accuracy (%Rec)	Precision (%Diff)	Precision (%Diff)
2,3,7,8-TCDD	70-130	≤20	70-130	≤20	≤25
2,3,7,8-TCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,7,8-PeCDD	70-130	≤20	70-130	≤20	≤25
1,2,3,7,8-PeCDF	70-130	≤20	70-130	≤20	≤25
2,3,4,7,8-PeCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,4,7,8-HxCDD	70-130	≤20	70-130	≤20	≤25
1,2,3,6,7,8-HxCDD	70-130	≤20	70-130	≤20	≤25
1,2,3,7,8,9-HxCDD	70-130	≤20	70-130	≤20	≤25
1,2,3,4,7,8-HxCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,6,7,8-HxCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,7,8,9-HxCDF	70-130	≤20	70-130	≤20	≤25
2,3,4,6,7,8-HxCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,4,6,7,8-HpCDD	70-130	≤20	70-130	≤20	≤25
1,2,3,4,6,7,8-HpCDF	70-130	≤20	70-130	≤20	≤25
1,2,3,4,7,8,9-HpCDF	70-130	≤20	70-130	≤20	≤25
OCDD	70-130	≤20	70-130	≤20	≤25
OCDF	70-130	≤20	70-130	≤20	≤25
C13-2,3,7,8-TCDD	40-135		40-135		
C13-1,2,3,7,8-PeCDD	40-135		40-135		
C13-1,2,3,6,7,8-HxCDD	40-135		40-135		
C13-1,2,3,4,6,7,8-HpCDD	40-135		40-135		
C13-OCDD	40-135		40-135		
C13-2,3,7,8-TCDF	40-135		40-135		
C13-1,2,3,7,8-PeCDF	40-135		40-135		
C13-1,2,3,4,7,8-HxCDF	40-135		40-135		
C13-1,2,3,4,6,7,8-HpCDF	40-135		40-135		
37Cl-2,3,7,8-TCDD	40-135		40-135		

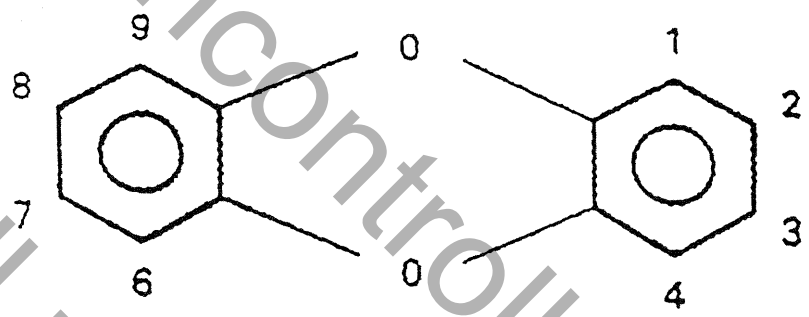
[a]Method acceptance criteria for Accuracy results interim guidelines. Actual acceptance criteria are updated annually based on the requirements of EPA SW-846 8000B and can be found in CAS LIMS.

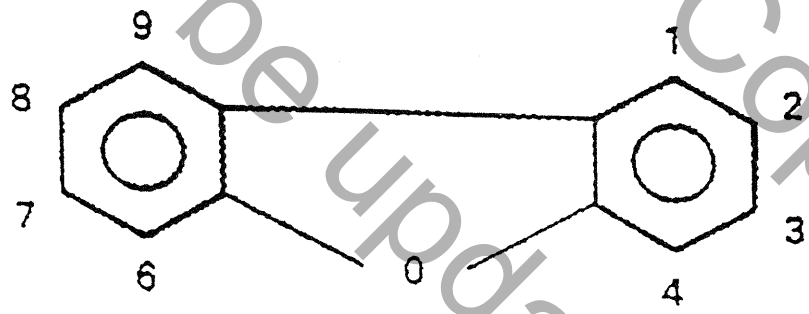
Uncontrolled Copy
Will not be updated

APPENDIX 2

FIGURE 1

GENERAL STRUCTURES OF DIBENZO-*p*-DIOXINS (TOP) AND DIBENZOFURANS (BOTTOM)



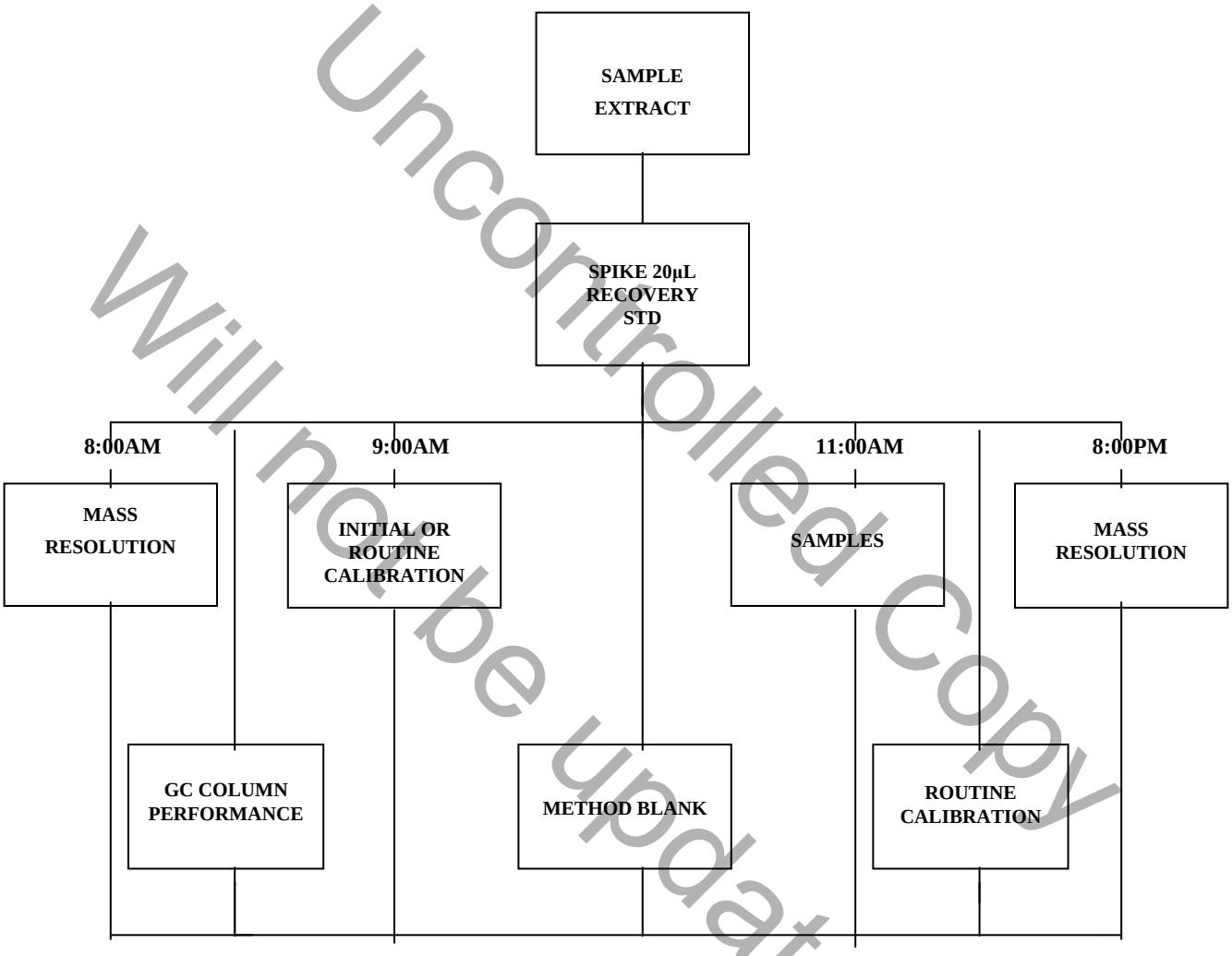


Uncontrolled Copy
Will not be updated

FIGURE 2

TYPICAL 12-HOUR ANALYSIS SEQUENCE OF EVENTS

ANALYTICAL PROCEDURE



Uncontrolled Copy
Will not be updated

FIGURE 3

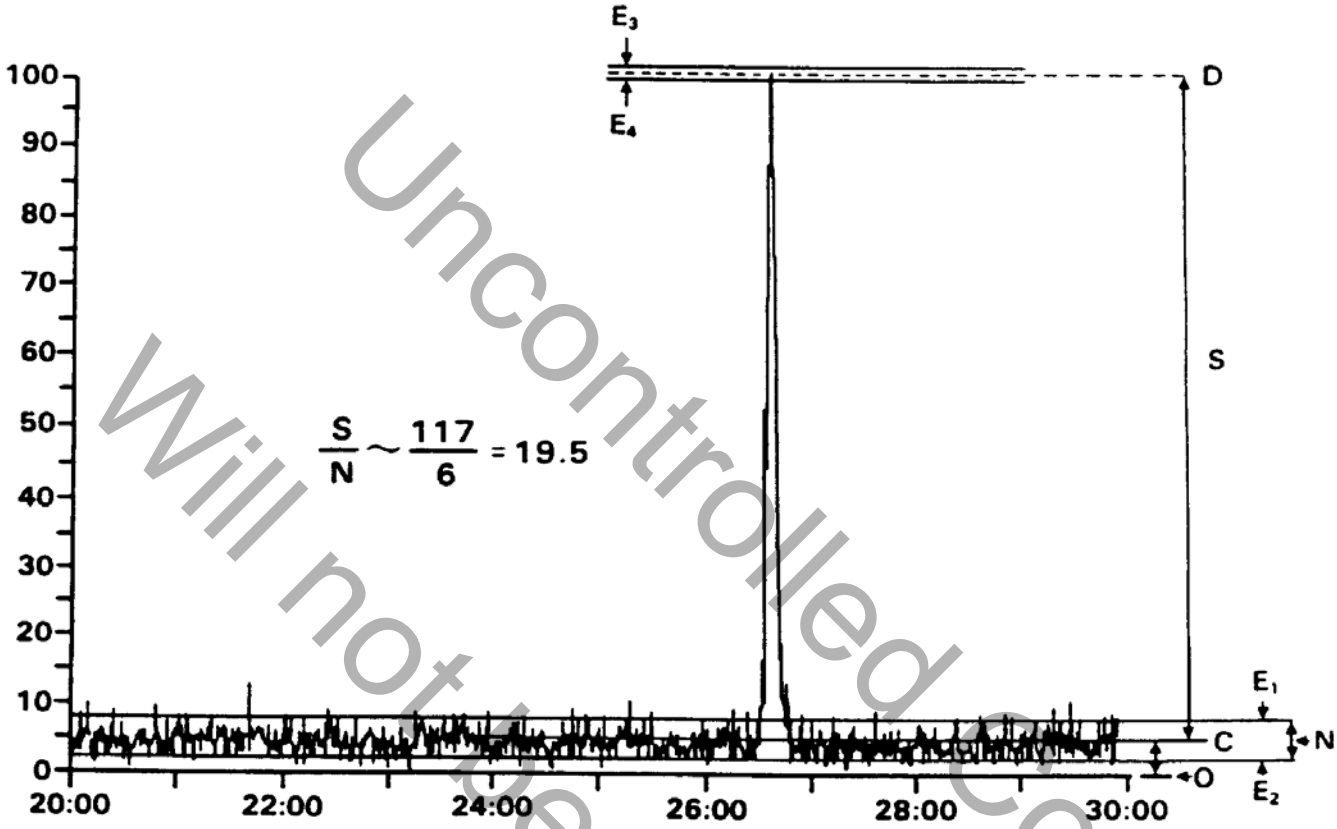
TYPICAL PREPARATION BATCH SEQUENCE

MB
LCS
DLCS (if applicable)
Field Sample 1
Field Sample 2
:
:
Field Sample n
Field Sample n MS (if applicable)
Field Sample n DMS (if applicable)
Field sample n DUP (if applicable)
:
:
Field Sample 19
Field Sample 20

Uncontrolled Copy
Will not be updated

FIGURE 4

MANUAL DETERMINATION OF S/N



The peak height (S) is measured between the mean noise (lines C and D.) These mean signal values are obtained by tracing the line between the baseline average noise extremes, E1 and E2, and between the apex average noise extremes, E3 and E4, at the apex of the signal.

NOTE: It is imperative that the instrument interface amplifier electronic zero offset be set high enough so that negative going baseline noise is recorded.

Uncontrolled Copy
Will not be updated

FIGURE 5

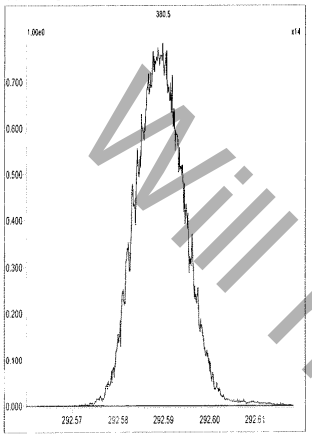
MASS RESOLUTION CHECK

Experiment Calibration Report **MassLynx 4.1** Page 1 of

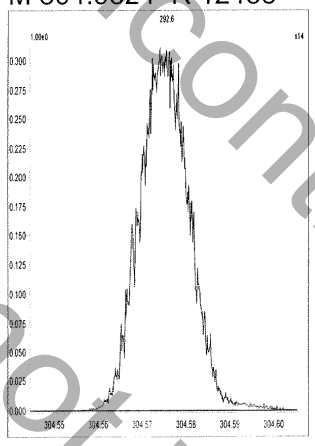
File: Experiment Reference: Pfk.ref Function: 1 @ 200 (ppm)

Printed: Friday, April 04, 2008 05:18:13 Central Standard Time

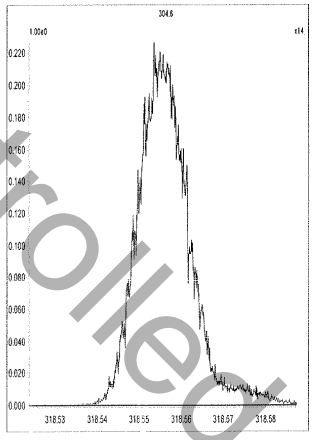
M 292.9824 R 12623



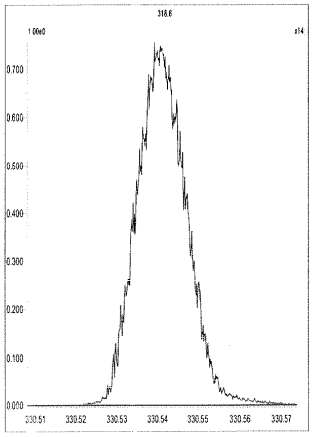
M 304.9824 R 12438



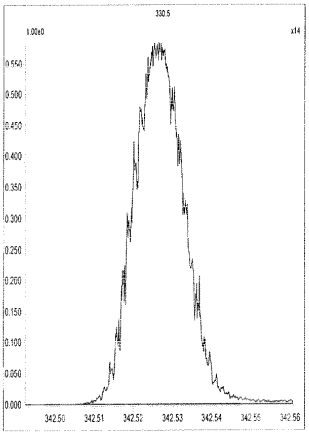
M 318.9792 R 11735



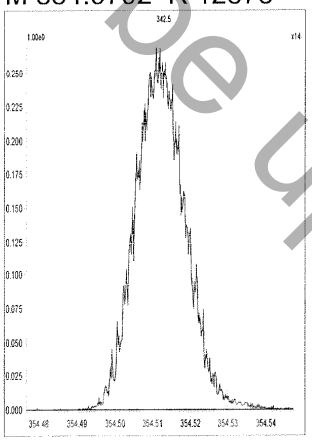
M 330.9792 R 12501



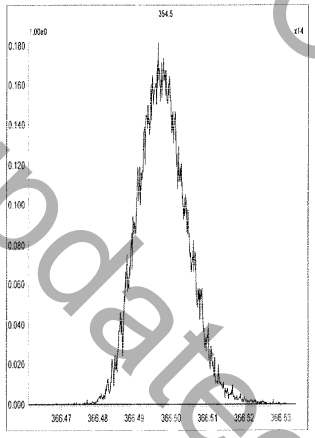
M 342.9792 R 12253



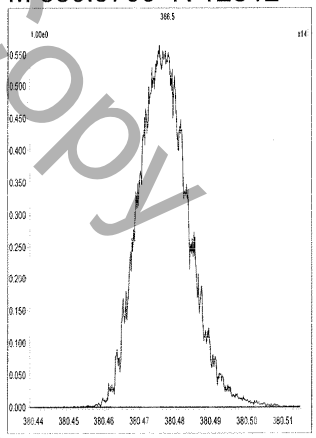
M 354.9792 R 12378



M 366.9792 R 11791



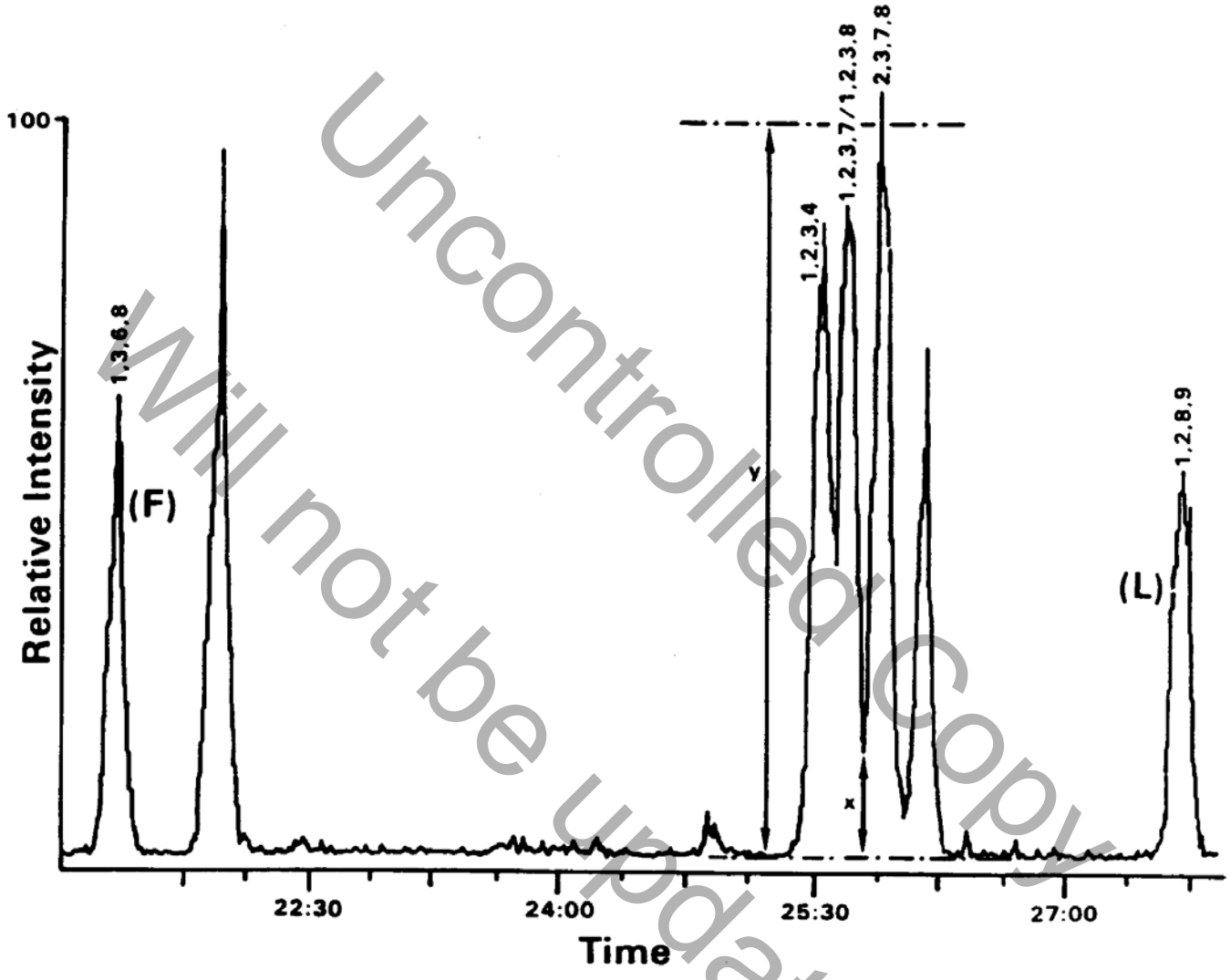
M 380.9760 R 12312



Uncontrolled Copy
Will not be updated

FIGURE 6

DB-5 GC COLUMN PERFORMANCE AND WINDOW DEFINITION



Uncontrolled Copy
Will not be updated

FIGURE 7

FORMAT FOR A TRAINING PLAN

1. Read and study SOP — Trainer: ____ Trainee: ____ Date: _____
2. Read published method.
3. Demonstrated scientific understanding of the analysis — Trainer: ____ Trainee: ____ Date: _____
   Sample preparation
   HR-Gas chromatography
   HR-Mass spectrometry
4. Demonstrated familiarity with related SOPs — Trainer: ____ Trainee: ____ Date: _____
   SOP for Analytical Batches and Analytical Sequences
   SOP for Making Entries into Logbooks and onto Bench sheets
   SOP for Manual Integration of Chromatographic Peaks
   SOP for Significant Figures
   SOP for Nonconformity and Corrective Action Documentation
   SOP for Determination of Method Detection Limits
5. Observe performance of SOP — Trainer: ____ Trainee: ____ Date: _____
   - sample preparation and sample loading
   - analytical sequence setup
   - initial calibration and continuing calibration verification
   - sample analysis
   - software introduction
   - data reduction and reporting
6. Perform SOP with supervision — Trainer: ____ Trainee: ____ Date: _____
   - sample preparation and sample loading
   - analytical sequence setup
   - initial calibration and continuing calibration verification
   - sample analysis
   - software use
   - data reduction and reporting
7. Independent performance of the SOP — Trainer: ____ Trainee: ____ Date: _____
   - sample preparation and sample loading
   - analytical sequence setup
   - initial calibration and continuing calibration verification
   - sample analysis
   -software proficiency
   - data reduction and reporting
   - initial demonstration of competency
   - IPR study
     - single blind PE sample
     - four consecutive LCSs
8. Instrument operation and maintenance — Trainer: ____ Trainee: ____ Date: _____
   - autosampler
   - gas chromatograph and capillary column installation
   - mass spectrometer
   - data system

Uncontrolled Copy
Will not be updated

THIS PAGE INTENTIONALLY BLANK

ATTACHMENT B
LABORATORY CERTIFICATIONS
(Included electronically as PDF only)

THIS PAGE INTENTIONALLY BLANK

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

COLUMBIA ANALYTICAL SERVICES, INC.

Houston, TX

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (QSM v4.1); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

Presented this 15th day of February 2010.

President & CEO
For the Accreditation Council
Certificate Number 2897.01
Valid to November 30, 2011

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

COLUMBIA ANALYTICAL SERVICES, INC.
19408 Park Row, Suite 320
Houston, Texas 77084
Andrew Biddle Phone: (713) 266 1599
abiddle@caslab.com

ENVIRONMENTAL

Valid To: November 30, 2011 Certificate Number: 2897.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1)) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

High Resolution Gas Chromatography/High Resolution Mass Spectrometry

Parameter/Analyte	**Nonpotable Water**	**Solid Hazardous Waste**	**Tissue**
PCBs			
PCB 1	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 2	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 3	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 4	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 5	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 6	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 7	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 8	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 9	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 10	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 11	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 12	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 13	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 14	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 15	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 16	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 17	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M

5301 Buckeystown Pike, Suite 350 | Frederick, Maryland 21704-8373 | Phone: 301 644 3248 | Fax: 301 662 2974 | www.A2LA.org

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
PCB 18	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 19	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 20	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 21	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 22	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 23	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 24	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 25	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 26	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 27	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 28	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 29	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 30	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 31	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 32	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 33	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 34	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 35	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 36	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 37	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 38	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 39	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 40	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 41	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 42	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 43	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 44	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 45	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 46	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 47	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 48	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 49	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 50	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 51	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 52	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 53	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 54	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 55	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 56	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 57	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 58	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 59	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
PCB 60	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 61	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 62	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 63	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 64	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 65	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 66	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 67	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 68	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 69	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 70	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 71	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 72	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 73	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 74	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 75	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 76	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 77	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 78	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 79	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 80	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 81	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 82	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 83	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 84	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 85	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 86	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 87	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 88	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 89	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 90	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 91	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 92	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 93	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 94	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 95	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 96	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 97	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 98	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 99	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 100	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 101	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 102	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
PCB 103	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 104	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 105	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 106	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 107	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 108	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 109	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 110	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 111	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 112	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 113	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 114	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 115	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 116	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 117	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 118	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 119	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 120	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 121	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 122	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 123	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 124	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 125	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 126	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 127	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 128	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 129	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 130	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 131	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 132	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 133	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 134	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 135	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 136	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 137	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 138	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 139	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 140	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 141	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 142	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 143	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 144	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 145	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
PCB 146	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 147	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 148	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 149	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 150	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 151	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 152	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 153	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 154	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 155	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 156	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 157	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 158	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 159	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 160	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 161	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 162	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 163	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 164	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 165	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 166	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 167	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 168	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 169	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 170	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 171	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 172	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 173	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 174	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 175	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 176	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 177	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 178	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 179	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 180	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 181	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 182	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 183	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 184	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 185	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 186	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 187	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 188	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
PCB 189	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 190	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 191	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 192	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 193	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 194	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 195	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 196	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 197	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 198	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 199	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 200	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 201	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 202	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 203	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 204	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 205	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 206	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 207	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 208	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
PCB 209	EPA 1668A-M	EPA 1668A-M	EPA 1668A-M
Sample Preparation	Liquid Liquid Extraction	Liquid Extraction, ASE, Soxhlet	Soxhlet
Dioxins/Furans			
2,3,7,8-TCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,7,8-PeCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,4,7,8-HxCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,6,7,8-HxCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,7,8,9-HxCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,4,6,7,8-HpCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
OCDD	EPA 8290-M	EPA 8290-M	EPA 8290-M
2,3,7,8-TCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,7,8-PeCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
2,3,4,7,8-PeCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,4,7,8-HxCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,6,7,8-HxCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,7,8,9-HxCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
2,3,4,6,7,8-HxCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,4,6,7,8-HpCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
1,2,3,4,7,8,9-HpCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M
OCDF	EPA 8290-M	EPA 8290-M	EPA 8290-M

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste	Tissue
Sample Preparation	Liquid Liquid Extraction	Liquid Extraction, ASE, Soxhlet	Soxhlet

M = Modified Method

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below, and for the test methods applicable to NELAC Chapter 5:

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	Foods
Dioxins/Furans				
2,3,7,8-TCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8-PeCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,7,8-HxCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,6,7,8-HxCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8,9-HxCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,6,7,8-HpCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
OCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
2,3,7,8-TCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8-PeCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
2,3,4,7,8-PeCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,7,8-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,6,7,8-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8,9-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
2,3,4,6,7,8-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,6,7,8-HpCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,7,8,9-HpCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
OCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
Sample Preparation	Liquid/Liquid	Liquid/liquid	Soxhlet, ASE	Soxhlet, ASE
ASE=accelerated solvent extraction				

LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 ***Certificate Number L2278***

EMAX Laboratories, Inc

1835 W 205th Street
Torrance, CA 90501

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation Granted through: January 10, 2014

R. Douglas Leonard, Jr., Managing Director
Laboratory Accreditation Bureau
Presented the 10th of January 2011

*See the laboratory's Scope of Accreditation for details of the DoD ELAP requirements
Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

LABORATORY ACCREDITATION BUREAU

Certificate # L2278

Scope of Accreditation For EMAX Laboratories, Inc.

1835 W 205th Street
Torrance, CA 90501
Kenette Pimentel
310-618-8889

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to **EMAX Laboratories, Inc.** to perform the following tests:

Accreditation granted through: **January 10, 2014**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	AK101	GRO
GC	AK102	DRO
GC	AK103	RRO
GC	RSK175	Methane
GC	RSK175	Acetylene
GC	RSK175	Ethylene
GC	RSK175	Ethane
GC	RSK175	Propane
GC	RSK175	Carbon dioxide
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NOrgC	TKN
Spectrometric	SM4500-PE	Phosphorus
Electrode	SM9040C	pH
Electrode	SM9045D	pH
Spectrometric	SM9065	Phenols
Pensky-Martens	SW1010	Ignitability
ICP	SW6010B & 6010C	Aluminum
ICP	SW6010B & 6010C	Antimony
ICP	SW6010B & 6010C	Arsenic
ICP	SW6010B & 6010C	Barium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	SW6010B & 6010C	Beryllium
ICP	SW6010B & 6010C	Boron
ICP	SW6010B & 6010C	Cadmium
ICP	SW6010B & 6010C	Calcium
ICP	SW6010B & 6010C	Chromium
ICP	SW6010B & 6010C	Cobalt
ICP	SW6010B & 6010C	Copper
ICP	SW6010B & 6010C	Iron
ICP	SW6010B & 6010C	Lead
ICP	SW6010B & 6010C	Magnesium
ICP	SW6010B & 6010C	Manganese
ICP	SW6010B & 6010C	Molybdenum
ICP	SW6010B & 6010C	Nickel
ICP	SW6010B & 6010C	Potassium
ICP	SW6010B & 6010C	Selenium
ICP	SW6010B & 6010C	Silver
ICP	SW6010B & 6010C	Sodium
ICP	SW6010B & 6010C	Strontium
ICP	SW6010B & 6010C	Thallium
ICP	SW6010B & 6010C	Tin
ICP	SW6010B & 6010C	Titanium
ICP	SW6010B & 6010C	Vanadium
ICP	SW6010B & 6010C	Zinc
ICP-MS	SW6020A	Aluminum
ICP-MS	SW6020A	Antimony
ICP-MS	SW6020A	Arsenic
ICP-MS	SW6020A	Barium
ICP-MS	SW6020A	Beryllium
ICP-MS	SW6020A	Boron
ICP-MS	SW6020A	Cadmium
ICP-MS	SW6020A	Calcium
ICP-MS	SW6020A	Chromium
ICP-MS	SW6020A	Cobalt
ICP-MS	SW6020A	Copper
ICP-MS	SW6020A	Iron
ICP-MS	SW6020A	Lead
ICP-MS	SW6020A	Magnesium
ICP-MS	SW6020A	Manganese
ICP-MS	SW6020A	Molybdenum
ICP-MS	SW6020A	Nickel

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	SW6020A	Potassium
ICP-MS	SW6020A	Selenium
ICP-MS	SW6020A	Silver
ICP-MS	SW6020A	Sodium
ICP-MS	SW6020A	Strontium
ICP-MS	SW6020A	Thallium
ICP-MS	SW6020A	Tin
ICP-MS	SW6020A	Titanium
ICP-MS	SW6020A	Uranium
ICP-MS	SW6020A	Vanadium
ICP-MS	SW6020A	Zinc
Spectrometric	SW7196A	Hex. Chromium
IC	SW7199	Hex. Chromium
Cold-Vapor	SW7470A / 7471A	Mercury
GC	SW8015B / 8015C	Gasoline
GC	SW8015B / 8015C	Diesel
GC	SW8015B / 8015C	Motor Oil
GC	SW8015B / 8015C	JP5
GC	SW8081A / 8081B	Aldrin
GC	SW8081A / 8081B	alpha-BHC
GC	SW8081A / 8081B	beta-BHC
GC	SW8081A / 8081B	delta-BHC
GC	SW8081A / 8081B	gamma-BHC (Lindane)
GC	SW8081A / 8081B	DDD (4,4)
GC	SW8081A / 8081B	DDE (4,4)
GC	SW8081A / 8081B	DDT (4,4)
GC	SW8081A / 8081B	Dieldrin
GC	SW8081A / 8081B	Endosulfan I
GC	SW8081A / 8081B	Endosulfan II
GC	SW8081A / 8081B	Endosulfan sulfate
GC	SW8081A / 8081B	Endrin
GC	SW8081A / 8081B	Endrin Aldehyde
GC	SW8081A / 8081B	Heptachlor
GC	SW8081A / 8081B	Heptachlor epoxide
GC	SW8081A / 8081B	Methoxychlor
GC	SW8081A / 8081B	alpha-Chlordane
GC	SW8081A / 8081B	gamma-Chlordane
GC	SW8081A / 8081B	Endrin Ketone
GC	SW8081A / 8081B	Toxaphene
GC	SW8081A / 8081B	Technical Chlordane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	SW8082 / 8082A	PCB1016
GC	SW8082 & 8082A	PCB1221
GC	SW8082 & 8082A	PCB1232
GC	SW8082 & 8082A	PCB1242
GC	SW8082 & 8082A	PCB1248
GC	SW8082 & 8082A	PCB1254
GC	SW8082 & 8082A	PCB1260
GC	SW8082 & 8082A	PCB1262
GC	SW8082 & 8082A	PCB1268
GC	SW8082 & 8082A	PCB 8
GC	SW8082 & 8082A	PCB 18
GC	SW8082 & 8082A	PCB 28
GC	SW8082 & 8082A	PCB 44
GC	SW8082 & 8082A	PCB 52
GC	SW8082 & 8082A	PCB 66
GC	SW8082 & 8082A	PCB 77
GC	SW8082 & 8082A	PCB 81
GC	SW8082 & 8082A	PCB 101
GC	SW8082 & 8082A	PCB 105
GC	SW8082 & 8082A	PCB 114
GC	SW8082 & 8082A	PCB 118
GC	SW8082 & 8082A	PCB 123
GC	SW8082 & 8082A	PCB 126
GC	SW8082 & 8082A	PCB 128
GC	SW8082 & 8082A	PCB 138
GC	SW8082 & 8082A	PCB 153
GC	SW8082 & 8082A	PCB 156
GC	SW8082 & 8082A	PCB 157
GC	SW8082 & 8082A	PCB 167
GC	SW8082 & 8082A	PCB 169
GC	SW8082 & 8082A	PCB 170
GC	SW8082 & 8082A	PCB 180
GC	SW8082 & 8082A	PCB 187
GC	SW8082 & 8082A	PCB 189
GC	SW8082 & 8082A	PCB 195
GC	SW8082 & 8082A	PCB 206
GC	SW8082 & 8082A	PCB 209
GC	SW8141A	Azinphos-methyl
GC	SW8141A	Bolstar
GC	SW8141A	Chlorpyrifos

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	SW8141A	Coumaphos
GC	SW8141A	Demeton
GC	SW8141A	Diazinon
GC	SW8141A	Dichlorvos
GC	SW8141A	Disulfoton
GC	SW8141A	Ethoprop
GC	SW8141A	Fensulfothion
GC	SW8141A	Fenthion
GC	SW8141A	Merphos
GC	SW8141A	Mevinphos
GC	SW8141A	Naled
GC	SW8141A	Methyl Parathion
GC	SW8141A	Phorate
GC	SW8141A	Ronnel
GC	SW8141A	Stirophos
GC	SW8141A	Tokuthion
GC	SW8141A	Trichloronate
GC	SW8141A	Dimethoate
GC	SW8141A	EPN
GC	SW8141A	Famphur
GC	SW8141A	Malathion
GC	SW8141A	Ethyl Parathion
GC	SW8141A	O,O,O-Triethylphosphorothioate
GC	SW8141A	Sulfotepp
GC	SW8141A	Thionazin
GC	SW8141A	Tributyl Phosphate
GC-MS	SW8260B	Acetone
GC-MS	SW8260B	Acrolein
GC-MS	SW8260B	Acrylonitrile
GC-MS	SW8260B	Benzene
GC-MS	SW8260B	Bromobenzene
GC-MS	SW8260B	Bromochloromethane
GC-MS	SW8260B	Bromodichloromethane
GC-MS	SW8260B	Bromoform
GC-MS	SW8260B	Bromomethane
GC-MS	SW8260B	tert-Butyl alcohol
GC-MS	SW8260B	2-Butanone (MEK)
GC-MS	SW8260B	n-Butylbenzene
GC-MS	SW8260B	sec-Butylbenzene
GC-MS	SW8260B	tert-Butylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8260B	Carbon disulfide
GC-MS	SW8260B	Carbon tetrachloride
GC-MS	SW8260B	Chlorobenzene
GC-MS	SW8260B	2-Chloroethyl vinyl ether
GC-MS	SW8260B	Chloroethane
GC-MS	SW8260B	Chloroform
GC-MS	SW8260B	1-Chlorohexane
GC-MS	SW8260B	Chloromethane
GC-MS	SW8260B	2-Chlorotoluene
GC-MS	SW8260B	4-Chlorotoluene
GC-MS	SW8260B	Isopropyl ether (DIPE)
GC-MS	SW8260B	Dibromochloromethane
GC-MS	SW8260B	1,2-Dibromo-3-chloropropane
GC-MS	SW8260B	1,2-Dibromoethane
GC-MS	SW8260B	Dibromomethane
GC-MS	SW8260B	1,1-Dichloroethane
GC-MS	SW8260B	1,2-Dichloroethane
GC-MS	SW8260B	1,2-Dichlorobenzene
GC-MS	SW8260B	1,3-Dichlorobenzene
GC-MS	SW8260B	trans-1,4-Dichloro-2-Butene
GC-MS	SW8260B	1,4-Dichlorobenzene
GC-MS	SW8260B	Dichlorodifluoromethane
GC-MS	SW8260B	1,1-Dichloroethene
GC-MS	SW8260B	cis-1,2-Dichloroethene
GC-MS	SW8260B	trans-1,2-Dichloroethene
GC-MS	SW8260B	Dichlorofluoromethane
GC-MS	SW8260B	1,1-Dichloropropene
GC-MS	SW8260B	1,2-Dichloropropane
GC-MS	SW8260B	1,3-Dichloropropane
GC-MS	SW8260B	2,2-Dichloropropane
GC-MS	SW8260B	cis-1,3-Dichloropropene
GC-MS	SW8260B	trans-1,3-Dichloropropene
GC-MS	SW8260B	tert-Butyl ethyl ether (ETBE)
GC-MS	SW8260B	Ethyl Methacrylate
GC-MS	SW8260B	Ethylbenzene
GC-MS	SW8260B	2-Hexanone (MBK)
GC-MS	SW8260B	Hexachlorobutadiene
GC-MS	SW8260B	Iodomethane
GC-MS	SW8260B	Isopropylbenzene
GC-MS	SW8260B	p-Isopropyltoluene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8260B	Methylene Chloride
GC-MS	SW8260B	4-Methyl-2-pentanone (MIBK)
GC-MS	SW8260B	tert-Butyl methyl ether
GC-MS	SW8260B	Naphthalene
GC-MS	SW8260B	n-Propylbenzene
GC-MS	SW8260B	Styrene
GC-MS	SW8260B	tert-Amyl methyl ether (TAME)
GC-MS	SW8260B	1,1,1,2-Tetrachloroethane
GC-MS	SW8260B	1,1,2,2-Tetrachloroethane
GC-MS	SW8260B	Tetrachloroethene
GC-MS	SW8260B	Toluene
GC-MS	SW8260B	1,1,1-Trichloroethane
GC-MS	SW8260B	1,1,2-Trichloroethane
GC-MS	SW8260B	1,2,3-Trichlorobenzene
GC-MS	SW8260B	1,2,4-Trichlorobenzene
GC-MS	SW8260B	Trichloroethene
GC-MS	SW8260B	Trichlorofluoromethane
GC-MS	SW8260B	1,2,3-Trichloropropane
GC-MS	SW8260B	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	SW8260B	1,2,4-Trimethylbenzene
GC-MS	SW8260B	1,3,5-Trimethylbenzene
GC-MS	SW8260B	Vinyl Acetate
GC-MS	SW8260B	Vinyl Chloride
GC-MS	SW8260B	m-Xylene & p-xylene
GC-MS	SW8260B	o-Xylene
GC-MS	SW8260B	2-Butanol
GC-MS	SW8260B	Cyclohexane
GC-MS	SW8260B SIM	Benzene
GC-MS	SW8260B SIM	Carbon tetrachloride
GC-MS	SW8260B SIM	Chloroform
GC-MS	SW8260B SIM	Chloromethane
GC-MS	SW8260B SIM	1,2-Dibromo-3-chloropropane
GC-MS	SW8260B SIM	1,2-Dibromoethane
GC-MS	SW8260B SIM	1,2-Dichloroethane
GC-MS	SW8260B SIM	1,1-Dichloroethene
GC-MS	SW8260B SIM	cis-1,2-Dichloroethene
GC-MS	SW8260B SIM	trans-1,2-Dichloroethene
GC-MS	SW8260B SIM	1,1,2,2-Tetrachloroethane
GC-MS	SW8260B SIM	Tetrachloroethene
GC-MS	SW8260B SIM	1,1,1-Trichloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8260B SIM	1,1,2-Trichloroethane
GC-MS	SW8260B SIM	Trichloroethene
GC-MS	SW8260B SIM	1,2,3-Trichloropropane
GC-MS	SW8260B SIM	Vinyl Chloride
GC-MS	SW8270C & 8270D	Acenaphthene
GC-MS	SW8270C & 8270D	Acenaphthylene
GC-MS	SW8270C & 8270D	Aniline
GC-MS	SW8270C & 8270D	Anthracene
GC-MS	SW8270C & 8270D	Azobenzene
GC-MS	SW8270C & 8270D	Benzidine
GC-MS	SW8270C & 8270D	Benzo(a)anthracene
GC-MS	SW8270C & 8270D	benzo(a)pyrene
GC-MS	SW8270C & 8270D	Benzo(b)fluoranthene
GC-MS	SW8270C & 8270D	Benzo(e)pyrene
GC-MS	SW8270C & 8270D	Benzo(g,h,i)perylene
GC-MS	SW8270C & 8270D	Benzo(k)fluoranthene
GC-MS	SW8270C & 8270D	Benzoic Acid
GC-MS	SW8270C & 8270D	Benzyl Alcohol
GC-MS	SW8270C & 8270D	Biphenyl
GC-MS	SW8270C & 8270D	bis(2-chloroethoxy)methane
GC-MS	SW8270C & 8270D	bis(2-chloroethyl)ether
GC-MS	SW8270C & 8270D	bis(2-chloroisopropyl)ether
GC-MS	SW8270C & 8270D	bis(2-Ethylhexyl)adipate
GC-MS	SW8270C & 8270D	bis(2-Ethylhexyl)phthalate
GC-MS	SW8270C & 8270D	4-Bromophenyl-phenylether
GC-MS	SW8270C & 8270D	Butylbenzylphthalate
GC-MS	SW8270C & 8270D	Carbazole
GC-MS	SW8270C & 8270D	4-Chloro-3-methylphenol
GC-MS	SW8270C & 8270D	4-Chloroaniline
GC-MS	SW8270C & 8270D	2-Chloronaphthalene
GC-MS	SW8270C & 8270D	2-Chlorophenol
GC-MS	SW8270C & 8270D	4-Chlorophenyl-phenylether
GC-MS	SW8270C & 8270D	Chrysene
GC-MS	SW8270C & 8270D	Dibenzo(a,h)anthracene
GC-MS	SW8270C & 8270D	Dibenzofuran
GC-MS	SW8270C & 8270D	1,2-Dichlorobenzene
GC-MS	SW8270C & 8270D	1,3-Dichlorobenzene
GC-MS	SW8270C & 8270D	1,4-Dichlorobenzene
GC-MS	SW8270C & 8270D	3,3'-Dichlorobenzidine
GC-MS	SW8270C & 8270D	2,4-Dichlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8270C & 8270D	Diethylphthalate
GC-MS	SW8270C & 8270D	2,6-Dimethylnaphthalene
GC-MS	SW8270C & 8270D	2,4-Dimethylphenol
GC-MS	SW8270C & 8270D	Dimethylphthalate
GC-MS	SW8270C & 8270D	Di-n-butylphthalate
GC-MS	SW8270C & 8270D	4,6-Dinitro-2-methylphenol
GC-MS	SW8270C & 8270D	2,4-Dinitrophenol
GC-MS	SW8270C & 8270D	2,4-Dinitrotoluene
GC-MS	SW8270C & 8270D	2-6-Dinitrotoluene
GC-MS	SW8270C & 8270D	Di-n-octylphthalate
GC-MS	SW8270C & 8270D	Fluoranthene
GC-MS	SW8270C & 8270D	Fluorene
GC-MS	SW8270C & 8270D	Hexachlorobenzene
GC-MS	SW8270C & 8270D	Hexachlorobutadiene
GC-MS	SW8270C & 8270D	Hexachlorocyclopentadiene
GC-MS	SW8270C & 8270D	Hexachloroethane
GC-MS	SW8270C & 8270D	Indeno(1,2,3-cd)pyrene
GC-MS	SW8270C & 8270D	Isophorone
GC-MS	SW8270C & 8270D	1-Methylnaphthalene
GC-MS	SW8270C & 8270D	2-Methylnaphthalene
GC-MS	SW8270C & 8270D	1-Methylphenanthrene
GC-MS	SW8270C & 8270D	2-Methylphenol
GC-MS	SW8270C & 8270D	4-Methylphenol
GC-MS	SW8270C & 8270D	Naphthalene
GC-MS	SW8270C & 8270D	2-Nitroaniline
GC-MS	SW8270C & 8270D	3-Nitroaniline
GC-MS	SW8270C & 8270D	4-Nitroaniline
GC-MS	SW8270C & 8270D	Nitrobenzene
GC-MS	SW8270C & 8270D	2-Nitrophenol
GC-MS	SW8270C & 8270D	4-Nitrophenol
GC-MS	SW8270C & 8270D	n-Nitrosodimethylamine
GC-MS	SW8270C & 8270D	n-Nitroso-di-n-propylamine
GC-MS	SW8270C & 8270D	n-Nitrosodiphenylamine
GC-MS	SW8270C & 8270D	Pentachlorophenol
GC-MS	SW8270C & 8270D	Perylene
GC-MS	SW8270C & 8270D	Phenanthrene
GC-MS	SW8270C & 8270D	Phenol
GC-MS	SW8270C & 8270D	Pyrene
GC-MS	SW8270C & 8270D	Pyridine
GC-MS	SW8270C & 8270D	2,3,4,6-Tetrachlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8270C & 8270D	1,2,4-Trichlorobenzene
GC-MS	SW8270C & 8270D	2,3,4-Trichlorophenol
GC-MS	SW8270C & 8270D	2,3,5-Trichlorophenol
GC-MS	SW8270C & 8270D	2,4,5-Trichlorophenol
GC-MS	SW8270C & 8270D	2,4,6-Trichlorophenol
GC-MS	SW8270C & 8270D	2,3,5-Trimethylnaphthalene
GC-MS	SW8270C & 8270D SIM	Acenaphthene
GC-MS	SW8270C & 8270D SIM	Acenaphthylene
GC-MS	SW8270C & 8270D SIM	Anthracene
GC-MS	SW8270C & 8270D SIM	Azobenzene
GC-MS	SW8270C & 8270D SIM	Benzo(a)anthracene
GC-MS	SW8270C & 8270D SIM	benzo(a)pyrene
GC-MS	SW8270C & 8270D SIM	Benzo(b)fluoranthene
GC-MS	SW8270C & 8270D SIM	Benzo(e)pyrene
GC-MS	SW8270C & 8270D SIM	Benzo(g,h,i)perylene
GC-MS	SW8270C & 8270D SIM	Benzo(k)fluoranthene
GC-MS	SW8270C & 8270D SIM	Biphenyl
GC-MS	SW8270C & 8270D SIM	bis(2-chloroethyl)ether
GC-MS	SW8270C & 8270D SIM	bis(2-Ethylhexyl)phthalate
GC-MS	SW8270C & 8270D SIM	Carbazole
GC-MS	SW8270C & 8270D SIM	4-Chloro-3-methylphenol
GC-MS	SW8270C & 8270D SIM	2-Chlorophenol
GC-MS	SW8270C & 8270D SIM	Chrysene
GC-MS	SW8270C & 8270D SIM	Dibenzo(a,h)anthracene
GC-MS	SW8270C & 8270D SIM	2,4-Dichlorophenol
GC-MS	SW8270C & 8270D SIM	2,6-Dimethylnaphthalene
GC-MS	SW8270C & 8270D SIM	2,4-Dimethylphenol
GC-MS	SW8270C & 8270D SIM	Fluoranthene
GC-MS	SW8270C & 8270D SIM	Fluorene
GC-MS	SW8270C & 8270D SIM	Hexachlorobenzene
GC-MS	SW8270C & 8270D SIM	Indeno(1,2,3-cd)pyrene
GC-MS	SW8270C & 8270D SIM	1-Methylnaphthalene
GC-MS	SW8270C & 8270D SIM	2-Methylnaphthalene
GC-MS	SW8270C & 8270D SIM	1-Methylphenanthrene
GC-MS	SW8270C & 8270D SIM	Naphthalene
GC-MS	SW8270C & 8270D SIM	n-Nitrosodimethylamine
GC-MS	SW8270C & 8270D SIM	n-Nitroso-di-n-propylamine
GC-MS	SW8270C & 8270D SIM	Pentachlorophenol
GC-MS	SW8270C & 8270D SIM	Perylene
GC-MS	SW8270C & 8270D SIM	Phenanthrene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	SW8270C & 8270D SIM	Phenol
GC-MS	SW8270C & 8270D SIM	Pyrene
GC-MS	SW8270C & 8270D SIM	2,4,5-Trichlorophenol
GC-MS	SW8270C & 8270D SIM	2,4,6-Trichlorophenol
GC-MS	SW8270C & 8270D SIM	2,3,5-Trimethylnaphthalene
GC-MS	SW8270C & 8270D SIM	1,4-Dioxane
HPLC	SW8310	Acenaphthene
HPLC	SW8310	Acenaphthylene
HPLC	SW8310	Anthracene
HPLC	SW8310	Benzo(a)anthracene
HPLC	SW8310	Benzo(a)pyrene
HPLC	SW8310	Benzo(b)fluoranthene
HPLC	SW8310	Benzo(g,h,i)perylene
HPLC	SW8310	Benzo(k)fluoranthene
HPLC	SW8310	Chrysene
HPLC	SW8310	Dibenzo(a,h)anthracene
HPLC	SW8310	Fluoranthene
HPLC	SW8310	Fluorene
HPLC	SW8310	Indeno(1,2,3-cd)pyrene
HPLC	SW8310	1-Methylnaphthalene
HPLC	SW8310	2-Methylnaphthalene
HPLC	SW8310	Naphthalene
HPLC	SW8310	Phenanthrene
HPLC	SW8310	Pyrene
HPLC	SW8330A	HMX
HPLC	SW8330A	RDX
HPLC	SW8330A	1,3,5-TNB
HPLC	SW8330A	1,3-DNB
HPLC	SW8330A	Tetryl
HPLC	SW8330A	Nitrobenzene
HPLC	SW8330A	2,4,6-TNT
HPLC	SW8330A	4-AM-2,6-DNT
HPLC	SW8330A	2-AM-4,6-DNT
HPLC	SW8330A	2,6-DNT
HPLC	SW8330A	2,4-DNT
HPLC	SW8330A	2-Nitrotoluene
HPLC	SW8330A	4-Nitrotoluene
HPLC	SW8330A	3-Nitrotoluene
GC	SW8151A	Acifluorfen
GC	SW8151A	Bentazon

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	SW8151A	Chloramben
GC	SW8151A	2,4-D
GC	SW8151A	2,4-DB
GC	SW8151A	Dacthal
GC	SW8151A	Dalapon
GC	SW8151A	Dicamba
GC	SW8151A	3,5 Dichlorobenzoic
GC	SW8151A	Dichlorprop
GC	SW8151A	Dinoseb
GC	SW8151A	MCPA
GC	SW8151A	MCPP
GC	SW8151A	4-Nitrophenol
GC	SW8151A	Pentachlorophenol
GC	SW8151A	Picloram
GC	SW8151A	Silvex
GC	SW8151A	2,4,5-T
Platinum Electrode	EPA 120.1	Specific Conductance
Titrimetric	EPA 130.2	Hardness
Electrode	EPA 150.1	pH
Gravimetric	EPA 160.1	TDS
Gravimetric	EPA 160.2	TSS
Gravimetric	EPA 160.3	Total Residue
Turbidimetric	EPA 180.1	Turbidity
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc
IC	EPA 218.6	Hexavalent Chromium
COLD VAPOR	EPA 245.1	Mercury
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Chloride
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Bromide
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Phosphate
IC	EPA 300.0	Sulfate
IC	EPA 300.0	Bromate
IC	EPA 300M	Lactate
IC	EPA 300M	Acetate
IC	EPA 300M	Propionate
IC	EPA 300M	Butyrate
IC	EPA 300M	Pyruvate
IC	EPA 310.1	Alkalinity
IC	EPA 314.0	Perchlorate
Titrimetric	EPA 330.3	Total Residual Chlorine
Spectrometric	EPA 352.1	Nitrate-N
Spectrometric	EPA 353.3	Nitrate-N
Spectrometric	EPA 354.1	Nitrite-N
Spectrometric	EPA 365.2	Ortho-phosphate
Spectrometric	EPA 420.1	Phenols
Spectrometric	EPA 425.1	MBAS
Spectrometric	EPA 335.2	Cyanide
Spectrometric	EPA 350.2	Ammonia
Spectrometric	EPA 351.3	TKN
Spectrometric	EPA 354.1	Nitrite-N

Non-Potable Water		
Technology	**Method**	**Analyte**
Spectrometric	EPA 365.2	Phosphorus
Spectrometric	EPA 370.1	Silica
Titrimetric	EPA 376.1	Sulfide
Spectrometric	EPA 376.2	Sulfide
Electrode	EPA 405.1	BOD
Spectrometric	EPA 410.4	COD
Combustion-IR	EPA 415.1	TOC
Turbidimetric	SM 2130B	Turbidity
Titrimetric	SM 2320B	Alkalinity
Titrimetric	SM 2340C	Hardness
Platinum Electrode	SM 2510B	Specific Conductance
Gravimetric	SM 2540C	TDS
Gravimetric	SM 2540D	TSS
Gravimetric	SM 2540B	Total Residue
Combustion-IR	SM5310	TOC
Spectrometric	SM3500-FeD	Ferrous iron
Titrimetric	SM4500-Cl B	Total Residual Chlorine
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NO2B	Nitrite-N
Spectrometric	SM4500-NO3E	Nitrate-N
Spectrometric	SM4500-NOrgC	TKN
Spectrometric	SM4500PE	Ortho-phosphate
Spectrometric	SM4500-PE(PB5)	Phosphorus
Spectrometric	SM4500-S2D	Sulfide
Titrimetric	SM4500-S2F	Sulfide
Spectrometric	SM4500-SiO2C	Silica
Electrode	SM5210B	BOD
Spectrometric	SM5220B	COD
Combustion-IR	SM 5310B	TOC
Spectrometric	SM5540C	Surfactants (MBAS)
ICP/ICP-MS	SM2340B	Hardness
GC	EPA 608	Aldrin
GC	EPA 608	alpha-BHC
GC	EPA 608	beta-BHC
GC	EPA 608	delta-BHC
GC	EPA 608	gamma-BHC (Lindane)
GC	EPA 608	DDD (4,4)
GC	EPA 608	DDE (4,4)
GC	EPA 608	DDT (4,4)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 608	Dieldrin
GC	EPA 608	Endosulfan I
GC	EPA 608	Endosulfan II
GC	EPA 608	Endosulfan sulfate
GC	EPA 608	Endrin
GC	EPA 608	Endrin Aldehyde
GC	EPA 608	Heptachlor
GC	EPA 608	Heptachlor epoxide
GC	EPA 608	Methoxychlor
GC	EPA 608	alpha-Chlordane
GC	EPA 608	gamma-Chlordane
GC	EPA 608	Endrin Ketone
GC	EPA 608	Toxaphene
GC	EPA 608	Technical Chlordane
GC	EPA 608	PCB1016
GC	EPA 608	PCB1221
GC	EPA 608	PCB1232
GC	EPA 608	PCB1242
GC	EPA 608	PCB1248
GC	EPA 608	PCB1254
GC	EPA 608	PCB1260
GC	EPA 608	PCB1262
GC	EPA 608	PCB1268
GC-MS	EPA 624	Acrolein
GC-MS	EPA 624	Acrylonitrile
GC-MS	EPA 624	Benzene
GC-MS	EPA 624	Bromodichloromethane
GC-MS	EPA 624	Bromoform
GC-MS	EPA 624	Bromomethane
GC-MS	EPA 624	Carbon tetrachloride
GC-MS	EPA 624	Chlorobenzene
GC-MS	EPA 624	2-Chloroethyl vinyl ether
GC-MS	EPA 624	Chloroethane
GC-MS	EPA 624	Chloroform
GC-MS	EPA 624	Chloromethane
GC-MS	EPA 624	Dibromochloromethane
GC-MS	EPA 624	1,1-Dichloroethane
GC-MS	EPA 624	1,2-Dichloroethane
GC-MS	EPA 624	1,2-Dichlorobenzene
GC-MS	EPA 624	1,3-Dichlorobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 624	1,4-Dichlorobenzene
GC-MS	EPA 624	Dichlorodifluoromethane
GC-MS	EPA 624	1,1-Dichloroethene
GC-MS	EPA 624	cis-1,2-Dichloroethene
GC-MS	EPA 624	trans-1,2-Dichloroethene
GC-MS	EPA 624	1,2-Dichloropropane
GC-MS	EPA 624	cis-1,3-Dichloropropene
GC-MS	EPA 624	trans-1,3-Dichloropropene
GC-MS	EPA 624	Ethylbenzene
GC-MS	EPA 624	Methylene Chloride
GC-MS	EPA 624	tert-Butyl methyl ether
GC-MS	EPA 624	Styrene
GC-MS	EPA 624	1,1,2,2-Tetrachloroethane
GC-MS	EPA 624	Tetrachloroethene
GC-MS	EPA 624	Toluene
GC-MS	EPA 624	1,1,1-Trichloroethane
GC-MS	EPA 624	1,1,2-Trichloroethane
GC-MS	EPA 624	1,2,4-Trichlorobenzene
GC-MS	EPA 624	Trichloroethene
GC-MS	EPA 624	Trichlorofluoromethane
GC-MS	EPA 624	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 624	Vinyl Chloride
GC-MS	EPA 624	m-Xylene & p-xylene
GC-MS	EPA 624	o-Xylene
GC-MS	EPA 625	Acenaphthene
GC-MS	EPA 625	Acenaphthylene
GC-MS	EPA 625	Aniline
GC-MS	EPA 625	Anthracene
GC-MS	EPA 625	Azobenzene
GC-MS	EPA 625	Benzidine
GC-MS	EPA 625	Benzo(a)anthracene
GC-MS	EPA 625	benzo(a)pyrene
GC-MS	EPA 625	Benzo(b)fluoranthene
GC-MS	EPA 625	Benzo(e)pyrene
GC-MS	EPA 625	Benzo(g,h,i)perylene
GC-MS	EPA 625	Benzo(k)fluoranthene
GC-MS	EPA 625	Benzoic Acid
GC-MS	EPA 625	Benzyl Alcohol
GC-MS	EPA 625	Biphenyl
GC-MS	EPA 625	bis(2-chloroethoxy)methane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 625	bis(2-chloroethyl)ether
GC-MS	EPA 625	bis(2-chloroisopropyl)ether
GC-MS	EPA 625	bis(2-Ethylhexyl)adipate
GC-MS	EPA 625	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 625	4-Bromophenyl-phenylether
GC-MS	EPA 625	Butylbenzylphthalate
GC-MS	EPA 625	Carbazole
GC-MS	EPA 625	4-Chloro-3-methylphenol
GC-MS	EPA 625	4-Chloroaniline
GC-MS	EPA 625	2-Chloronaphthalene
GC-MS	EPA 625	2-Chlorophenol
GC-MS	EPA 625	4-Chlorophenyl-phenylether
GC-MS	EPA 625	Chrysene
GC-MS	EPA 625	Dibenzo(a,h)anthracene
GC-MS	EPA 625	Dibenzofuran
GC-MS	EPA 625	1,2-Dichlorobenzene
GC-MS	EPA 625	1,3-Dichlorobenzene
GC-MS	EPA 625	1,4-Dichlorobenzene
GC-MS	EPA 625	3,3'-Dichlorobenzidine
GC-MS	EPA 625	2,4-Dichlorophenol
GC-MS	EPA 625	Diethylphthalate
GC-MS	EPA 625	2,6-Dimethylnaphthalene
GC-MS	EPA 625	2,4-Dimethylphenol
GC-MS	EPA 625	Dimethylphthalate
GC-MS	EPA 625	Di-n-butylphthalate
GC-MS	EPA 625	4,6-Dinitro-2-methylphenol
GC-MS	EPA 625	2,4-Dinitrophenol
GC-MS	EPA 625	2,4-Dinitrotoluene
GC-MS	EPA 625	2-6-Dinitrotoluene
GC-MS	EPA 625	Di-n-octylphthalate
GC-MS	EPA 625	1,2-Diphenylhydrazine
GC-MS	EPA 625	Fluoranthene
GC-MS	EPA 625	Fluorene
GC-MS	EPA 625	Hexachlorobenzene
GC-MS	EPA 625	Hexachlorobutadiene
GC-MS	EPA 625	Hexachlorocyclopentadiene
GC-MS	EPA 625	Hexachloroethane
GC-MS	EPA 625	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 625	Isophorone
GC-MS	EPA 625	1-Methylnaphthalene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 625	2-Methylnaphthalene
GC-MS	EPA 625	1-Methylphenanthrene
GC-MS	EPA 625	2-Methylphenol
GC-MS	EPA 625	4-Methylphenol
GC-MS	EPA 625	Naphthalene
GC-MS	EPA 625	2-Nitroaniline
GC-MS	EPA 625	3-Nitroaniline
GC-MS	EPA 625	4-Nitroaniline
GC-MS	EPA 625	Nitrobenzene
GC-MS	EPA 625	2-Nitrophenol
GC-MS	EPA 625	4-Nitrophenol
GC-MS	EPA 625	n-Nitrosodimethylamine
GC-MS	EPA 625	n-Nitroso-di-n-propylamine
GC-MS	EPA 625	n-Nitrosodiphenylamine
GC-MS	EPA 625	Pentachlorophenol
GC-MS	EPA 625	Perylene
GC-MS	EPA 625	Phenanthrene
GC-MS	EPA 625	Phenol
GC-MS	EPA 625	Pyrene
GC-MS	EPA 625	Pyridine
GC-MS	EPA 625	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 625	1,2,4-Trichlorobenzene
GC-MS	EPA 625	2,3,4-Trichlorophenol
GC-MS	EPA 625	2,3,5-Trichlorophenol
GC-MS	EPA 625	2,4,5-Trichlorophenol
GC-MS	EPA 625	2,4,6-Trichlorophenol
GC-MS	EPA 625	2,3,5-Trimethylnaphthalene
Gravimetric	EPA 1664A	Oil & Grease
GFAA	CA 939M	Organo Lead
GC-MS	EPA 524.2	Acetone
GC-MS	EPA 524.2	Benzene
GC-MS	EPA 524.2	Bromobenzene
GC-MS	EPA 524.2	Bromochloromethane
GC-MS	EPA 524.2	Bromodichloromethane
GC-MS	EPA 524.2	Bromoform
GC-MS	EPA 524.2	Bromomethane
GC-MS	EPA 524.2	tert-Butyl alcohol
GC-MS	EPA 524.2	2-Butanone (MEK)
GC-MS	EPA 524.2	n-Butylbenzene
GC-MS	EPA 524.2	sec-Butylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 524.2	tert-Butylbenzene
GC-MS	EPA 524.2	Carbon disulfide
GC-MS	EPA 524.2	Carbon tetrachloride
GC-MS	EPA 524.2	Chlorobenzene
GC-MS	EPA 524.2	Chloroethane
GC-MS	EPA 524.2	Chloroform
GC-MS	EPA 524.2	Chloromethane
GC-MS	EPA 524.2	2-Chlorotoluene
GC-MS	EPA 524.2	4-Chlorotoluene
GC-MS	EPA 524.2	Dibromochloromethane
GC-MS	EPA 524.2	1,2-Dibromo-3-chloropropane
GC-MS	EPA 524.2	1,2-Dibromoethane
GC-MS	EPA 524.2	Dibromomethane
GC-MS	EPA 524.2	1,1-Dichloroethane
GC-MS	EPA 524.2	1,2-Dichloroethane
GC-MS	EPA 524.2	1,2-Dichlorobenzene
GC-MS	EPA 524.2	1,3-Dichlorobenzene
GC-MS	EPA 524.2	1,4-Dichlorobenzene
GC-MS	EPA 524.2	Dichlorodifluoromethane
GC-MS	EPA 524.2	1,1-Dichloroethene
GC-MS	EPA 524.2	cis-1,2-Dichloroethene
GC-MS	EPA 524.2	trans-1,2-Dichloroethene
GC-MS	EPA 524.2	1,1-Dichloropropene
GC-MS	EPA 524.2	1,2-Dichloropropane
GC-MS	EPA 524.2	1,3-Dichloropropane
GC-MS	EPA 524.2	2,2-Dichloropropane
GC-MS	EPA 524.2	cis-1,3-Dichloropropene
GC-MS	EPA 524.2	trans-1,3-Dichloropropene
GC-MS	EPA 524.2	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 524.2	Ethylbenzene
GC-MS	EPA 524.2	2-Hexanone (MBK)
GC-MS	EPA 524.2	Hexachlorobutadiene
GC-MS	EPA 524.2	Isopropyl ether (DIPE)
GC-MS	EPA 524.2	Isopropylbenzene
GC-MS	EPA 524.2	p-Isopropyltoluene
GC-MS	EPA 524.2	Methylene Chloride
GC-MS	EPA 524.2	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 524.2	tert-Butyl methyl ether
GC-MS	EPA 524.2	Naphthalene
GC-MS	EPA 524.2	n-Propylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 524.2	Styrene
GC-MS	EPA 524.2	tert-Amyl methyl ether (TAME)
GC-MS	EPA 524.2	1,1,1,2-Tetrachloroethane
GC-MS	EPA 524.2	1,1,2,2-Tetrachloroethane
GC-MS	EPA 524.2	Tetrachloroethene
GC-MS	EPA 524.2	Toluene
GC-MS	EPA 524.2	1,1,1-Trichloroethane
GC-MS	EPA 524.2	1,1,2-Trichloroethane
GC-MS	EPA 524.2	1,2,3-Trichlorobenzene
GC-MS	EPA 524.2	1,2,4-Trichlorobenzene
GC-MS	EPA 524.2	Trichloroethene
GC-MS	EPA 524.2	Trichlorofluoromethane
GC-MS	EPA 524.2	1,2,3-Trichloropropane
GC-MS	EPA 524.2	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 524.2	1,2,4-Trimethylbenzene
GC-MS	EPA 524.2	1,3,5-Trimethylbenzene
GC-MS	EPA 524.2	Vinyl Chloride
GC-MS	EPA 524.2	m-Xylene & p-xylene
GC-MS	EPA 524.2	o-Xylene
HPLC-MS	EPA 6850	Perchlorate
Preparation	**Method**	**Type**
Purge & Trap	SW5030B	Volatiles Prep
Acid Digestion	SW3005A/SW3010A/ EPA200.8	Metals Prep
Continuous Liquid-Liquid	SW3520C	Organic Extraction
Separatory Funnel	SW3510B	Organic Extraction
Waste Dilution	SW3580A	Organic Extraction
TCLP	SW1311	Leaching
SPLP	SW1312	Leaching

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	AK101	GRO
GC	AK102	DRO
GC	AK103	RRO
GC	RSK175	Methane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	RSK175	Acetylene
GC	RSK175	Ethylene
GC	RSK175	Ethane
GC	RSK175	Propane
GC	RSK175	Carbon dioxide
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NOrgC	TKN
Spectrometric	SM4500-PE(PB5)	Phosphorus
Electrode	SM9040C	pH
Electrode	SM9045D	pH
Spectrometric	SM9065	Phenols
Penskey-Martens	SW1010	Ignitability
ICP	SW6010B & 6010C	Aluminum
ICP	SW6010B & 6010C	Antimony
ICP	SW6010B & 6010C	Arsenic
ICP	SW6010B & 6010C	Barium
ICP	SW6010B & 6010C	Beryllium
ICP	SW6010B & 6010C	Boron
ICP	SW6010B & 6010C	Cadmium
ICP	SW6010B & 6010C	Calcium
ICP	SW6010B & 6010C	Chromium
ICP	SW6010B & 6010C	Cobalt
ICP	SW6010B & 6010C	Copper
ICP	SW6010B & 6010C	Iron
ICP	SW6010B & 6010C	Lead
ICP	SW6010B & 6010C	Magnesium
ICP	SW6010B & 6010C	Manganese
ICP	SW6010B & 6010C	Molybdenum
ICP	SW6010B & 6010C	Nickel
ICP	SW6010B & 6010C	Potassium
ICP	SW6010B & 6010C	Selenium
ICP	SW6010B & 6010C	Silver
ICP	SW6010B & 6010C	Sodium
ICP	SW6010B & 6010C	Strontium
ICP	SW6010B & 6010C	Thallium
ICP	SW6010B & 6010C	Tin
ICP	SW6010B & 6010C	Titanium
ICP	SW6010B & 6010C	Vanadium
ICP	SW6010B & 6010C	Zinc

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
IPC-MS	SW6020A	Aluminum
IPC-MS	SW6020A	Antimony
IPC-MS	SW6020A	Arsenic
IPC-MS	SW6020A	Barium
IPC-MS	SW6020A	Beryllium
IPC-MS	SW6020A	Boron
IPC-MS	SW6020A	Cadmium
IPC-MS	SW6020A	Calcium
IPC-MS	SW6020A	Chromium
IPC-MS	SW6020A	Cobalt
IPC-MS	SW6020A	Copper
ICP-MS	SW6020A	Iron
ICP-MS	SW6020A	Lead
ICP-MS	SW6020A	Magnesium
ICP-MS	SW6020A	Manganese
ICP-MS	SW6020A	Molybdenum
ICP-MS	SW6020A	Nickel
ICP-MS	SW6020A	Potassium
ICP-MS	SW6020A	Selenium
ICP-MS	SW6020A	Silver
ICP-MS	SW6020A	Sodium
ICP-MS	SW6020A	Strontium
ICP-MS	SW6020A	Thallium
ICP-MS	SW6020A	Tin
ICP-MS	SW6020A	Titanium
ICP-MS	SW6020A	Uranium
ICP-MS	SW6020A	Vanadium
ICP-MS	SW6020A	Zinc
Spectrometric	SW7196A	Hex. Chromium
IC	SW7199	Hex. Chromium
Cold-Vapor	SW7470A / 7471A	Mercury
GC	SW8015B / 8015C	Gasoline
GC	SW8015B / 8015C	Diesel
GC	SW8015B / 8015C	Motor Oil
GC	SW8015B / 8015C	JP5
GC	SW8081A / 8081B	Aldrin
GC	SW8081A / 8081B	alpha-BHC
GC	SW8081A / 8081B	beta-BHC
GC	SW8081A / 8081B	delta-BHC
GC	SW8081A / 8081B	gamma-BHC (Lindane)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	SW8081A / 8081B	DDD (4,4)
GC	SW8081A / 8081B	DDE (4,4)
GC	SW8081A / 8081B	DDT (4,4)
GC	SW8081A / 8081B	Dieldrin
GC	SW8081A / 8081B	Endosulfan I
GC	SW8081A / 8081B	Endosulfan II
GC	SW8081A / 8081B	Endosulfan sulfate
GC	SW8081A / 8081B	Endrin
GC	SW8081A / 8081B	Endrin Aldehyde
GC	SW8081A / 8081B	Heptachlor
GC	SW8081A / 8081B	Heptachlor epoxide
GC	SW8081A / 8081B	Methoxychlor
GC	SW8081A / 8081B	alpha-Chlordane
GC	SW8081A / 8081B	gamma-Chlordane
GC	SW8081A / 8081B	Endrin Ketone
GC	SW8081A / 8081B	Toxaphene
GC	SW8081A / 8081B	Technical Chlordane
GC	SW8082 / 8082A	PCB1016
GC	SW8082 / 8082A	PCB1221
GC	SW8082 / 8082A	PCB1232
GC	SW8082 / 8082A	PCB1242
GC	SW8082 / 8082A	PCB1248
GC	SW8082 / 8082A	PCB1254
GC	SW8082 / 8082A	PCB1260
GC	SW8082 / 8082A	PCB1262
GC	SW8082 / 8082A	PCB1268
GC	SW8082 / 8082A	PCB 8
GC	SW8082 / 8082A	PCB 18
GC	SW8082 / 8082A	PCB 28
GC	SW8082 / 8082A	PCB 44
GC	SW8082 / 8082A	PCB 52
GC	SW8082 / 8082A	PCB 66
GC	SW8082 / 8082A	PCB 77
GC	SW8082 / 8082A	PCB 81
GC	SW8082 / 8082A	PCB 101
GC	SW8082 / 8082A	PCB 105
GC	SW8082 / 8082A	PCB 114
GC	SW8082 / 8082A	PCB 118
GC	SW8082 / 8082A	PCB 123
GC	SW8082 / 8082A	PCB 126

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	SW8082 / 8082A	PCB 128
GC	SW8082 / 8082A	PCB 138
GC	SW8082 / 8082A	PCB 153
GC	SW8082 / 8082A	PCB 156
GC	SW8082 / 8082A	PCB 157
GC	SW8082 / 8082A	PCB 167
GC	SW8082 / 8082A	PCB 169
GC	SW8082 / 8082A	PCB 170
GC	SW8082 / 8082A	PCB 180
GC	SW8082 / 8082A	PCB 187
GC	SW8082 / 8082A	PCB 189
GC	SW8082 / 8082A	PCB 195
GC	SW8082 / 8082A	PCB 206
GC	SW8082 / 8082A	PCB 209
GC	SW8141A	Azinphos-methyl
GC	SW8141A	Bolstar
GC	SW8141A	Chlorpyrifos
GC	SW8141A	Coumaphos
GC	SW8141A	Demeton
GC	SW8141A	Diazinon
GC	SW8141A	Dichlorvos
GC	SW8141A	Disulfoton
GC	SW8141A	Ethoprop
GC	SW8141A	Fensulfothion
GC	SW8141A	Fenthion
GC	SW8141A	Merphos
GC	SW8141A	Mevinphos
GC	SW8141A	Naled
GC	SW8141A	Methyl Parathion
GC	SW8141A	Phorate
GC	SW8141A	Ronnel
GC	SW8141A	Stirophos
GC	SW8141A	Tokuthion
GC	SW8141A	Trichloronate
GC	SW8141A	Dimethoate
GC	SW8141A	EPN
GC	SW8141A	Famphur
GC	SW8141A	Malathion
GC	SW8141A	Ethyl Parathion
GC	SW8141A	O,O,O-Triethylphosphorothioate

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	SW8141A	Sulfotepp
GC	SW8141A	Thionazin
GC	SW8141A	Tributyl Phosphate
GC-MS	SW8260B	Acetone
GC-MS	SW8260B	Acrolein
GC-MS	SW8260B	Acrylonitrile
GC-MS	SW8260B	Benzene
GC-MS	SW8260B	Bromobenzene
GC-MS	SW8260B	Bromochloromethane
GC-MS	SW8260B	Bromodichloromethane
GC-MS	SW8260B	Bromoform
GC-MS	SW8260B	Bromomethane
GC-MS	SW8260B	tert-Butyl alcohol
GC-MS	SW8260B	2-Butanone (MEK)
GC-MS	SW8260B	n-Butylbenzene
GC-MS	SW8260B	sec-Butylbenzene
GC-MS	SW8260B	tert-Butylbenzene
GC-MS	SW8260B	Carbon disulfide
GC-MS	SW8260B	Carbon tetrachloride
GC-MS	SW8260B	Chlorobenzene
GC-MS	SW8260B	2-Chloroethyl vinyl ether
GC-MS	SW8260B	Chloroethane
GC-MS	SW8260B	Chloroform
GC-MS	SW8260B	1-Chlorohexane
GC-MS	SW8260B	Chloromethane
GC-MS	SW8260B	2-Chlorotoluene
GC-MS	SW8260B	4-Chlorotoluene
GC-MS	SW8260B	Isopropyl ether (DIPE)
GC-MS	SW8260B	Dibromochloromethane
GC-MS	SW8260B	1,2-Dibromo-3-chloropropane
GC-MS	SW8260B	1,2-Dibromoethane
GC-MS	SW8260B	Dibromomethane
GC-MS	SW8260B	1,1-Dichloroethane
GC-MS	SW8260B	1,2-Dichloroethane
GC-MS	SW8260B	1,2-Dichlorobenzene
GC-MS	SW8260B	1,3-Dichlorobenzene
GC-MS	SW8260B	trans-1,4-Dichloro-2-Butene
GC-MS	SW8260B	1,4-Dichlorobenzene
GC-MS	SW8260B	Dichlorodifluoromethane
GC-MS	SW8260B	1,1-Dichloroethene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	SW8260B	cis-1,2-Dichloroethene
GC-MS	SW8260B	trans-1,2-Dichloroethene
GC-MS	SW8260B	Dichlorofluoromethane
GC-MS	SW8260B	1,1-Dichloropropene
GC-MS	SW8260B	1,2-Dichloropropane
GC-MS	SW8260B	1,3-Dichloropropane
GC-MS	SW8260B	2,2-Dichloropropane
GC-MS	SW8260B	cis-1,3-Dichloropropene
GC-MS	SW8260B	trans-1,3-Dichloropropene
GC-MS	SW8260B	tert-Butyl ethyl ether (ETBE)
GC-MS	SW8260B	Ethyl Methacrylate
GC-MS	SW8260B	Ethylbenzene
GC-MS	SW8260B	2-Hexanone (MBK)
GC-MS	SW8260B	Hexachlorobutadiene
GC-MS	SW8260B	Iodomethane
GC-MS	SW8260B	Isopropylbenzene
GC-MS	SW8260B	p-Isopropyltoluene
GC-MS	SW8260B	Methylene Chloride
GC-MS	SW8260B	4-Methyl-2-pentanone (MIBK)
GC-MS	SW8260B	tert-Butyl methyl ether
GC-MS	SW8260B	Naphthalene
GC-MS	SW8260B	n-Propylbenzene
GC-MS	SW8260B	Styrene
GC-MS	SW8260B	tert-Amyl methyl ether (TAME)
GC-MS	SW8260B	1,1,1,2-Tetrachloroethane
GC-MS	SW8260B	1,1,2,2-Tetrachloroethane
GC-MS	SW8260B	Tetrachloroethene
GC-MS	SW8260B	Toluene
GC-MS	SW8260B	1,1,1-Trichloroethane
GC-MS	SW8260B	1,1,2-Trichloroethane
GC-MS	SW8260B	1,2,3-Trichlorobenzene
GC-MS	SW8260B	1,2,4-Trichlorobenzene
GC-MS	SW8260B	Trichloroethene
GC-MS	SW8260B	Trichlorofluoromethane
GC-MS	SW8260B	1,2,3-Trichloropropane
GC-MS	SW8260B	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	SW8260B	1,2,4-Trimethylbenzene
GC-MS	SW8260B	1,3,5-Trimethylbenzene
GC-MS	SW8260B	Vinyl Acetate
GC-MS	SW8260B	Vinyl Chloride

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	SW8260B	m-Xylene & p-xylene
GC-MS	SW8260B	o-Xylene
GC-MS	SW8260B	2-Butanol
GC-MS	SW8260B	Cyclohexane
GC-MS	SW8260B SIM	Benzene
GC-MS	SW8260B SIM	Carbon tetrachloride
GC-MS	SW8260B SIM	Chloroform
GC-MS	SW8260B SIM	Chloromethane
GC-MS	SW8260B SIM	1,2-Dibromo-3-chloropropane
GC-MS	SW8260B SIM	1,2-Dibromoethane
GC-MS	SW8260B SIM	1,2-Dichloroethane
GC-MS	SW8260B SIM	1,1-Dichloroethene
GC-MS	SW8260B SIM	cis-1,2-Dichloroethene
GC-MS	SW8260B SIM	trans-1,2-Dichloroethene
GC-MS	SW8260B SIM	1,1,2,2-Tetrachloroethane
GC-MS	SW8260B SIM	Tetrachloroethene
GC-MS	SW8260B SIM	1,1,1-Trichloroethane
GC-MS	SW8260B SIM	1,1,2-Trichloroethane
GC-MS	SW8260B SIM	Trichloroethene
GC-MS	SW8260B SIM	1,2,3-Trichloropropane
GC-MS	SW8260B SIM	Vinyl Chloride
GC-MS	SW8270C / 8270D	Acenaphthene
GC-MS	SW8270C / 8270D	Acenaphthylene
GC-MS	SW8270C / 8270D	Aniline
GC-MS	SW8270C / 8270D	Anthracene
GC-MS	SW8270C / 8270D	Azobenzene
GC-MS	SW8270C / 8270D	Benzidine
GC-MS	SW8270C / 8270D	Benzo(a)anthracene
GC-MS	SW8270C / 8270D	benzo(a)pyrene
GC-MS	SW8270C / 8270D	Benzo(b)fluoranthene
GC-MS	SW8270C / 8270D	Benzo(e)pyrene
GC-MS	SW8270C / 8270D	Benzo(g,h,i)perylene
GC-MS	SW8270C / 8270D	Benzo(k)fluoranthene
GC-MS	SW8270C / 8270D	Benzoic Acid
GC-MS	SW8270C / 8270D	Benzyl Alcohol
GC-MS	SW8270C / 8270D	Biphenyl
GC-MS	SW8270C / 8270D	bis(2-chloroethoxy)methane
GC-MS	SW8270C / 8270D	bis(2-chloroethyl)ether
GC-MS	SW8270C / 8270D	bis(2-chloroisopropyl)ether
GC-MS	SW8270C / 8270D	bis(2-Ethylhexyl)adipate

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	SW8270C / 8270D	bis(2-Ethylhexyl)phthalate
GC-MS	SW8270C / 8270D	4-Bromophenyl-phenylether
GC-MS	SW8270C / 8270D	Butylbenzylphthalate
GC-MS	SW8270C / 8270D	Carbazole
GC-MS	SW8270C / 8270D	4-Chloro-3-methylphenol
GC-MS	SW8270C / 8270D	4-Chloroaniline
GC-MS	SW8270C / 8270D	2-Chloronaphthalene
GC-MS	SW8270C / 8270D	2-Chlorophenol
GC-MS	SW8270C / 8270D	4-Chlorophenyl-phenylether
GC-MS	SW8270C / 8270D	Chrysene
GC-MS	SW8270C / 8270D	Dibenzo(a,h)anthracene
GC-MS	SW8270C / 8270D	Dibenzofuran
GC-MS	SW8270C / 8270D	1,2-Dichlorobenzene
GC-MS	SW8270C / 8270D	1,3-Dichlorobenzene
GC-MS	SW8270C / 8270D	1,4-Dichlorobenzene
GC-MS	SW8270C / 8270D	3,3'-Dichlorobenzidine
GC-MS	SW8270C / 8270D	2,4-Dichlorophenol
GC-MS	SW8270C / 8270D	Diethylphthalate
GC-MS	SW8270C / 8270D	2,6-Dimethylnaphthalene
GC-MS	SW8270C / 8270D	2,4-Dimethylphenol
GC-MS	SW8270C / 8270D	Dimethylphthalate
GC-MS	SW8270C / 8270D	Di-n-butylphthalate
GC-MS	SW8270C / 8270D	4,6-Dinitro-2-methylphenol
GC-MS	SW8270C / 8270D	2,4-Dinitrophenol
GC-MS	SW8270C / 8270D	2,4-Dinitrotoluene
GC-MS	SW8270C / 8270D	2-6-Dinitrotoluene
GC-MS	SW8270C / 8270D	Di-n-octylphthalate
GC-MS	SW8270C / 8270D	Fluoranthene
GC-MS	SW8270C / 8270D	Fluorene
GC-MS	SW8270C / 8270D	Hexachlorobenzene
GC-MS	SW8270C / 8270D	Hexachlorobutadiene
GC-MS	SW8270C / 8270D	Hexachlorocyclopentadiene
GC-MS	SW8270C / 8270D	Hexachloroethane
GC-MS	SW8270C / 8270D	Indeno(1,2,3-cd)pyrene
GC-MS	SW8270C / 8270D	Isophorone
GC-MS	SW8270C / 8270D	1-Methylnaphthalene
GC-MS	SW8270C / 8270D	2-Methylnaphthalene
GC-MS	SW8270C / 8270D	1-Methylphenanthrene
GC-MS	SW8270C / 8270D	2-Methylphenol
GC-MS	SW8270C / 8270D	4-Methylphenol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	SW8270C / 8270D	Naphthalene
GC-MS	SW8270C / 8270D	2-Nitroaniline
GC-MS	SW8270C / 8270D	3-Nitroaniline
GC-MS	SW8270C / 8270D	4-Nitroaniline
GC-MS	SW8270C / 8270D	Nitrobenzene
GC-MS	SW8270C / 8270D	2-Nitrophenol
GC-MS	SW8270C / 8270D	4-Nitrophenol
GC-MS	SW8270C / 8270D	n-Nitrosodimethylamine
GC-MS	SW8270C / 8270D	n-Nitroso-di-n-propylamine
GC-MS	SW8270C / 8270D	n-Nitrosodiphenylamine
GC-MS	SW8270C / 8270D	Pentachlorophenol
GC-MS	SW8270C / 8270D	Perylene
GC-MS	SW8270C / 8270D	Phenanthrene
GC-MS	SW8270C / 8270D	Phenol
GC-MS	SW8270C / 8270D	Pyrene
GC-MS	SW8270C / 8270D	Pyridine
GC-MS	SW8270C / 8270D	2,3,4,6-Tetrachlorophenol
GC-MS	SW8270C / 8270D	1,2,4-Trichlorobenzene
GC-MS	SW8270C / 8270D	2,3,4-Trichlorophenol
GC-MS	SW8270C / 8270D	2,3,5-Trichlorophenol
GC-MS	SW8270C / 8270D	2,4,5-Trichlorophenol
GC-MS	SW8270C / 8270D	2,4,6-Trichlorophenol
GC-MS	SW8270C / 8270D	2,3,5-Trimethylnaphthalene
GC-MS	SW8270C / 8270D SIM	Acenaphthene
GC-MS	SW8270C / 8270D SIM	Acenaphthylene
GC-MS	SW8270C / 8270D SIM	Anthracene
GC-MS	SW8270C / 8270D SIM	Azobenzene
GC-MS	SW8270C / 8270D SIM	Benzo(a)anthracene
GC-MS	SW8270C / 8270D SIM	benzo(a)pyrene
GC-MS	SW8270C / 8270D SIM	Benzo(b)fluoranthene
GC-MS	SW8270C / 8270D SIM	Benzo(e)pyrene
GC-MS	SW8270C / 8270D SIM	Benzo(g,h,i)perylene
GC-MS	SW8270C / 8270D SIM	Benzo(k)fluoranthene
GC-MS	SW8270C / 8270D SIM	Biphenyl
GC-MS	SW8270C / 8270D SIM	bis(2-chloroethyl)ether
GC-MS	SW8270C / 8270D SIM	bis(2-Ethylhexyl)phthalate
GC-MS	SW8270C / 8270D SIM	Carbazole
GC-MS	SW8270C / 8270D SIM	4-Chloro-3-methylphenol
GC-MS	SW8270C / 8270D SIM	2-Chlorophenol
GC-MS	SW8270C / 8270D SIM	Chrysene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	SW8270C / 8270D SIM	Dibenzo(a,h)anthracene
GC-MS	SW8270C / 8270D SIM	2,4-Dichlorophenol
GC-MS	SW8270C / 8270D SIM	2,6-Dimethylnaphthalene
GC-MS	SW8270C / 8270D SIM	2,4-Dimethylphenol
GC-MS	SW8270C / 8270D SIM	Fluoranthene
GC-MS	SW8270C / 8270D SIM	Fluorene
GC-MS	SW8270C / 8270D SIM	Hexachlorobenzene
GC-MS	SW8270C / 8270D SIM	Indeno(1,2,3-cd)pyrene
GC-MS	SW8270C / 8270D SIM	1-Methylnaphthalene
GC-MS	SW8270C / 8270D SIM	2-Methylnaphthalene
GC-MS	SW8270C / 8270D SIM	1-Methylphenanthrene
GC-MS	SW8270C / 8270D SIM	Naphthalene
GC-MS	SW8270C / 8270D SIM	n-Nitrosodimethylamine
GC-MS	SW8270C / 8270D SIM	n-Nitroso-di-n-propylamine
GC-MS	SW8270C / 8270D SIM	Pentachlorophenol
GC-MS	SW8270C / 8270D SIM	Perylene
GC-MS	SW8270C / 8270D SIM	Phenanthrene
GC-MS	SW8270C / 8270D SIM	Phenol
GC-MS	SW8270C / 8270D SIM	Pyrene
GC-MS	SW8270C / 8270D SIM	2,4,5-Trichlorophenol
GC-MS	SW8270C / 8270D SIM	2,4,6-Trichlorophenol
GC-MS	SW8270C / 8270D SIM	2,3,5-Trimethylnaphthalene
GC-MS	SW8270C / 8270D SIM	1,4-Dioxane
HPLC	SW8310	Acenaphthene
HPLC	SW8310	Acenaphthylene
HPLC	SW8310	Anthracene
HPLC	SW8310	Benzo(a)anthracene
HPLC	SW8310	Benzo(a)pyrene
HPLC	SW8310	Benzo(b)fluoranthene
HPLC	SW8310	Benzo(g,h,i)perylene
HPLC	SW8310	Benzo(k)fluoranthene
HPLC	SW8310	Chrysene
HPLC	SW8310	Dibenzo(a,h)anthracene
HPLC	SW8310	Fluoranthene
HPLC	SW8310	Fluorene
HPLC	SW8310	Indeno(1,2,3-cd)pyrene
HPLC	SW8310	1-Methylnaphthalene
HPLC	SW8310	2-Methylnaphthalene
HPLC	SW8310	Naphthalene
HPLC	SW8310	Phenanthrene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	SW8310	Pyrene
HPLC	SW8330A	HMX
HPLC	SW8330A	RDX
HPLC	SW8330A	1,3,5-TNB
HPLC	SW8330A	1,3-DNB
HPLC	SW8330A	Tetryl
HPLC	SW8330A	Nitrobenzene
HPLC	SW8330A	2,4,6-TNT
HPLC	SW8330A	4-AM-2,6-DNT
HPLC	SW8330A	2-AM-4,6-DNT
HPLC	SW8330A	2,6-DNT
HPLC	SW8330A	2,4-DNT
HPLC	SW8330A	2-Nitrotoluene
HPLC	SW8330A	4-Nitrotoluene
HPLC	SW8330A	3-Nitrotoluene
GC	SW8151A	Acifluorfen
GC	SW8151A	Bentazon
GC	SW8151A	Chloramben
GC	SW8151A	2,4-D
GC	SW8151A	2,4-DB
GC	SW8151A	Dacthal
GC	SW8151A	Dalapon
GC	SW8151A	Dicamba
GC	SW8151A	3,5 Dichlorobenzoic
GC	SW8151A	Dichlorprop
GC	SW8151A	Dinoseb
GC	SW8151A	MCPA
GC	SW8151A	MCPP
GC	SW8151A	Pentachlorophenol
GC	SW8151A	Picloram
GC	SW8151A	Silvex
GC	SW8151A	2,4,5-T
GFAA	CA 939M	Organo Lead
Preparation	**Method**	**Type**
Purge & Trap	SW5030B/SW5035	Volatiles Prep
Acid Digestion	SW3010/SW3050B	Metals Prep
Alkaline Digestion	SW3060A	Hexavalent Chrom
Soxhlet	SW3540C	Organic Extraction
Sonication	SW3520C/SW3550C	Organic Extraction
Waste Dilution	SW3580A	Organic Extraction

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Preparation	**Method**	**Type**
TCLP	SW1311	Leaching
SPLP	SW1312	Leaching
Floricil Clean-up	SW3520B	Extract Clean-Up
GPC Clean-up	SW3640A	Extract Clean-Up
Sulfur Clean-up	SW3660B	Extract Clean-Up
Acid/Permanganate Clean-up	SW3665A	Extract Clean-Up

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	1,1,1-trichloroethane
GC-MS	TO-15	1,1,2,2-tetrachloroethane
GC-MS	TO-15	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	TO-15	1,1,2-trichloroethane
GC-MS	TO-15	1,1-dichloroethane
GC-MS	TO-15	1,1-Dichloroethene
GC-MS	TO-15	1,2,4-trichlorobenzene
GC-MS	TO-15	1,2,4-trimethylbenzene
GC-MS	TO-15	1,2-dibromoethane
GC-MS	TO-15	1,2-dichlorobenzene
GC-MS	TO-15	1,2-dichloroethane
GC-MS	TO-15	1,2-dichloroethene
GC-MS	TO-15	1,2-dichloropropane
GC-MS	TO-15	1,3,5-trimethylbenzene
GC-MS	TO-15	1,3-Butadiene
GC-MS	TO-15	1,3-Butadiene, 1,1,2,3,4,Hexachloro
GC-MS	TO-15	1,3-dichlorobenzene
GC-MS	TO-15	1,4-dichlorobenzene
GC-MS	TO-15	1,4-Dioxane
GC-MS	TO-15	2,2,4-Trimethylpentane
GC-MS	TO-15	4-Ethyltoluene
GC-MS	TO-15	Acetone
GC-MS	TO-15	Acrylonitrile
GC-MS	TO-15	Allyl Chloride
GC-MS	TO-15	Benzene
GC-MS	TO-15	Benzyl Chloride
GC-MS	TO-15	Bromodichloromethane
GC-MS	TO-15	Bromoform
GC-MS	TO-15	Bromomethane
GC-MS	TO-15	Carbon Disulfide
GC-MS	TO-15	Carbon Tetrachloride

LABORATORY ACCREDITATION BUREAU

Certificate # L2278

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	Chlorobenzene
GC-MS	TO-15	Chloroethane
GC-MS	TO-15	Chloroethene
GC-MS	TO-15	Chloroform
GC-MS	TO-15	Chloromethane
GC-MS	TO-15	cis-1,3-Dichloropropene
GC-MS	TO-15	Cyclohexane
GC-MS	TO-15	Dibromochloromethane
GC-MS	TO-15	Dichlorodifluoromethane
GC-MS	TO-15	Dichlorotetrafluoroethane
GC-MS	TO-15	Ethyl Acetate
GC-MS	TO-15	Ethylbenzene
GC-MS	TO-15	Isopropyl Alcohol
GC-MS	TO-15	m+p-Xylene
GC-MS	TO-15	Methyl butyl Ketone
GC-MS	TO-15	Methyl Ethyl Ketone
GC-MS	TO-15	Methyl Isobutyl Ketone
GC-MS	TO-15	Methyl Tert-Butyl Ether
GC-MS	TO-15	Methylene Chloride
GC-MS	TO-15	n-Heptane
GC-MS	TO-15	n-Hexane
GC-MS	TO-15	o-Xylene
GC-MS	TO-15	Styrene
GC-MS	TO-15	Tetrachloroethylene
GC-MS	TO-15	Tetrahydrofuran
GC-MS	TO-15	Toluene
GC-MS	TO-15	Trans-1,2-Dichloroethene
GC-MS	TO-15	trans-1,3-Dichloropropene
GC-MS	TO-15	Trichloroethylene
GC-MS	TO-15	Trichloromonofluoromethan
GC-MS	TO-15	Vinyl Acetate
GC-MS	TO-15	Vinyl Bromide

Notes:

1) This laboratory offers commercial testing service.

Approved By: _____ Date: January 10, 2011

R. Douglas Leonard
Chief Technical Officer

Issued: 1/10/11

The Site Safety and Health Plan has been removed from this document at the request of NMED.

The Standard Operating Procedures have been removed from this document at the request of NMED.

INCLUDED INFORMATION:

April 2011 Site Visit Notes

Photographic Log – Site Visit

Aerial Photograph (April 1991) (electronic [PDF] on CD only)

POL Yard Historical Photographic Log

1995 USGS Data Submission, Vol. 1 and 2 (electronic [PDF] on CD only)

Former Gas Station Site (ST-C502)

Base Support/Operations Generator Former UST Site (ST-C503)

Hospital Abandoned UST Site (ST-C504)

Flightline Generator USTs Site (ST-C505)

Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129)

April 2011 Site Visit Notes

Cannon AFB Site Visit (4-19/20-2011) Notes

1. Met with Anita Lafuente (575-784-1092), Karen Walker (210-553-5100), and Gene Smith (575-784-1096) in office to discuss schedule, answer questions, and review historical site documents. Gene Smith had a file on ST-C502, ST-C503, ST-C504, and ST-C505. These were four of the sites investigated by USGS in 1995. These files contained various documents including as-built drawings, UST excavation worksheets, 7-day written notification forms from Cannon AFB to NMED, UST inspection reports, photographs of site in 1995, UST closure sheets, and previous environmental investigation documents. After the meeting, a site walk was conducted at the 8 sites

    a. **Former Aerospace Ground Equipment (AGE) Dispatch Facility Spills Site (SS-C501):** Currently, the site is a new asphalt parking lot re-paved in June 2009 that formerly stored AGE. Gene mentioned and located 2-60 gallon spills where the AGE was stored on cracked asphalt. These locations were acquired by GPS. Gene mentioned focus of investigation should be down center of asphalt parking lot – look at historical aerial photo for location of AGE (including large maintenance equipment that was pulled out to the flightline to service aircraft). AGE could be fuel, oil, coolant, water, hydraulic fluid, and air. Consider petroleum, VOCs, SVOCs, PCBs, and metals analytical list.

    b. **Former Gas Station Site (ST-C502):** Currently, a credit union at Cannon AFB, the site is an asphalt parking lot with a drive-thru and a grass patch northwest of credit union. The site was formerly a gas station and vehicle service center. The current drive-thru was used as two service bays with hydraulic lifts. Gene's file was reviewed and the as-built drawings were found. As-built drawings show the exact location of pump islands and location of USTs with measurements off the building. As-built shows four USTs to the west of building 368. An NMED UST inspection report (1-23-1995) was found in Gene's file and identified three USTs (10,000 gal each). The tanks in the inspection report are identified as A, B, and C. UST A being farthest from the building and C being closest.

    c. **Base Support/Operations Generator Former UST Site (ST-C503):** Previously contained a 500 gallon diesel UST constructed of steel and the base of the tank was approximately 7 feet bgs. Currently, the site is a grassed area, has brick wall to the west, picket fence to the east and, open to the north and south. South is asphalt and concrete. Between the asphalt curb and the grassed area is a concrete trench with a metal cover containing the existing diesel lines from the AST to the east. This AST is still in use, therefore cannot be considered part of the investigation. The concrete trench along the curb is approximately 21 feet and the trench turns to the north and is approximately 17 feet long. Exposed pipes are visible at either end of the concrete trench (pipes from the AST to Bldg. 600). Just east of the AST are two dumpsters. There is a manhole

and sewer lines at this site. In Gene's file, photographs of the open excavation show that the excavation went directly up to the brick wall, the southern concrete trench, and the eastern picket fence. As-built drawings show the former fuel UST not within the boundary of the excavation shown on figures in the 1995 USGS document. Photos of the 1995 USGS sampling locations are consistent with the sampling maps in the 1995 USGS document.

d. **Hospital Abandoned UST Site (ST-C504):** The UST was a 25,000 gal diesel UST, constructed of steel, with the base of the UST at approximately 18 feet bgs, and was filled and abandoned in place (tank was approximately 12 foot in diameter – so 6 foot deep). Currently, the site is grassed with two large cooling towers, and asphalt to the west. The asphalt curb appears to be unchanged from the 1995 USGS investigation. The cooling towers are surrounded by an 8 foot chain link fence. The exact location of the abandoned tank is unknown – the map in the 1995 USGS document does not match with the available space between the curb (which has likely remained unchanged) and the cooling towers (likely new since 1995). This site may also be a candidate for a geophysical investigation (GPR). Gene's file has documentation of the tank closure report which indicated the tank was disposed in place on 10-5-94. . Gene's file has a report from Keers Environmental that presented results of a limited subsurface investigation (3 borings to 15 feet on 8-17-94 and a follow up investigation which included 4 borings to 20 feet on 9-22-94). TRPH were above NMED limits to the west of the tank and hydrocarbon odors were noted in B-1.

e. **Flightline Generator UST Site (ST-C505):** Previously contained two 500 gallon diesel USTs constructed of fiberglass and the base of the tanks were at approximately 9 feet bgs. Currently, the site has generator building and UST in a vault to the south of the building. The generator is used in case of a power loss. Fuel lines are in concrete trench with steel plate over the top. Former UST excavation is somewhat visible at the surface (stressed vegetation and red soil). Gene's folder for 505 (building 3060) did not have as-built plan, and as-built plans could not be located. Gene's folder did have photographs of 1995 USGS sampling locations that are consistent with site sampling maps in 1995 USGS document. Gene's file also had 7-day written notice of release at 3060 that indicates release from overfilling (not leaking), follow up sampling result from 12-28-1994, and excavation site worksheets indicating 48 CY of contaminated soil was removed at only UST B.

f. **Former Petroleum, Oil, and Lubricants (POL) Yard Refueling Area Site (SS-C507):** Met with William (Bill) O'Shea (575-784-2087) at southeast gate of POL yard. Former POL yard to be investigated is to west of JP-8 tanks and containment berm. New POL yard is located to the east. Historical aerial photo

will be used to define our site boundary. Bill was asked if he could provide as-built drawing – he mentioned none were available for the site. Bill mentioned they are responsible to maintain the containment berms and 2 foot beyond berms, so the rest of the site inside the fence is the area to be investigated. Bill also mentioned an area outside of the fence to the west that was a former railroad yard. Mr. O'Shea stated that the railroad yard was deactivated prior to 1992. He was not aware of POLs stored in this area, and stated that this area was used to deliver general supplies to the base. In the summer of 2009, the POL yard refueling area was closed and is inactive. MOGAS filling station was first stop just inside east gate and east of road. Small concrete area where vehicles could pull off to the side. Bill and Gene mentioned a MOGAS spill at the dispensing port/fill port (the GPS location was acquired). Bill recommended investigating the concrete area and around MOGAS pipe stick-up. MOGAS fill port stick-up is set back off the concrete by approximately 25 feet. Underground MOGAS lines went to the north to MOGAS vault (see photo and GPS coordinates) and Building 390. MOGAS line markers not visible at surface. Sewer manhole is directly adjacent to MOGAS fill port stick-up. Next stop was at JP-8 refueling islands (two islands parallel north south). There was a former OWS to the east that sat in a below ground vault. There was also a drum containment area with four 55-gallon drums (contents unknown). The two pump islands were surrounded by concrete (see aerial photo) and the area sloped to the east where a drainage swale is located, leading to a break in the curb. The dispensers have been removed but the underground JP-4/JP-8 lines are still present. The concrete surrounding the pump islands, the drainage swale leading to the break in the curb, and the area just outside the curb (in the grassed oval area) should be investigated (highest likelihood of potential contamination per Gene). Gene mentioned spills on either side of pump islands. Pipe stick-ups are still present on JP-8 pump islands. Next stop was MOGAS vault (see photo). Four pipes are sticking up out of the ground (furthest south is MOGAS). Three north pipes were JP-8 leading to Building 390. Just west of MOGAS vault was the location of former Building 390 (see aerial photo.) Gene mentioned large spill of JP-8 to the north of Building 390. Bill mentioned that the seals in piping directly north of Building 390 broke twice and there were two spills (unknown sizes and exact areas unknown – presumably around piping under former canopy). Gene said a soil excavation was complete to the north and east of 390. Red soil backfill is visible at surface. JP-8 lines lead to Building 390 from north (in from Clovis) and from west (from Building 392 and tub containment area). There is a JP-8 vault to the east (see photo and coordinates) that is the low point from Building 392 to 390. Lines also exist from Building 390 to JP-8 pump islands. Next stop was diesel fill areas (two stick-ups) on concrete. The two diesel fill areas were 398 (to the south) and 399 (to the north). The fill ports were in the concrete and set back off the curb by less than 2 feet (short – 1 foot stick-ups). These two

diesel fill pipes lead to former diesel piping that sat inside a canopy. Above ground pipes were present east of the former canopy location (see aerial photo for canopy and above ground lines). A break in the concrete curb was observed to the west of the diesel pump island (see GPS coordinates). There is an overflow valve to the south small containment berm that previously had four ASTs. This valve is still used to discharge storm water that collects inside active containment areas. Next stop was two concrete tub areas (fuel unloading areas) on the west side of the grassed oval area. 8,000 gallon tankers brought in JP-8 in the northwest gate and unloaded to fill ports inside concrete trenched covered with steel plates. Previously, train tankers brought fuel to the unloading area – RR tracks were previously present west of the fill ports. The former RR spur in visible to the north. At the former fill port locations, holes in the steel plates are still visible where the JP-8 was filled. All piping inside the concrete trenches is gone. There is a grate within each concrete tub area that has a small 4" by 4" square drain that leads to a clean out due east and then leads into a former OWS in the grassed oval area (see aerial photo and GPS coordinates). Building 392 would receive the JP-8 from the truck/tanker and transfer it to building 390. Gene and Bill mentioned a previous release occurred to the southwest of Building 392 (approximately 400 gallons of JP-8). This area was excavated – approximate excavation limits were provided by Bill and Gene. The last stop was to the south of the grassed oval area where a break in the concrete curb was photographed (GPS coordinates acquired) which is a likely area for runoff (sediment from runoff was visible on the asphalt near the break in the curb. This is one of the main low spots. There is a set of three protective posts near the break in the concrete curb – with an electrical conduit sticking out – use was unknown. According to Bill and Gene, the oval landscaped area inside the asphalt pavement was not used to store or dispose of any substances. This area was strictly aesthetical.

g. **Surface Disposal Area Site (SD-C508)** EOD does training in the area – more to the south where UXO signs are posted. Location of surface disposal was found using GPS coordinates from compliance sampling in 2009. Surface disposal is still visible at surface composed of burned metal, wood, pipes, and other debris. The localized area around the debris is void of vegetation. Other burned metal was observed throughout the field. From a distance the area is slightly mounded and the main portion of the visible debris is at the peak of the mound. The vegetation on the mounded area looked slightly different from the surrounding vegetation that is not as noticeable on the aerial photo. This mounded area may be from the disposal of debris that was removed from the adjacent FTA #3. There is another site (SWMU 107 FTA #3) located to the south and west of the surface disposal. The small tree to the south (visible on the aerial photo) is no

longer at the site. The metal storage box (visible on the aerial photo) has been moved to the north just onto the abandoned runway.

h. **Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129)** URS explained to Cannon AFB that focus of this investigation should be leach field associated with site, not the former AST area - per NMED. This site is within SWMU 129 and there are no plans to sample around former OWS or ASTs. The site is currently not in use and is mainly grass, soil, and some concrete. Gene explained this was an unmanned disposal facility with three dump pits (two north of OWS and one south of OWS). Dump pits lead to OWS and water was discharged to leach field. There were also two drains within the AST containment area between tanks 2 and 3, and 3 and 4 (tanks 1-5, 5,000 gallon each from north to south). These drains lead to OWS. Leach field is located to the southwest. As-built drawing indicated the leach field is 95' from clean out. Former site fence boundary (38'X65') was located and approximate location of clean out was found and coordinates collected with GPS. Trench for pipe leading from clean out to leach field distribution box was visible at surface (grassed linear feature, consistent with as-built). Trench line and location of distribution box was surveyed with GPS. End of leach field is inside the flightline fence (12 feet from fence).

THIS PAGE INTENTIONALLY BLANK

Photographic Log – Site Visit

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base **Cannon Air Force Base, New Mexico**	**AFCEE and Cannon AFB**	**Contract No. FA8903-08-D-8783** **Task Order No. 0169**

Photograph No. 01

Description:

SS-C501: View southwest from the northern part of the site. Approximate area of northeastern spill is visible in the foreground.

Photograph No. 02

Description:

ST-C502: View southwest from the north side of the site. Grassed area and paved area to the southwest is near the former pump island locations.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 03

Description:

ST-C502: View southeast from the northwest part of the site, showing former pump island area and current credit union.

Photograph No. 04

Description:

ST-C503: View northeast of the former UST location (left side of photo) and the currently present AST enclosure (right side of photo).

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 05

Description:

ST-C503: View south of the former UST location and the AST enclosure.

Photograph No. 06

Description:

ST-C503: View west of the brick wall enclosing the generator and the diesel line leading to the generator.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 07

Description:

ST-C504: View east from the west corner of the site. The grassed area is the location of the abandoned UST.

Photograph No. 08

Description:

ST-C504: View east from the southern part of the site showing a concrete pad, transformers, and the north corner of the hospital.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base **Cannon Air Force Base, New Mexico**	**AFCEE and Cannon AFB**	**Contract No. FA8903-08-D-8783** **Task Order No. 0169**

Photograph No. 09

Description:

ST-C504: View northeast from the south side of the site. Fenced area with cooling towers and associated piping is visible on the right side of the photo.

Photograph No. 10

Description:

ST-C504: View southwest from the north side of the site with cooling tower and piping in fenced in area.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 11

Description:

ST-C504: View southwest of the transformer and cooling towers on the northeast part of the site.

Photograph No. 12

Description:

ST-C504: View of manhole cover that appears to be located near the area above the center of the UST.

Photograph No. 13

Description:

ST-C505: View south from the north part of the site, showing the previous excavated area left of the building (note sparse vegetation).

Photograph No. 14

Description:

ST-C505: View northwest from the south part of the site, showing the currently present generator, diesel UST vault, and concrete trench containing the connecting pipe.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 15

Description:

SS-C507: View southwest from the northeastern part of the site. Elbow connector pipe ends and the location of former diesel piping and canopy are visible in the foreground, with the diesel fuel pump island to the right.

Photograph No. 16

Description:

SS-C507: View northwest from the southeastern part of the site. The former MOGAS unloading and dispensing area.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 17

Description:

SS-C507: View east from the central portion of the site. The former JP-4 and JP-8 pump islands are visible, with the ASTs and concrete berms in the background.

Photograph No. 18

Description:

SS-C507: View north from the southeast part of the site. The former JP-4 and JP-8 pump islands are visible, with the diesel fuel pump island in the background.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 19

Description:

SS-C507: View south from the north end of JP-4/JP-8 unloading area and associated grated concrete trench. Former unloading ports shown to the right.

Photograph No. 20

Description:

SS-C507: View south, showing the former location of Building 392 (concrete pad in center of photo), former location of above ground piping and canopy, and metal plate-covered concrete trenches formerly containing fuel lines visible on the right side of the photo.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 21

Description:

SS-C507: Location of former unloading ports in the JP-4/JP-8 fuel unloading area.

Photograph No. 22

Description:

SS-C507: View northeast showing the northern diesel fuel unloading port (399), with the former location of the above ground diesel fuel lines and canopy in the background.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base **Cannon Air Force Base, New Mexico**	**AFCEE and Cannon AFB**	**Contract No. FA8903-08-D-8783** **Task Order No. 0169**

Photograph No. 23

Description:

SS-C507: View east showing the southern diesel fuel unloading port (398).

Photograph No. 24

Description:

SD-C508: View of surface debris such as burned metal slag, wood, and mechanical parts within site boundary.

SITE INVESTIGATION PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 25

Description:

TA/AS-C129: View northwest from southern portion of leach field site boundary. Approximate location of former ASTs directly west of fenced in storage area.

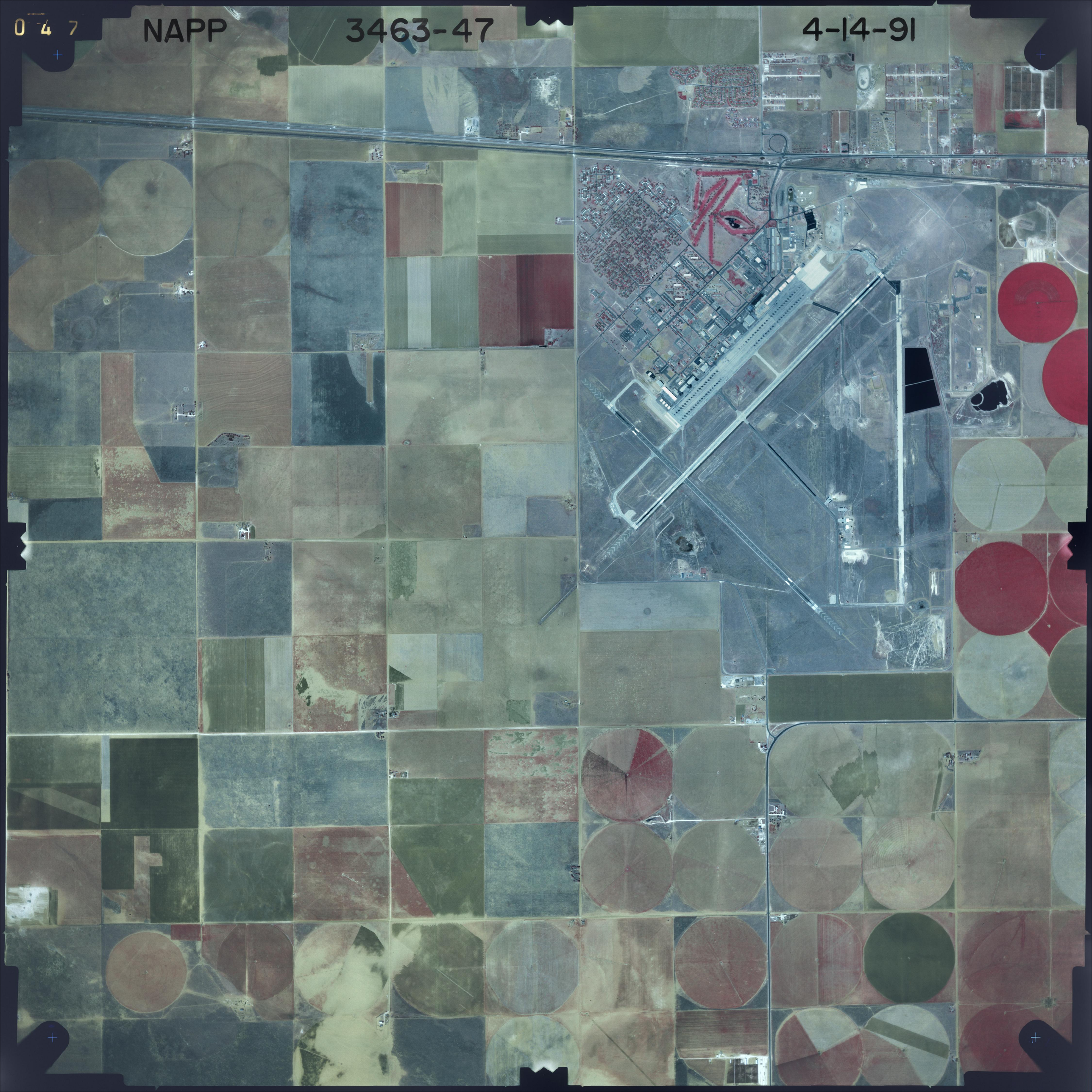
Photograph No. 26

Description:

TA/AS-C129: View southeast from northern portion of leach field site boundary. Note line of grass matching the location of the leach field drain pipe (presumably former trench for drain pipe).

Aerial Photograph (April 1991)

(electronic [PDF] on CD only)


0 4 7
NAPP
3463-47
4-14-91

POL Yard Historical Photographic Log

SITE HISTORY PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 01

Description:

SS-C507: View to the north from south end of two pump islands used to dispense JP-4/JP-8. Diesel fuel island in the background.

Photograph No. 02

Description:

SS-C507: View southwest from the northeast side of the site showing former Building 390 and above ground fuel lines under canopy.

SITE HISTORY PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 03

Description:

SS-C507: View south from the north portion of the site showing former Building 390, above ground fuel lines, fuel dispensers, and unloading ports. Above ground diesel fuel lines and canopy are visible at the bottom of photo.

Photograph No. 04

Description:

SS-C507: View northwest from the south portion of the site. Concrete drainage swale in foreground and former landscaped berm in background.

SITE HISTORY PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 05

Description:

SS-C507: View north from the middle of oval shaped non paved part of the site, showing former landscaped berm.

Photograph No. 06

Description:

SS-C507: View west from the central part of the site showing a former landscaped berm, pond, and JP-4/JP-8 unloading area in the background.

SITE HISTORY PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 07

Description:

SS-C507: View east from the northwest corner of the former pond with active ASTs in background.

Photograph No. 08

Description:

SS-C507: View north from south end of JP-4/JP-8 unloading area. Building 392 and unloading ports (right side of photo) and former train tanker storage rail yard (left side of photo).

SITE HISTORY PHOTOGRAPHIC LOG

Site Investigation at Cannon Air Force Base Cannon Air Force Base, New Mexico	AFCEE and Cannon AFB	Contract No. FA8903-08-D-8783 Task Order No. 0169

Photograph No. 09

Description:

SS-C507: View west from the former fuel unloading port and concrete unloading area with metal grated drain.

Photograph No. 10

Description:

SS-C507: View south from north end of JP-4/JP-8 unloading area with Building 392 and canopy in background.

1995 USGS Data Submission

Investigation of Eight Underground Storage Tank Facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico. 1995. (Vol. 1 and 2)

(electronic [PDF] on CD only)

INVESTIGATION OF EIGHT UNDERGROUND STORAGE TANK FACILITIES ON CANNON AIR FORCE BASE AND MELROSE BOMBING RANGE, NEW MEXICO, 1995

VOLUME I

PREPARED FOR

ENVIRONMENTAL MANAGEMENT FLIGHT
CANNON AIR FORCE BASE, NEW MEXICO 88103

PREPARED BY

FREDRICK E. GEBHARDT
U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION
4501 INDIAN SCHOOL ROAD NE, SUITE 200
ALBUQUERQUE, NEW MEXICO 87110

PREFACE

The purpose of this investigation was to assess potential contamination in soils at or immediately adjacent to eight Underground Storage Tank (UST) facilities on Cannon Air Force Base and Melrose Bombing Range, New Mexico, where contaminants may have been released due to leaks or spills.

Project Chief of this investigation is Fredrick Gebhardt. Technical support was provided by employees of the U.S. Geological Survey's New Mexico District and National Water Quality Lab. Text and illustrations were prepared by the Publications Unit of the New Mexico District. Chemical analyses were performed by Quanterra Environmental Services a Division of Quanterra Incorporated in Arvada, Colorado.

Appreciation is extented to the base point of contact, Mr. Rick Chandler, Environmental Management, Cannon Air Force Base. The assistance and cooperation of personnel from Cannon AFB and Melrose Bombing Range is greatly appreciated.

Approved:

Russell K. Livingston
District Chief, New Mexico
U.S. Geological Survey

Rick Chandler
Technical Project Manager
Cannon AFB, New Mexico

NOTICE

This report has been prepared for Cannon Air Force Base by the U.S. Geological Survey, Water Resources Division, New Mexico District, for the purpose of aiding in the implementation of remedial action at eight Underground Storage Tank (UST) facilities. As the report relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest.

It should be noted that all subsurface investigations are inherently limited in the sense that conclusions are drawn and recommendations are developed from test samples which depict subsurface conditions over short periods of time. Subsurface conditions elsewhere may differ from those at the sampling locations. In addition, subsurface conditions at sampling locations may vary over longer periods of time than can be observed in a study of this type.

Acceptance of this report in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

TABLE OF CONTENTS
VOLUME I

Page

1.0 INTRODUCTION/ SCOPE OF WORK 1

2.0 PROJECT SUMMARY 3-8

2.1 FIELD INVESTIGATION 3
2.1.1 Decontamination Procedure for Geoprobe Brass Sleeves 4

2.2 LABORATORY ANAYLSIS 7
2.2.1 Sample Identification 7
2.2.2 Methods of Sampling for Petroleum Hydrocarbons 8

3.0 ENVIRONMENTAL SETTING 9-11

3.1 CLIMATE 9

3.2 GEOGRAPHY 9

3.3 GEOLOGY 10

3.4 SOILS 10
3.4.1 Soil Boring Descriptions 10

3.5 SURFACE WATER 11

3.6 GROUNDWATER 11

4.0 SITE SPECIFIC DATA 12-60

4.1 FACILITY 728 12-15
4.1.1 Site Description 12
4.1.2 U.S. Geological Investigation 12
4.1.3 Recommendations 12

4.2 FACILITY 2285 16-19
4.2.1 Site Description 16
4.2.2 USGS Investigation 16
4.2.3 Recommendations 16

4.3 FACILITY 130 20-23
4.3.1 Site Descriptions 20
4.3.2 USGS Investigation 20
4.4.3 Recommendations 20

TABLE OF CONTENTS -- Continued

Page

4.4 FACILITY 600 24-29
- 4.4.1 Site Description 24
- 4.4.2 USGS Investigation 24
- 4.4.3 Recommendations 25

4.5 FACILITY 3060 30-35
- 4.5.1 Site Description 30
- 4.5.2 USGS Investigation 30
- 4.5.3 Recommendations 31

4.6 FACILITY 1400 36-43
- 4.6.1 Site Description 36
- 4.6.2 USGS Investigation 36
- 4.6.3 Recommendations 37
- 4.6.4 Soil Boring Descriptions -- Facility 1400 37

4.7 FACILITY 368 44-52
- 4.7.1 Site Description 44
- 4.7.2 USGS Investigation 44-45
- 4.7.3 Recommendations 45
- 4.7.4 Soil Boring Descriptions -- Facility 368 45

4.8 FACILITY 3121 53-60
- 4.8.1 Site Description 53
- 4.8.2 USGS Investigation 53-54
- 4.8.3 Recommendations 54
- 4.8.4 Soil Boring Descriptions -- Facility 3121 54

TABLE OF CONTENTS -- Continued

List of Figures

		Page
Figure 1.1	Map showing location of Cannon Air Force Base and Melrose Bombing Range, New Mexico	2
Figure 2.1.1	Map showing location of Underground Storage Tanks on Cannon Air Force Base	5
Figure 4.1.1	Location of boreholes at Facility 728 (Rapcon Building)	13
Figure 4.2.1	Location of boreholes at Facility 2285 (runway)	17
Figure 4.3.1	Location of boreholes at Facility 130 (Fire Department)	21
Figure 4.4.1	Location of boreholes at Facility 600 (Base Support Center/ Operation Group)	26
Figure 4.5.1	Location of boreholes at Facility 3060 (generator shed)	32
Figure 4.6.1	Location of boreholes at Facility 1400 (Hospital)	38
Figure 4.7.1	Location of boreholes at Facility 368 (old gas station)	46
Figure 4.7.2	Location of boreholes at Facility 368 (pump island)	47
Figure 4.8.1	Location of boreholes at Facility 3121 (Melrose Bombing Range)	55

List of Tables

Table 4.1.1	Summary of analytical data results, Facility 728	14
Table 4.2.1	Summary of analytical data results, Facility 2285	18
Table 4.3.1	Summary of analytical data results, Facility 130	22
Table 4.4.1	Summary of analytical data results, Facility 600	27-28
Table 4.5.1	Summary of analytical data results, Facility 3060	33-34

TABLE OF CONTENTS -- Concluded

		Page
Table 4.6.1	Summary of analytical data results, Facility 1400	39-41
Table 4.7.1	Summary of analytical data results, Facility 368	48-50
Table 4.8.1	Summary of analytical data results, Facility 3121	56-58

List of Gas Chromatograms

Gas Chromatograms 2.1.1	Gas Chromatograph Standards	6
Gas Chromatograms 4.1.1	Facility 728, samples CAFB-FAC0728-0104, -0303	15
Gas Chromatograms 4.2.1	Facility 2285, samples CAFB-FAC2285-0202, -0502	19
Gas Chromatograms 4.3.1	Facility 130, samples CAFB-FAC0130-0102, -0402	23
Gas Chromatograms 4.4.1	Facility 600, samples CAFB-FAC0600-0104, -0302, -0702	29
Gas Chromatograms 4.5.1	Facility 3060, samples CAFB-FAC3060-0302, -0601	35
Gas Chromatograms 4.6.1	Facility 1400, samples CAFB-FAC1400-0301, -0305, -1101, -0306, -0307	42-43
Gas Chromatograms 4.7.1	Facility 368, samples CAFB-FAC0368-0102, -0102M, -1001, -1005, -1006, -1601	51-52
Gas Chromatograms 4.8.1	Facility 3121, samples CAFB-FAC3121-0101, -0301, -0601, -0801, -0107, -0108	59-60

VOLUME II

APPENDICES (Laboratory Analytical Data)

1.0 INTRODUCTION/ SCOPE OF WORK

U.S. Geological Survey, WRD, New Mexico District conducted an subsurface investigation of eight Underground Storage Tanks (UST's) facilities at Cannon Air Force Base, Curry County and Melrose Bombing Range, Roosevelt County, New Mexico (Figure 1.1). The purpose of this investigation was to determine if subsurface soils at eight UST's facilities had been contaminated with petroleum hydrocarbons, and if contamination does exist, what is the magnitude and extent of the contamination. The suspect contamination may have resulted from leaks/spills from UST's previously utilized on the sites. All UST's with the exception of one (Facility 1400, CAFB Hospital) were recently decommissioned and excavated. The UST laocated adjacent to the Base Hospital at Cannon AFB (Facility 1400) has been decommissioned and abandoned in place.

The subsurface field investigation consisted of the collection of soil borings at the eight UST facilities, which was conducted from April 5, 1995 thru December 13, 1995. The investigation was performed in accordance with New Mexico Environmental Department's Underground Storage Tank Regulations, Section 1205. The soil borings were analyzed for Diesel Range Organics (DRO; modified method 8015), or Gasoline Range Organics (GRO; modified 8015). Complete description of the analysis, laboratory results, and chain of custody forms are attached in the Appendices of this report.

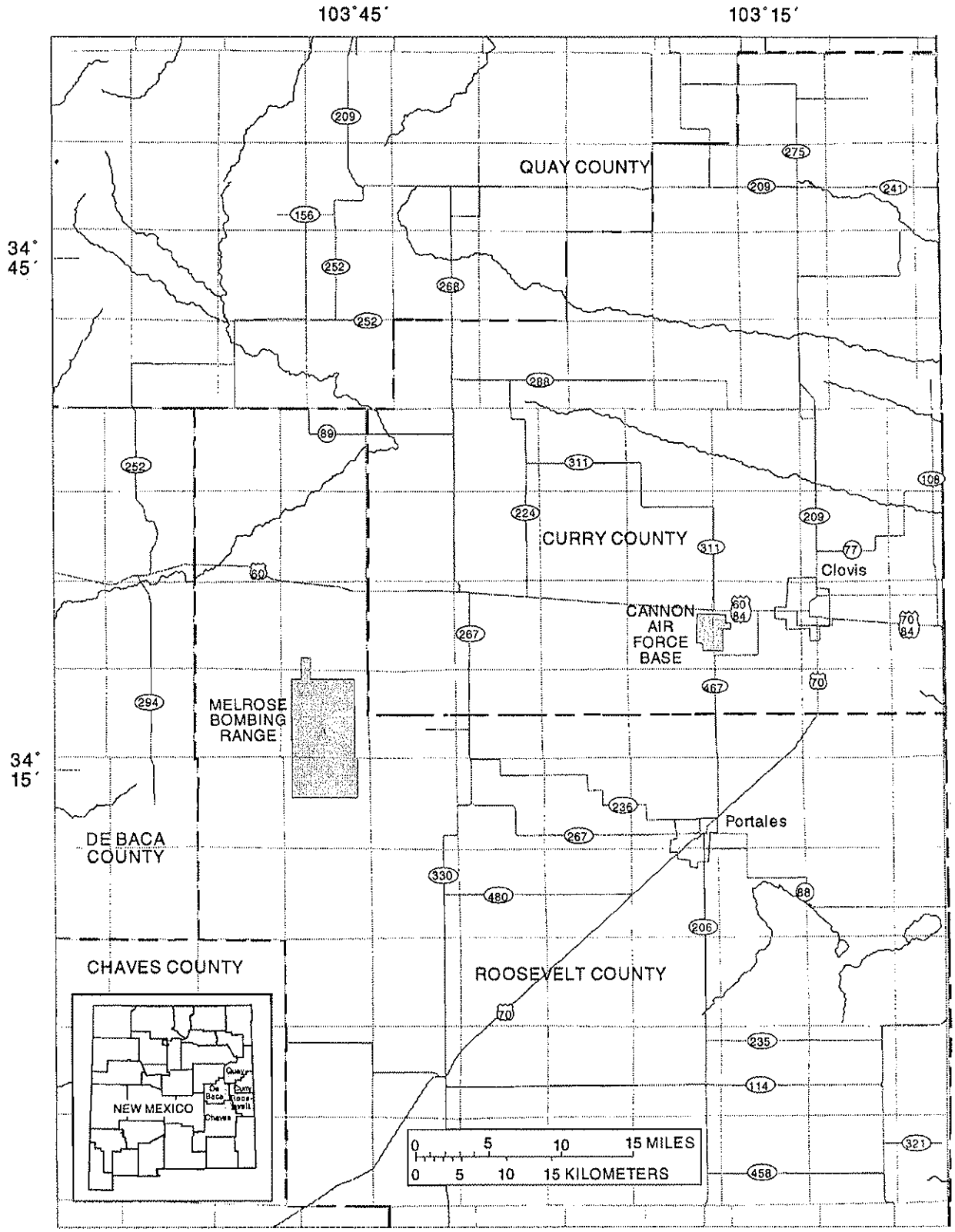


Figure 1.1--Location of Cannon Air Force Base and Melrose Bombing Range, New Mexico.

2.0 PROJECT SUMMARY

2.1 FIELD INVESTIGATION

On April 5, 1995 the U.S. Geological Survey, WRD began a subsurface investigation of eight Underground Storage Tank (UST) facilities, on Cannon Air Force Base (Fig. 2.1.1) and Melrose Bombing Range. After reviewing each individual UST site, and with the approval of Rick Chandler of the Cannon AFB Environmental Department, sampling locations and procedures were determined.

The initial investigation, consisted of the validation of original samples, collected during the excavation of the UST's (EXCEPTION: Facility 1400--CAFB Hospital, samples were collected with this tank in place). After the evaluation of these samples, if contamination levels were above reporting limits, additional soil borings and and sampling occured in an outward and downward direction from contaminated soil locations.

The procedure for evaluating samples were by utilizing field instruments and/or analyzed by an approved laboratory (Section 2.2).

FIELD INSTRUMENTS

(2) Photovac Gas Chromatograph (GC)
Model 10S50 Serial # 6180151
Model 10S50 Serial # 0471492/ 6071535
Standards for Gas Chromatograph (G.C. 2.1.1):
Benzene - Toluene - Xylene (BTX)
Diesel Fuel

Photovac - Microtip
Photoionization Detector
Model HL-2000 Serial # PA930103
Calibrated to 100 ppm Isobutylene

The initial equipment used to advance the soil borings on the UST facilities were a Model 8-MU GEOPROBE (hydraulic punch system). Brass sleeves were used for the collection of soil samples for field screening and lab analysis (Decontamination Procedure for Brass Sleeves 2.1.1).

Due to the lithology of the subsurface soil, larger drilling equipment was needed to investigate the extent of the contamination. A Mobile Drill B53 auger drilling rig and a Gardner-Denver 17W rotary drilling rig were used. A hollow stem auger retrofitted with a split-barrel sampling devise was used to collect soil for screening and sampling.

The 5-foot split-barrel sampling devise was decontaminated between sampling events to prevent cross contamination of samples.

Decontamination procedure for split-barrel:
Liquinox - Deionized Water - Methanol - Deionized Water

2.1.1 Decontamination Procedure for Geoprobe Brass Sleeves

RE: Cleaning and decontamination procedure for Geoprobe metal soil sampler liners.

The following procedures are used in the cleaning and decontamination of all brass and stainless steel liners used to retain samples in Geoprobe Systems Large Bore and Macro Core soil samplers. These procedures apply to liners with the following part numbers: AT-723, AT-666, and AT-667.

All liners are first washed in an agitated detergent bath at a temperature of approximately 180 degrees F.

After detergent wash, all liners are placed in mesh bottom trays and rinsed with hot high pressure tap water at a temperature of approximately 180 degrees F.

Following this rinse, the liners are allowed to air dry before being placed on a stainless steel arbor and clad with a heat shrinkable PVC outer wrap. Once removed from this arbor, the assembled liners are capped with vinyl end caps.

GEOPROBE SYSTEMS

Thomas M. Christy, P.E.
Vice President

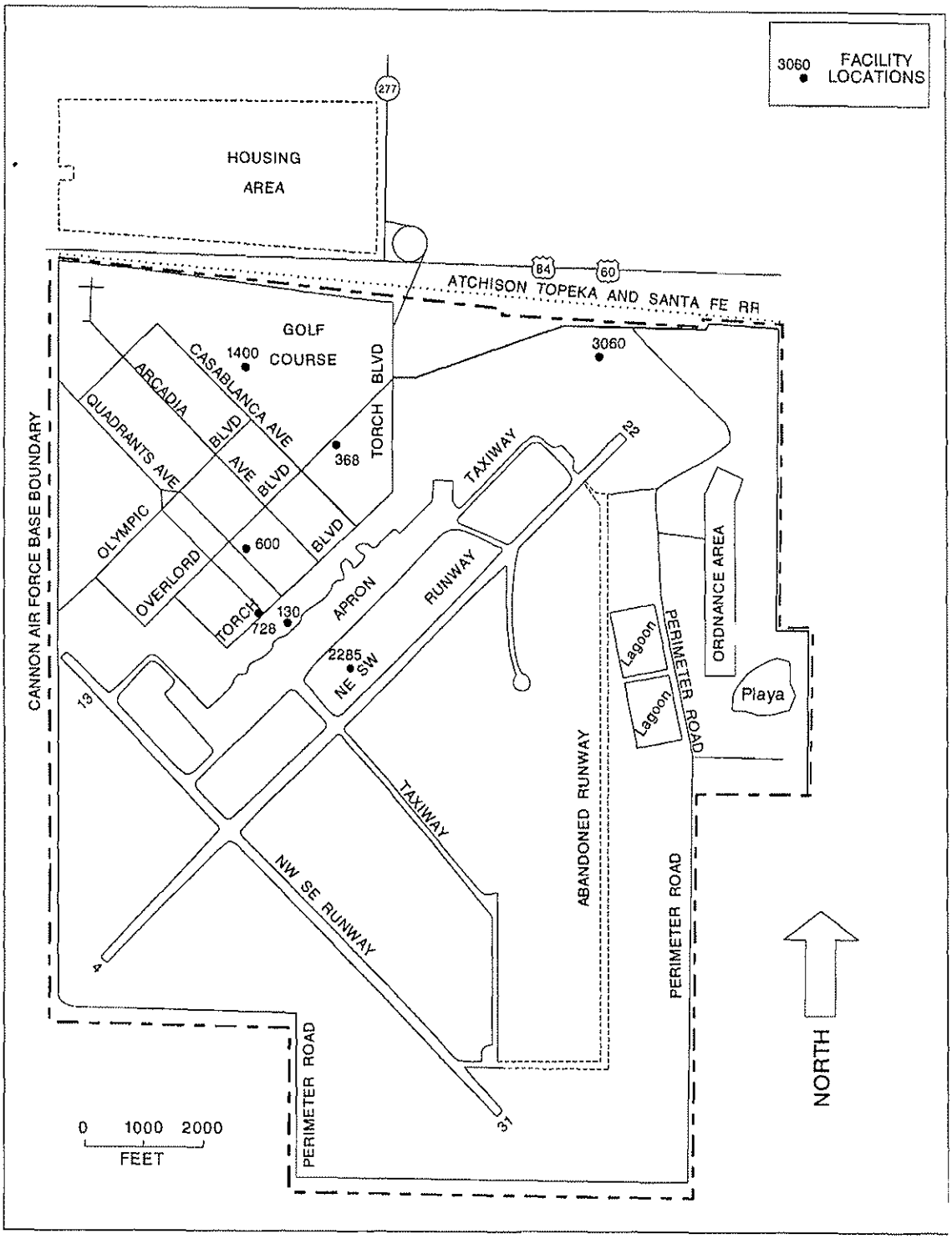
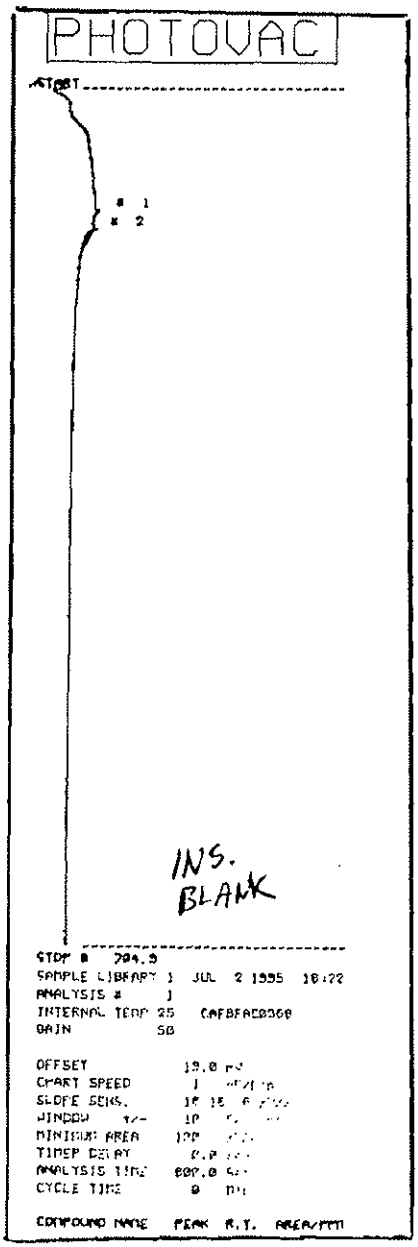
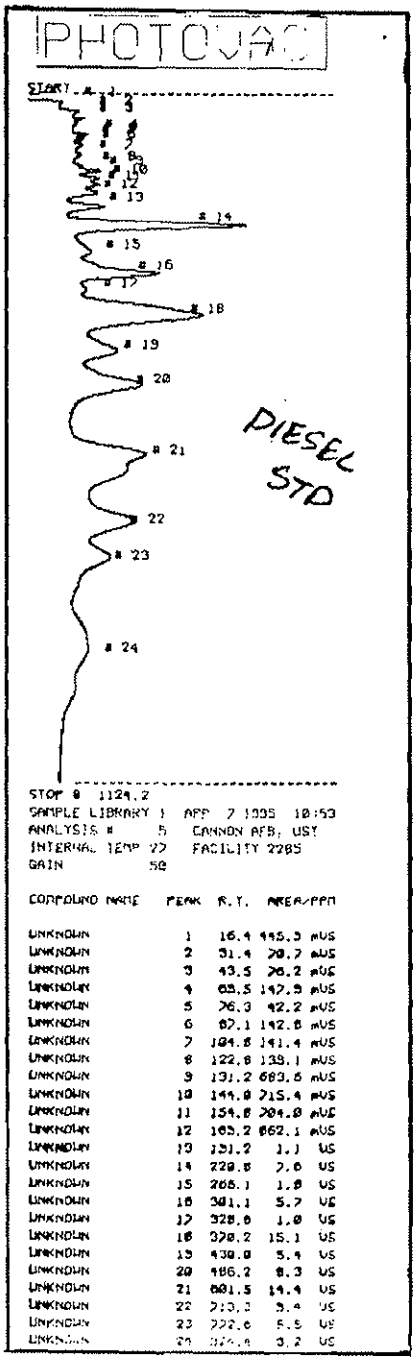


Figure 2.1.1--Location of underground storage tanks on Cannon Air Force Base.

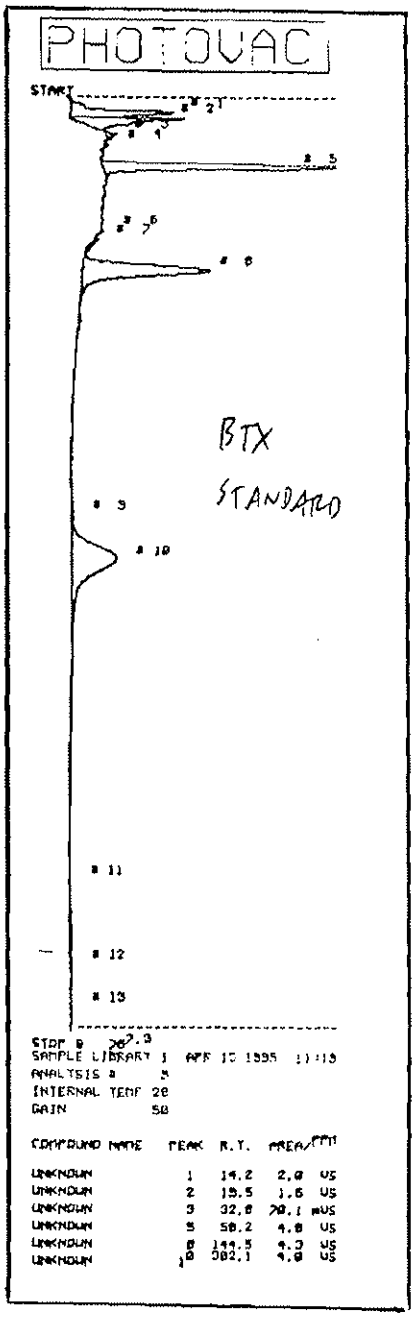
2.1.1 Gas Chromatograph Standards



Instrument Blank



Diesel Standard



BTX Standard
Benzene-Tolune-Xylene

2.2 LABORATORY ANALYSIS

At each Underground Storage Tank facility, soil samples were collected for field screening and/or lab anaylsis. Soil samples were tested for suspected contamination, specifically Petroleum Hydrocarbons. The method of anaylsis was Diesel Range Organics (DRO; modified method 8015), or Gasoline range Organics (GRO; modified method 8015). A complete description of the methods of analizing for Petroleum Hydrocarbons can be found in Section 2.2.2.

Soil samples for lab anaylsis were submitted to an accredited laboratory, Quanterra Environmental Services, Arvada, Colorado. Samples were recieved by the laboratory's Sample Control Group and were carefully checked for label identification, chain-of-custody, and any discrepencies. Each sample was then assigned a unique laboratory identification number through a computerized Laboratory Information Management System (LIMS), which stores all identifications and essential information. Access to the laboratory is restricted to prevent any unauthorized contact with samples, extracts or documentation.

Quality Assurance (QA) and Quality Control (QC) procedures were followed according to Environmental Protection Agency (EPA) and New Mexico Environmental Department (NMED).

2.2.1 SAMPLE IDENTIFICATION

Each soil sample collected was uniquely identified by both a field and a laboratory sample identification number. The field number is assigned by the Geological Survey sampling crew using a 16-character string of letters and numbers. For example, the field sample identification number CAFB-FAC1400-0102 signifies:

CAFB for Cannon Air Force Base
FAC1400 for facility number
01 for borehole number
02 for sample number

For laboratory number, Quanterra assignes a six-digit project number to each set of samples recieved in one day, and each sample was assigned a four-digit sample number in addition to the project number. For example, 043723-0002 is a unique sample number, where 043723 is the project number, 0002 is the sample number.

Quanterra
Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

Gasoline Range Organics (GRO; modified method 8015)

This is a purge and trap GC/FID method that measures the volatile hydrocarbons present in a sample. The carbon range covered is C6 to C10. Higher molecular weight hydrocarbons cannot be measured using this method because they are not sufficiently volatile to be recovered by purge and trap.

Diesel Range Organics (DRO; modified method 8015)

In this method, samples are extracted with methylene chloride and analyzed by GC/FID. Normally, the hydrocarbon range analyzed is from C10 to C28. However, this range can easily be expanded to meet specific project requirements. For example, the range can be expanded to C8 to C32 to provide data equivalent to the TCO method described below. Lower molecular weight hydrocarbons (less than C8) generally cannot be analyzed by this method since their volatility causes them to be lost during sample preparation.

Total Chromatographable Organics (TCO; modified method 8015)

The TCO method is a GC/FID method which was developed in the late 1980's and has since been replaced by other methods (e.g. GRO and DRO). This method is currently provided only by Quanterra's Denver lab and we are no longer recommending its use. The TCO method will continue to be offered when necessary for on-going projects. For new projects, and existing projects where a method change is acceptable, we recommend the use of the DRO method. Equivalent results to TCO can be obtained by adjusting the integration range for the DRO method to match the TCO range (C8 to C32). Since these methods are so similar, use of both TCO and DRO is redundant and unnecessarily increases the analytical costs.

Total Recoverable Petroleum Hydrocarbons (Method 418.1)

This is a general screening method that measures freon-extractable material. Certain non-petroleum compounds can cause "false" positive results. Low molecular weight hydrocarbons may be lost due to their volatility. High molecular weigh hydrocarbons may be incompletely recovered due to their limited solubility in freon. Furthermore, as you may know, the production of Freon is being phased out under the Clean Air Act Amendments of 1990. As a result of the phase-out, Freon costs are rising and availability is limited. At some point in the future, we will no longer be able to perform these methods for our clients. The EPA has proposed replacing these methods with a hexane extraction/ gravimetric procedure, with or without a silica gel clean-up. This method has not yet been finalized and we will continue to offer the Freon-based methods for as long as possible. We also hope to offer whatever replacement method(s) are developed by the EPA. However, when these methods are not required for regulatory reasons (e.g. NPDES), we are recommending that our clients switch to one of the GC/FID methods described above.

3.0 ENVIRONMENTAL SETTING

3.1 CLIMATE

The climate for the Underground Storage Tank (UST) subject areas are semiarid. Average annual rainfall recorded at Cannon AFB is 15.2 inches, most of which falls during the summer months as thundershowers. Monthly averages vary from 0.4 inches in the winter months to 2.5 and 2.7 inches in July and August, respectively. Maximum monthly rainfall is 11.4 inches in July and maximum daily rainfall is 4.8 inches. Annual snowfall for this region is 10 to 13 inches and the record snowfall is 19 inches.

Average monthly temperatures range from the mid-30's in January to the upper 70's in July. Occasional days of temperature more than 100 degrees occur in summer, the highest recorded temperature is 106 degrees. Minimum temperatures range from the low- 20's in January to the mid- 60's in July, the lowest recorded temperature is 11 degrees.

Winds in the area are often gusty and can average 19 miles per hour(mph) or greater. The prevailing surface wind direction is west. These west winds blow primarily from October to May. During the remainder of the year, winds tend to be from the south. Monthy wind averages range from 6 to 10 mph; the maximum recorded wind gust is 84 mph.

3.2 GEOGRAPHY

The majority of UST facilities on this project are located on Cannon Air Force Base, which is located on the U.S.G.S. Portair, New Mexico Quadrangle, 7.5 Minute Topographic Map. One facility is on Melrose Bombing Range located on U.S.G.S. Tolar S.E. New Mexico Quadrangle, 7.5 Minute Topographic Map.

Both Cannon AFB and Melrose Bombing Range are situated in the Southern High Plains Pysiographic Province. The region is essentially a plateau, bounded on the north by the Canadian River and on the east and west by prominent escarpments rising as much as 300 or more feet above the lower lands.

The surface of the plains is flat throughout much of the area and gently undulating in the remainder. An exception to the flat surface is the Portales Valley, which is the drainage for much of the area.

3.3 GEOLOGY

The UST facilities of this project, as previously stated are located in Curry and Roosevelt Counties of New Mexico. These two countiues lie within the region of the High Plains Aquifer, which is underlain by rocks of the late Tertiary or Quaternary age. The rocks of the late Tertiary age consist of the Ogallala Formation, and the Quaternary deposits consist of alluvial, dune sand, and valley-fill deposits. The Ogallala is the principal geologic unit in the majority of the subject area, however, the alluvial deposits are significant in the northern part of Roosevelt County.

The Ogallala Formation is mostly unconsolidated clay, silt, fine- to coarse- grained sand and gravel. Also, in the upper part of the Ogallala the sediments have been cemented, chiefly by calcium carbonate, forming single or multiple beds of caliche.

The unconsolidated Quaternary alluvial and valley-fill deposits, like the Ogallala Formation, consist of clay, silt, sand and gravel. These rocks primarily are derived from reworked Ogallala material.

3.4 SOILS

The soil on Cannon Air Force is characterized by the Amarillo Soils. Amarillo Soils have formed on medium texture to moderatly coarse textured calcareous materials, probably alluvium reworked by wind. These soils have well developed profiles.

The Amarillo series is represented in Curry County by three soil types. Amarillo Loam, Amarillo fine sandy loam and Amarillo loamy fine sand.

The soil at the UST facilities on Cannon AFB are generally classified as Amarillo fine sandy loam, these soils have a moderate to rapid permeability.

The soils on Melrose Bombing Range are generally of the Amarillo-Clovis loams and Amarrillo-Clovis fine sandy loams association. However, the soil at the UST Facility 3121 can further be subdivided into either Amarillo Loam and/or Olton Loam.

3.4.1 Soil Boring Desription

A general description of the subsurface soil (0-20 feet) on Cannon AFB is described as follows:

0-3 feet	moderate brown sandy silt, very fined grained (vfg) - fine grained (fg) root zone.
3-6 feet	light brown-pinkish gray caliche cemented sand, vfg.
6-12 feet	light brown sand mixed with pinkish gray cemented sand, vfg-fg.
12-20 feet	reddish-brown sandy silt, vfg-fg, with pinkish gray caliche nodules throughout the interval.

3.5 SURFACE WATER

Surface water is not located on or adjacent to any of the UST facilities, however, a man-made lake is situated within the golf course located several hundred yards to the north of Facility 368 (Old Gas Station) and northeast of Facility 1400(Hospital).

There is no natural occuring perennial surface water in the area. However, during intense periods of precipitation, water flows in the normally dry stream channels and overland. Ephemeral lakes form in playa basins after a heavy event of precipitation.

3.6 GROUNDWATER

The majority of the subject areas are located on Cannon Air Force Base. The Base is situated in the Southern High Plains Pysiographic Province. The aquifer underlying the Base is the Ogallala Formation, which is easterly dipping and thickening aquifer having its western edge and recharge area about 40 miles west of the Base. Recharge also occurs from precipitation infiltrating into the ground over the whole area. Depth to water on the Base is approximatly 280 feet below land surface, with the general direction of the ground water flow towards the southeast.

One UST facility is located on Melrose Bombing Range. Underlying the Range is Quaternary alluvium of the Portales Valley which is considered the southwestern edge of the Ogallala Formation. Groundwater in the Ogallala is unconfined and contained in the pore spaces of the uncolidated or partially consolidated sediments. The saturated thickness of Ogallala material is estimated to be less than 100 feet on the Range due to its proximity to the western edge of the aquifer.

Depth to water varies from 41 feet below land surface along the Canada del Tule on the southeast corner of the Range to 128 feet along the east-central Range boundary. Groundwater on the Range flows in a northeasterly direction toward the Portales Valley.

4.0 SITE SPECIFIC DATA

4.1 FACILITY 728

4.1.1 Site Description

The Underground Storage Tank (UST) at Facility 728 had a capacity of 1000 gallons and contained diesel fuel, required for an emergency generator at the Rapcon Building on Cannon Air Force Base (Fig. 2.1.1). The tank was constructed of steel and the base of tank was approximately nine feet below land surface.

In September and October 1994 a private contractor collected five soil samples during the excavation of the UST. The samples were taken at the center and at each of the four corners of the excavated area, and at least two feet below the base of the tank. One sample collected during the excavation had above reporting limits of "Total Petroleum Hydrocarbons (TPH)" concentrations. The sample taken at the west end of tank had a concentration of 577 ppm TPH.

4.1.2 U.S. Geological Survey Investigation

On April 6, 1995 with the use of a Geoprobe, five boreholes were advanced, collecting eleven environmental samples, ranging in depth from 4 to 21 feet (Fig. 4.1.1 and Table 4.1.1). The purpose of these samples was to validate the results from soil samples taken during the removal of the tank.

The results from field screening indicated no contamination (Gas Chromatograms 4.1.1), and lab anaylsis (DRO method) confirmed that concentrations were below reporting limits (Table 4.1.1).

4.1.3 Recommendations

No further investigation should be required for this facility.

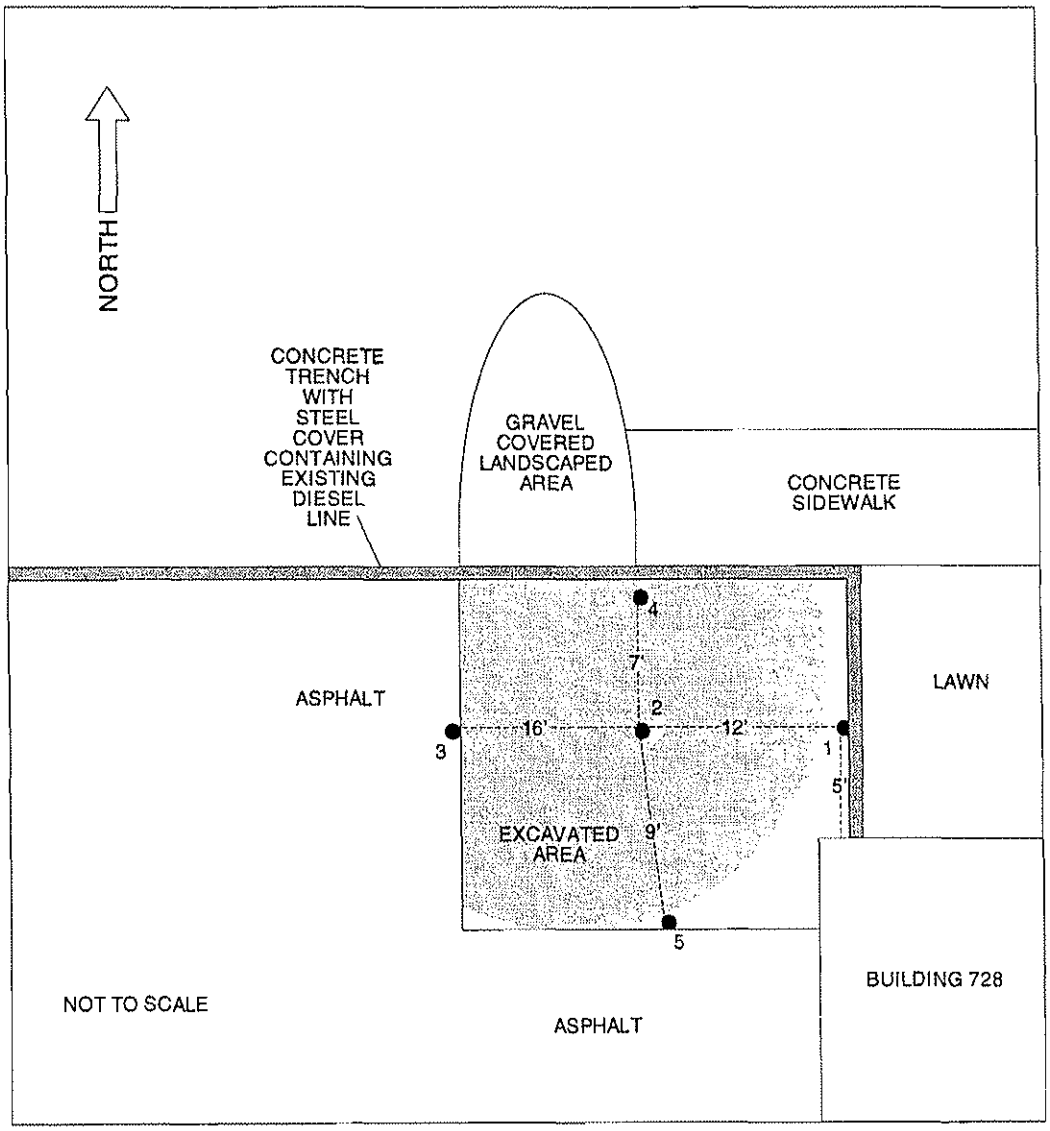


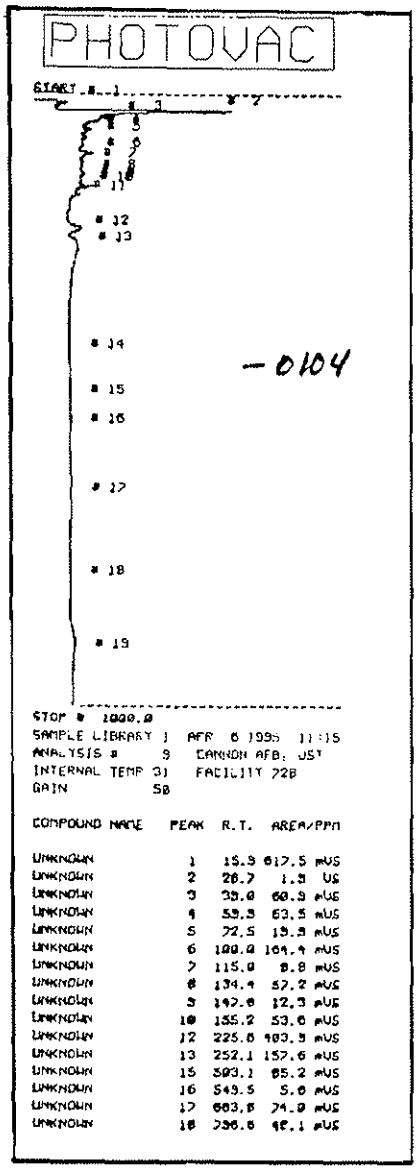
Figure 4.1.1--Location of boreholes at Facility 728 (Rapcon Building).

Facility 728 (RAPCON BUILDING)

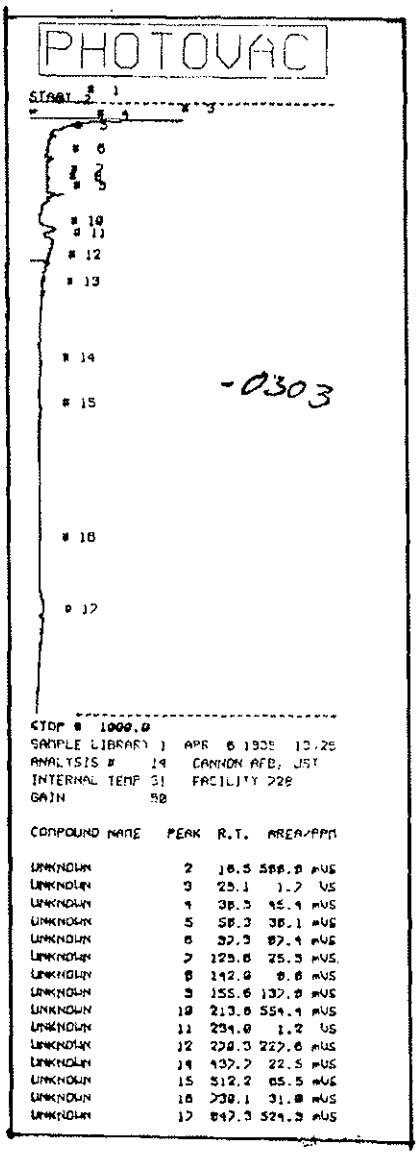
Table 1.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 728 , Cannon Air Force Base, New Mexico. [DRO,Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C12-C24 (for detail, see project 041427 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved]

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC0728-0101	4.5-6.5	06APR95	Soil	Environmental	8.3 ql	4.0
CAFB-FAC0728-0102	9.0-11.0	06APR95	Soil	Environmental	6.2 ql	4.0
CAFB-FAC0728-0103	14.0-16.0	06APR95	Soil	Environmental	5.9 ql	4.0
CAFB-FAC0728-0104	19.0-21.0	06APR95	Soil	Environmental	5.5 ql	4.0
CAFB-FAC0728-0201	13.0-15.0	06APR95	Soil	Environmental	4.9 ql	4.0
CAFB-FAC0728-0301	4.0-6.0	06APR95	Soil	Environmental	4.6 ql	4.0
CAFB-FAC0728-0302	9.0-11.0	06APR95	Soil	Environmental	ND	4.0
CAFB-FAC0728-0303	14.0-16.0	06APR95	Soil	Environmental	12.0 ql	4.0
CAFB-FAC0728-0401	13.0-15.0	06APR95	Soil	Environmental	5.7 ql	4.0
CAFB-FAC0728-0501	4.0-6.0	06APR95	Soil	Environmental	4.5 ql	4.0
CAFB-FAC0728-0502	4.0-6.0	06APR95	Soil	Duplicate	7.7 ql	4.0
CAFB-FAC0728-0503		06APR95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC0728-0504	9.0-11.0	06APR95	Soil	Environmental	3.9 j	4.0
CAFB-FAC0728-0505	14.0-16.0	06APR95	Soil	Environmental	5.8 ql	4.0

4.1.1 Gas Chromatograms -- Facility 728



CAFB-FAC0728-0104



CAFB-FAC0728-0303

4.2 FACILITY 2285

4.2.1 Site Description

The Underground Storage Tank (UST) at Facility 2285 had a capacity of 500 gallons and contained diesel fuel, required for an emergency generator located adjacent to the runway on Cannon AFB (Fig. 2.1.1). The tank was constructed of steel and the base of tank was approximately nine feet below land surface..

A private contractor in January 1995 collected four soil samples during the excavation of the UST. They were taken at each of the four corners of the excavated area, and two feet below the base of the tank. All samples collected during the excavation had above reporting limits of "Total Recoverable Petroleum Hydrocarbons (TRPH)" concentrations. The TRPH concentrations ranged from 271 to 1,040 ppm.

4.2.2 USGS Investigation

On April 7, 1995 with the use of a Geoprobe, five boreholes were advanced, collecting nine environmental samples, ranging in depth from 9 to 16 feet (Fig. 4.2.1 and Table 4.2.1). The purpose of these samples was to validate the results from soil samples taken during the removal of the tank.

The results from field screening indicated only low concentrations of contamination (G.C. 4.2.1), and the lab anaylsis (DRO method) confirmed that concentrations were below reporting limits (Table 4.2.1).

4.2.3 Recommendations

No further investigation should be required for this faciity

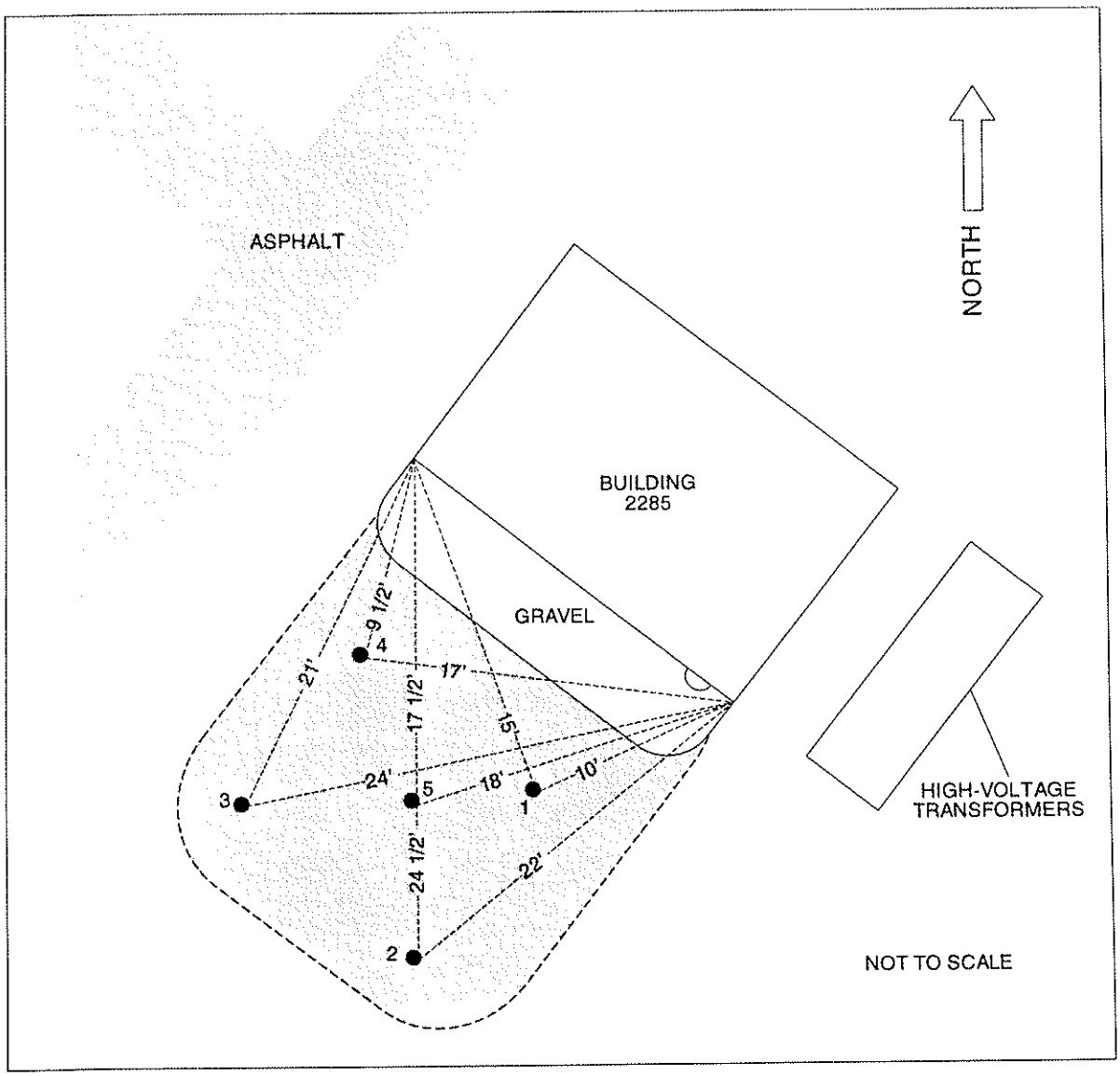


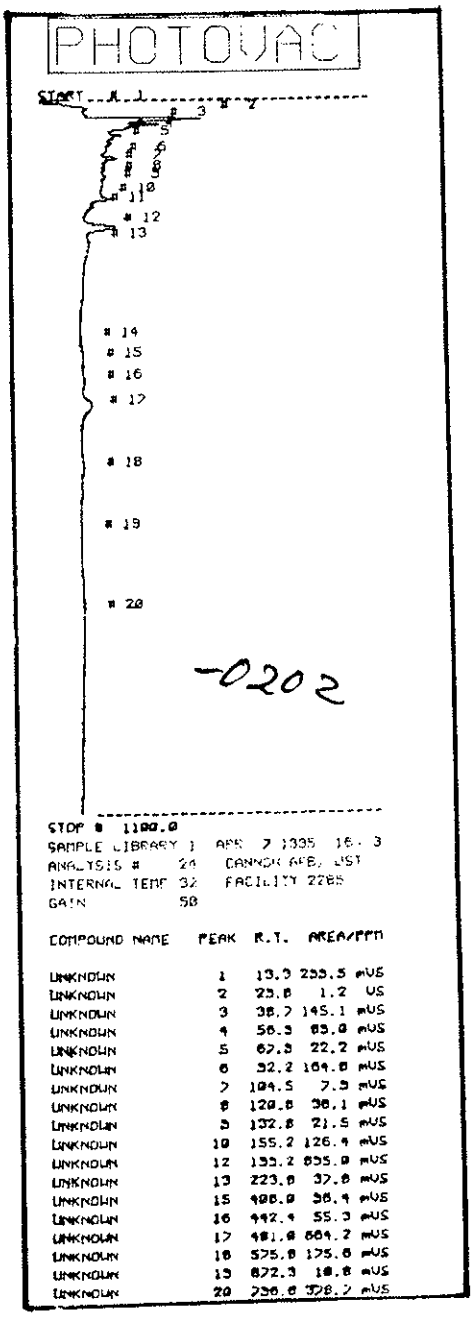
Figure 4.2.1--Location of boreholes at Facility 2285 (runway).

FACILITY 2285 (RUNWAY)

Table 2.--Summary of analytical data results in soil samples from underground tank site Facility 2285, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C26 (for detail, see project 041449 in Appendix); q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.]

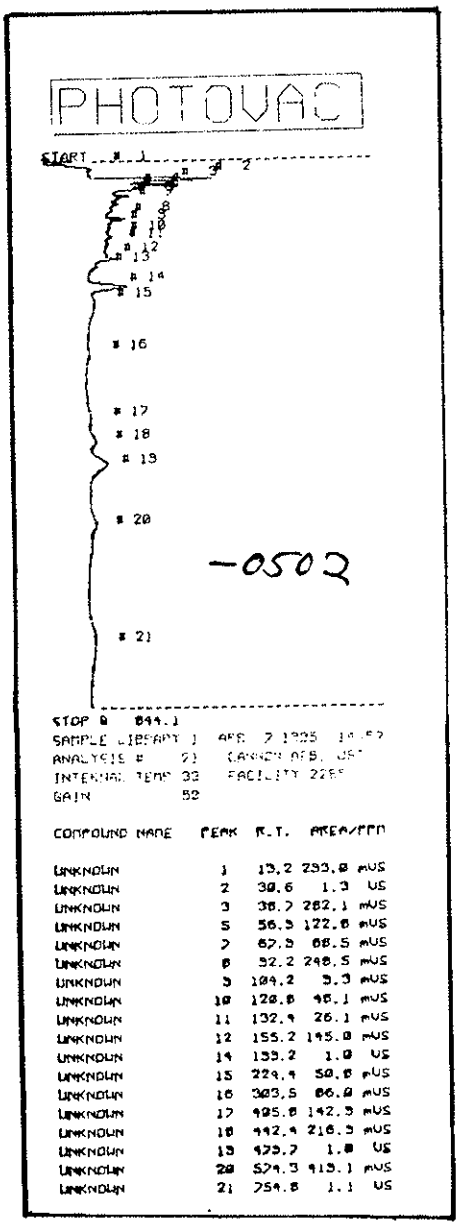
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg	Reporting Limit
CAFB-FAC2285-0101	9.0-11.0	07APR95	Soil	Environmental	20.0 ql	4.0
CAFB-FAC2285-0102	14.0-16.0	07APR95	Soil	Environmental	24.0 ql	4.0
CAFB-FAC2285-0201	9.0-11.0	07APR95	Soil	Environmental	3.2 j	4.0
CAFB-FAC2285-0202	14.0-16.0	07APR95	Soil	Environmental	3.0 j	4.0
CAFB-FAC2285-0301	9.0-11.0	07APR95	Soil	Environmental	3.2 j	4.0
CAFB-FAC2285-0401	9.0-11.0	07APR95	Soil	Environmental	5.3 ql	4.0
CAFB-FAC2285-0402	13.0-15.0	07APR95	Soil	Environmental	13.0 ql	4.0
CAFB-FAC2285-0501	9.0-11.0	07APR95	Soil	Environmental	6.6 ql	4.0
CAFB-FAC2285-0502	14.0-16.0	07APR95	Soil	Environmental	8.2 ql	4.0

4.2.1 Gas Chromatograms -- Facility 2285



COMPOUND NAME	PEAK	R.T.	AREA/FFD	
UNKNOWN	1	13.9	233.5	mVS
UNKNOWN	2	23.8	1.2	VS
UNKNOWN	3	38.7	145.1	mVS
UNKNOWN	4	56.3	83.0	mVS
UNKNOWN	5	67.3	22.2	mVS
UNKNOWN	6	92.2	164.8	mVS
UNKNOWN	7	104.5	7.3	mVS
UNKNOWN	8	120.8	38.1	mVS
UNKNOWN	9	132.8	21.5	mVS
UNKNOWN	10	155.2	126.4	mVS
UNKNOWN	12	155.2	855.0	mVS
UNKNOWN	13	223.8	37.8	mVS
UNKNOWN	15	408.0	38.4	mVS
UNKNOWN	16	442.4	55.3	mVS
UNKNOWN	17	481.8	864.2	mVS
UNKNOWN	18	575.8	175.6	mVS
UNKNOWN	19	872.3	18.8	mVS
UNKNOWN	20	756.8	328.2	mVS

CAFB-FAC2285-0202



COMPOUND NAME	PEAK	R.T.	AREA/FFD	
UNKNOWN	1	13.2	233.8	mVS
UNKNOWN	2	30.6	1.3	VS
UNKNOWN	3	38.7	282.1	mVS
UNKNOWN	5	56.3	122.6	mVS
UNKNOWN	7	67.3	68.5	mVS
UNKNOWN	8	92.2	248.5	mVS
UNKNOWN	9	104.2	9.3	mVS
UNKNOWN	10	120.8	45.1	mVS
UNKNOWN	11	132.4	26.1	mVS
UNKNOWN	12	155.2	145.8	mVS
UNKNOWN	14	155.2	1.0	VS
UNKNOWN	15	229.4	50.6	mVS
UNKNOWN	16	303.5	86.0	mVS
UNKNOWN	17	425.8	142.3	mVS
UNKNOWN	18	442.4	216.3	mVS
UNKNOWN	19	479.7	1.8	VS
UNKNOWN	20	574.3	415.1	mVS
UNKNOWN	21	754.8	1.1	VS

CAFB-FAC2285-0502

4.3 FACILITY 130

4.3.1 Site Description

The Underground Storage Tank (UST) at Facility 130 had a capacity of 500 gallons and contained diesel fuel, required for an emergency generator at the Fire Department on Cannon AFB (Fig. 2.1.1). The tank was constructed of steel and the base of tank was approximately nine feet below land surface.

A private contractor in January 1995 collected four soil samples during the excavation of the UST. They were taken at the four corners of the excavated area, and below the base of the tank. One sample collected during the excavation had above reporting limits of "Total Recoverable Petroleum Hydrocarbon (TRPHC)" concentration. The sample collected at the southwest corner of tank had a concentration of 153.5 ppm TRPHC.

4.3.2 USGS Investigation

On April 8, 1995 with the use of a Geoprobe, five boreholes were advanced, collecting twelve environmental samples, ranging in depth from 9 to 21 feet (Fig. 4.3.1 and Table 4.3.1). The purpose of these samples was to validate the results from the soil sample collected during the removal of the tank.

The results from the field screening indicated only low concentrations of contamination (G.C. 4.3.1) and the lab anaylsis (DRO method) confirmed that concentrations were below reporting limits (Table 4.3.1).

4.3.3 Recommendations

No further investigation should be required for this facility.

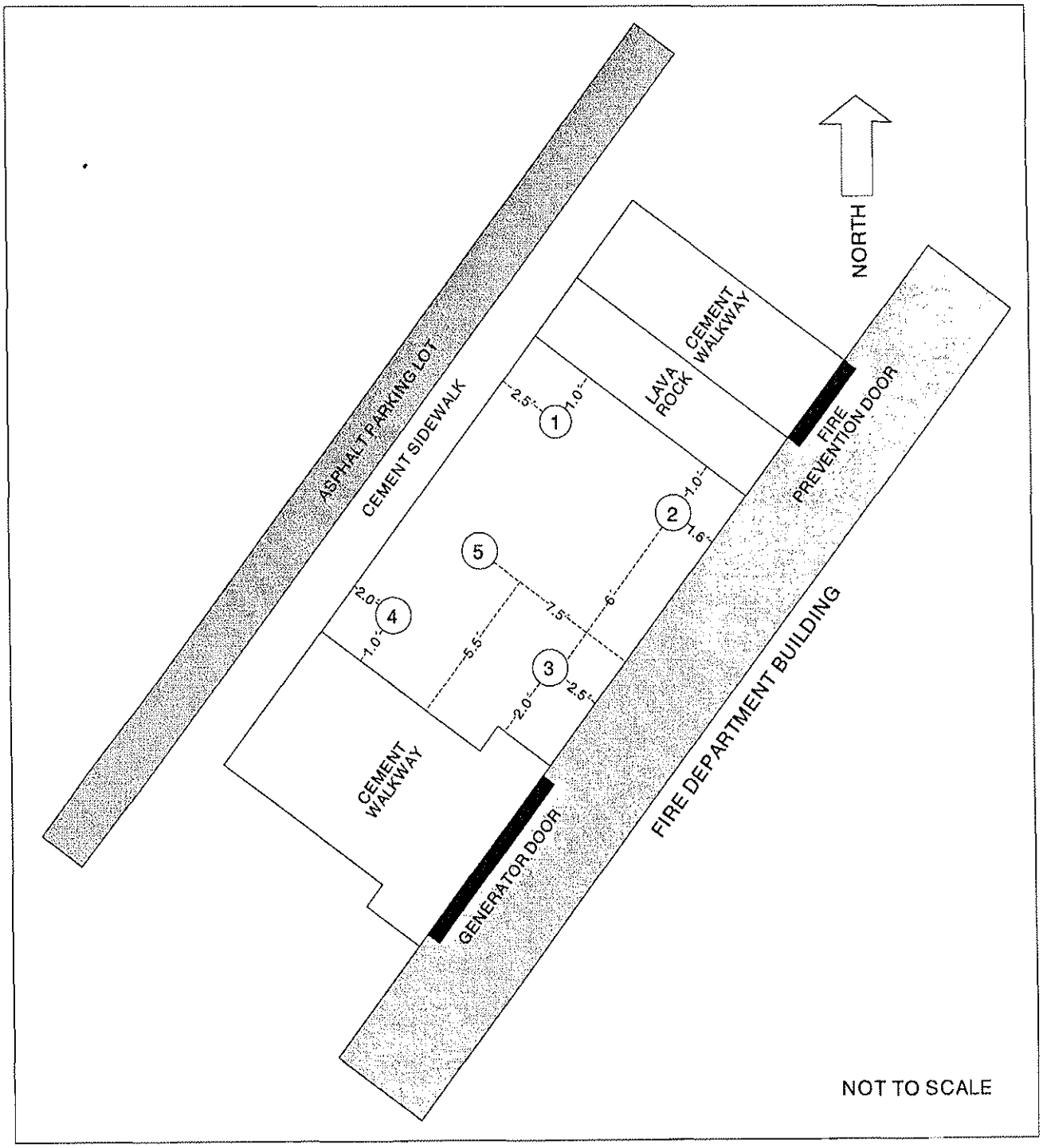


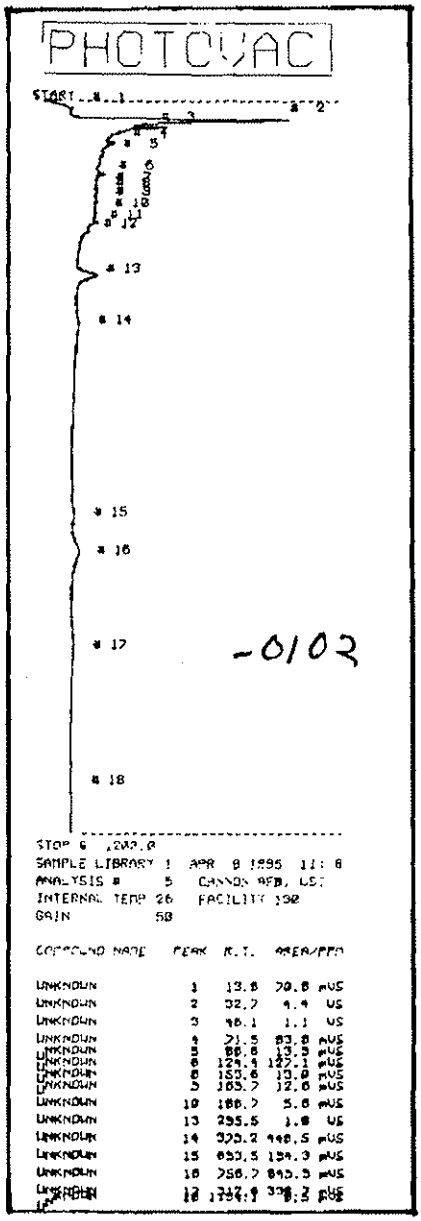
Figure 4.3.1--Location of boreholes at Facility 130 (Fire Department).

FACILITY 130 (FIRE DEPARTMENT)

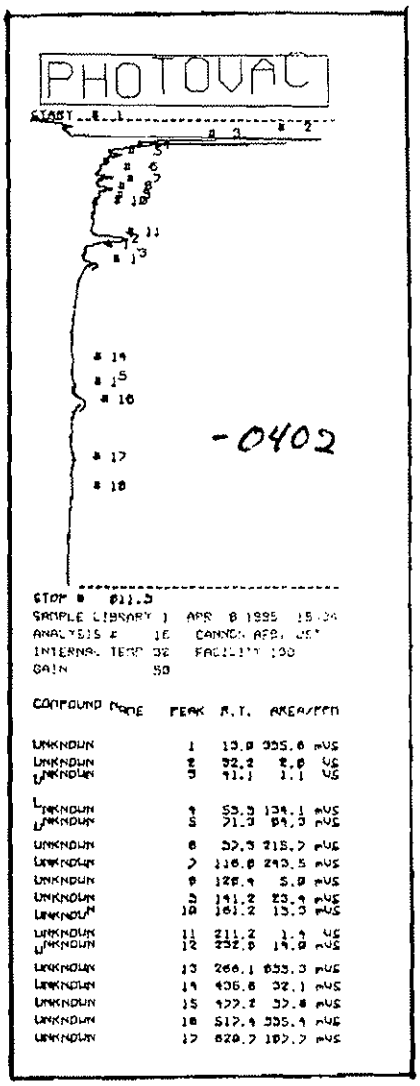
Table 3.--Summary of analytical data results in soil samples from underground tank site Facility 130, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample contains a single peak C16 or C24 (for detail, see project 041450 in Appendix) ; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; *, Field G.C. slight peak reading.]

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg	Reporting Limit
CAFB-FAC0130-0101	9.0-11.0	08APR95	Soil	Environmental	2.6 j	4.0
CAFB-FAC0130-0102	14.0-16.0	08APR95	Soil	Environmental	5.0 ql	4.0
CAFB-FAC0130-0201	9.0-11.0	08APR95	Soil	Environmental	2.2 j	4.0
CAFB-FAC0130-0202	14.0-16.0	08APR95	Soil	Environmental (Field screening only)	Positive *	
CAFB-FAC0130-0203	19.0-21.0	08APR95	Soil	Environmental	8.8 ql	4.0
CAFB-FAC0130-0301	9.0-11.0	08APR95	Soil	Environmental	4.1 ql	4.0
CAFB-FAC0130-0302	14.0-16.0	08APR95	Soil	Environmental	5.5 ql	4.0
CAFB-FAC0130-0401	9.0-11.0	08APR95	Soil	Environmental	6.0 ql	4.0
CAFB-FAC0130-0402	14.0-16.0	08APR95	Soil	Environmental	6.9 ql	4.0
CAFB-FAC0130-0501	9.0-11.0	08APR95	Soil	Environmental	3.5 j	4.0
CAFB-FAC0130-0502	14.0-16.0	08APR95	Soil	Environmental	4.4 ql	4.0
CAFB-FAC0130-0503	19.0-21.0	08APR95	Soil	Environmental	3.2 j	4.0

4.3.1 Gas Chromatograms -- Facility 130



CAFB-FAC0130-0102



CAFB-FAC0130-0402

4.4 FACILITY 600

4.4.1 Site Description

The Underground Storage Tank (UST) at Facility 600 had a capacity of 500 gallons and contained diesel fuel, required for an emergency generator at the Base Support Center/ Operation Group Building on Cannon AFB (Fig. 2.1.1). The tank was constructed of steel and the base of tank was approximately seven feet below land surface.

In October 1994 during the excavation of the UST, four soil samples were taken at a depth two feet below the tank bottom. Three soil samples, had concentrations above the reporting limits. Sample results indicated 3,940 ppm, 6,760 ppm, and 18,100 ppm "Total Petroleum Hydrocarbon (TPH)" concentrations.

Upon receipt of the original sample results, the contractor removed an additional two feet of soil and took two samples at a depth of four feet below the tank bottom. Both soil samples had high TPH concentrations. The sample collected at the north end of the excavation had a concentration of 705 ppm TPH, and on the south end had a concentration of 1,369 ppm TPH.

4.4.2 USGS Investigation

On April 9, 1995 with the use of a Geoprobe, five boreholes were advanced, collecting fifteen environmental samples, ranging in depth from 10 to 21 feet (Fig. 4.4.1 and Table 4.4.1). The purpose of these samples was to validate the results from the second set of the original soil samples collected after the tank excavation.

The results from the field screening indicated high concentrations of contamination (G.C. 4.4.1) and the lab anaylsis (DRO method) confirmed that concentrations were above reporting limits in two of the boreholes (Table 4.4.1).

The assessment of the results from this first series of samples identified the vertical extent of the contamination, however additional sampling was needed to determine the extent of the lateral migration. On July 27 the Geoprobe was used to investigate lateral migration inside the excavated area, and on August 23 a Mobile Drill B53 auger rig was utilized to determine if the contamination had migrated outside the excavation (Fig. 4.4.1 and Table 4.4.1).

A comprehensive site assessment determined that the contamination's lateral migration has been confined inside the excavated area, and the extent of it's vertical migration will not impact the groundwater.

4.4.3 Recommendations

Remedial method for this facility should be Natural Attenuation/ Assimilation. However, the New Mexico Environmental Department's Underground Storage Tank Regulations, Section 1209 -- Treatment of Highly Contaminated Soils, suggest that a Corrective Action System should be implemented, specifically soil excavation and/ or enhanced soil venting.

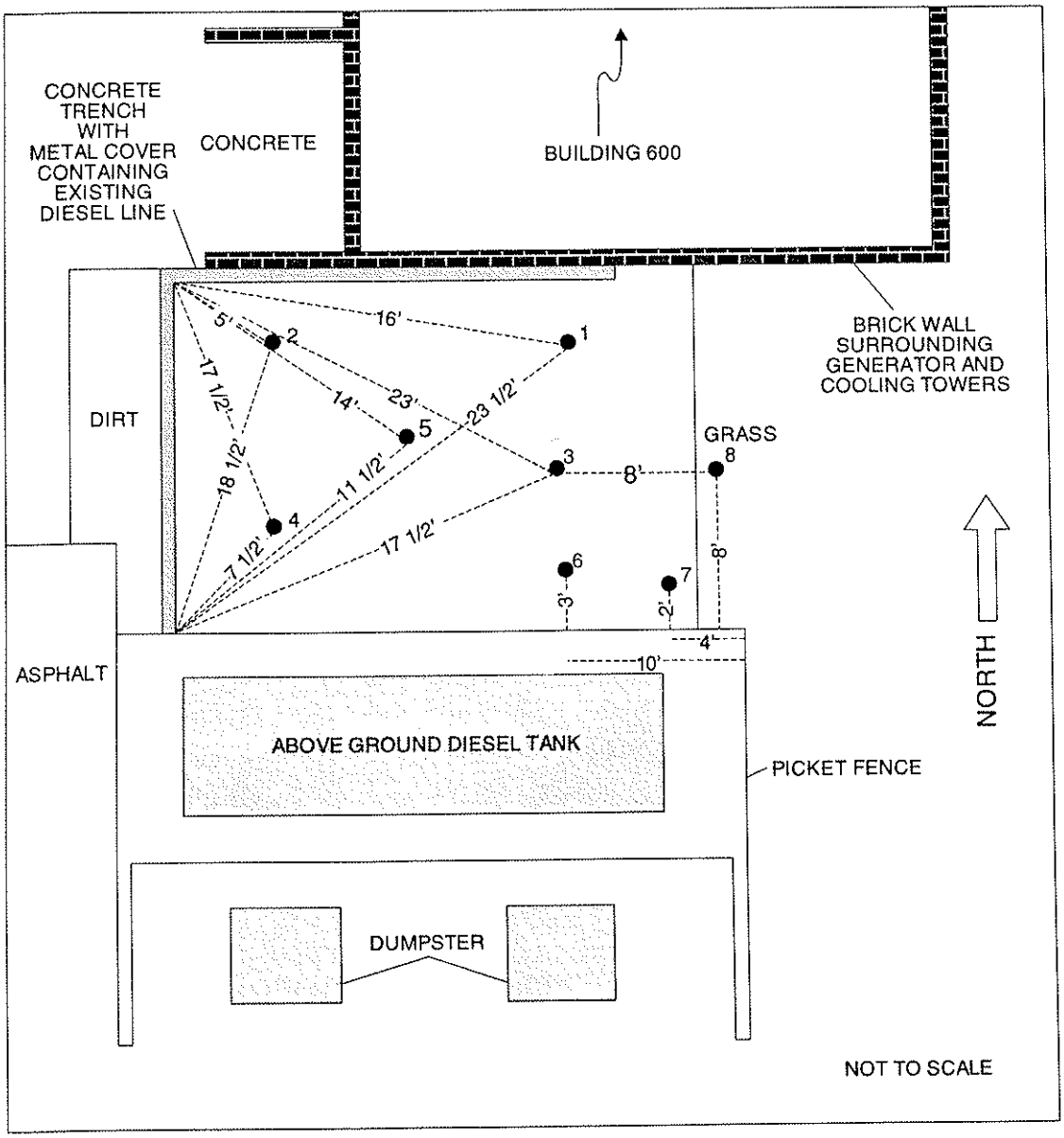


Figure 4.4.1--Location of boreholes at Facility 600 (Base Support Center/Operation Group).

FACILITY 600 (BASE SUPPORT CENTER / OPERATION GROUP)

Table 4.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 600, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28. This sample has GC/FID characteristics that are similar to Fuel Oil #2 (for detail, see projects 041450, 043171, and 044268 in Appendix); q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]

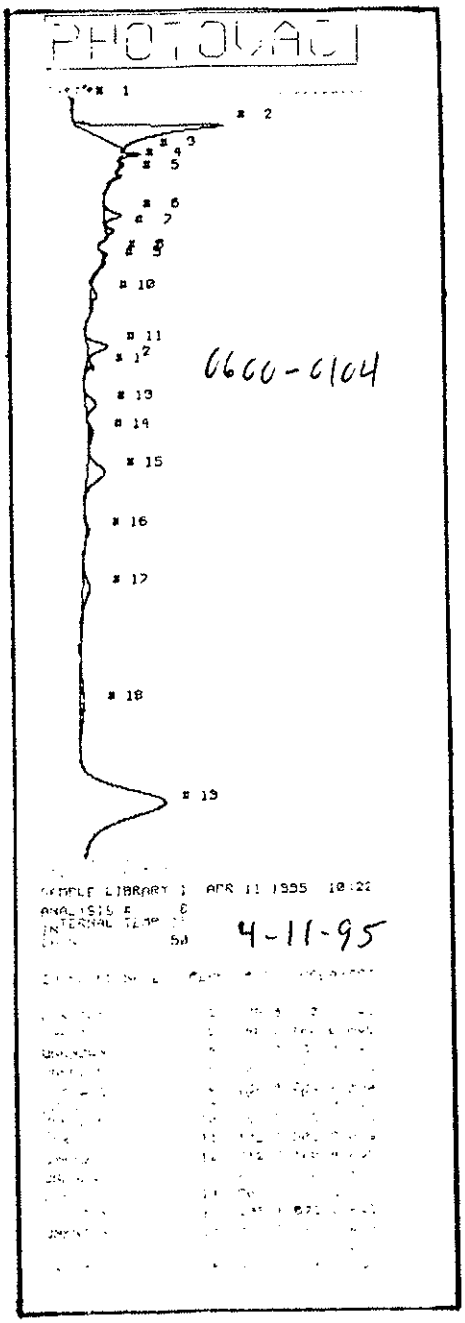
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC0600-0101	10.0-12.0	09APR95	Soil	Environmental	2.4 j	4.0
CAFB-FAC0600-0102	10.0-12.0	09APR95	Soil	Duplicate	2.5 j	4.0
CAFB-FAC0600-0103	14.0-16.0	09APR95	Soil	Environmental	ND	4.0
CAFB-FAC0600-0104	19.0-21.0	09APR95	Soil	Environmental	2.6 j	4.0
CAFB-FAC0600-0201	10.0-12.0	09APR95	Soil	Environmental	2.6 j	4.0
CAFB-FAC0600-0202	14.0-16.0	09APR95	Soil	Environmental	ND	4.0
CAFB-FAC0600-0203	19.0-21.0	09APR95	Soil	Environmental	3.1 j	4.0
CAFB-FAC0600-0301	10.0-12.0	09APR95	Soil	Environmental	2,800.0 lt	400.0
CAFB-FAC0600-0302	14.0-16.0	09APR95	Soil	Environmental	3,500.0 lt	400.0
CAFB-FAC0600-0303		09APR95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC0600-0304	19.0-21.0	09APR95	Soil	Environmental	7.8 ql	4.0
CAFB-FAC0600-0401	10.0-12.0	09APR95	Soil	Environmental	4.1 ql	4.0

FACILITY 600 (BASE SUPPORT CENTER / OPERATION GROUP)

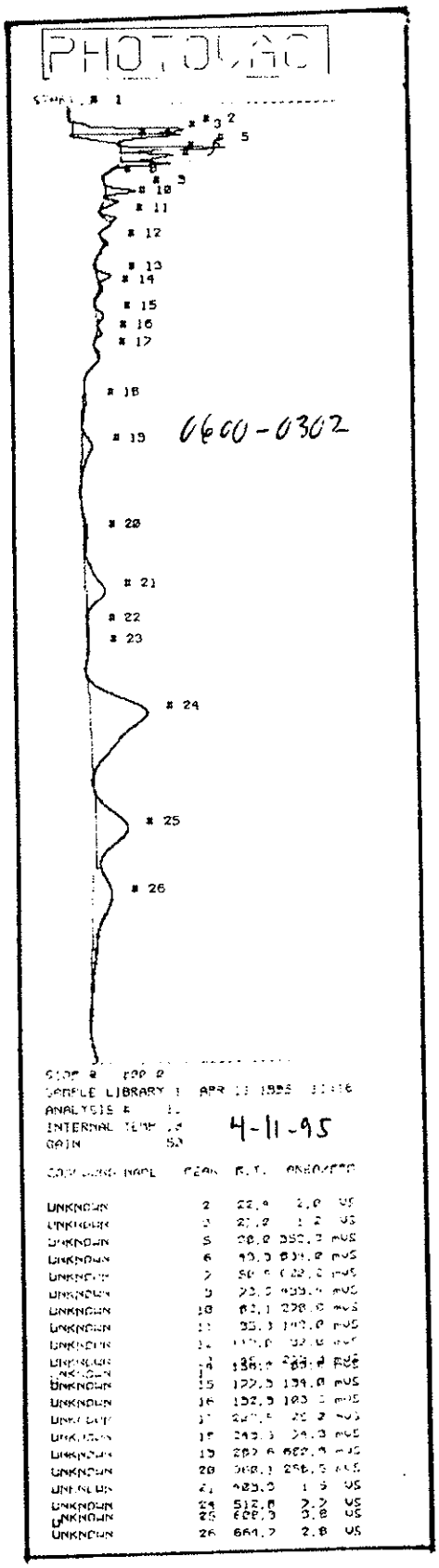
Table 4.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 600, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28. This sample has GC/FID characteristics that are similar to Fuel Oil #2 (for detail, see projects 041450, 043171, and 044268 in Appendix); q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC0600-0402	14.0-16.0	09APR95	Soil	Environmental	2.9 j	4.0
CAFB-FAC0600-0403	18.0-20.0	09APR95	Soil	Environmental	3.8 j	4.0
CAFB-FAC0600-0501	10.0-12.0	09APR95	Soil	Environmental	820.0 qlt	80.0
CAFB-FAC0600-0502	14.0-16.0	09APR95	Soil	Environmental	14.0 ql	4.0
CAFB-FAC0600-0503	19.0-21.0	09APR95	Soil	Environmental	7.6 ql	4.0
CAFB-FAC0600-0601	14.0-16.0	27JUN95	Soil	Environmental	13.0 ql	4.0
CAFB-FAC0600-0602	19.0-21.0	27JUN95	Soil	Environmental	6.5 ql	4.0
CAFB-FAC0600-0701	14.0-16.0	27JUN95	Soil	Environmental	18.0 ql	4.0
CAFB-FAC0600-0702	19.0-21.0	27JUN95	Soil	Environmental	7.4 ql	4.0
CAFB-FAC0600-0801		23AUG95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC0600-0802	15.0-16.0	23AUG95	Soil	Environmental	ND	4.0

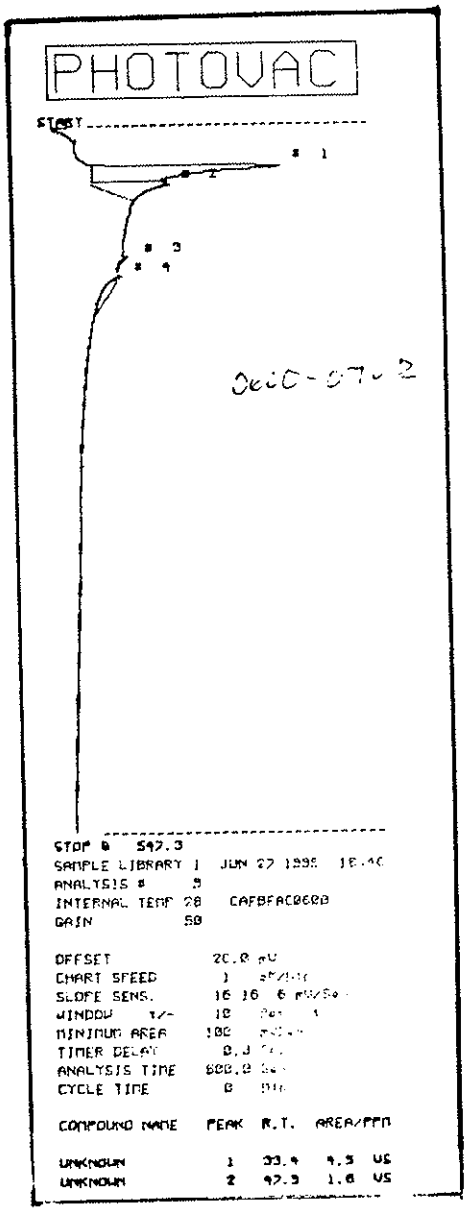
4.4.1 Gas Chromatograms -- Facility 600



CAFB-FAC0600-0104



CAFB-FAC0600-0302



CAFB-FAC0600-0702

4.5 FACILITY 3060

4.5.1 Site Description

There were two 500 gallon Underground Storage Tanks (UST's), containing diesel fuel at Facility 3060. This fuel was required for an emergency generator, which is inside a shed located southeast of the Environmental Management Building on Cannon AFB (Fig 2.1.1). The tanks were constructed of fiberglass and the base of the tanks were approximately nine feet below land suface.

In December 1994 and January 1995 a private contractor collected eight soil samples during the excavation of the two USTs. The samples were taken at the four corners of each tank, and two feet below the base of the tanks. It is assumed from information provided by Cannon AFB Environmental Management that the western tank was Tank 1(A) and eastern tank was Tank 2(B). The results from the soil samples indicates that Tank 1 samples were all below reporting limits. However, Tank 2 samples were all above reporting limits of "Total Recoverable Petroleum Hydrocarbons (TRPHC) concentrations. The TRPHC concentrations ranged from 118.9 ppm to 1,782 ppm.

4.5.2 USGS Investigation

On April 11, 1995 with the use of a Geoprobe, seven boreholes were advanced, collecting nine environmental samples, ranging in depth from 9 to 16 feet (Fig. 4.5.1 and Table 4.5.1). The purpose of these samples were to validate the results from soil samples taken during the removal of Tank 2.

The results from the field screening indicated only a low concentrations of contamination (G.C. 4.5.1), however, lab anaylsis (DRO method) confirmed that high levels of contamination existed in two of the boreholes (Table 4.5.1).

The investigation with the Geoprobe resumed on June 28, this was to determine the lateral extent of the contamination. This phase of sampling was inconclusive, and it appeared that the contamination was moving northward. A Mobile Drill B53 was used July 25 to confirm that the furthest extent of the downward migration of contamination was within exceptable concentration limits. The completion of the investigation was accomplished August 23 with the Geoprobe, when the northern extent of the lateral migration was identified (Fig. 4.5.1 and Table 4.5.1).

A comprehensive site assessment determined that the contamination's lateral migration has been confined just north of the excavated area, and the extent of it's vertical migration will not impact the groundwater.

4.5.3 Recommendations

Remedial method for this facility should be Natural Attenuation/ Assimilation. However, the New Mexico Environmental Department's Underground Storage Tank Regulations, Section 1209 -- Treatment of Highly Contaminated Soils suggest that a Corrective Action System should be implemented, specifically soil excavation and/ or enhanced soil venting.

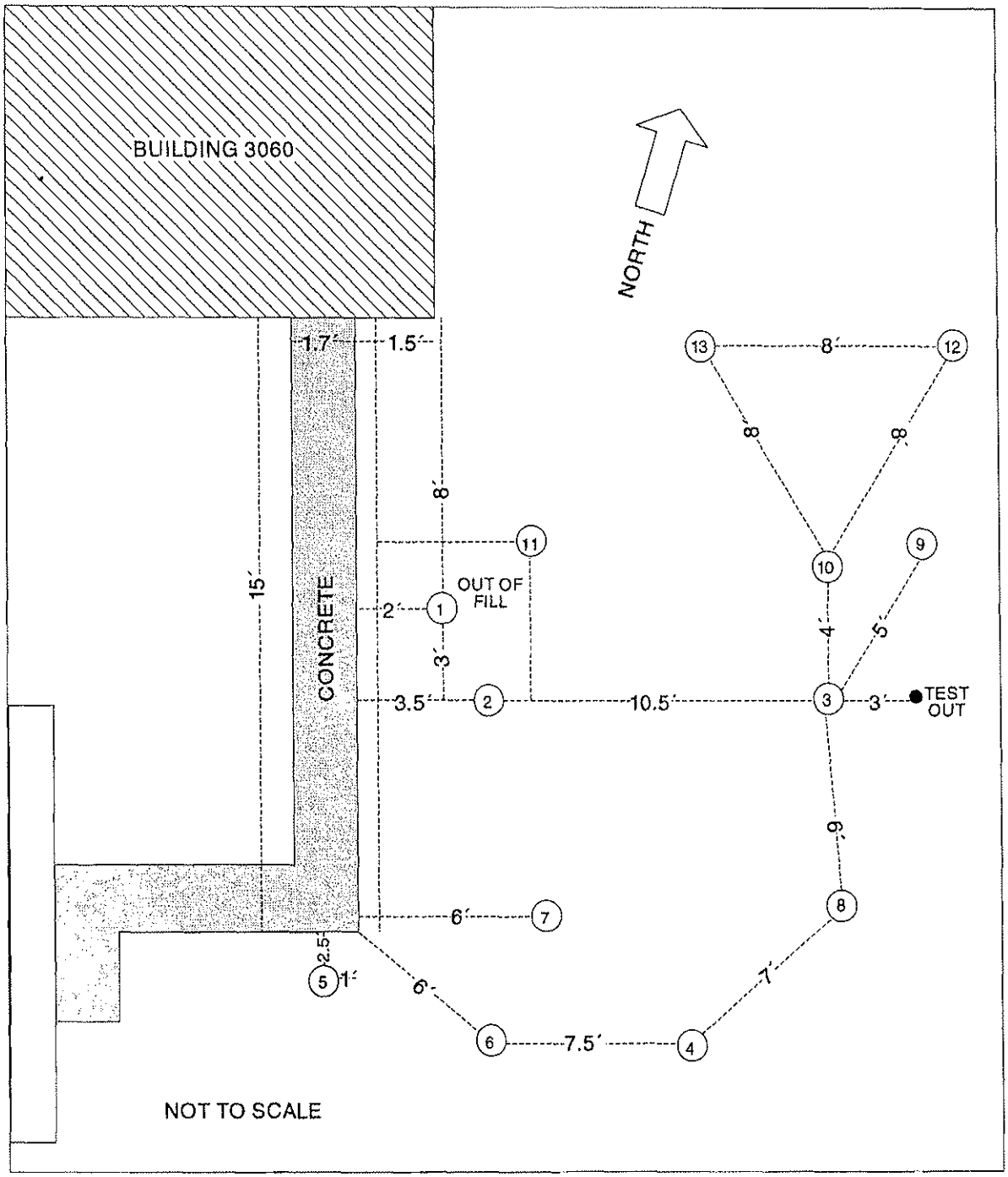


Figure 4.5.1--Location of boreholes at Facility 3060 (generator shed).

FACILITY 3060 (GENERATOR SHED)

Table 5.--Summary of analytical data results in soil samples from underground tank site Facility 3060, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28. Sample has GC/FID characteristics that are similar to fuel #2 (for detail, see projects 041519, 043171, 043723, and 044301 in Appendix); q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]

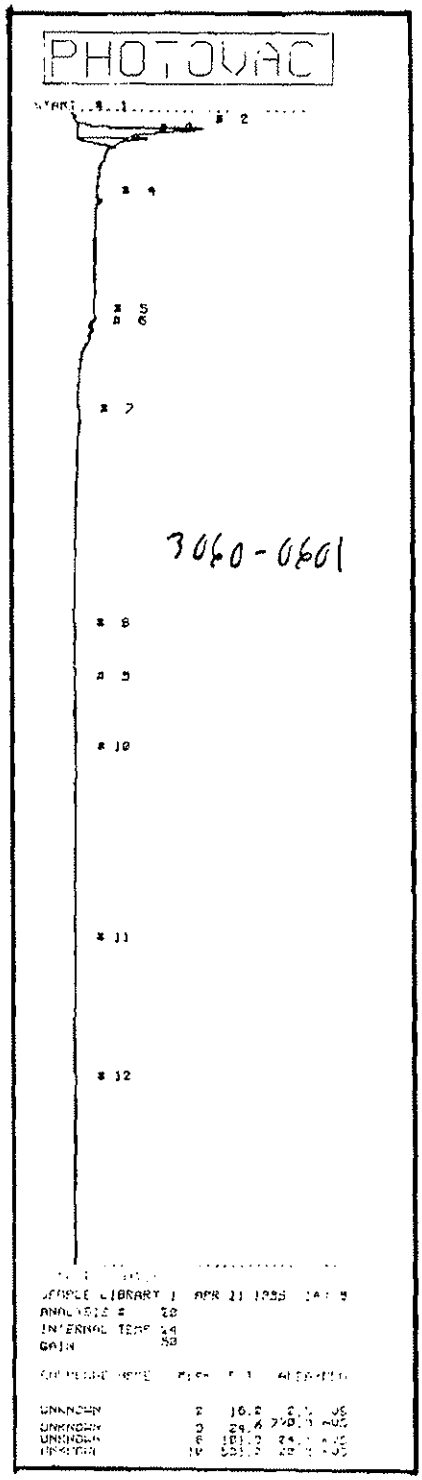
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil- mg/kg; Aqueous- Mg/L	Reporting Limit
CAFB-FAC3060-0101	9.0-11.0	11APR95	Soil	Environmental (Field screening only)	ND	
CAFB-FAC3060-0201	9.0-11.0	11APR95	Soil	Environmental	1,300.0 tl	40.0
CAFB-FAC3060-0202	14.0-16.0	11APR95	Soil	Environmental	8.7 ql	4.0
CAFB-FAC3060-0301	9.0-11.0	11APR95	Soil	Environmental	5,300.0 tl	400.0
CAFB-FAC3060-0302	14.0-16.0	11APR95	Soil	Environmental	23.0 l	4.0
CAFB-FAC3060-0303	24.0	25JUL95	Soil	Environmental	78.0 l	4.0
CAFB-FAC3060-0304EB		25JUL95	Aqueous	Equipment blank	0.47 ql	0.10
CAFB-FAC3060-0401	9.0-11.0	11APR95	Soil	Environmental	4.3 ql	4.0
CAFB-FAC3060-0501	9.0-11.0	11APR95	Soil	Environmental	3.2 j	4.0
CAFB-FAC3060-0601	9.0-11.0	11APR95	Soil	Environmental	37.0 l	4.0
CAFB-FAC3060-0701	9.0-10.0	11APR95	Soil	Environmental (Field screening only)	ND	

FACILITY 3060 (GENERATOR SHED)

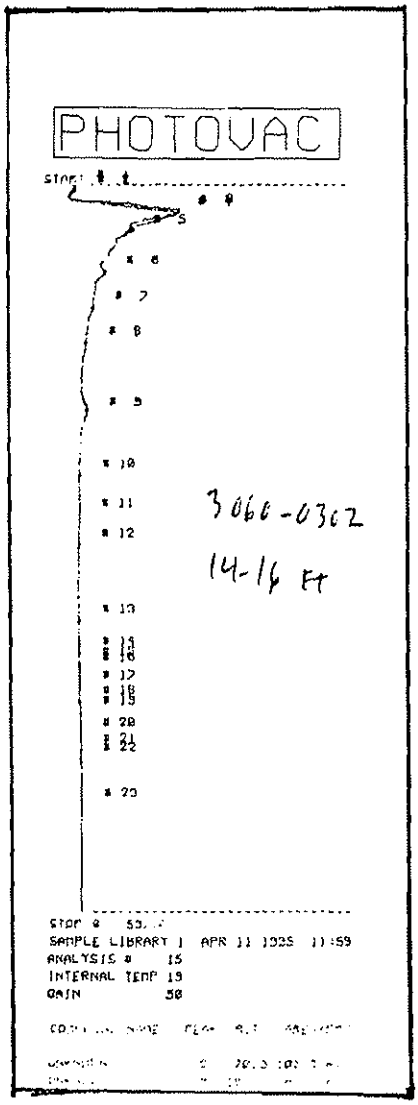
Table 5.--Summary of analytical data results in soil samples from underground tank site Facility 3060, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28. Sample has GC/FID characteristics that are similar to fuel #2 (for detail, see projects 041519, 043171, 043723, and 044301 in Appendix); q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil- mg/kg; Aqueous- Mg/L	Reporting Limit
CAFB-FAC3060-0801	10.0-12.0	28JUN95	Soil	Environmental	15.0 ql	4.0
CAFB-FAC3060-0901	9.0-11.0	28JUN95	Soil	Environmental	40.0 ql	4.0
CAFB-FAC3060-1001	11.0-13.0	28JUN95	Soil	Environmental	160.0 ql	4.0
CAFB-FAC3060-1101	10.0-12.0	28JUN95	Soil	Environmental	22.0 ql	4.0
CAFB-FAC3060-1201	12.0-14.0	23AUG95	Soil	Environmental	ND	4.0
CAFB-FAC3060-1301	11.0-13.0	23AUG95	Soil	Environmental	ND	4.0
CAFB-FAC3060-1302	11.0-13.0	23AUG95	Soil	Duplicate	ND	4.0

4.5.1 Gas Chromatograms -- Facility 3060



CAFB-FAC3060-0601



CAFB-FAC3060-0302

4.6 FACILITY 1400

4.6.1 Site Description

The Underground Storage Tank (UST) at Facility 1400 had a capacity of 25,000 gallons and contained diesel fuel, required to operate an emergency generator at the Cannon Air Force Base Hospital (Fig. 2.1.1). The UST has been decommissioned and prepared for abandonment in place. The tank is constructed of steel and the base of the tank is approximately eighteen feet below land surface.

A private contractor in September 1994 collected four soil samples around the abandoned UST, samples were taken between 18 and 20 feet. The soil sample collected on the northwest side of the UST had above reporting limit of "Total Recoverable Petroleum Hydrocarbons (TRPH)", the concentration of TRPH was 8,200 ppm.

4.6.2 USGS Investigation

On April 12 and 14, 1995, with the use of a Geoprobe, six boreholes were advanced, collecting ten environmental samples (Fig. 4.6.1 and Table 4.6.1). The pupose of these samples was to validate the existence of contamination that was discovered in the original samples collected in September 1994.

The results from field screening indicated high concentrations of contamination (G.C. 4.6.1) and the laboratory anaylsis confirmed that high concentrations of contamination existed on all sides of the abandoned UST with the exception of the southwest corner (Table 4.6.1).

Due to the location, lithology of subsurface soils, and the wide spread migration of contamination at Facility 1400, a combination of drilling equipment was used.

Geoprobe - July 2, 1995 and December 12, 1995.
Mobile Drill B53 auger drilling rig - August 26, 27, 28, 1995.
Gardner-Denver 17W rotary drilling rig - December 14, 1995.

It was also determined that one deep borehole would be significant to identify the extent of the downward migration, due to the close proximity of the other contaminated boreholes

A comprehensive site assessment determined that the lateral and downward migration of contamination has been confined. Northwest and western movement of the contamination has been confined to the middle of the hospital's paved road. North and eastern confinement area is within a few feet of the UST (Fig. 4.6.1). The downward extent of the contamination was determined in Borehole #3, soil samples collected at 83 and 92 feet had "not detected" contamination levels. This suggest that the vertical extent of the contamination will not impact the growndwater.

4.6.3 Recommendations

Remedial method for this facility should be Natural Attenuation/ Assimilation. However, the New Mexico Environmental Department's Underground Storage Tank Regulations, Section 1209 -- Treatment of Highly Contaminated Soils suggest that a Corrective Action System should be implemented, specifically soil excavation and/ or enhanced soil venting.

4.6.4 Soil Boring Description - Facility 1400

A general description of the subsurface soil (0-20 feet) on Cannon Air Force Base can be found in Section 3.3.1 of this text.

Lithology below twenty feet is described as follows:

20-21 ft. pinkish gray caliche layer.
21-26 ft. light-brown sand, vfg, slightly indurated with pinkish gray caliche nodules.
26-34 ft. light brown sandy-silt, vfg, mixed with pinkish gray caliche nodules.
34-40 ft. light-brown silty-sand, unconsolidated, vfg.
40-46 ft. light-brown sandy-silt to sandy-clay, vfg, caliche layer at 46 ft.
46-51 ft. light-brown silty-sand, vfg.
51-80 ft. light-brown sand, vfg-mg.
80-92 ft. light brown cemented silty-sand, vfg-fg.

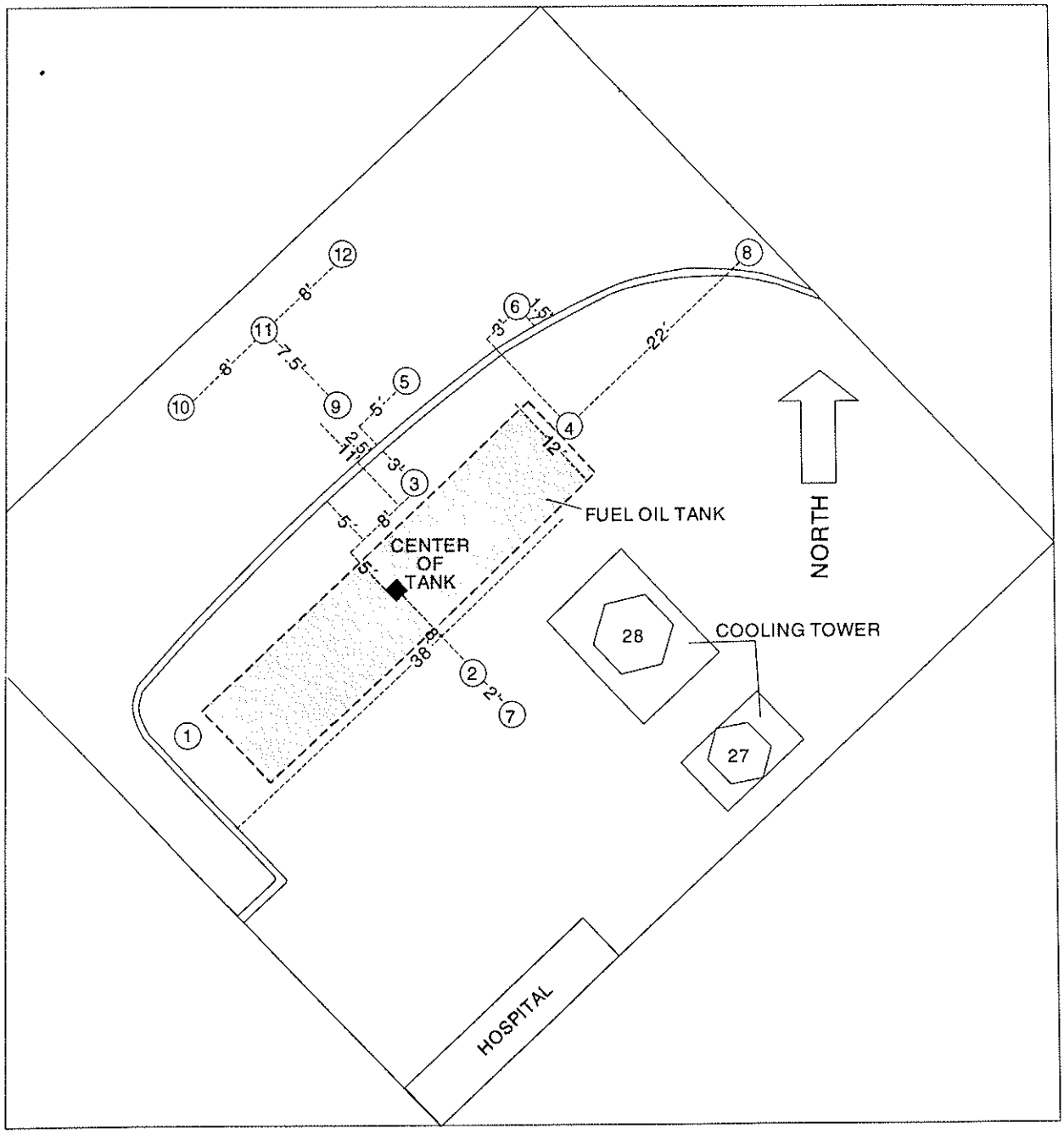


Figure 4.6.1--Location of boreholes at Facility 1400 (Hospital).

FACILITY 1400 (HOSPITAL)

Table 6.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 1400, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041519, 041554, 043197, 044320, and 046431 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC1400-0101	14.0-16.0	12APR95	Soil	Environmental (Field screening only)	ND	
CAFB-FAC1400-0102	16.0-18.0	12APR95	Soil	Environmental	51.0 tql	8.0
CAFB-FAC1400-0201	18.0-20.0	12APR95	Soil	Environmental	6,200.0 tl	400.0
CAFB-FAC1400-0301	18.0-20.0	12APR95	Soil	Environmental	9,900.0 tl	400.0
CAFB-FAC1400-0302	22.0-24.0	12APR95	Soil	Environmental	370.0 tl	8.0
CAFB-FAC1400-0302	36.0-37.0	28AUG95	Soil	Environmental	8,000.0 lt	400.0
CAFB-FAC1400-0303	36.0-37.0	28AUG95	Soil	Duplicate	8,000.0 lt	400.0
CAFB-FAC1400-0304	49.5-50.5	28AUG95	Soil	Environmental	11,000.0 lt	400.0
CAFB-FAC1400-0305	65.0-66.0	28AUG95	Soil	Environmental	5,800.0 lt	400.0
CAFB-FAC1400-0306	75.0	14DEC95	Soil	Environmental	9,300.0 tl	400.0
CAFB-FAC1400-0307	83.0	14DEC95	Soil	Environmental	ND	4.0
CAFB-FAC1400-0308	91.0-92.0	14DEC95	Soil	Environmental	ND	0.1

FACILITY 1400 (HOSPITAL)

Table 6.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 1400, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041519, 041554, 043197, 044320, and 046431 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

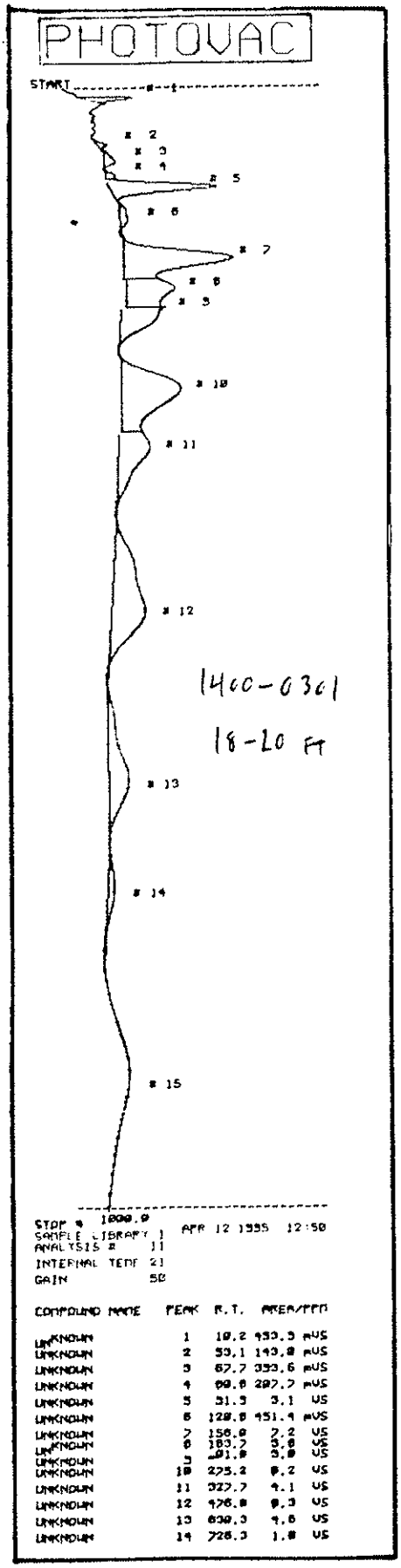
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC1400-0401	17.0-19.0	12APR95	Soil	Environmental	16.0 ql	4.0
CAFB-FAC1400-0402	20.0-22.0	12APR95	Soil	Environmental	2,500.0 tl	80.0
CAFB-FAC1400-0403		12APR95	Aqueous	Equipment blank	ND	0.10
CAFB-FAC1400-0501	10	14APR95	Soil	Environmental (Field screening only)	ND	
CAFB-FAC1400-0601	9.5-11.5	14APR95	Soil	Environmental (Field screening only)	ND	
CAFB-FAC1400-0602	20.0-22.0	14APR95	Soil	Environmental	5.2 ql	4.0
CAFB-FAC1400-0701	19.0-20.0	02JUL95	Soil	Environmental	20.0 ql	4.0
CAFB-FAC1400-0702EB		02JUL95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC1400-0801	25.0-26.0	26AUG95	Soil	Environmental	ND	4.0
CAFB-FAC1400-0901EB		27AUG95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC1400-0902	25.0-26.0	27AUG95	Soil	Environmental	890.0 qlt	16.0
CAFB-FAC1400-1001	23.0-25.0	12DEC95	Soil	Environmental	ND	4.0
CAFB-FAC1400-1101	22.0-24.0	12DEC95	Soil	Environmental	ND	4.0

FACILITY 1400 (HOSPITAL)

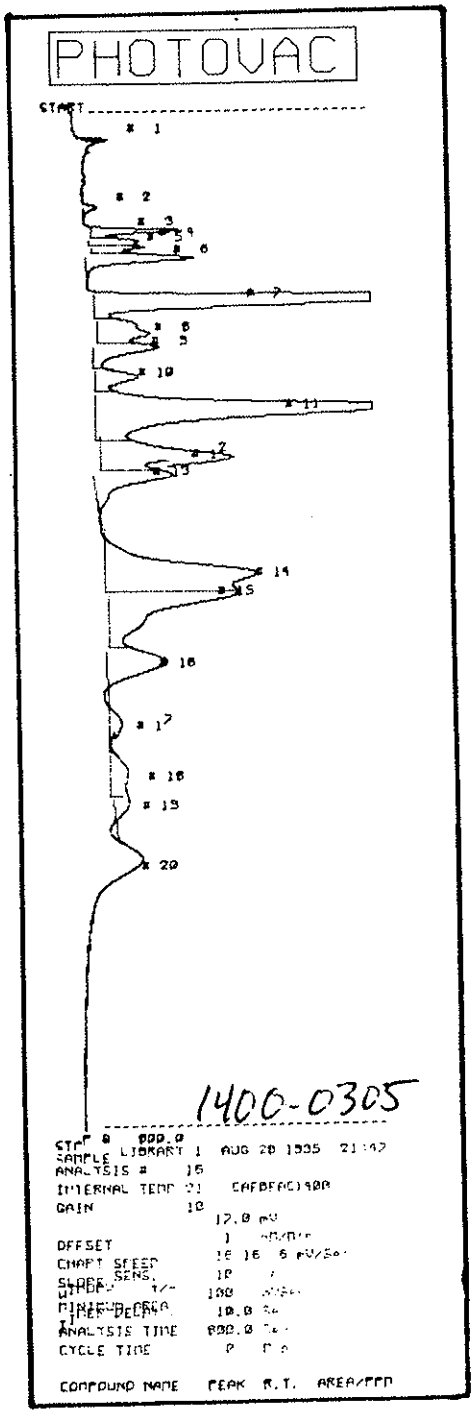
Table 6.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 1400, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041519, 041554, 043197, 044320, and 046431 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC1400-1201	24.0-26.0	12DEC95	Soil	Environmental	16.0 ql	4.0

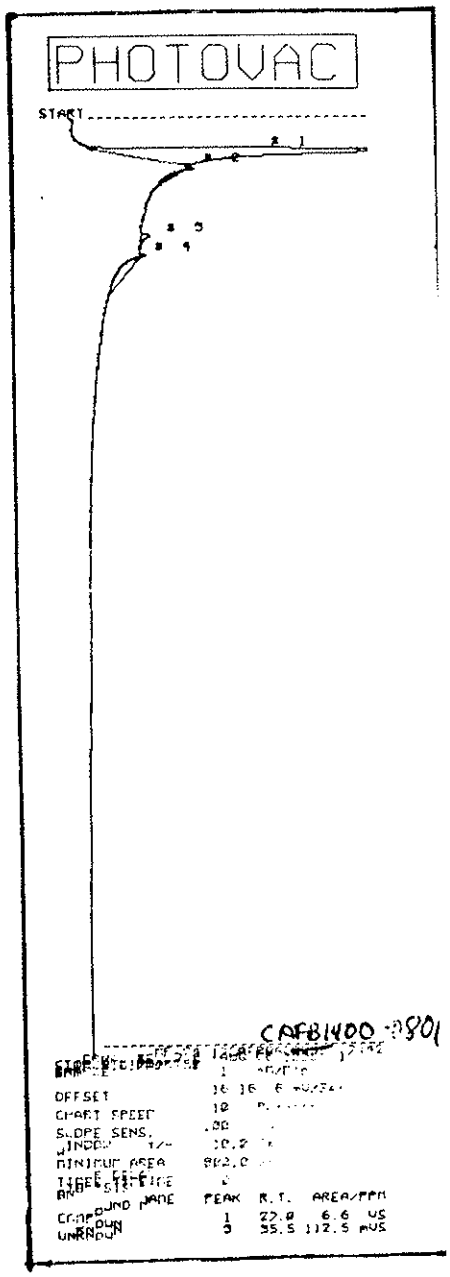
4.6.1 Gas Chromatograms -- Facility 1400



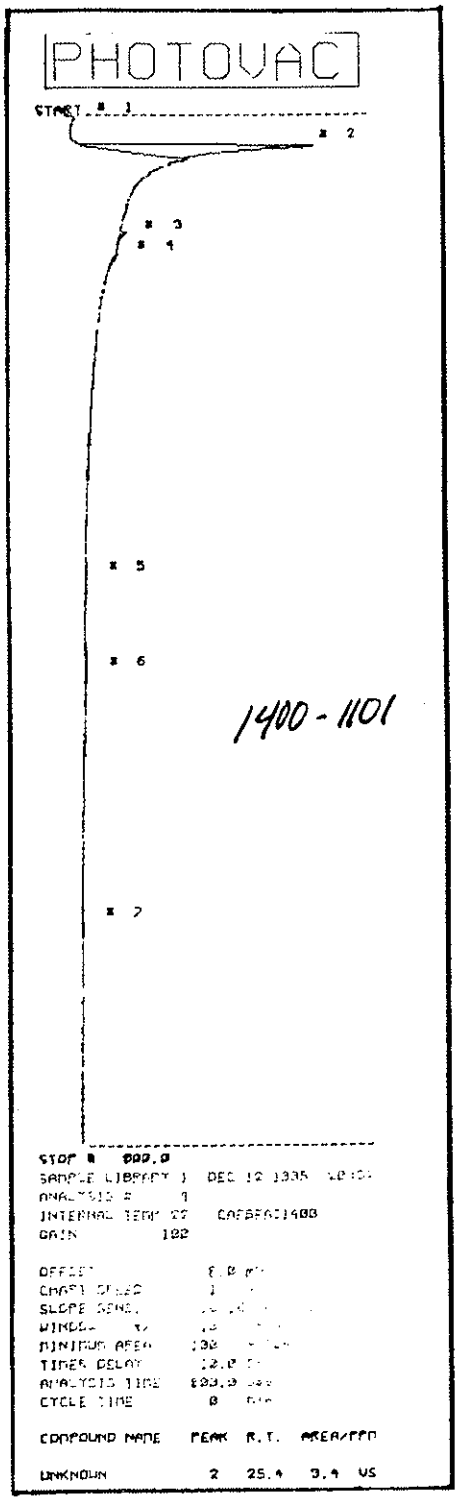
CAFB-FAC1400-0301



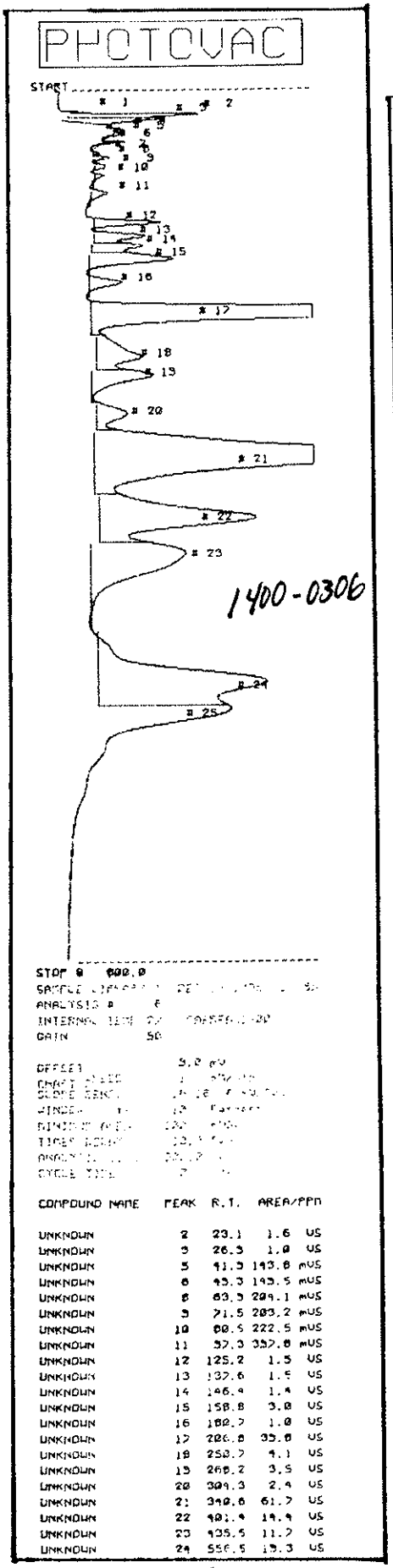
CAFB-FAC1400-0305



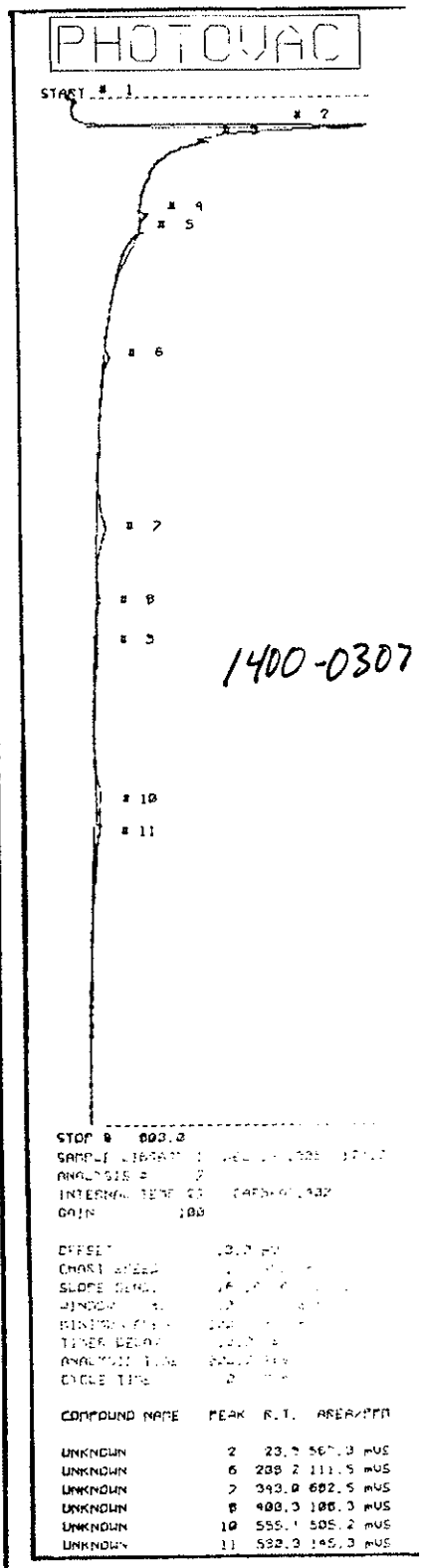
CAFB-FAC1400-0801



CAFB -FAC1400-1101



CAFB-FAC1400-0306



CAFB-FAC1400-0307

4.7 FACILITY 368

4.7.1 Site Description

Facility 368 consisted of three Underground Storage Tanks (USTs), having a capacity of 10,000 gallons each and contained gasoline, which supplied the gasoline pumps at the old gasoline station on Cannon AFB (Fig. 2.1.1). The tanks were constructed of steel and the base of the tanks were approximately twelve feet below land surface.

In July 1995, the gasoline pump islands were added to the field investigation. The gasoline pumps have been removed, leaving two islands areas approximately thirty-six feet in length and six feet wide (Fig. 4.7.2).

In January 1995, a private contractor collected six soil samples during the excavation of the three USTs. The samples were taken at the four corners, and the east and west sides of the excavated area. The samples were also taken at a level two feet below the bottom of the tanks. One sample collected during the excavation had above reporting limits of "Total Recoverable Petroleum Hydrocarbon (TRPHC)" concentrations. The sample taken at the southwest end of the excavation had a concentration of 2,447 ppm TRPHC.

4.7.2 USGS Investigation

On April 13 and 14, with the use of a Geoprobe nine boreholes were advanced, collecting eleven environmental samples, ranging in depth from 10 to 16 feet (Fig. 4.7.1 and Table 4.7.1). The pupose of these samples was to validate the results from soil samples taken during the removal of the tanks.

The results from the field screening indicated no contamination (G.C. 4.7.1), and lab anaylsis (GRO method) confirmed that concentrations were below reporting limits (Table 4.7.1).

NOTE: Initial Gasoline Range Organic (GRO) sampling April 13 & 14 were performed following NMUST Regulations Part II Section 1209(D). However, NMED revised this section in March 1995, by adopting the Methanol Extraction Method. The U.S. Geological Survey was informed of this revision April 21. Two of the borehole samples collected April 13 were resampled July 1 using the Methanol Extration Method (These samples are distinguished by the field ID being followed by an M). This allowed a comparison of the two different lab anaylize for GRO, qualifying the initial set of samples. As of July 1, 1995 all GRO sampling was collected and analyized by using the Methanol Extration Method.

On July 1 and 2, the pump island investigation, with the Geoprobe was initiated. Eight boreholes were advanced collecting nine environmental samples (Fig. 4.7.2). The purpose of these samples were to determine if the recently removed gasoline pumps had leaked.

Intially four boreholes were advanced at each end of the excavated pump islands, collecting one sample per borehole. Field screening indicated high concentrations of contamination in Borehole #10 (G.C. 4.7.1 and Table 4.7.1). To determine lateral migration an additional of four boreholes were advanced encompassing Borehole #10, one sample was collected from each borehole (Fig. 4.7.2). The results from field screening indicated no lateral migration. Lab anaylsis confirmed the high concentrations of contamination in Borehole #10, and also confirmed no to low concentrations in the encompassing boreholes (Table 4.7.1).

To determine the extent of downward migration of the contamination at Borehole #10, a Mobile Drill B53 auger drill rig was used August 25 and 26. At 52 feet the concentration of the contamination was below reporting limits.

A comprehensive site assessment determined that contamination levels at the excavation area are below reporting limits, and the extent of downward migration at the pump island (Borehole #10) will not impact the groundwater.

4.7.3 Recommendations

No further investigation should be required for the excavated area at this facility. Remedial method for the pump island (Borehole #10) should follow New Mexico Environmental Department's Underground Storage Regulation, Section 1209 -- Treatment of Highly Contaminated Soils, specifically, enhanced soil venting.

4.7.4 Soil Boring Description - Facility 368

A general description of the subsurface soil (0-20 feet) on Cannon Air Force Base can be found in Section 3.3.1 of this text.

Lithology below twenty feet is described as follows:

20-23 ft. the soil consisted of reddish-brown sandy silt, vfg-fg, with pinkish gray caliche nodules.
23-24 ft. dark brown silty-clay with a few pinkish gray caliche nodules.
24-26 ft. light-brown sand, vfg, slightly indurated with pinkish gray caliche.
26-39 ft. light-brown silty-sand, vfg.
39-41 ft. caliche cemented sand, vfg, pinkish gray.
41-49 ft. light-brown sand ,vfg, mixed with pinkish gray caliche and cemented sand.
49-52 ft. light-brown silty-sand, unconsolidated, vfg-fg.

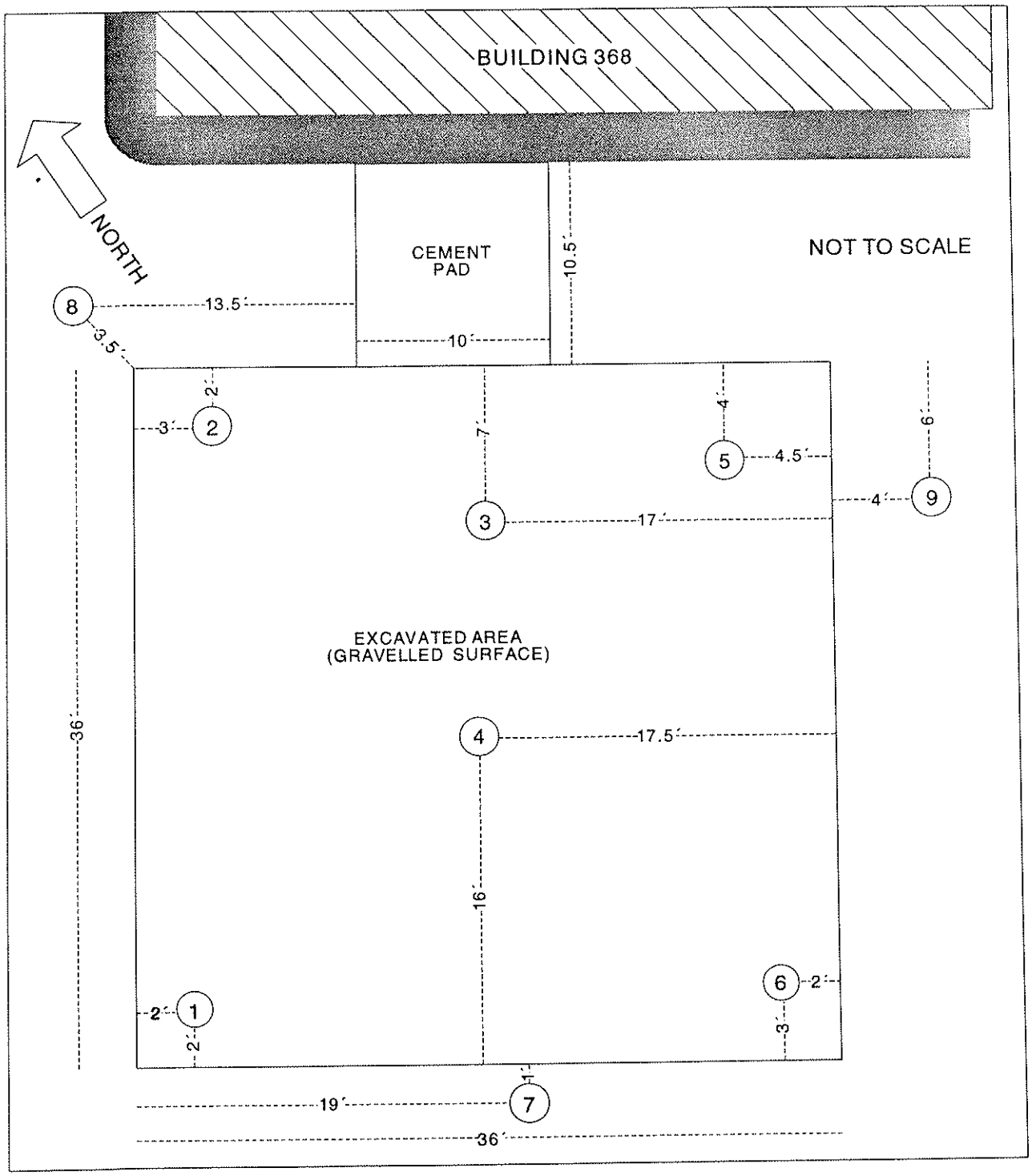


Figure 4.7.1--Location of boreholes at Facility 368 (old gas station).

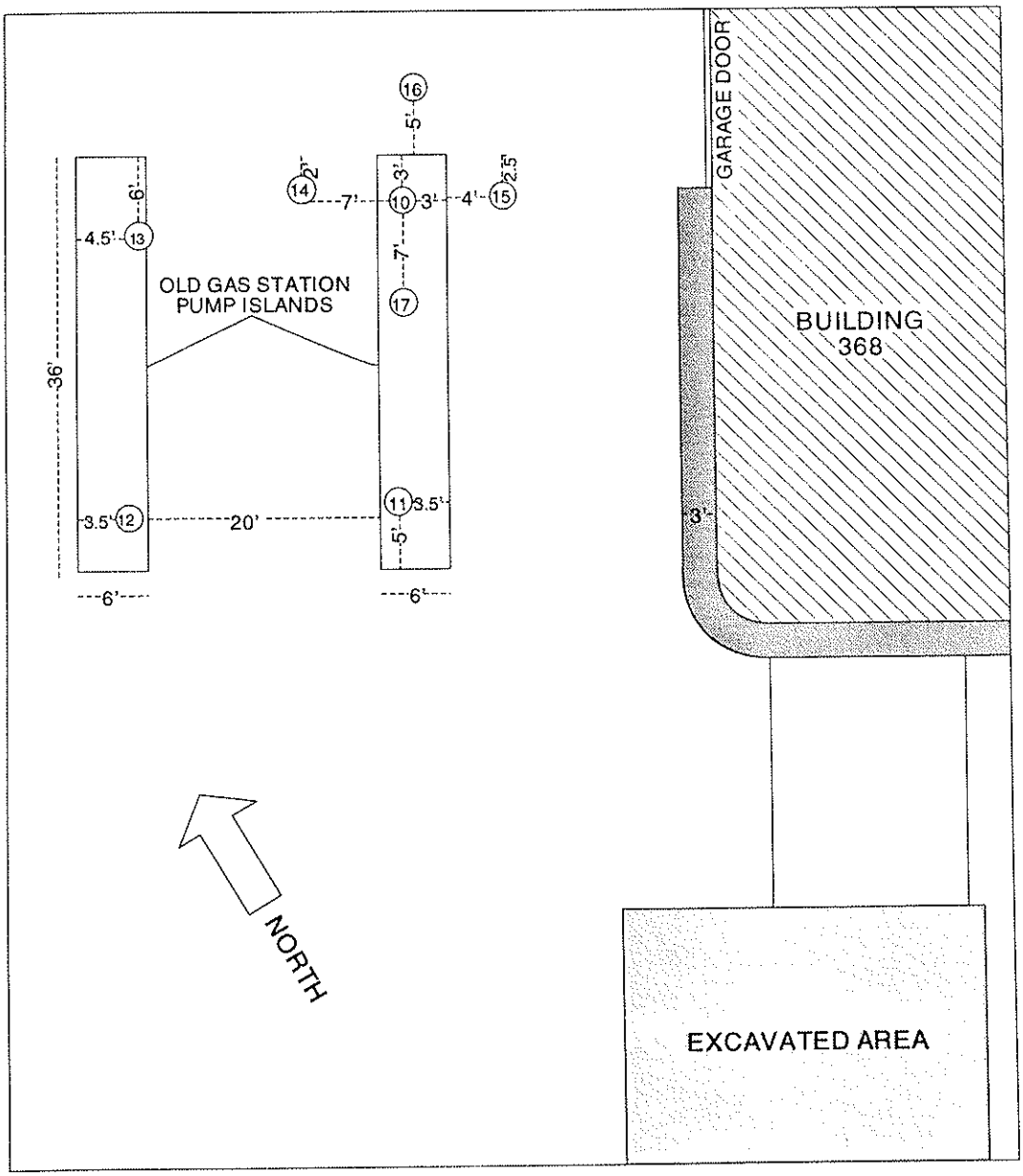


Figure 4.7.2--Location of boreholes at Facility 368 (pump island).

FACILITY 368 (OLD GAS STATION)

Table 7.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 368, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; GRO, Gasoline range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26 (for detail, see project 041554, 043197, and 044268 in Appendix); m, This sample has GC/FID characteristics that are similar to weathered gasoline; ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.]

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg, Aqueous-ug/L	SW8015 (GRO),Soil-mg/kg, Aqueous-ug/L	Reporting Limit
CAFB-FAC0368-0101	10.0-12.0	13APR95	Soil	Environmental		0.57 q	0.5
CAFB-FAC0368-0102	13.0-15.0	13APR95	Soil	Environmental		0.44 qj	0.5
CAFB-FAC0368-0102M	13.0-15.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-0201	10.0-12.0	13APR95	Soil	Environmental		0.27 qj	0.5
CAFB-FAC0368-0202	14.0-16.0	13APR95	Soil	Environmental		ND	0.5
CAFB-FAC0368-0301	12.0-14.0	13APR95	Soil	Environmental		ND	0.5
CAFB-FAC0368-0401	11.0-13.0	13APR95	Soil	Environmental		0.25 qj	0.5
CAFB-FAC0368-0501	10.0-11.0	13APR95	Soil	Environmental		0.57 q	0.5
CAFB-FAC0368-0601	12.0-14.0	13APR95	Soil	Environmental		ND	0.5
CAFB-FAC0368-0601M	12.0-14.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-0602		13APR95	Aqueous	Equipment blank		ND	10.0
CAFB-FAC0368-0701	13.0-15.0	14APR95	Soil	Environmental		ND	0.5

FACILITY 368 (OLD GAS STATION)

Table 7.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 368, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; GRO, Gasoline range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26 (for detail, see project 041554, 043197, and 044268 in Appendix); m, This sample has GC/FID characteristics that are similar to weathered gasoline; ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.]--Continued

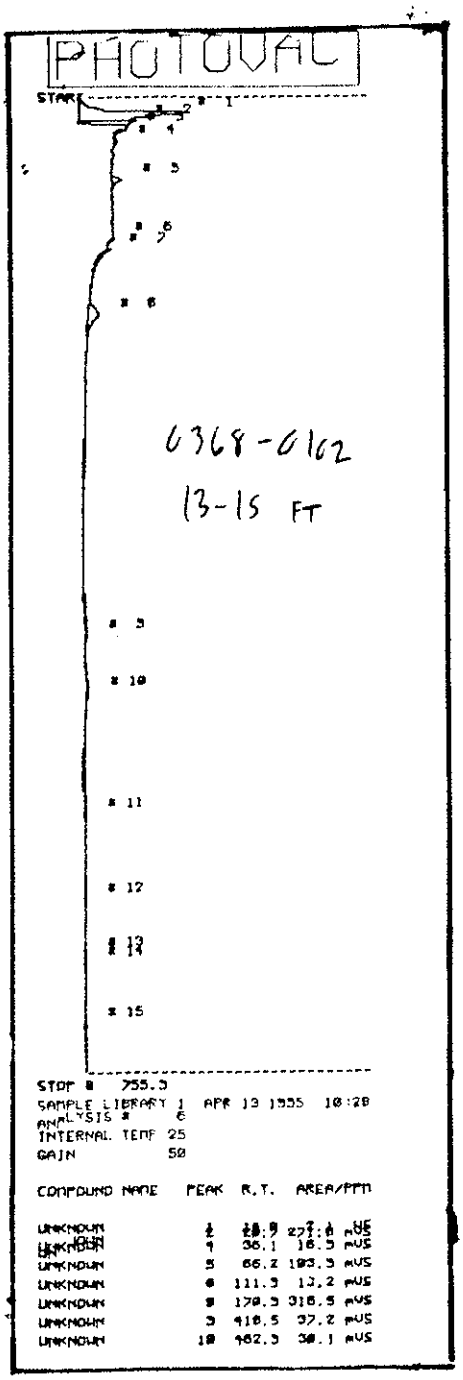
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg, Aqueous-ug/L	SW8015 (GRO),Soil-mg/kg, Aqueous-ug/L	Reporting Limit
CAFB-FAC0368-0801	10.0	14APR95	Soil	Environmental (Field Screening only)		ND	
CAFB-FAC0368-0901	10.0	14APR95	Soil	Environmental (Field screening only)		ND	
CAFB-FAC0368-1001	12.0-14.0	01JUL95	Soil	Environmental		800.0 q	100.0
CAFB-FAC0368-1001	12.0-14.0	02JUL95	Soil	Environmental	160.0 ql		4.0
CAFB-FAC0368-1002EB		25AUG95	Aqueous	Equipment blank		ND	10.0
CAFB-FAC0368-1003	24.0-25.0	25AUG95	Soil	Environmental		1,000.0 m	50.0
CAFB-FAC0368-1004	24.0-25.0	25AUG95	Soil	Duplicate		830.0 m	40.0
CAFB-FAC0368-1005	35.0-36.0	26AUG95	Soil	Environmental		37.0 q	10.0
CAFB-FAC0368-1006	50.0-52.0	26AUG95	Soil	Environmental		0.97 j	1.0
CAFB-FAC0368-1007TB		26AUG95	Aqueous	Trip blank		ND	1.0
CAFB-FAC0368-1101	10.0-11.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-1201	12.0-14.0	01JUL95	Soil	Environmental		ND	1.0

FACILITY 368 (OLD GAS STATION)

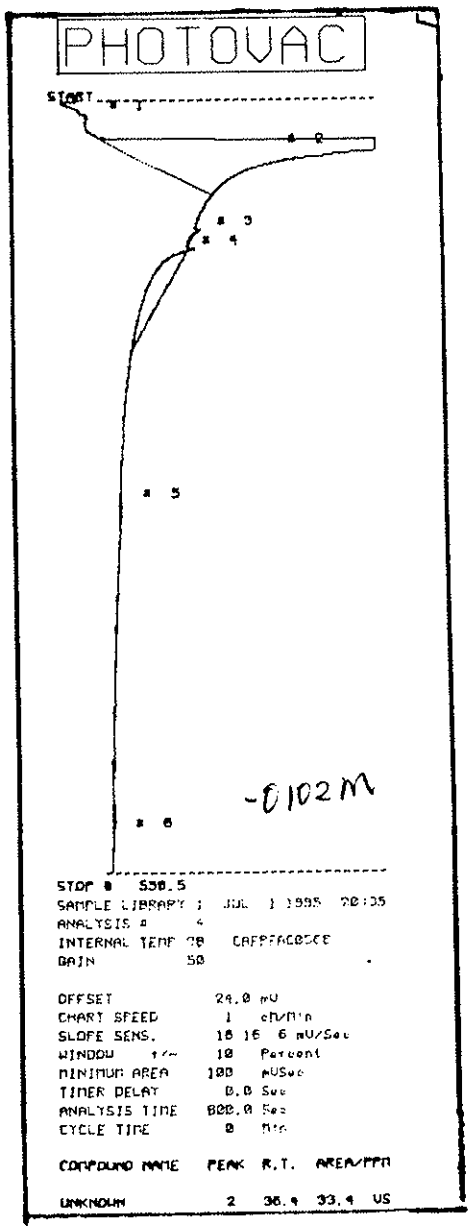
Table 7.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 368, Cannon Air Force Base, New Mexico. [DRO, Diesel range organics; GRO, Gasoline range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26 (for detail, see project 041554, 043197, and 044268 in Appendix); m, This sample has GC/FID characteristics that are similar to weathered gasoline; ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.]--Continued

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO),Soil-mg/kg, Aqueous-ug/L	SW8015 (GRO),Soil-mg/kg, Aqueous-ug/L	Reporting Limit
CAFB-FAC0368-1301	10.0-11.0	01JUL95	Soil	Environmental		18.0 m	1.0
CAFB-FAC0368-1401	13.0-15.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-1501	12.0-14.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-1601	13.0-15.0	01JUL95	Soil	Environmental		ND	1.0
CAFB-FAC0368-1602		01JUL95	Aqueous	Equipment blank		ND	10.0
CAFB-FAC0368-1701	13.0-15.0	02JUL95	Soil	Environmental	5.1 ql		4.0

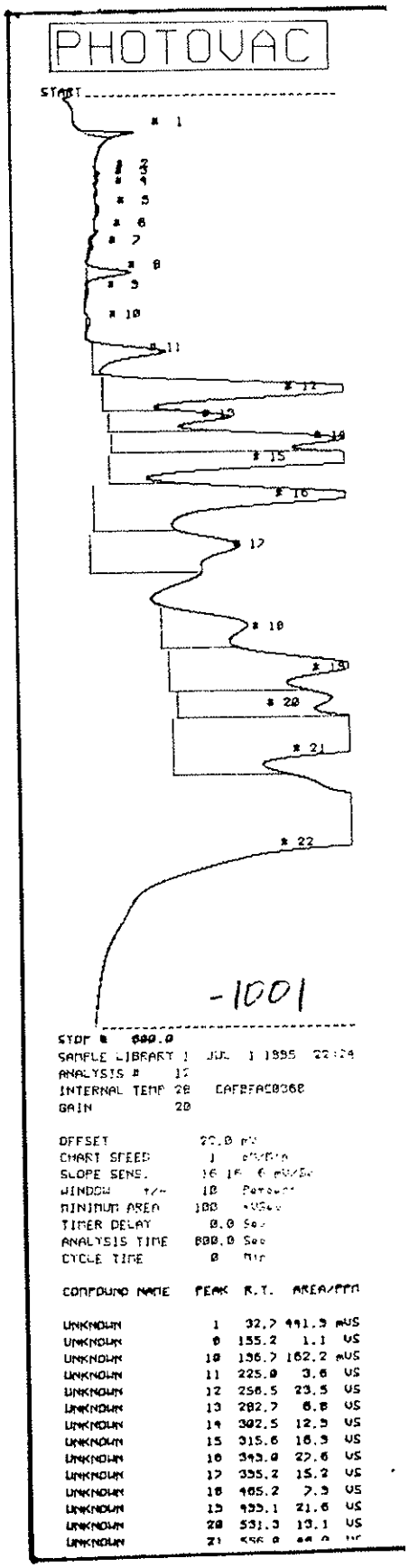
4.7.1 Gas Chromatograms -- Facility 368



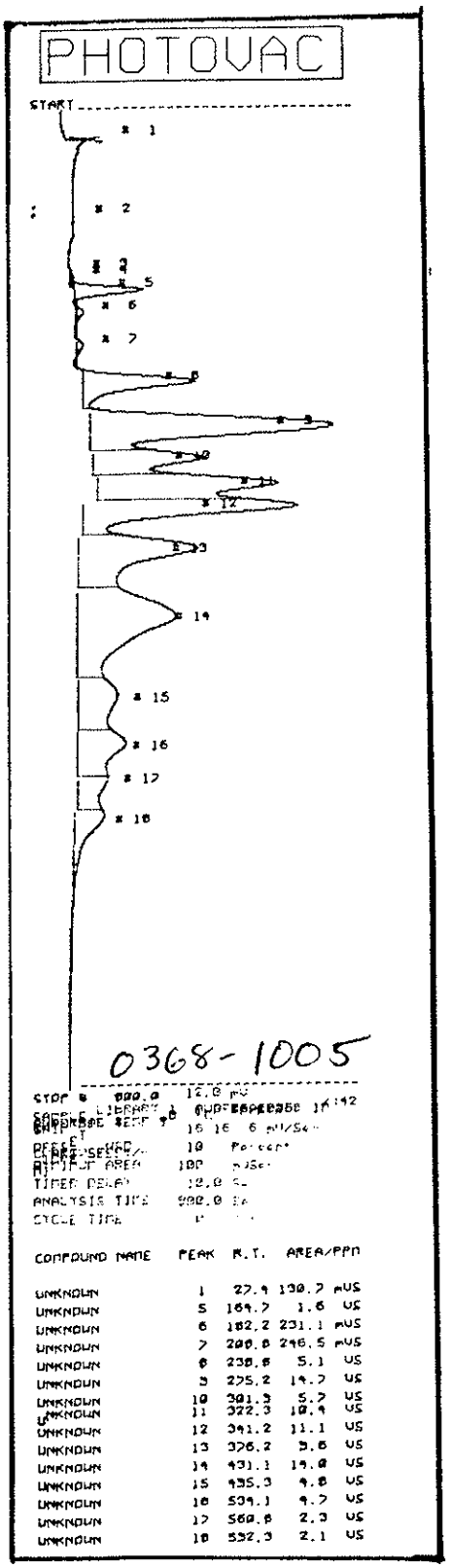
CAFB-FAC0368-0102



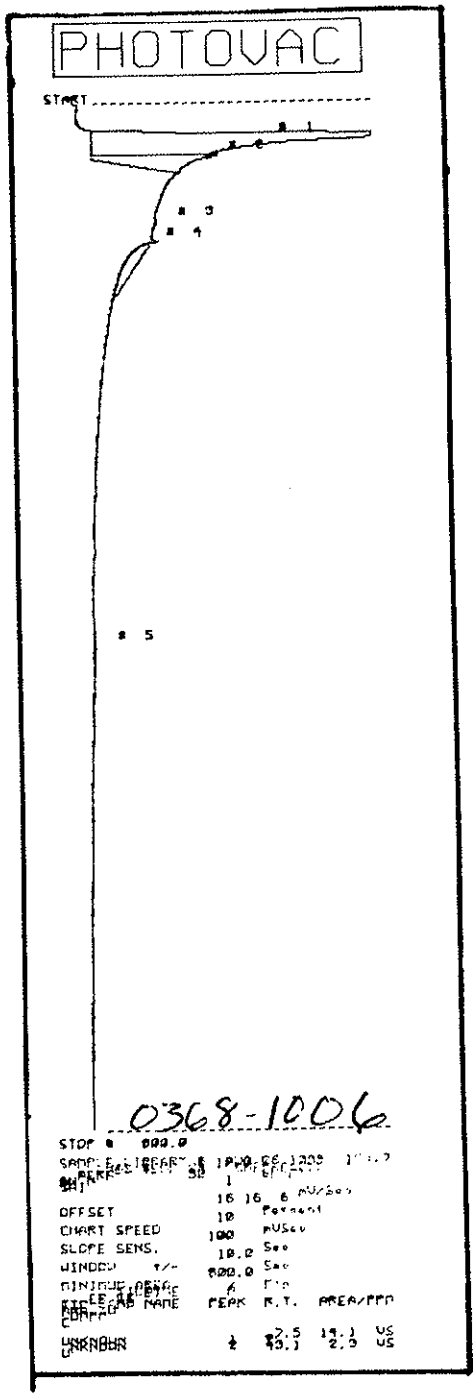
CAFB-FAC0368-0102M



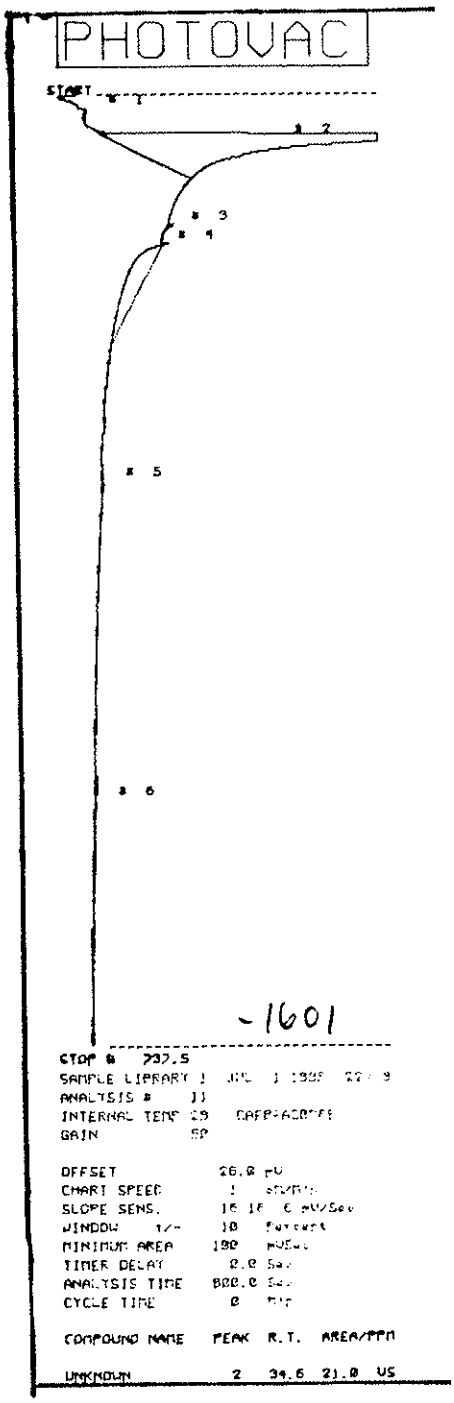
CAFB-FAC0368-1001



CAFB-FAC0368-1005



CAFB-FAC0368-1006



CAFB-FAC0368-1601

4.8 FACILITY 3121

4.8.1 Site Description

The Underground Storage Tank (UST) at Facility 3121 had a capacity of 275 gallons and contained heating oil, which was used for heating the building complex at Melrose Bombing Range. The tank was constructed of steel and the base of tank was approximetly nine feet below land surface.

In November 1994 a private contractor collected four samples during the excavation of the UST. They were taken at each of the four corners of the excavated area. Two of the samples collected during the excavation had above reporting limits of "Total Petroleum Hydrocarbon (TPH)" concentrations. The sample collected at the southeast corner of the excavation had a concentration of 1,850 ppm TPH, and on the northwest corner the concentration was 12,900 ppm TPH.

4.8.2 USGS Investigation

On April 18, 1995, with the use of a Geoprobe, seven boreholes were advanced, collecting eight environmental samples, ranging in depth from 8 to 16 feet (Fig. 4.8.1 and Table 4.8.1). The purpose of these samples were to validate the results from soil samples taken during the removal of the tank.

The results from field screening indicated high concentrations of contamination (G.C. 4.8.1) and the lab anaylses confirmed that high concentrations of contamination existed in all boreholes except for the northern most borehole, Borehole #7 (Table 4.8.1).

A second series of soil samples were collected with the Geoprobe on June 29. These samples were collected to determine the extent of lateral migration. Four boreholes were advanced collecting four environmental samples (Fig. 4.8.1 and Table 4.8.1). The results from Borehole #8 was to determine if the contamination had migrated east, under the Melrose Bombing Range Building Complex. A 30 degree angled borehole was advanced underneath the building, this allowed a sample to be collected at a fifteen foot vertical depth and nine foot horizontal distance. The results from the second series of samples showed only low concentration of contamination, identifing the extent of the lateral migration (Table 4.8.1).

On July 26-27 a Mobile Drill B53 auger rig was used to find the downward extent of the contamination. However, due to mechanical difficulties with the auger rig the results were inconclusive. August 24-25 the auger rig was again used reaching a total depth of 60.5 feet. At this depth the concentrations of contamination were below reporting limits (Table 4.8.1). It was also determined that one deep borehole would be significant to identify the extent of the downward migration, due to the close proximity of the other contaminated boreholes (Fig. 4.8.1).

NOTE: The lab samples collected at 40-41 feet, indicated "no detection" of contamination. At this depth was a large reddish brown clay layer. It is speculated that the contamination found a fracture in the clay allowing it to migrate into the sand below. The next two sample intervals had the same sand composition, indicating the furthest extent of the contamination's downward migration was between 51-60 feet.

After evaluating the data collected, it is difficult to make a complete assessment of the problems that may occur at this facility due to the release of this contamination. Groundwater levels in this area are not well defined. So it must be assumed that there is the possibility that the contamination may impact the groundwater.

4.8.3 Recommendations

Remedial methods for this facility should follow New Mexico Environmental Department's Underground Storage Tank Regulation, Section 1209 -- Treatment of Highly Contaminated Soils should be implemented immediately, specifically enhanced soil venting. However, Section 1210 -- Hydrogeologic Investigation must be addressed.

4.8.4 Soil Description -- Facility 3121

0-3 ft. Moderate-brown silt, lightly compacted with some fine sand and traces of small pepples.
3-7 ft. Light-brown silty sand with caliche and minor pepples, sand vfg-fg.
7-9 ft. Moderate-brown sandy silt, with small amount of clay, sand vfg-fg.
9-11ft. Moderate-reddish brown silty sand with some clay, sand vfg-fg.
11-18 ft. Light-reddish brown clayey silt with sand, slightly compacted due to calcification, sand vfg-fg-mg.
18-24 ft. Silty clay, similar to previous interval.
24-31 ft. Light-brown sandy silt with clay, sand vfg-fg in lower part of this interval, upper part has vfg-mg sand moderately compacted, weakly cemented by calcification.
31-38 ft. Moderate-brown sandy silt mixed equally with silty clay, and few pepples, slightly compacted, sand fg-mg.
38-44 ft. Dark-reddish brown clay, few pinkish gray caliche nodules throughout this interval.
44-47 ft. Dark-brown silty clay, small amount of pepples mixed with vfg-fg sand, few large caliche nodules.
47-50 ft. Yellowish-gray sand vfg-fg, strongly cemented by calcification.
50-60 ft. Light-dark gray sand fg-mg, slightly to moderately cemented by calcification.

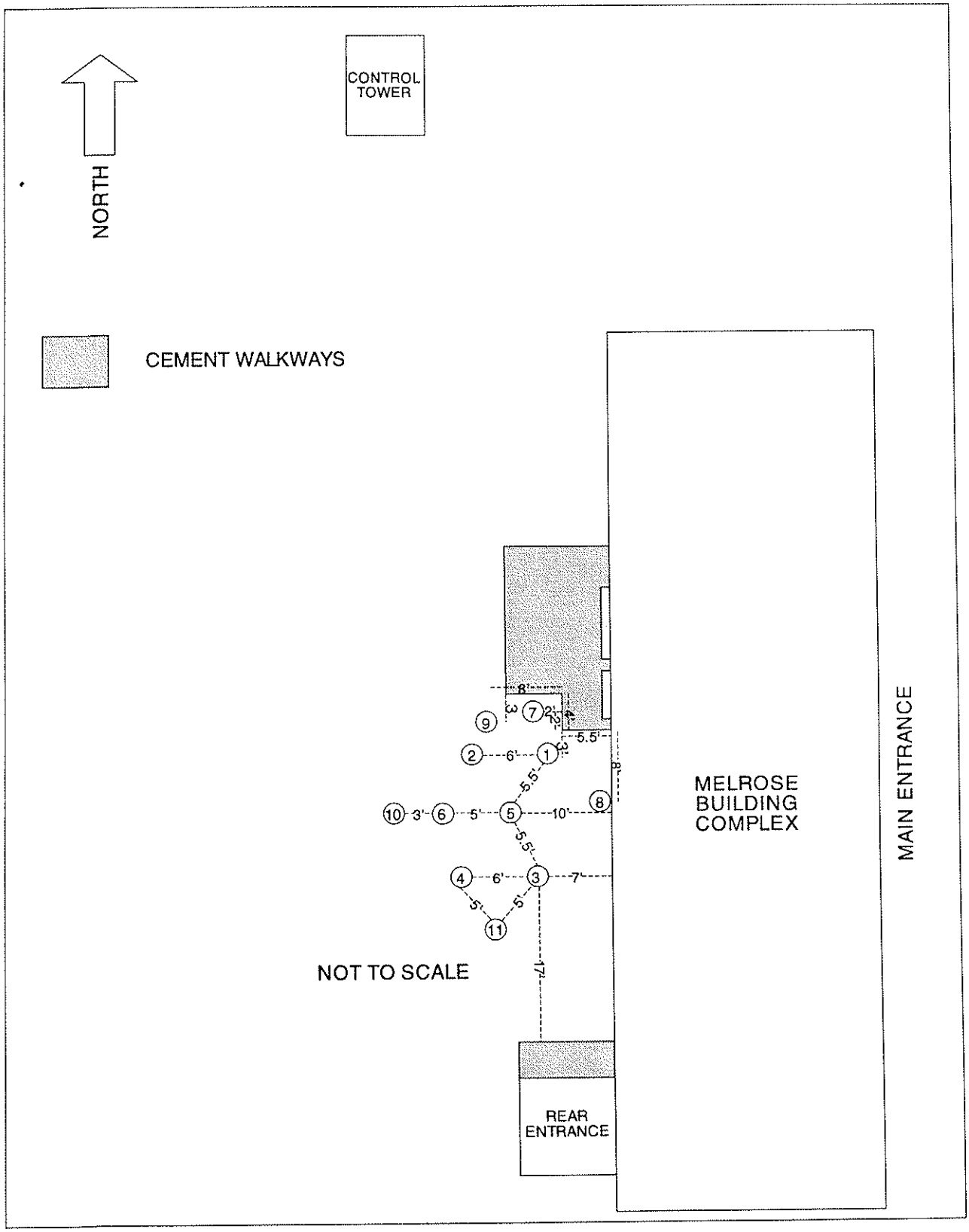


Figure 4.8.1--Location of boreholes at Facility 3121 (Melrose Bombing Range).

FACILITY 3121 (MELROSE BOMBING RANGE)

Table 8.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 3121, Melrose Air Force Range, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041621, 043171, 043723, and 044268 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC3121-0101	8.0-10.0	18APR95	Soil	Environmental	17,000.0 qlt	400.0
CAFB-FAC3121-0102	14.0-16.0	18APR95	Soil	Environmental	5,000.0 lt	400.0
CAFB-FAC3121-0103EB		26JUL95	Aqueous	Equipment blank	0.12 ql	0.1
CAFB-FAC3121-0104	24.0-26.0	26JUL95	Soil	Environmental	13,000.0 tl	400.0
CAFB-FAC3121-0105	29.0-31.0	26JUL95	Soil	Environmental	11,000.0 tl	400.0
CAFB-FAC3121-0106	40.0-41.0	24AUG95	Soil	Environmental	ND	4.0
CAFB-FAC3121-0107	49.5-50.5	24AUG95	Soil	Environmental	9,500.0 lt	400.0
CAFB-FAC3121-0108	59.5-60.5	25AUG95	Soil	Environmental	ND	4.0
CAFB-FAC3121-0201	10.5-12.5	18APR95	Soil	Environmental	3,500.0 qlt	400.0
CAFB-FAC3121-0301	10.0-12.0	18APR95	Soil	Environmental	12,000.0 lt	400.0
CAFB-FAC3121-0302	10.0-12.0	18APR95	Soil	Duplicate	8,800.0 lt	400.0

FACILITY 3121 (MELROSE BOMBING RANGE)

Table 8.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 3121, Melrose Air Force Range, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041621, 043171, 043723, and 044268 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

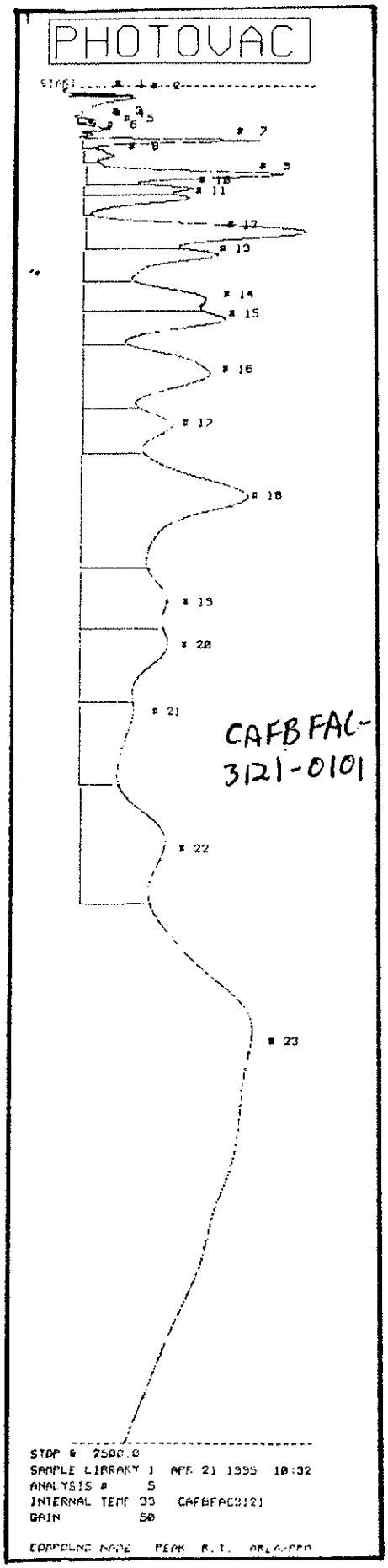
Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC3121-0303		27JUL95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC3121-0303	19.0-21.0	27JUL95	Soil	Environmental	25,000.0 tl	400.0
CAFB-FAC3121-0304	29.0-29.5	27JUL95	Soil	Environmental	17,000.0 tl	400.0
CAFB-FAC3121-0401	11.0-13.0	18APR95	Soil	Environmental	10,000.0 lt	400.0
CAFB-FAC3121-0501	11.0-13.0	18APR95	Soil	Environmental	5,900.0 lt	400.0
CAFB-FAC3121-0601	11.0-13.0	18APR95	Soil	Environmental	3,700.0 lt	400.0
CAFB-FAC3121-0701	12.0-14.0	18APR95	Soil	Environmental	3.2 j	4.0
CAFB-FAC3121-0702		18APR95	Aqueous	Equipment blank	ND	0.1
CAFB-FAC3121-0801	15.0	29JUN95	Soil	Environmental	3.7 j	4.0
CAFB-FAC3121-0901	11.0-13.0	29JUN95	Soil	Environmental	7.2 ql	4.0
CAFB-FAC3121-0902	11.0-13.0	29JUN95	Soil	Duplicate	4.2 ql	4.0
CAFB-FAC3121-1001	14.0-16.0	29JUN95	Soil	Environmental	2.5 j	4.0
CAFB-FAC3121-1101	13.0-15.0	29JUN95	Soil	Environmental	8.6 ql	4.0

FACILITY 3121 (MELROSE BOMBING RANGE)

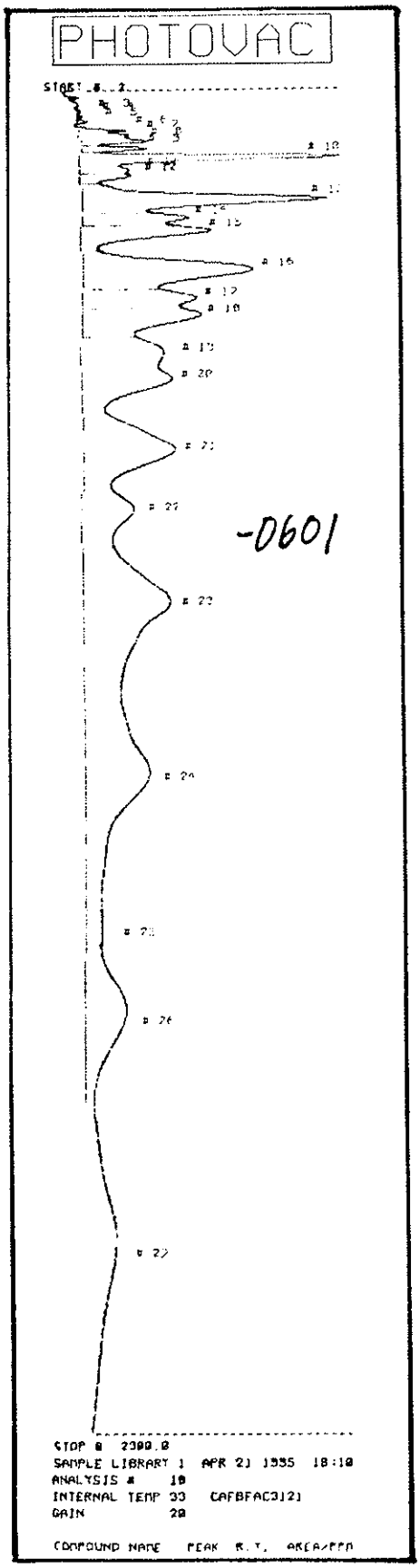
Table 8.--Summary of analytical data results in soil samples and quality control samples from underground tank site Facility 3121, Melrose Air Force Range, New Mexico. [DRO, Diesel range organics; j, Result is detected below the reporting limit or is an estimated concentration; l, Sample resembles a hydrocarbon product occrring within the n-alkane range of C10-C28; Sample has GC/FID characteristics that are similar to fuel oil #2 (for detail, see projects 041621, 043171, 043723, and 044268 in Appendix); ND, Not detected; q, This sample has GC/FID characteristics for which reliable identification of a product could not be achieved; t, Sample diluted due to the concentration of target compounds.]--Continued

Field Sample ID	Sampling Depth (feet)	Sampling Date	Sample Matrix	Sample Description	SW8015 (DRO), Soil-mg/kg, Aqueous-mg/L	Reporting Limit
CAFB-FAC3121-1102		29JUN95	Aqueous	Equipment blank	ND	0.1

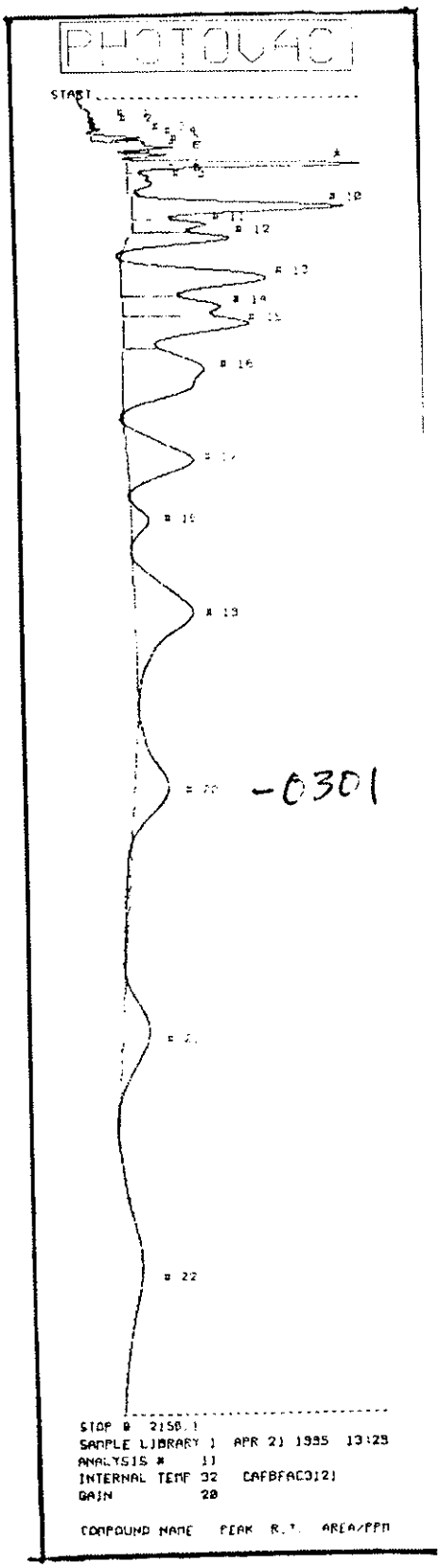
4.8.1 Gas Chromatograms -- Facility 3121



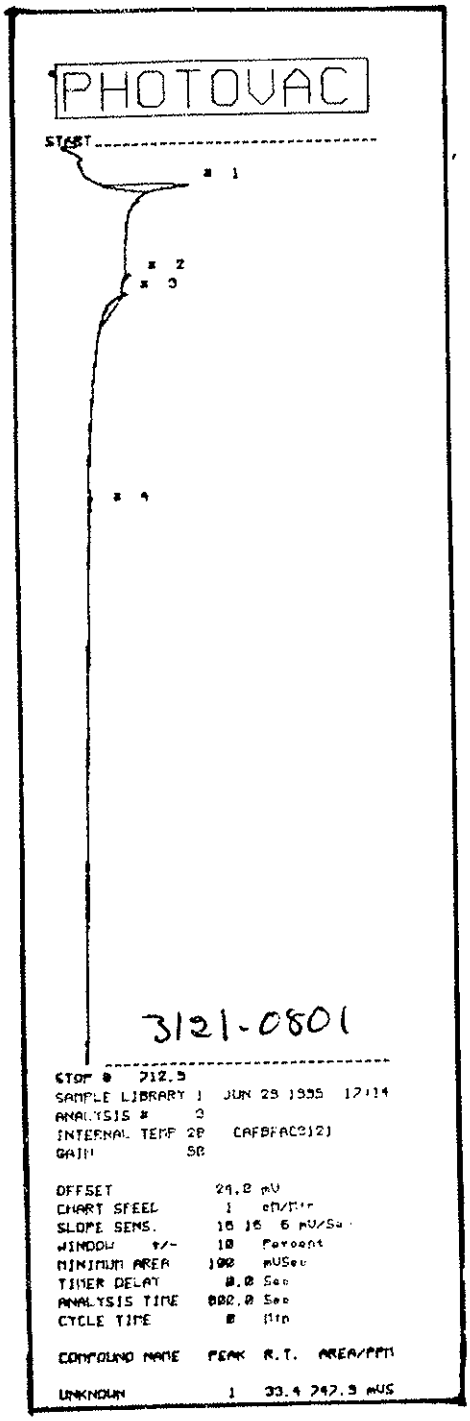
CAFB-FAC3121-0101



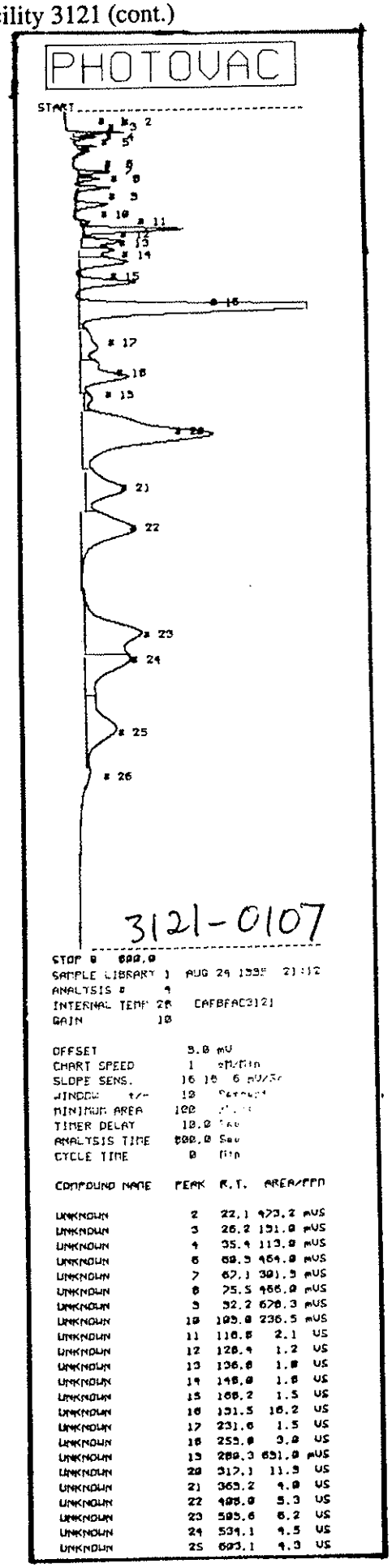
CAFB-FAC3121-0601



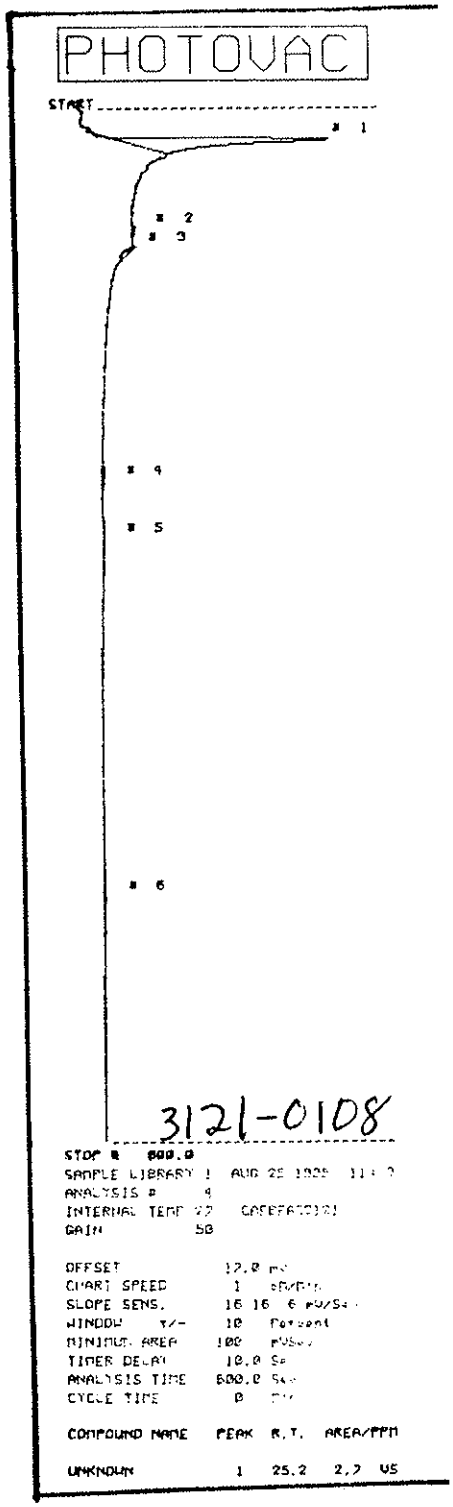
CAFB-FAC3121-0301



CAFB-FAC3121-0801



CAFB-FAC3121-0107



CAFB-FAC3121-0108

THIS PAGE INTENTIONALLY BLANK

CANNON AFB
NEW MEXICO

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 1328

INVESTIGATION OF EIGHT UNDERGROUND STORAGE TANK FACILITIES ON CANNON AIR FORCE BASE AND MELROSE BOMBING RANGE, NEW MEXICO, 1995

VOLUME II

PREPARED FOR

ENVIRONMENTAL MANAGEMENT FLIGHT
CANNON AIR FORCE BASE, NEW MEXICO 88103

PREPARED BY

FREDRICK E. GEBHARDT
U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION
4501 INDIAN SCHOOL ROAD NE, SUITE 200
ALBUQUERQUE, NEW MEXICO 87110

Quanterra Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

FIC 728

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041427

APRIL 26, 1995

Reviewed by: Grant Wilton

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 8, 1995, Quanterra Environmental Services, Denver received one aqueous and thirteen soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical
IV. Quality Control Report

Standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041427-0001-SA	CAFB-FAC0728-0101	SOIL	06 APR 95	08:45	08 APR 95
041427-0002-SA	CAFB-FAC0728-0102	SOIL	06 APR 95	09:45	08 APR 95
041427-0003-SA	CAFB-FAC0728-0103	SOIL	06 APR 95	10:10	08 APR 95
041427-0004-SA	CAFB-FAC0728-0104	SOIL	06 APR 95	10:50	08 APR 95
041427-0005-SA	CAFB-FAC0728-0201	SOIL	06 APR 95	11:20	08 APR 95
041427-0006-SA	CAFB-FAC0728-0301	SOIL	06 APR 95	12:00	08 APR 95
041427-0007-SA	CAFB-FAC0728-0302	SOIL	06 APR 95	12:20	08 APR 95
041427-0008-SA	CAFB-FAC0728-0303	SOIL	06 APR 95	12:50	08 APR 95
041427-0009-SA	CAFB-FAC0728-0401	SOIL	06 APR 95	13:30	08 APR 95
041427-0010-SA	CAFB-FAC0728-0501	SOIL	06 APR 95	14:00	08 APR 95
041427-0011-SA	CAFB-FAC0728-0502	SOIL	06 APR 95	14:20	08 APR 95
041427-0012-SA	CAFB-FAC0728-0504	SOIL	06 APR 95	14:35	08 APR 95
041427-0013-SA	CAFB-FAC0728-0505	SOIL	06 APR 95	14:50	08 APR 95
041427-0014-EB	CAFB-FAC0728-0503	AQUEOUS	06 APR 95	14:30	08 APR 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041427	Group Code	Analysis Description	Custom Test?
0001 - 0013	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0014	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method.

The analytical data reported are subject to the following limitations of the analytical methodology:

Quanterra
Environmental Services

Volatile Organics

a) Due to the chemical nature of ethanol, this component cannot be consistently recovered using EPA Method 624 or 8240. This component is reported with a NR (Not Recoverable) in place of a reporting limit.

b) Methylene chloride and acetone are common laboratory contaminants in GC/MS analysis. We have programs in place to minimize contamination, occasionally these compounds will be found at low levels in samples.

Semivolatile Organics

a) Benzo(b) and benzo(k) fluoranthene cannot be differentiated based on their mass spectra; retention times are almost identical. The isomer which is the closest in retention time to the sample is reported.

b) 1,2-diphenylhydrazine is measured as azobenzene.

c) Diphenylamine cannot be distinguished from N-nitrosodiphenylamine.

d) 3-Methyl phenol and 4-methyl phenol cannot be differentiated because their mass spectra and retention times are almost identical. Results are reported as 3/4-methyl phenol (or m&p-cresols).

e) Several Appendix IX and Refinery List compounds are not consistently recovered using Method 8270, and reporting limits cannot be established. These compounds include: dimethoate, famphur, hexachlorophene, 4-nitroquinoline-1-oxide, 4-phenylenediamine, and benzenethiol.

f) Two Refinery List compounds, pyridine and quinoline, are not recovered after alumina column cleanup.

g) Bis-2-(ethylhexyl)phthalate is a common laboratory contaminant in GC/MS analysis. We have programs in place to minimize this contamination, occasionally these compounds will be found at low levels in samples.

Tentatively Identified Compounds

This report presents results for the "identification" of unknown compounds that were detected in the GC/MS analysis. The results from this work are presented as "tentatively identified compounds" (TIC). The approach used for reporting TICs was based on the protocol established for this purpose in the EPA Superfund methods and on guidelines established by the American Chemical Society (ACS).

In summary, the mass spectrum of chromatographic peaks in concentrations in excess of 10% of the internal standard were obtained. Normally, the number of unknown compounds identified is limited to 10 compounds in the volatile fraction and 20 compounds in the semivolatile fraction. Each mass spectrum was then compared to a library of over 30,000 reference spectra in a computerized "library search." The three "best" matches obtained by the computer were hardcopied along with the mass spectrum of the unknown peak. This information was then reviewed by an analyst who "identified" the compound based on the available information.

All identifications were based on the "Guidelines for GC/MS Identification" developed by the American Chemical Society (Environmental Science and Technology, 1982, 16 143A). As recommended in these guidelines, identifications of unknown substances were reported with a level of confidence. The three levels of confidence cited in the ACS guidelines and used in this report are as follows:

Level 3: Confirmed Identification

The identification is based on the analysis of an authentic standard.

Level 2: Confident Identification

- Good agreement was observed between the unknown compound and a specific library spectrum.

Level 1: Tentative Identification

The unknown compound is only indicative of a specific library spectrum.

Class Identification

The unknown compound was not similar to a specific library spectrum, but it did contain ions characteristic of a class of compounds (saturated hydrocarbon, chlorinated hydrocarbon, etc.).

If there were no library spectra similar to the unknown, and it could not be assigned to a particular class of compounds, the compound is reported as "unknown."

Quantitation of TICs is based on the total ionization peak area relative to an internal standard, assuming a response factor of one. Accordingly, the reported concentration is an estimate.

In general, mass spectrometry cannot distinguish isomers (compounds with the same molecular formula). Therefore, an identified compound may be any one of several different isomers.

The tentatively identified compounds in this report include some compounds reported as "siloxanes". Siloxanes are common laboratory and field artifacts or contaminants. Potential sources include silicon-based grease in the field or laboratory plus the liquid phase coating on gas chromatography columns, as well as other equipment in the laboratory. However, siloxanes may be present in environmental samples from spills of silicone oils or lubricating oils with siloxane additives.

Metals

All nominal reporting limits for metals have been established from instrument detection limit (IDL) evaluations and represent the level above which reliable data can be routinely obtained. Low level standards are analyzed seven times on three non-consecutive days on each instrument. The standard deviations of the three runs are summed to yield the IDL. Nominal reporting limits are generally 2-5 times the IDL (consistent with the American Chemical Society definition for the Limit of Quantification). The ability to achieve these quoted reporting limits is verified each quarter. Reporting limits above the nominal levels are often submitted due to matrix interferences or elevated analyte levels.

Reporting limits for metals analyzed by Inductively Coupled Plasma (ICP) are typically raised only for dilution due to an analyte exceeding the instrument linear range. Background and interelement interferences are corrected automatically and do not require dilution.

Metals analyzed by Graphite Furnace Atomic Absorption (GFAA) are subject to matrix interferences. Consequently, Quanterra Environmental Services, Denver laboratory's protocol is to analyze a spiked aliquot with every sample. The severity of the interference, based upon analyte level and spike recovery, is assessed against specific criteria and the need for an elevated reporting limit or dilution is determined.

The analysis of mercury by Cold Vapor Atomic Absorption (CVAA) is generally free from matrix interferences. As with ICP, reporting limits are raised only for dilution due to a sample concentration exceeding the linear range of the instrument.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analysts judgement) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as in the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatile Organics, 1/10 of the reporting limit for GC/MS Semivolatile Organics, 1/2 the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

Quanterra
Environmental Services

T Preferred value unless footnoted on the secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with the footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multi-analyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0101
Lab ID: 041427-0001-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.3	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	96	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0102
Lab ID: 041427-0002-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.2	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	102	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C20.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0103
Lab ID: 041427-0003-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.9	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	96	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C16.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0104
Lab ID: 041427-0004-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.5	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	90	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0201
Lab ID: 041427-0005-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.9	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	91	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0301
Lab ID: 041427-0006-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.6	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	91	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C20.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0302
Lab ID: 041427-0007-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	94	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0303
Lab ID: 041427-0008-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	12	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	99	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C22.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0401
Lab ID: 041427-0009-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.7	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	105	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0501
Lab ID: 041427-0010-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.5	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	94	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0502
Lab ID: 041427-0011-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.7	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	100	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0504
Lab ID: 041427-0012-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.9	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	89	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0505
Lab ID: 041427-0013-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 14 APR 95 Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.8	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	90	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0503
Lab ID: 041427-0014-EB
Matrix: AQUEOUS Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: 12 APR 95 Analyzed: 14 APR 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	95	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0101
Lab ID: 041427-0001-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.7	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0102
Lab ID: 041427-0002-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0103
Lab ID: 041427-0003-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0104
Lab ID: 041427-0004-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0201
Lab ID: 041427-0005-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0301
Lab ID: 041427-0006-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0302
Lab ID: 041427-0007-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0303
Lab ID: 041427-0008-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0401
Lab ID: 041427-0009-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0501
Lab ID: 041427-0010-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0502
Lab ID: 041427-0011-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0504
Lab ID: 041427-0012-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0728-0505
Lab ID: 041427-0013-SA
Matrix: SOIL Sampled: 06 APR 95 Received: 08 APR 95
Authorized: 08 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a rigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results)

to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery:

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD):

$$\text{RPD} = \frac{\left| \text{Measured Concentration DCS1} - \text{Measured Concentration DCS2} \right|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041427-0001-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0002-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0003-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0004-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0005-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0006-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0007-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0008-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0009-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0010-SA	SOIL	8015M-D-S	14 APR 95-N21	14 APR 95-N21
041427-0011-SA	SOIL	8015M-D-S	14 APR 95-N22	14 APR 95-N22
041427-0012-SA	SOIL	8015M-D-S	14 APR 95-N22	14 APR 95-N22
041427-0013-SA	SOIL	8015M-D-S	14 APR 95-N22	14 APR 95-N22
041427-0014-EB	AQUEOUS	8015M-D-A	12 APR 95-N11	12 APR 95-N11

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 14 APR 95-N21 Concentration Units: mg/kg								
Diesel Range Organics	20.0	20.6	19.5	20.0	100	48-138	5.5	32
Category: 8015M-D-S Matrix: SOIL QC Lot: 14 APR 95-N22 Concentration Units: mg/kg								
Diesel Range Organics	20.0	21.3	19.1	20.2	101	48-138	11	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 12 APR 95-N11 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.347	0.320	0.334	67	26-121	8.1	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 14 APR 95-N21 QC Run: 14 APR 95-N21				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.816	102	64-136
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 14 APR 95-N22 QC Run: 14 APR 95-N22				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.741	93	64-136
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 12 APR 95-N11 QC Run: 12 APR 95-N11				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0197	98	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit	
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 14 APR 95-N21 QC Run: 14 APR 95-N21				
Diesel Range Organics	3.8	mg/kg	4.0	J
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 14 APR 95-N22 QC Run: 14 APR 95-N22				
Diesel Range Organics	3.8	mg/kg	4.0	J
Test: 8015M-DRO-FID-A Matrix: AQUEOUS QC Lot: 12 APR 95-N11 QC Run: 12 APR 95-N11				
Diesel Range Organics	ND	mg/L	0.10	

J = Result is detected below the reporting limit or is an estimated concentration.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number	PACKING AND SHIPPING DETAILS	
Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	Packed and Sealed for Shipping by: Ralph Wilcox	Seal Number: 001
Sampling Location: Facility 728	Delivered to Shipper by: Ralph Wilcox	Airbill Number: 3436569673
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing	

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
04/06/95	0845	CAFB-FAC0728-0101	SOIL	1	SW8015 (DRO)	Environmental Sample	-01
"	0945	" -0102	"	"	"	"	-02
"	1010	" -0103	"	"	"	"	-03
"	1050	" -0104	"	"	"	"	-04
"	1120	" -0201	"	"	"	"	-05
"	1200	" -0301	"	"	"	"	-06
"	1220	" -0302	"	"	"	"	-07
"	1250	" -0303	"	"	"	"	-08
"	1330	" -0401	"	"	"	"	-09
"	1400	" -0501	"	"	"	"	-10
"	1420	" -0502	"	"	"	"	-11
"	1435	" -0504	"	"	"	"	-12
"	1450	" -0505	"	"	"	"	-13
"	1430	" -0503	WATER	"	"	Equipment Blank	-14

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt ☒ Yes ☐ No
Ralph Wilcox III	to Federal Express	04/07/95	1400	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: Good
	[illegible] QDL	4/8/95	0900	ph: (303) 421-6611	Contents Temperature: 4.1°C
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41427

QDL# 41427

Quanterra Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

FIDC
130
2285

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041449

APRIL 30, 1995

Reviewed by:

Grant Wilton

FOR

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 11, 1995, Quanterra Environmental Services, Denver received nineteen soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical
IV. Quality Control Report

Standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041449-0001-SA	CAFB-FAC2285-0101	SOIL	07 APR 95	09:50	11 APR 95
041449-0002-SA	CAFB-FAC2285-0201	SOIL	07 APR 95	10:20	11 APR 95
041449-0003-SA	CAFB-FAC2285-0301	SOIL	07 APR 95	10:50	11 APR 95
041449-0004-SA	CAFB-FAC2285-0401	SOIL	07 APR 95	11:30	11 APR 95
041449-0005-SA	CAFB-FAC2285-0402	SOIL	07 APR 95	12:00	11 APR 95
041449-0006-SA	CAFB-FAC2285-0501	SOIL	07 APR 95	13:50	11 APR 95
041449-0007-SA	CAFB-FAC2285-0502	SOIL	07 APR 95	14:30	11 APR 95
041449-0008-SA	CAFB-FAC2285-0102	SOIL	07 APR 95	15:00	11 APR 95
041449-0009-SA	CAFB-FAC2285-0202	SOIL	07 APR 95	15:40	11 APR 95
041449-0010-SA	CAFB-FAC0130-0101	SOIL	08 APR 95	09:50	11 APR 95
041449-0010-MS	CAFB-FAC0130-0101	SOIL	08 APR 95	09:50	11 APR 95
041449-0010-SD	CAFB-FAC0130-0101	SOIL	08 APR 95	09:50	11 APR 95
041449-0011-SA	CAFB-FAC0130-0102	SOIL	08 APR 95	10:45	11 APR 95
041449-0012-SA	CAFB-FAC0130-0201	SOIL	08 APR 95	11:20	11 APR 95
041449-0013-SA	CAFB-FAC0130-0203	SOIL	08 APR 95	12:20	11 APR 95
041449-0014-SA	CAFB-FAC0130-0301	SOIL	08 APR 95	12:55	11 APR 95
041449-0015-SA	CAFB-FAC0130-0302	SOIL	08 APR 95	13:20	11 APR 95
041449-0016-SA	CAFB-FAC0130-0401	SOIL	08 APR 95	13:55	11 APR 95
041449-0017-SA	CAFB-FAC0130-0402	SOIL	08 APR 95	14:20	11 APR 95
041449-0018-SA	CAFB-FAC0130-0501	SOIL	08 APR 95	15:20	11 APR 95
041449-0019-SA	CAFB-FAC0130-0502	SOIL	08 APR 95	15:45	11 APR 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041449	Group Code	Analysis Description	Custom Test?
0001 - 0019	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N

Quanterra
Environmental Services

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analysts judgement) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as in the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatile Organics, 1/10 of the reporting limit for GC/MS Semivolatile Organics, 1/2 the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

T Preferred value unless footnoted on the secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with the footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multi-analyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0101
Lab ID: 041449-0001-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	20	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	107	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0201
Lab ID: 041449-0002-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	91	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0301
Lab ID: 041449-0003-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	95	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0401
Lab ID: 041449-0004-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.3	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	101	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0402
Lab ID: 041449-0005-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	13	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	110	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C16-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0501
Lab ID: 041449-0006-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.6	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	96	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C16-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0502
Lab ID: 041449-0007-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.2	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	104	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0102
Lab ID: 041449-0008-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 24 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	24	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	104	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0202
Lab ID: 041449-0009-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 24 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.0	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	98	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0101
Lab ID: 041449-0010-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 24 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.6	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	98	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0102
Lab ID: 041449-0011-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.0	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	102	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0201
Lab ID: 041449-0012-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	97	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0203
Lab ID: 041449-0013-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.8	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	97	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0301
Lab ID: 041449-0014-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.1	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	101	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0302
Lab ID: 041449-0015-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.5	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	108	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0401
Lab ID: 041449-0016-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.0	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	101	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0402
Lab ID: 041449-0017-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.9	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	95	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0501
Lab ID: 041449-0018-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.5	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	99	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0502
Lab ID: 041449-0019-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 17 APR 95 Analyzed: 21 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.4	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	98	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0101
Lab ID: 041449-0001-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0201
Lab ID: 041449-0002-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0301
Lab ID: 041449-0003-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.8	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0401
Lab ID: 041449-0004-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0402
Lab ID: 041449-0005-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0501
Lab ID: 041449-0006-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0502
Lab ID: 041449-0007-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0102
Lab ID: 041449-0008-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC2285-0202
Lab ID: 041449-0009-SA
Matrix: SOIL Sampled: 07 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0101
Lab ID: 041449-0010-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	7.5	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0102
Lab ID: 041449-0011-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.8	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0201
Lab ID: 041449-0012-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0203
Lab ID: 041449-0013-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0301
Lab ID: 041449-0014-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0302
Lab ID: 041449-0015-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0401
Lab ID: 041449-0016-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.2	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0402
Lab ID: 041449-0017-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.9	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0501
Lab ID: 041449-0018-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0502
Lab ID: 041449-0019-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorjzed: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results)

to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery:

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD):

$$\text{RPD} = \frac{\left| \text{Measured Concentration DCS1} - \text{Measured Concentration DCS2} \right|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041449-0001-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0002-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0003-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0004-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0005-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0006-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0007-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0008-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0009-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0010-SA	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0010-MS	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0010-SD	SOIL	8015M-D-S	17 APR 95-N12	17 APR 95-N12
041449-0011-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0012-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0013-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0014-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0015-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0016-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0017-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0018-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1
041449-0019-SA	SOIL	8015M-D-S	17 APR 95-N1	17 APR 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 17 APR 95-N12 Concentration Units: mg/kg								
Diesel Range Organics	20.0	21.6	20.2	20.9	105	48-138	6.7	32
Category: 8015M-D-S Matrix: SOIL QC Lot: 17 APR 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	22.0	20.5	21.2	106	48-138	7.1	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 17 APR 95-N12 QC Run: 17 APR 95-N12				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.789	99	64-136
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 17 APR 95-N1 QC Run: 17 APR 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.835	104	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 17 APR 95-N12 QC Run: 17 APR 95-N12			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 17 APR 95-N12 QC Run: 17 APR 95-N12			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 17 APR 95-N1 QC Run: 17 APR 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

Quanterra
Environmental Services

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Organics by Chromatography

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE DUPLICATE	8015M-DRO-FID-S	041449-0010-SD	17 APR 95-N12
MATRIX SPIKE	8015M-DRO-FID-S	041449-0010-MS	17 APR 95-N12

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
ganics by Chromatography
Project: 041449

Category: 8015M-D-S Diesel Range Organics in Solid Samples
Matrix: SOIL
Sample: 041449-0010
MS Run: 17 APR 95-N12
Units mg/kg Units Qualifier: Wet wt.

Analyte	Concentration Sample Result		MS Result	MSD Result	Amount Spiked MS	Amount Spiked MSD	% Recovery MS	% Recovery MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Diesel Range Organics (C8-C32)	2.6	J	19	24	20	20	84	107	48-138	24	32

J = Result is detected below the reporting limit or is an estimated concentration.

Calculations are performed before rounding to avoid round-off errors in calculated results.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITIES 2285, 130, and 600	Packed and Sealed for Shipping by: Fred Gebhardt — Seal Number: 001
Team Leader: Fred Gebhardt	Delivered to Shipper by: Fred Gebhardt — Airbill Number: 3436570701
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
04/07/95	0950	CAFB-FAC2285-0101	SOIL	1	SW8015 (DRO)	Environmental Sample
"	1020	" -0201	"	"	"	"
"	1050	" -0301	"	"	"	"
"	1130	" -0401	"	"	"	"
"	1200	" -0402	"	"	"	"
"	1350	" -0501	"	"	"	"
"	1430	" -0502	"	"	"	"
"	1500	" -0102	"	"	"	"
"	1540	" -0202	"	"	"	"
04/08/95	0950	CAFB-FAC0130-0101	"	2	"	Environmental Sample plus MS and MSD

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick E. Gebhardt		4/10/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	[illegible]	4/11/95	915	ph: (303) 421-6611	Contents Temperature: 2.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41449

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITIES 2285, 130, and 600	Packed and Sealed for Shipping by: Fred Gebhardt — Seal Number: 001
Team Leader: Fred Gebhardt	Delivered to Shipper by: Fred Gebhardt — Airbill Number: 3436570701
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
04/08/95	1045	CAFB-FAC0130-0102	SOIL	1	SW8015 (DRO)	Environmental Sample	-11
"	1120	" -0201	"	"	"	"	-12
~~" 1150~~		~~" -0202~~	~~"~~	~~"~~	~~"~~	~~"~~	
"	1220	" -0203	"	"	"	"	-13
"	1255	" -0301	"	"	"	"	-14
"	1320	" -0302	"	"	"	"	-15
"	1355	" -0401	"	"	"	"	-16
"	1420	" -0402	"	"	"	"	-17
"	1520	" -0501	"	"	"	"	-18
"	1545	" -0502	"	"	"	"	-19

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick E. Gebhardt		4/10/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: Good
	J. McChas	4/11/95	915	ph: (303) 421-6611	Contents Temperature: 2.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41449

Quanterra
Environmental Services

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041450

MAY 5, 1995

FMC
130
600

Reviewed by: _____ FOR
Grant Wilton

_____
Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 11, 1995, Quanterra Environmental Services, Denver laboratory received 1 aqueous and 17 soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

DEISEL RANGE ORGANICS

All analyses at Quanterra's Denver laboratory are performed so that the maximum concentration of sample consistent with the method is analyzed. Dilutions are at times required to achieve linearity of the specific parameter or to reduce matrix interferences. In this event, reporting limits are adjusted proportionately. Surrogates may not be reportable in samples that have been diluted. The surrogates for samples 041450-0009-SA, -0010-SA, -0016-SA, -0016-MS and -0016-SD were diluted out.

With the exceptions as noted above, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041450-0001-SA	CAFB-FAC0130-0503	SOIL	08 APR 95	16:15	11 APR 95
041450-0002-SA	CAFB-FAC0600-0101	SOIL	09 APR 95	08:30	11 APR 95
041450-0003-SA	CAFB-FAC0600-0102	SOIL	09 APR 95	08:30	11 APR 95
041450-0004-SA	CAFB-FAC0600-0103	SOIL	09 APR 95	09:00	11 APR 95
041450-0005-SA	CAFB-FAC0600-0104	SOIL	09 APR 95	09:20	11 APR 95
041450-0006-SA	CAFB-FAC0600-0201	SOIL	09 APR 95	10:10	11 APR 95
041450-0007-SA	CAFB-FAC0600-0202	SOIL	09 APR 95	10:40	11 APR 95
041450-0008-SA	CAFB-FAC0600-0203	SOIL	09 APR 95	11:00	11 APR 95
041450-0009-SA	CAFB-FAC0600-0301	SOIL	09 APR 95	11:30	11 APR 95
041450-0010-SA	CAFB-FAC0600-0302	SOIL	09 APR 95	11:45	11 APR 95
041450-0011-EB	CAFB-FAC0600-0303	AQUEOUS	09 APR 95	12:00	11 APR 95
041450-0012-SA	CAFB-FAC0600-0304	SOIL	09 APR 95	12:05	11 APR 95
041450-0013-SA	CAFB-FAC0600-0401	SOIL	09 APR 95	12:30	11 APR 95
041450-0014-SA	CAFB-FAC0600-0402	SOIL	09 APR 95	12:50	11 APR 95
041450-0015-SA	CAFB-FAC0600-0403	SOIL	09 APR 95	13:20	11 APR 95
041450-0016-SA	CAFB-FAC0600-0501	SOIL	09 APR 95	13:50	11 APR 95
041450-0016-MS	CAFB-FAC0600-0501	SOIL	09 APR 95	13:50	11 APR 95
041450-0016-SD	CAFB-FAC0600-0501	SOIL	09 APR 95	13:50	11 APR 95
041450-0017-SA	CAFB-FAC0600-0502	SOIL	09 APR 95	14:20	11 APR 95
041450-0018-SA	CAFB-FAC0600-0503	SOIL	09 APR 95	14:40	11 APR 95

– diluted

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041450	Group Code	Analysis Description	Custom Test?
0001 - 0010, 0012 - 0018	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0011	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Custom footnotes may be used for example, with GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgement) the product that appears to be present. The general qualifiers that serve to identify problems and pertinent observations made during sample analysis and review that are not discussed in the Overview section of this report are described below:

B Compound is also detected in the method blank.

This footnote indicates that the compound was detected in the sample as well as in the method blank. Please note that the "B" flag is not used when the sample result is ND (not detected).

G Reporting limit raised due to matrix interference.

This footnote indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all compounds determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the compound was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit (MDL) study, "J" values are generally reported to 1/5 of the reporting limit for GC/MS volatile organics, 1/10 of the reporting limit for GC/MS semivolatile organics, 1/2 of the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

T Preferred value unless footnoted on the secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footenote will be listed only for the first compound but pertains to all the compounds determined by the method. It is used in conjunction with the "V" footnote.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the "T" footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates the reporting limits were raised due to the presence of target compounds outside the calibration range of the method. For multi-compound methods, the footnote will appear only for the first compound but pertains to all compounds determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0503
Lab ID: 041450-0001-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	89	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0101
Lab ID: 041450-0002-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.4	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	98	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0102
Lab ID: 041450-0003-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.5	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	95	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0103
Lab ID: 041450-0004-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	93	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0104
Lab ID: 041450-0005-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.6	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	98	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0201
Lab ID: 041450-0006-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.6	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	100	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0202
Lab ID: 041450-0007-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	86	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0203
Lab ID: 041450-0008-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.1	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	94	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0301
Lab ID: 041450-0009-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2800	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0302
Lab ID: 041450-0010-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3500	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0303
Lab ID: 041450-0011-EB
Matrix: AQUEOUS Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 15 APR 95 Analyzed: 21 APR 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	113	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0304
Lab ID: 041450-0012-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.8	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	98	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0401
Lab ID: 041450-0013-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.1	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	97	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : This sample contains a single peak C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0402
Lab ID: 041450-0014-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.9	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	92	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0403
Lab ID: 041450-0015-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.8	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	80	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0501
Lab ID: 041450-0016-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	820	mg/kg	80	qlt
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0502
Lab ID: 041450-0017-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	14	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	97	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0503
Lab ID: 041450-0018-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: 18 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.6	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	94	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0130-0503
Lab ID: 041450-0001-SA
Matrix: SOIL Sampled: 08 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0101
Lab ID: 041450-0002-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0102
Lab ID: 041450-0003-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0103
Lab ID: 041450-0004-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0104
Lab ID: 041450-0005-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0201
Lab ID: 041450-0006-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	4.2	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0202
Lab ID: 041450-0007-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0203
Lab ID: 041450-0008-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0301
Lab ID: 041450-0009-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.6	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0302
Lab ID: 041450-0010-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0304
Lab ID: 041450-0012-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	6.3	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0401
Lab ID: 041450-0013-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0402
Lab ID: 041450-0014-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.7	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0403
Lab ID: 041450-0015-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0501
Lab ID: 041450-0016-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.9	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0502
Lab ID: 041450-0017-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0600-0503
Lab ID: 041450-0018-SA
Matrix: SOIL Sampled: 09 APR 95 Received: 11 APR 95
Authorized: 11 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{Measured Concentration DCS1} - \text{Measured Concentration DCS2}|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041450-0001-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0002-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0003-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0004-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0005-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0006-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0007-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0008-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0009-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0010-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0011-EB	AQUEOUS	8015M-D-A	15 APR 95-N1	15 APR 95-N1
041450-0012-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0013-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0014-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0015-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0016-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0016-MS	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0016-SD	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0017-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2
041450-0018-SA	SOIL	8015M-D-S	18 APR 95-N2	18 APR 95-N2

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Limits	Precision (RPD) DCS	Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 18 APR 95-N2 Concentration Units: mg/kg								
Diesel Range Organics	20.0	17.8	17.4	17.6	88	48-138	2.3	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 15 APR 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.473	0.310	0.391	78	26-121	42	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 18 APR 95-N2 QC Run: 18 APR 95-N2				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.751	94	64-136
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 15 APR 95-N1 QC Run: 15 APR 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0218	109	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 18 APR 95-N2 QC Run: 18 APR 95-N2			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 15 APR 95-N1 QC Run: 15 APR 95-N1			
Diesel Range Organics	ND	mg/L	0.10
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 18 APR 95-N2 QC Run: 18 APR 95-N2			
Diesel Range Organics	ND	mg/kg	4.0

Quanterra
Environmental Services

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Organics by Chromatography

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE DUPLICATE	8015M-DRO-FID-S	041450-0016-SD	18 APR 95-N2
MATRIX SPIKE	8015M-DRO-FID-S	041450-0016-MS	18 APR 95-N2

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
ganics by Chromatography
Project: 041450

Category: 8015M-D-S Diesel Range Organics in Solid Samples
Matrix: SOIL
Sample: 041450-0016
MS Run: 18 APR 95-N2
Units mg/kg Units Qualifier: Wet wt.

Analyte	Concentration Sample Result	MS Result	MSD Result	Amount Spiked MS	MSD	% Recovery MS	MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Diesel Range Organics (C8-C32)	820	800	810	20	20	NC	NC	48-138	NC	32

NC = Not Calculated, calculation not applicable.

Calculations are performed before rounding to avoid round-off errors in calculated results.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	PACKING AND SHIPPING DETAILS: Packed and Sealed for Shipping by: FRED GEBHARDT; Seal Number: 001
Sampling Location: FACILITIES 2285, 130, and 600	Delivered to Shipper by: FRED GEBHARDT; Airbill Number: 3436570701
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
04/08/95	1615	CAFB-FAC0130-0503	SOIL	1	SW8015 (DRO)	Environmental Sample	-01
04/09/95	0830	CAFB-FAC0600-0101	"	"	"	"	-02
"	0830	" -0102	"	"	"	"	-03
"	0900	" -0103	"	"	"	"	-04
"	0920	" -0104	"	"	"	"	-05
"	1010	" -0201	"	"	"	"	-06
"	1040	" -0202	"	"	"	"	-07
"	1100	" -0203	"	"	"	"	-08
"	1130	" -0301	"	"	"	"	-09
"	1145	" -0302	"	"	"	"	-10

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick E. Gebhardt		4/10/95	1200	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[illegible]	4/11/95	915	ph: (303) 421-6611	Contents Temperature: 2.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41450

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITIES 2285, 130, and 600	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 001
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436570701
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
04/09/95	1200	CAFB-FAC0600-0303	WATER	1	SW8015 (DRO)	Equipment Blank	-11
"	1205	" -0304	SOIL	"	"	Environmental Sample	-12
"	1230	" -0401	"	"	"	"	-13
"	1250	" -0402	"	"	"	"	-14
"	1320	" -0403	"	"	"	"	-15
"	1350	" -0501	"	2	"	Environmental Sample plus MS and MSD	-16 MS SD
"	1420	" -0502	"	1	"	Environmental Sample	-17
"	1440	" -0503	"	"	"	"	-18

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick E. Gebhardt		4/10/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	[illegible]	4/11/95	915	ph: (303) 421-6611	Contents Temperature: 2.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 7450

Quanterra Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

1060
1400

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041519

MAY 11, 1995

Reviewed by: Grant Wilton

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 14, 1995, Quanterra Environmental Services, Denver received one aqueous and thirteen soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical
IV. Quality Control Report

DIESEL RANGE ORGANIC ANALYSIS

Due to the dilutions required to bring the samples within the calibration range of the instrument, surrogate recoveries could not be determined for Quanterra sample numbers 041519-0003-SA, -0009-SA, -0010-SA and -0013-SA.

Except where indicated above, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041519-0001-SA	CAFB-FAC3060-0201	SOIL	11 APR 95	11:00	14 APR 95
041519-0002-SA	CAFB-FAC3060-0202	SOIL	11 APR 95	11:15	14 APR 95
041519-0003-SA	CAFB-FAC3060-0301	SOIL	11 APR 95	11:30	14 APR 95
041519-0004-SA	CAFB-FAC3060-0302	SOIL	11 APR 95	12:15	14 APR 95
041519-0005-SA	CAFB-FAC3060-0401	SOIL	11 APR 95	12:45	14 APR 95
041519-0006-SA	CAFB-FAC3060-0501	SOIL	11 APR 95	13:15	14 APR 95
041519-0007-SA	CAFB-FAC3060-0601	SOIL	11 APR 95	13:45	14 APR 95
041519-0008-SA	CAFB-FAC1400-0102	SOIL	12 APR 95	10:00	14 APR 95
041519-0009-SA	CAFB-FAC1400-0201	SOIL	12 APR 95	11:00	14 APR 95
041519-0010-SA	CAFB-FAC1400-0301	SOIL	12 APR 95	12:30	14 APR 95
041519-0011-SA	CAFB-FAC1400-0302	SOIL	12 APR 95	14:00	14 APR 95
041519-0012-SA	CAFB-FAC1400-0401	SOIL	12 APR 95	15:00	14 APR 95
041519-0013-SA	CAFB-FAC1400-0402	SOIL	12 APR 95	16:20	14 APR 95
041519-0014-EB	CAFB-FAC1400-0403	AQUEOUS	12 APR 95	17:30	14 APR 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041519	Group Code	Analysis Description	Custom Test?
0001 - 0013	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0014	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041519	Group Code	Analysis Description	Custom Test?
0001 - 0013	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0014	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analysts judgement) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as in the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatile Organics, 1/10 of the reporting limit for GC/MS Semivolatile Organics, 1/2 the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

T Preferred value unless footnoted on the secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with the footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multi-analyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0201
Lab ID: 041519-0001-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	1300	mg/kg	40	t1
Surrogate	Recovery			
o-Terphenyl	194	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0202
Lab ID: 041519-0002-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.7	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	104	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0301
Lab ID: 041519-0003-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5300	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0302
Lab ID: 041519-0004-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	23	mg/kg	4.0	1
Surrogate	Recovery			
o-Terphenyl	122	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0401
Lab ID: 041519-0005-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.3	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	111	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0501
Lab ID: 041519-0006-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	104	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0601
Lab ID: 041519-0007-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	37	mg/kg	4.0	1
Surrogate	Recovery			
o-Terphenyl	118	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0102
Lab ID: 041519-0008-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	51	mg/kg	8.0	tql
Surrogate	Recovery			
o-Terphenyl	124	%		

Note t : Sample diluted due to the concentration of target compounds.

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0201
Lab ID: 041519-0009-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 02 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6200	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0301
Lab ID: 041519-0010-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	9900	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0302
Lab ID: 041519-0011-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 02 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	370	mg/kg	8.0	t1
Surrogate	Recovery			
o-Terphenyl	127	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0401
Lab ID: 041519-0012-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 02 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	16	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	128	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0402
Lab ID: 041519-0013-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 22 APR 95 Analyzed: 02 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2500	mg/kg	80	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0403
Lab ID: 041519-0014-EB
Matrix: AQUEOUS Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: 15 APR 95 Analyzed: 21 APR 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	97	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0201
Lab ID: 041519-0001-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0202
Lab ID: 041519-0002-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0301
Lab ID: 041519-0003-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0302
Lab ID: 041519-0004-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.1	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0401
Lab ID: 041519-0005-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	6.9	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0501
Lab ID: 041519-0006-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3060-0601
Lab ID: 041519-0007-SA
Matrix: SOIL Sampled: 11 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.8	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0102
Lab ID: 041519-0008-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	3.5	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0201
Lab ID: 041519-0009-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0301
Lab ID: 041519-0010-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.9	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0302
Lab ID: 041519-0011-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.6	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0401
Lab ID: 041519-0012-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0402
Lab ID: 041519-0013-SA
Matrix: SOIL Sampled: 12 APR 95 Received: 14 APR 95
Authorized: 14 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	19	%	0.10	D2216	NA	19 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results)

to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery:

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD):

$$\text{RPD} = \frac{\left| \text{Measured Concentration DCS1} - \text{Measured Concentration DCS2} \right|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041519-0001-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0002-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0003-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0004-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0005-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0006-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0007-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0008-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0009-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0010-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0011-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0012-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0013-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1
041519-0014-EB	AQUEOUS	8015M-D-A	15 APR 95-N1	15 APR 95-N1

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 22 APR 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	22.8	21.9	22.4	112	48-138	4.0	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 15 APR 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.473	0.310	0.391	78	26-121	42	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 22 APR 95-N1 QC Run: 22 APR 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.938	117	64-136
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 15 APR 95-N1 QC Run: 15 APR 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0218	109	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 22 APR 95-N1 QC Run: 22 APR 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 15 APR 95-N1 QC Run: 15 APR 95-N1			
Diesel Range Organics	ND	mg/L	0.10

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number	PACKING AND SHIPPING DETAILS.	
Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	Packed and Sealed for Shipping by: FRED GEBHARDT	Seal Number: 001
Sampling Location: FACILITY 3060 & 1400	Delivered to Shipper by: FRED GEBHARDT	Airbill Number: 3436570690
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing	

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
4/11/95	1100	CAFB-FAC3060-0201	SOIL	1	SW8015 (DRO)	ENVIRONMENTAL SAMPLE	-01
"	1115	" -0202	"	1	"	"	-02
"	1130	" -0301	"	1	"	"	-03
"	1215	" -0302	"	1	"	"	-04
"	1245	" -0401	"	1	"	"	-05
"	1315	" -0501	"	1	"	"	-06
"	1345	" -0601	"	1	"	"	-07
4/12/95	1000	CAFB-FAC1400-0102	SOIL	1	"	"	-08
	1100	" -0201	"	1	"	"	-09
	1230	" -0301	"	1	"	"	-10

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick E. Gebhardt	TO FEDERAL EXPRESS	4/13/95	1400	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: Good
	[illegible]	4/14/95	845	ph: (303) 421-6611	Contents Temperature: 2.1
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 4159

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number	PACKING AND SHIPPING DETAILS	
Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	Packed and Sealed for Shipping by: FRED GEBHARDT	Seal Number: 001
Sampling Location: FACILITY 1400	Delivered to Shipper by: FRED GEBHARDT	Airbill Number: 3436570690
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☐ Continuing	

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
4/12/95	1400	CAFB FAC 1400-0302	SOIL	1	SW8015 (DRO)	ENVIRONMENTAL SAMPLE	-11
"	1500	" -0401	"	1	"	"	-12
"	1620	" -0402	"	1	"	"	-13
"	1730	" -0403	WATER	1	"	EQUIPMENT BLANK	-14

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick G. Gebhardt	TO FEDERAL EXPRESS	4/13/95	1400	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: Good
	[illegible]	4/14/95	845	ph: (303) 421-6611	Contents Temperature: 2.1
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 415/9

Quanterra
Environmental Services

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041554

MAY 4, 1995

Reviewed by: _____ FOR
Grant Wilton

_____
Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 18, 1995, Quanterra Environmental Services, Denver laboratory received 1 aqueous and 10 soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

Standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041554-0001-SA	CAFB-FAC0368-0101	SOIL	13 APR 95	09:15	18 APR 95
041554-0002-SA	CAFB-FAC0368-0102	SOIL	13 APR 95	10:15	18 APR 95
041554-0003-SA	CAFB-FAC0368-0201	SOIL	13 APR 95	10:45	18 APR 95
041554-0004-SA	CAFB-FAC0368-0202	SOIL	13 APR 95	11:15	18 APR 95
041554-0005-SA	CAFB-FAC0368-0301	SOIL	13 APR 95	11:45	18 APR 95
041554-0006-SA	CAFB-FAC0368-0401	SOIL	13 APR 95	12:30	18 APR 95
041554-0007-SA	CAFB-FAC0368-0501	SOIL	13 APR 95	14:00	18 APR 95
041554-0008-SA	CAFB-FAC0368-0601	SOIL	13 APR 95	14:30	18 APR 95
041554-0009-EB	CAFB-FAC0368-0602	AQUEOUS	13 APR 95	15:00	18 APR 95
041554-0010-SA	CAFB-FAC0368-0701	SOIL	14 APR 95	12:30	18 APR 95
041554-0011-SA	CAFB-FAC1400-0602	SOIL	14 APR 95	10:45	18 APR 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041554	Group Code	Analysis Description	Custom Test?
0001 - 0008,	A	Percent Water: ASTM D2216	N
0010		Gasoline Range Organics	N
0009	B	Gasoline Range Organics	N
0011	C	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Custom footnotes may be used for example, with GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgement) the product that appears to be present. The general qualifiers that serve to identify problems and pertinent observations made during sample analysis and review that are not discussed in the Overview section of this report are described below:

B Compound is also detected in the method blank.

This footnote indicates that the compound was detected in the sample as well as in the method blank. Please note that the "B" flag is not used when the sample result is ND (not detected).

G Reporting limit raised due to matrix interference.

This footnote indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all compounds determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the compound was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit (MDL) study, "J" values are generally reported to 1/5 of the reporting limit for GC/MS volatile organics, 1/10 of the reporting limit for GC/MS semivolatile organics, 1/2 of the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

T Preferred value unless footnoted on the secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footenote will be listed only for the first compound but pertains to all the compounds determined by the method. It is used in conjunction with the "V" footnote.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the "T" footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates the reporting limits were raised due to the presence of target compounds outside the calibration range of the method. For multi-compound methods, the footnote will appear only for the first compound but pertains to all compounds determined by the method.

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0101
Lab ID: 041554-0001-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Gasoline Range Organics	0.57	mg/kg	0.50	q
Surrogate	Recovery			
a,a,a-Trifluorotoluene	94	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0102
Lab ID: 041554-0002-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Gasoline Range Organics	0.44	mg/kg	0.50	qJ
Surrogate	Recovery			
a,a,a-Trifluorotoluene	96	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0201
Lab ID: 041554-0003-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Gasoline Range Organics	0.27	mg/kg	0.50	qJ
Surrogate	Recovery			
a,a,a-Trifluorotoluene	90	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0202
Lab ID: 041554-0004-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit
Gasoline Range Organics	ND	mg/kg	0.50
Surrogate	Recovery		
a,a,a-Trifluorotoluene	91	%	

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0301
Lab ID: 041554-0005-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit
Gasoline Range Organics	ND	mg/kg	0.50
Surrogate	Recovery		
a,a,a-Trifluorotoluene	94	%	

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0401
Lab ID: 041554-0006-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Gasoline Range Organics	0.25	mg/kg	0.50	qJ
Surrogate	Recovery			
a,a,a-Trifluorotoluene	94	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0501
Lab ID: 041554-0007-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 19 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Gasoline Range Organics	0.57	mg/kg	0.50	q
Surrogate	Recovery			
a,a,a-Trifluorotoluene	92	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0601
Lab ID: 041554-0008-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit
Gasoline Range Organics	ND	mg/kg	0.50
Surrogate	Recovery		
a,a,a-Trifluorotoluene	93	%	

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0602
Lab ID: 041554-0009-EB
Matrix: AQUEOUS Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 20 APR 95

Parameter	Result	Units	Reporting Limit
Gasoline Range Organics	ND	ug/L	10
Surrogate	Recovery		
a,a,a-Trifluorotoluene	95	%	

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Gasoline Range Organics

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0701
Lab ID: 041554-0010-SA
Matrix: SOIL Sampled: 14 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: NA Analyzed: 20 APR 95

Parameter	Result	Wet wt. Units	Reporting Limit
Gasoline Range Organics	ND	mg/kg	0.50
Surrogate	Recovery		
a,a,a-Trifluorotoluene	94	%	

ND = Not detected
NA = Not applicable

Reported By: Dan Appelhans Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0602
Lab ID: 041554-0011-SA
Matrix: SOIL Sampled: 14 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: 22 APR 95 Analyzed: 02 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.2	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	120	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0101
Lab ID: 041554-0001-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	7.6	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0102
Lab ID: 041554-0002-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	4.3	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0201
Lab ID: 041554-0003-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.0	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0202
Lab ID: 041554-0004-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0301
Lab ID: 041554-0005-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.7	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0401
Lab ID: 041554-0006-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.0	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall

Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0501
Lab ID: 041554-0007-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.1	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0601
Lab ID: 041554-0008-SA
Matrix: SOIL Sampled: 13 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC0368-0701
Lab ID: 041554-0010-SA
Matrix: SOIL Sampled: 14 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.8	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC1400-0602
Lab ID: 041554-0011-SA
Matrix: SOIL Sampled: 14 APR 95 Received: 18 APR 95
Authorized: 18 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall

Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{Measured Concentration DCS1} - \text{Measured Concentration DCS2}|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041554-0001-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0002-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0003-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0004-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0005-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0006-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0007-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0008-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0009-EB	AQUEOUS	8015M-G-A	20 APR 95-A	20 APR 95-A
041554-0010-SA	SOIL	8015M-G-S	19 APR 95-A	19 APR 95-A
041554-0011-SA	SOIL	8015M-D-S	22 APR 95-N1	22 APR 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Category: 8015M-G-S Matrix: SOIL QC Lot: 19 APR 95-A Concentration Units: mg/kg								
Gasoline Range Organics	25.0	21.6	21.8	21.7	87	75-125	0.9	20
Category: 8015M-G-A Matrix: AQUEOUS QC Lot: 20 APR 95-A Concentration Units: ug/L								
Gasoline Range Organics	500	417	419	418	84	75-125	0.5	20
Category: 8015M-D-S Matrix: SOIL QC Lot: 22 APR 95-NI Concentration Units: mg/kg								
Diesel Range Organics	20.0	22.8	21.9	22.4	112	48-138	4.0	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-G-S				
Matrix: SOIL				
QC Lot: 19 APR 95-A QC Run: 19 APR 95-A				
Concentration Units: mg/kg				
a,a,a-Trifluorotoluene	1.50	1.41	94	89-117
Category: 8015M-G-A				
Matrix: AQUEOUS				
QC Lot: 20 APR 95-A QC Run: 20 APR 95-A				
Concentration Units: ug/L				
a,a,a-Trifluorotoluene	30.0	27.6	92	81-120
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 22 APR 95-N1 QC Run: 22 APR 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.938	117	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8015M-GRO-S			
Matrix: SOIL			
QC Lot: 19 APR 95-A QC Run: 19 APR 95-A			
Gasoline Range Organics	ND	mg/kg	0.50
Test: 8015M-GRO-AP			
Matrix: AQUEOUS			
QC Lot: 20 APR 95-A QC Run: 20 APR 95-A			
Gasoline Range Organics	ND	ug/L	10
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 22 APR 95-N1 QC Run: 22 APR 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number	PACKING AND SHIPPING DETAILS	
Cannon Air Force Base, Underground Storage Tank Sampling (463536004) 2	Packed and Sealed for Shipping by: FRED GEBHARDT	Seal Number: 001
Sampling Location: FACILITY 0368	Delivered to Shipper by: FRED GEBHARDT	Airbill Number: 3436570712
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing	

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
4/13/95	0915	CAFB-FAC0368-0101	SOIL	1	SW8015 (GRO) (-01)	ENVIRONMENTAL SAMPLE
"	1015	" -0102	"	1	" (-02)	"
"	1045	" -0201	"	1	" (-03)	"
"	1115	" -0202	"	1	" (-04)	"
"	1145	" -0301	"	1	" (-05)	"
"	1230	" -0401	"	1	" (-06)	"
"	1400	" -0501	"	1	" (-07)	"
"	1430 ~~1500~~	" -0601	"	1	" (-08)	"
"	1500	" -0602	WATER	3	" (-09)	EQUIPMENT BLANK
4/14/95	1230	CAFB-FAC0368-0701	SOIL	1	" (-10)	ENVIRONMENTAL SAMPLE

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick E Gebhardt	TO FEDERAL EXPRESS	4/17/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	Anthony Jerry (DOL)	4/18/95	0890	ph: (303) 421-6611	Contents Temperature: 3.0°C
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41554

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004) 2	PACKING AND SHIPPING DETAILS: Packed and Sealed for Shipping by: FRED GEBHARDT; Seal Number: 001
Sampling Location: FACILITY 1400	Delivered to Shipper by: FRED GEBHARDT; Airbill Number: 3436570712
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
4/14/95	1045	CAFB-FAC1400-D602	SOIL	1	SW8015 (DRO) (-11)	ENVIRONMENTAL SAMPLE

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick S. Gebhardt	TO FEDERAL EXPRESS	4/17/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	Anthony Turner (QPQ)	4/18/95	0840	ph: (303) 421-6611	Contents Temperature: 3.0 °C
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41554

Quanterra Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA ENVIRONMENTAL SERVICES, DENVER

PROJECT NUMBER: 041621

MAY 11, 1995

FNC 3121

Reviewed by: Grant Wilton

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On April 20, 1995, Quanterra Environmental Services, Denver received one aqueous and nine soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical
IV. Quality Control Report

DIESEL RANGE ORGANIC ANALYSIS

Due to the dilutions required to bring the samples within the calibration range of the instrument, surrogate recoveries could not be determined for Quanterra sample numbers 041621-0001-SA through -0008-SA,-MS and -SD. In addition, the matrix spike compounds were also diluted out.

Except where indicated above, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
041621-0001-SA	CAFB-FAC3121-0101	SOIL	18 APR 95	09:15	20 APR 95
041621-0002-SA	CAFB-FAC3121-0102	SOIL	18 APR 95	10:10	20 APR 95
041621-0003-SA	CAFB-FAC3121-0201	SOIL	18 APR 95	11:10	20 APR 95
041621-0004-SA	CAFB-FAC3121-0301	SOIL	18 APR 95	12:00	20 APR 95
041621-0005-SA	CAFB-FAC3121-0302	SOIL	18 APR 95	12:00	20 APR 95
041621-0006-SA	CAFB-FAC3121-0401	SOIL	18 APR 95	12:50	20 APR 95
041621-0007-SA	CAFB-FAC3121-0501	SOIL	18 APR 95	13:30	20 APR 95
041621-0008-SA	CAFB-FAC3121-0601	SOIL	18 APR 95	14:10	20 APR 95
041621-0008-MS	CAFB-FAC3121-0601	SOIL	18 APR 95	14:10	20 APR 95
041621-0008-SD	CAFB-FAC3121-0601	SOIL	18 APR 95	14:10	20 APR 95
041621-0009-SA	CAFB-FAC3121-0701	SOIL	18 APR 95	14:50	20 APR 95
041621-0010-EB	CAFB-FAC3121-0702	AQUEOUS	18 APR 95	17:00	20 APR 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 041621	Group Code	Analysis Description	Custom Test?
0001 - 0009	A	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0010	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analysts judgement) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as in the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatile Organics, 1/10 of the reporting limit for GC/MS Semivolatile Organics, 1/2 the reporting limit for GC and HPLC or to the Instrument Detection Limit (IDL) for metals.

Quanterra
Environmental Services

T Preferred value unless footnoted on the secondary column test.

. This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with the footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multi-analyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0101
Lab ID: 041621-0001-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	17000	mg/kg	400	qlt
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0102
Lab ID: 041621-0002-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0201
Lab ID: 041621-0003-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3500	mg/kg	400	q1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0301
Lab ID: 041621-0004-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	12000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0302
Lab ID: 041621-0005-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8800	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0401
Lab ID: 041621-0006-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	10000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0501
Lab ID: 041621-0007-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5900	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0601
Lab ID: 041621-0008-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3700	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0701
Lab ID: 041621-0009-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 27 APR 95 Analyzed: 03 MAY 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.2	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	104	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Mark Pokorny

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0702
Lab ID: 041621-0010-EB
Matrix: AQUEOUS Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: 25 APR 95 Analyzed: 01 MAY 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	107	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Mark Pokorny

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0101
Lab ID: 041621-0001-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0102
Lab ID: 041621-0002-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0201
Lab ID: 041621-0003-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0301
Lab ID: 041621-0004-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0302
Lab ID: 041621-0005-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0401
Lab ID: 041621-0006-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0501
Lab ID: 041621-0007-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0601
Lab ID: 041621-0008-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC3121-0701
Lab ID: 041621-0009-SA
Matrix: SOIL Sampled: 18 APR 95 Received: 20 APR 95
Authorized: 20 APR 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	26 APR 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results)

to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery:

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD):

$$\text{RPD} = \frac{\left| \text{Measured Concentration DCS1} - \text{Measured Concentration DCS2} \right|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
041621-0001-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0002-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0003-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0004-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0005-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0006-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0007-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0008-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0008-MS	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0008-SD	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0009-SA	SOIL	8015M-D-S	27 APR 95-N1	27 APR 95-N1
041621-0010-EB	AQUEOUS	8015M-D-A	25 APR 95-N1	25 APR 95-N1

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 27 APR 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	20.2	20.6	20.4	102	48-138	2.0	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 25 APR 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.372	0.357	0.364	73	26-121	4.1	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 27 APR 95-N1 QC Run: 27 APR 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.908	114	64-136
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 25 APR 95-N1 QC Run: 25 APR 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0224	112	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit	
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 27 APR 95-N1 QC Run: 27 APR 95-N1				
Diesel Range Organics	2.0	mg/kg	4.0	J
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 27 APR 95-N1 QC Run: 27 APR 95-N1				
Diesel Range Organics	2.0	mg/kg	4.0	J
Test: 8015M-DRO-FID-A Matrix: AQUEOUS QC Lot: 25 APR 95-N1 QC Run: 25 APR 95-N1				
Diesel Range Organics	ND	mg/L	0.10	

J = Result is detected below the reporting limit or is an estimated concentration.

Quanterra
Environmental Services

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Organics by Chromatography

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE DUPLICATE	8015M-DRO-FID-S	041621-0008-SD	27 APR 95-N1
MATRIX SPIKE	8015M-DRO-FID-S	041621-0008-MS	27 APR 95-N1

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Organics by Chromatography
Project: 041621

Category: 8015M-D-S Diesel Range Organics in Solid Samples
Matrix: SOIL
Sample: 041621-0008
MS Run: 27 APR 95-N1
Units mg/kg Units Qualifier: Wet wt.

Analyte	Concentration Sample Result	MS Result	MSD Result	Amount Spiked MS	MSD	% Recovery MS	MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accep Limit
Diesel Range Organics (C8-C32)	3700	3900	4000	20	20	NC	NC	48-138	NC	32

NC = Not Calculated, calculation not applicable.

Calculations are performed before rounding to avoid round-off errors in calculated results.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number	PACKING AND SHIPPING DETAILS	
Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	Packed and Sealed for Shipping by: FRED GEBHARDT	Seal Number: 001
Sampling Location: FACILITY 3121	Delivered to Shipper by: FRED GEBHARDT	Airbill Number: 3436569684
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing HOWEVER, TEMPORARY ON HOLD	

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
4/18/95	0915	CAFB-FAC 3121-0101	SOIL	1	SW8015 (DRO)	ENVIRONMENTAL SAMPLE -01
"	1010	" -0102	"	1	"	" -02
"	1110	" -0201	"	1	"	" -03
"	1200	" -0301	"	1	"	" -0
"	1200	" -0302	"	1	"	" -0
"	1250	" -0401	"	1	"	" -06
"	1330	" -0501	"	1	"	" -07
"	1410	CAFB-FAC 3121-0601	SOIL	2	SW8015 (DRO)	ENVIRONMENTAL SAMPLE, MATRIX SPIKE & MSD -08
"	1450	" -0701	"	1	"	ENVIRONMENTAL SAMPLE -0
"	1700	CAFB-FAC 3121-0702	WATER	1	SW8015 (DRO)	EQUIPMENT BLANK -10

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick G. Gebhardt	TO FEDERAL EXPRESS	4/19/95		Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
		4/20/95	1500	ph: (303) 421-6611	Contents Temperature: 3.1
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 41621

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 043171
JULY 25, 1995

IAS
600
2060

Reviewed by:

Grant Wilton

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On July 1, 1995 Quanterra Environmental Services, received one aqueous and thirteen soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
043171-0001-SA	CAFBFAC0600-0601	SOIL	27 JUN 95	10:20	01 JUL 95
043171-0002-SA	CAFBFAC0600-0602	SOIL	27 JUN 95	11:00	01 JUL 95
043171-0003-SA	CAFBFAC0600-0701	SOIL	27 JUN 95	14:45	01 JUL 95
043171-0004-SA	CAFBFAC0600-0702	SOIL	27 JUN 95	15:35	01 JUL 95
043171-0005-SA	CAFBFAC3060-0801	SOIL	28 JUN 95	11:20	01 JUL 95
043171-0006-SA	CAFBFAC3060-0901	SOIL	28 JUN 95	12:00	01 JUL 95
043171-0007-SA	CAFBFAC3060-1001	SOIL	28 JUN 95	12:50	01 JUL 95
043171-0008-SA	CAFBFAC3060-1101	SOIL	28 JUN 95	13:15	01 JUL 95
043171-0009-SA	CAFBFAC3121-0801	SOIL	29 JUN 95	10:00	01 JUL 95
043171-0010-SA	CAFBFAC3121-0901	SOIL	29 JUN 95	11:15	01 JUL 95
043171-0011-SA	CAFBFAC3121-0902	SOIL	29 JUN 95	11:30	01 JUL 95
043171-0012-SA	CAFBFAC3121-1001	SOIL	29 JUN 95	12:00	01 JUL 95
043171-0013-SA	CAFBFAC3121-1101	SOIL	29 JUN 95	12:45	01 JUL 95
043171-0014-EB	CAFBFAC3121-1102	AQUEOUS	29 JUN 95	17:30	01 JUL 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 043171	Group Code	Analysis Description	Custom Test?
0001 - 0013	A	Percent Water: ASTM D2216	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
0014	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0601
Lab ID: 043171-0001-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	13	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	87	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0602
Lab ID: 043171-0002-SA
Matrix: SOIL
Authorized: 01 JUL 95

Sampled: 27 JUN 95
Prepared: 10 JUL 95

Received: 01 JUL 95
Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.5	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	81	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux

Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0701
Lab ID: 043171-0003-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	18	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	95	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0702
Lab ID: 043171-0004-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.4	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	90	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC306C-0801
Lab ID: 043171-0005-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	15	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	94	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-0901
Lab ID: 043171-0006-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	40	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	96	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-1001
Lab ID: 043171-0007-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 24 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	160	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	119	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-1101
Lab ID: 043171-0008-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	22	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	92	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0801
Lab ID: 043171-0009-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.7	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	89	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0901
Lab ID: 043171-0010-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 24 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.2	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	90	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0902
Lab ID: 043171-0011-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	4.2	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	66	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-1001
Lab ID: 043171-0012-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	2.5	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	85	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-1101
Lab ID: 043171-0013-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.6	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	102	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method GC/FID

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-1102
Lab ID: 043171-0014-EB
Matrix: AQUEOUS Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: NA Analyzed: 05 JUL 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	94	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Verniero

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0601
Lab ID: 043171-0001-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall

Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0602
Lab ID: 043171-0002-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0701
Lab ID: 043171-0003-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0702
Lab ID: 043171-0004-SA
Matrix: SOIL Sampled: 27 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-0801
Lab ID: 043171-0005-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.5	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-0901
Lab ID: 043171-0006-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	14	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-1001
Lab ID: 043171-0007-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	1C	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3060-1101
Lab ID: 043171-0008-SA
Matrix: SOIL Sampled: 28 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.1	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0801
Lab ID: 043171-0009-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0901
Lab ID: 043171-0010-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0902
Lab ID: 043171-0011-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-1001
Lab ID: 043171-0012-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-1101
Lab ID: 043171-0013-SA
Matrix: SOIL Sampled: 29 JUN 95 Received: 01 JUL 95
Authorized: 01 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	08 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
043171-0001-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0002-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0003-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0004-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0005-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0006-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0007-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0008-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0009-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0010-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0011-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0012-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0013-SA	SOIL	8015M-D-S	10 JUL 95-N2	10 JUL 95-N2
043171-0014-EB	AQUEOUS	DRO-A	05 JUL 95-N1	05 JUL 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 10 JUL 95-N2 Concentration Units: mg/kg								
Diesel Range Organics	20.0	20.2	22.6	21.4	107	48-138	11	32
Category: DRO-A Matrix: AQUEOUS QC Lot: 05 JUL 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.342	0.352	0.347	69	26-121	2.9	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 10 JUL 95-N2 QC Run: 10 JUL 95-N2				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.719	90	64-136
Category: DRO-A				
Matrix: AQUEOUS				
QC Lot: 05 JUL 95-N1 QC Run: 05 JUL 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0187	94	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 10 JUL 95-N2 QC Run: 10 JUL 95-N2			
Diesel Range Organics	ND	mg/kg	4.0
Test: DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 05 JUL 95-N1 QC Run: 05 JUL 95-N1			
Diesel Range Organics	ND	mg/L	0.10

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number Cannon Air Force Base, Underground Storage Tank Sampling 463536002 ~~(463536004)~~	PACKING AND SHIPPING DETAILS
Sampling Location FACILITIES 600 + 3060	Packed and Sealed for Shipping by: FRED GEBHARDT Seal Number: 001
Team Leader Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT Airbill Number: 3436570756
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
6/27/95	1020	CAFBFAC0600-0601	SOIL	1	SW8015 -1	ENVIRONMENTAL SAMPLE
6/27/95	1100	CAFBFAC0600-0602	"	1	" -2	"
6/27/95	1445	CAFBFAC0600-0701	"	1	" -3	"
6/27/95	1535	CAFBFAC0600-0702	"	1	" -4	"
6/28/95	1120	CAFBFAC3060-0801	SOIL	1	SW8015 -5	ENVIRONMENTAL SAMPLE
6/28/95	1200	CAFBFAC3060-0901	"	1	" -6	"
6/28/95	1250	CAFBFAC3060-1001	"	1	" -7	"
6/28/95	1315	CAFBFAC3060-1101	"	1	" -8	"

Additional Comments: PAGE 1 OF 2

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick S. Gebhardt	TO FEDERAL EXPRESS	6/30/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	[illegible]	7/1/95	900	ph: (303) 421-6611	Contents Temperature: 5.2
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 4371

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number Cannon Air Force Base, Underground Storage Tank Sampling 463536002 ~~(463536004)~~	PACKING AND SHIPPING DETAILS.
Sampling Location FACILITY 3121	Packed and Sealed for Shipping by: FRED GEBHARDT Seal Number: 001
Team Leader Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT Airbill Number: 3436570756
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
6/29/95	1000	CAFBFAC3121-0801	SOIL	1	SW8015 -9	ENVIRONMENTAL SAMPLE
6/29/95	1115	CAFBFAC3121-0901	"	1	" -10	"
6/29/95	1130	CAFBFAC3121-0902	"	1	" -11	"
6/29/95	1200	CAFBFAC3121-1001	"	1	" -12	"
6/29/95	1245	CAFBFAC3121-1101	"	1	" -13	"
6/29/95	1730	CAFBFAC3121-1102	WATER	1	" -14	EQUIPMENT BLANK

Additional Comments: PAGE 2 OF 2

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick S. Gebhardt	TO FEDERAL EXPRESS	6/30/95	1200	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: Good
	[illegible]	7/1/95	1100	ph: (303) 421-6611	Contents Temperature: 5.2
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 43171

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 043197
AUGUST 3, 1995

FMCs
2 of
3 of
[illegible]

Reviewed by:

FOR
Grant Wilton

Lindsay Breyer

I. OVERVIEW

On July 6, 1995 Quanterra Environmental Services, Denver received two aqueous and seventeen soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

Gasoline Range Organics

The soil samples were analyzed using the field methanol extraction method. Pre-weighed vials were supplied for sampling, and the vials were weighed again after sample collection. Labels placed on the vials at the time of sampling contributed to the measured sample weight, and the results may therefore have a negative bias.

Examination of the raw data will reveal an apparent discrepancy in the sample weights and extract volumes used in the calculations. The vials were supplied with 20 mL of solvent and the sample weights were between 12 and 20 grams. Due to software limitations, calculations had to be performed on the basis of 10 mL solvent. In order to obtain the correct results, the sample weights were therefore divided by two for entry into the data system.

The reporting limits were not adjusted based on sample weight. The reporting limit used is above the low point on the calibration curve, so the same reporting limit can be supported for all of the samples despite variations in the sample weights analyzed.

Diesel Range Organics

The samples were received between four and six days after collection. The laboratory was able to meet the applicable holding times except for sample 043197-0019-SA, which was extracted one day after the extraction holding time had expired.

Low surrogate recovery was obtained for sample 043197-0001-SA. The sample was re-extracted and analyzed with improved surrogate recovery. The re-extracted sample is reported as 043197-0001-RE. The second extraction took place after the extraction holding time had expired. The DCS associated with the re-extracted sample was mistakenly spiked at four times the normal spiking level. This was taken into account in calculating the recoveries.

General Inorganics

The only container received for sample 043197-0008-SA was for field extraction of GRO. The moisture content could not be measured.

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
043197-0001-SA	CAFBFAC0244-0101	SOIL	30 JUN 95	09:00	06 JUL 95
043197-0001-RE	CAFBFAC0244-0101	SOIL	30 JUN 95	09:00	06 JUL 95
043197-0002-SA	CAFBFAC0244-0201	SOIL	30 JUN 95	09:40	06 JUL 95
043197-0003-SA	CAFBFAC0244-0301	SOIL	30 JUN 95	10:15	06 JUL 95
043197-0004-SA	CAFBFAC0244-0401	SOIL	30 JUN 95	10:45	06 JUL 95
043197-0005-SA	CAFBFAC0244-0501	SOIL	30 JUN 95	11:10	06 JUL 95
043197-0006-SA	CAFBFAC0368-0102M	SOIL	01 JUL 95	08:20	06 JUL 95
043197-0007-SA	CAFBFAC0368-0601M	SOIL	01 JUL 95	09:15	06 JUL 95
043197-0008-SA	CAFBFAC0368-1001	SOIL	01 JUL 95	09:45	06 JUL 95
043197-0009-SA	CAFBFAC0368-1101	SOIL	01 JUL 95	11:00	06 JUL 95
043197-0010-SA	CAFBFAC0368-1201	SOIL	01 JUL 95	11:35	06 JUL 95
043197-0011-SA	CAFBFAC0368-1301	SOIL	01 JUL 95	12:25	06 JUL 95
043197-0012-SA	CAFBFAC0368-1401	SOIL	01 JUL 95	13:00	06 JUL 95
043197-0013-SA	CAFBFAC0368-1501	SOIL	01 JUL 95	13:45	06 JUL 95
043197-0014-SA	CAFBFAC0368-1601	SOIL	01 JUL 95	14:20	06 JUL 95
043197-0015-EB	CAFBFAC0368-1602	AQUEOUS	01 JUL 95	15:00	06 JUL 95
043197-0016-SA	CAFBFAC0368-1001	SOIL	02 JUL 95	07:55	06 JUL 95
043197-0017-SA	CAFBFAC0368-1701	SOIL	02 JUL 95	08:35	06 JUL 95
043197-0018-SA	CAFBFAC1400-0701	SOIL	02 JUL 95	09:40	06 JUL 95
043197-0019-EB	CAFBFAC1400-0702	AQUEOUS	02 JUL 95	12:00	06 JUL 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 043197	Group Code	Analysis Description	Custom Test?
0006 - 0014	A	Percent Water: ASTM D2216	N
		Gasoline Range Organics and Selected Components	N
		Gasoline Range Organics and Selected Components	N
0015	B	Gasoline Range Organics and Selected Components	N
0016 - 0018	C	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0001 - 0005	D	Percent Water: ASTM D2216	N
		Gasoline Range Organics and Selected Components	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Gasoline Range Organics and Selected Components	N
0019	E	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0101
Lab ID: 043197-0001-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	78	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0201
Lab ID: 043197-0002-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	71	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0301
Lab ID: 043197-0003-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	81	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0401
Lab ID: 043197-0004-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	88	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0501
Lab ID: 043197-0005-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	90	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-0102M
Lab ID: 043197-0006-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	78	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-0601M
Lab ID: 043197-0007-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	80	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1001
Lab ID: 043197-0008-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	5.0	t
Toluene	ND	mg/kg	5.0	
Ethylbenzene	ND	mg/kg	5.0	
Xylenes (total)	42	mg/kg	5.0	
Gasoline Range Organics	800	mg/kg	100	q

Surrogate	Recovery	
a,a,a-Trifluorotoluene	105	%

Note t : Sample diluted due to the concentration of target compounds.

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1101
Lab ID: 043197-0009-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	99	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1201
Lab ID: 043197-0010-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 11 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	93	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1301
Lab ID: 043197-0011-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	0.050	
Toluene	ND	mg/kg	0.050	
Ethylbenzene	0.038	mg/kg	0.050	J
Xylenes (total)	0.25	mg/kg	0.050	
Gasoline Range Organics	18	mg/kg	1.0	m

Surrogate	Recovery	
a,a,a-Trifluorotoluene	105	%

Note J : Result is detected below the reporting limit or is an estimated concentration.

Note m : This sample has GC/FID characteristics that are similar to weathered gasoline.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1401
Lab ID: 043197-0012-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	94	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1501
Lab ID: 043197-0013-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	99	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1601
Lab ID: 043197-0014-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	101	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1602
Lab ID: 043197-0015-EB
Matrix: AQUEOUS Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: NA Analyzed: 12 JUL 95

Parameter	Result	Units	Reporting Limit
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	0.50
Gasoline Range Organics	ND	ug/L	10

Surrogate	Recovery	
a,a,a-Trifluorotoluene	99	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Audrey Verniero

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0101
Lab ID: 043197-0001-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	6.7	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	30	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0101
Lab ID: 043197-0001-RE
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 25 JUL 95 Analyzed: 26 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.7	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	106	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C20.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0201
Lab ID: 043197-0002-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	3.7	mg/kg	4.0	J
Surrogate	Recovery			
o-Terphenyl	91	%		

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0301
Lab ID: 043197-0003-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	11	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	98	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0401
Lab ID: 043197-0004-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	10	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	97	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0501
Lab ID: 043197-0005-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8.3	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	95	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1001
Lab ID: 043197-0016-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	160	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	107	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product cccurring within the n-alkane range of C10-C16.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1701
Lab ID: 043197-0017-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5.1	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	100	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0701
Lab ID: 043197-0018-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 13 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	20	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	95	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0702
Lab ID: 043197-0019-EB
Matrix: AQUEOUS Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: 10 JUL 95 Analyzed: 21 JUL 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	106	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Audrey Cornell

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0101
Lab ID: 043197-0001-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0201
Lab ID: 043197-0002-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0301
Lab ID: 043197-0003-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0401
Lab ID: 043197-0004-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.6	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0244-0501
Lab ID: 043197-0005-SA
Matrix: SOIL Sampled: 30 JUN 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.7	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-0102M
Lab ID: 043197-0006-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-0601M
Lab ID: 043197-0007-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.9	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1101
Lab ID: 043197-0009-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	18	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1201
Lab ID: 043197-0010-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.2	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1301
Lab ID: 043197-0011-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.9	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1401
Lab ID: 043197-0012-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1501
Lab ID: 043197-0013-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	6.9	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1601
Lab ID: 043197-0014-SA
Matrix: SOIL Sampled: 01 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	15	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1001
Lab ID: 043197-0016-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1701
Lab ID: 043197-0017-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0701
Lab ID: 043197-0018-SA
Matrix: SOIL Sampled: 02 JUL 95 Received: 06 JUL 95
Authorized: 06 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	11	%	0.10	D2216	NA	12 JUL 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is
charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
043197-0001-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0002-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0003-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0004-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0005-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0006-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0007-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0008-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0009-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0010-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0011-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0012-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0013-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0014-SA	SOIL	8020-F-S	11 JUL 95-K	11 JUL 95-K
043197-0015-EB	AQUEOUS	8020-G-A	11 JUL 95-B	11 JUL 95-B

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Category: 8020-F-S Matrix: SOIL QC Lot: 11 JUL 95-K Concentration Units: mg/kg								
Benzene	0.525	0.598	0.565	0.582	111	69-124	5.7	10
Toluene	1.12	1.31	1.33	1.32	118	65-139	1.5	11
Ethylbenzene	0.535	0.558	0.500	0.529	99	73-120	11	11
Xylenes (total)	2.60	2.76	2.65	2.70	104	50-128	4.1	10
Gasoline Range Organics	25.0	18.3	18.5	18.4	74	51- 99	1.1	10
Category: 8020-G-A Matrix: AQUEOUS QC Lot: 11 JUL 95-B Concentration Units: ug/L								
Benzene	10.5	10.8	10.7	10.8	102	70-120	0.9	10
Toluene	22.4	18.6	18.6	18.6	83	71-126	0.0	10
Ethylbenzene	10.7	11.5	11.6	11.6	108	74-119	0.9	10
Xylenes (total)	52.1	48.0	47.4	47.7	92	72-122	1.3	10
Gasoline Range Organics	500	351	346	348	70	50-100	1.4	10

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8020-F-S				
Matrix: SOIL				
QC Lot: 11 JUL 95-K QC Run: 11 JUL 95-K				
Concentration Units: mg/kg				
a,a,a-Trifluorotoluene	1.50	1.51	101	89-117
Category: 8020-G-A				
Matrix: AQUEOUS				
QC Lot: 11 JUL 95-B QC Run: 11 JUL 95-B				
Concentration Units: ug/L				
a,a,a-Trifluorotoluene	30.0	29.4	98	81-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8020-GRO-FIELD-S			
Matrix: SOIL			
QC Lot: 11 JUL 95-K QC Run: 11 JUL 95-K			
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0
Test: 8020-GRO-FIELD-S			
Matrix: SOIL			
QC Lot: 11 JUL 95-K QC Run: 11 JUL 95-K			
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0
Test: 8020-GRO-AP			
Matrix: AQUEOUS			
QC Lot: 11 JUL 95-B QC Run: 11 JUL 95-B			
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	0.50
Gasoline Range Organics	ND	ug/L	10

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
043197-0001-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0001-RE	SOIL	8015M-D-S	25 JUL 95-N1	25 JUL 95-N1
043197-0002-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0003-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0004-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0005-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0016-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0017-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0018-SA	SOIL	8015M-D-S	13 JUL 95-N1	13 JUL 95-N1
043197-0019-EB	AQUEOUS	8015M-D-A	10 JUL 95-N1	10 JUL 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 13 JUL 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	19.0	17.9	18.4	92	48-138	6.0	32
Category: 8015M-D-S Matrix: SOIL QC Lot: 25 JUL 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	80.0	76.6	77.9	77.2	97	48-138	1.7	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 10 JUL 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.426	0.420	0.423	85	26-121	1.4	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S Matrix: SOIL QC Lot: 13 JUL 95-N1 QC Run: 13 JUL 95-N1 Concentration Units: mg/kg				
o-Terphenyl	0.800	0.872	109	64-136
Category: 8015M-D-S Matrix: SOIL QC Lot: 25 JUL 95-N1 QC Run: 25 JUL 95-N1 Concentration Units: mg/kg				
o-Terphenyl	0.800	0.595	74	64-136
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 10 JUL 95-N1 QC Run: 10 JUL 95-N1 Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0230	115	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 13 JUL 95-N1 QC Run: 13 JUL 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 25 JUL 95-N1 QC Run: 25 JUL 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S Matrix: SOIL QC Lot: 13 JUL 95-N1 QC Run: 13 JUL 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-A Matrix: AQUEOUS QC Lot: 10 JUL 95-N1 QC Run: 10 JUL 95-N1			
Diesel Range Organics	ND	mg/L	0.10

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling 463536002 ~~(463536004)~~	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITIES 244 & 368	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 001
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436570734
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
6/30/95	0900	CAFBFAC0244-0101	SOIL	2	GRO SW8015M, DRO SW815, D2216	ENVIRONMENTAL SAMPLES	-1
6/30/95	0940	CAFBFAC0244-0201	"	2	" " "	"	-2
6/30/95	1015	CAFBFAC0244-0301	"	2	" " "	"	-3
6/30/95	1045	CAFBFAC0244-0401	"	2	" " "	"	-4
6/30/95	1110	CAFBFAC0244-0501	"	2	" " "	"	-5
7/1/95	0820	CAFBFAC0368-0102M	"	2	GRO SW8015M, D2216	"	-6
7/1/95	0915	CAFBFAC0368-0601M	"	2	" "	"	-7
7/1/95	0945	CAFBFAC0368-1001	"	2	" "	"	-8
7/1/95	1100	CAFBFAC0368-1101	"	2	" "	"	-9
7/1/95	1135	CAFBFAC0368-1201	"	2	" "	"	-10

Additional Comments: SAMPLE CAFBFAC0368-1001 HAD VERY HIGH HITS ON FIELD INSTRUMENTS.

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick G. Gebhardt	TO FEDERAL EXPRESS	7/5/95	1400	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[illegible]	7/6/95	830	ph: (303) 421-6611	Contents Temperature: 4.3
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 43197

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling ~~(463536004)~~ 463536002	PACKING AND SHIPPING DETAILS..
	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 001
Sampling Location: FACILITY 368 & 1400	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436570734
Team Leader: Fred Gebhardt	Sampling Status: ☐ Done ☒ Continuing HOWEVER, TEMPORARY DELAYED.

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
7/1/95	1225	CAFBFAC0368-1301	SOIL	2	GRO SW8015M, D2216	ENVIRONMENTAL SAMPLES	-11
7/1/95	1300	CAFBFAC0368-1401	"	2	" "	"	-12
7/1/95	1345	CAFBFAC0368-1501	"	2	" "	"	-13
7/1/95	1420	CAFBFAC0368-1601	"	2	" "	"	-14
7/1/95	1500	CAFBFAC0368-1602	WATER	3	GRO SW8015M	EQUIPMENT BLANK	-15
7/2/95	0755	CAFBFAC0368-1001	SOIL	1	DRO SW8015, D2216	ENVIRONMENTAL SAMPLES	-16
7/2/95	0835	CAFBFAC0368-1701	"	1	DRO SW8015, D2216	"	-17
7/2/95	0940	CAFBFAC1400-0701	"	1	DRO SW8015, D2216	"	-18
7/2/95	1200	CAFBFAC1400-0702	WATER	1	DRO SW8015	EQUIPMENT BLANK	-19

Additional Comments: SAMPLE CAFBFAC0368-1001 WAS COLLECTED BOTH 7/1 & 7/2, I WANT THESE SAMPLES TO BE ANALYSISED FOR BOTH GRO & DRO.

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick E. Gebhardt	TO FEDERAL EXPRESS	7/5/95	1400	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[signature]	7/6/95	830	ph: (303) 421-6611	Contents Temperature: 4.3
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 43197

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 043723
AUGUST 23, 1995

FACS
3060

Reviewed by:

Mark D. Stella

Lindsay Breyer

I. OVERVIEW

On July 29, 1995 Quanterra Environmental Services, Denver received three aqueous and five soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

Diesel Range Organics

Samples 043723-0004-SA, -0005-SA, -0007-SA, and -0008-SA required dilution due to the concentration of target analytes present. As a result of the required dilutions, the concentrations of the surrogates in the samples were reduced to nondetectable levels.

The concentration of DRQ in the matrix spike duplicate (043723-0002-SD) was lower than the unspiked sample. As a result, the recovery and RPD could not be calculated. The sample was re-analyzed and the original result was confirmed. It is suspected that this problem was caused by sample inhomogeneity.

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
043723-0001-EB	CAFB-FAC-3060-0304EB	AQUEOUS	25 JUL 95	12:30	29 JUL 95
043723-0002-SA	CAFB-FAC-3060-0303	SOIL	25 JUL 95	14:49	29 JUL 95
043723-0002-MS	CAFB-FAC-3060-0303MSMSD	SOIL	25 JUL 95	14:49	29 JUL 95
043723-0002-SD	CAFB-FAC-3060-0303MSMSD	SOIL	25 JUL 95	14:49	29 JUL 95
043723-0003-EB	CAFB-FAC-3121-0103EB	AQUEOUS	26 JUL 95	11:20	29 JUL 95
043723-0004-SA	CAFB-FAC-3121-0104	SOIL	26 JUL 95	13:30	29 JUL 95
043723-0005-SA	CAFB-FAC-3121-0105	SOIL	26 JUL 95	15:20	29 JUL 95
043723-0006-EB	CAFB-FAC-3121-0303	AQUEOUS	27 JUL 95	09:20	29 JUL 95
043723-0007-SA	CAFB-FAC-3121-0303	SOIL	27 JUL 95	10:20	29 JUL 95
043723-0008-SA	CAFB-FAC-3121-0304	SOIL	27 JUL 95	15:15	29 JUL 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 043723	Group Code	Analysis Description	Custom Test?
0002 , 0004,	A	Percent Water: ASTM D2216	N
0005 , 0007,		Extractable Petroleum Hydrocarbons	N
0008		Prep - Hydrocarbons by GC	N
0001 , 0003,	B	Extractable Petroleum Hydrocarbons	N
0006		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3060-0304EB
Lab ID: 043723-0001-EB
Matrix: AQUEOUS Sampled: 25 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 01 AUG 95 Analyzed: 02 AUG 95

Parameter	Result	Units	Reporting Limit	
Diesel Range Organics	0.47	mg/L	0.10	q1
Surrogate	Recovery			
o-Terphenyl	85	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3060-0303
Lab ID: 043723-0002-SA
Matrix: SOIL Sampled: 25 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 18 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	78	mg/kg	4.0	1
Surrogate	Recovery			
o-Terphenyl	118	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C12-C28.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0103EB
Lab ID: 043723-0003-EB
Matrix: AQUEOUS Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 01 AUG 95 Analyzed: 02 AUG 95

Parameter	Result	Units	Reporting Limit	
Diesel Range Organics	0.12	mg/L	0.10	q1
Surrogate	Recovery			
o-Terphenyl	83	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0303
Lab ID: 043723-0006-EB
Matrix: AQUEOUS Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 01 AUG 95 Analyzed: 02 AUG 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	102	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0105
Lab ID: 043723-0005-SA
Matrix: SOIL Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 21 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	11000	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0104
Lab ID: 043723-0004-SA
Matrix: SOIL Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 21 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	13000	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0105
Lab ID: 043723-0005-SA
Matrix: SOIL Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 21 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	11000	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0303
Lab ID: 043723-0006-EB
Matrix: AQUEOUS Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 01 AUG 95 Analyzed: 02 AUG 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	102	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0303
Lab ID: 043723-0007-SA
Matrix: SOIL Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 21 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	25000	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0304
Lab ID: 043723-0008-SA
Matrix: SOIL Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: 08 AUG 95 Analyzed: 21 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	17000	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3060-0303
Lab ID: 043723-0002-SA
Matrix: SOIL Sampled: 25 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	03 AUG 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0104
Lab ID: 043723-0004-SA
Matrix: SOIL Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.9	%	0.10	D2216	NA	03 AUG 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0105
Lab ID: 043723-0005-SA
Matrix: SOIL Sampled: 26 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.3	%	0.10	D2216	NA	03 AUG 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0303
Lab ID: 043723-0007-SA
Matrix: SOIL Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.8	%	0.10	D2216	NA	03 AUG 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFB-FAC-3121-0304
Lab ID: 043723-0008-SA
Matrix: SOIL Sampled: 27 JUL 95 Received: 29 JUL 95
Authorized: 29 JUL 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.1	%	0.10	D2216	NA	03 AUG 95

ND = Not detected
NA = Not applicable

Reported By: Siri Dunn Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is
charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \text{ X } 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \text{ X } 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
043723-0001-EB	AQUEOUS	8015M-D-A	01 AUG 95-N1	01 AUG 95-N1
043723-0002-SA	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0002-MS	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0002-SD	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0003-EB	AQUEOUS	8015M-D-A	01 AUG 95-N1	01 AUG 95-N1
043723-0004-SA	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0005-SA	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0006-EB	AQUEOUS	8015M-D-A	01 AUG 95-N1	01 AUG 95-N1
043723-0007-SA	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1
043723-0008-SA	SOIL	8015M-D-S	08 AUG 95-N1	08 AUG 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 01 AUG 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.314	0.348	0.331	66	26-121	10	44
Category: 8015M-D-S Matrix: SOIL QC Lot: 08 AUG 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	23.6	21.1	22.4	112	48-138	11	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 01 AUG 95-N1 QC Run: 01 AUG 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0192	96	47-137
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 08 AUG 95-N1 QC Run: 08 AUG 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.829	104	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 01 AUG 95-N1 QC Run: 01 AUG 95-N1			
Diesel Range Organics	ND	mg/L	0.10
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 08 AUG 95-N1 QC Run: 08 AUG 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 08 AUG 95-N1 QC Run: 08 AUG 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

Quanterra
Environmental Services

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Semivolatile Organics by GC

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE DUPLICATE	8015M-DRO-FID-S	043723-0002-SD	08 AUG 95-N1
MATRIX SPIKE	8015M-DRO-FID-S	043723-0002-MS	08 AUG 95-N1

Quanterra
Environmental Services

TRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Semivolatile Organics by GC
Project: 043723

Category: 8015M-D-S Diesel Range Organics in Solid Samples
Matrix: SOIL
Sample: 043723-0002
MS Run: 08 AUG 95-N1
Units mg/kg Units Qualifier: Wet wt.

Analyte	Concentration Sample Result	MS Result	MSD Result	Amount Spiked MS	MSD	% Recovery MS	MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Diesel Range Organics (C8-C32)	78	98	74	20	20	100	NC	48-138	NC	32

NC = Not Calculated, calculation not applicable.

Calculations are performed before rounding to avoid round-off errors in calculated results.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536004)	PACKING AND SHIPPING DETAILS
Sampling Location: FAC 3060 & Melrose 3121	Packed and Sealed for Shipping by: Jerry Larson — Seal Number: 001
Team Leader: ~~Fred Gebhardt~~ Jerry Larson	Delivered to Shipper by: Jerry Larson — Airbill Number: 3436968461
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
7-25-95	1230	CAFBFAC-3060-0304 EB	water	1	SW8015 – DRO	Equipment Blank	-01
7-25-95	1445	CAFBFAC-3060-0303	soil	1	SW8015 – DRO	Enviro Sample	-02
7-25-95	1445	CAFBFAC-3060-0303 MS/MSD	Soil	1	" "	MS – MSD	-02 MS/SD
7-26-95	1120	CAFBFAC-3121-0103 EB	water	1	" "	Equip Blank	-03
7-26-95	1330	CAFBFAC-3121-0104	soil	1	" "	Enviro 24-26 ft	-04
7-26-95	1520	CAFBFAC-3121-0105	Soil	1	" "	Enviro 29-31 ft	-05
7-27-95	0920	CAFBFAC-3121-0303	water	1	" "	Equip Blank	-06
7-27-95	1020	CAFBFAC-3121-0303	Soil	1	" "	Enviro 19-21 ft	-07
7-27-95	1515	CAFBFAC-3121-0304	Soil	1	" "	Enviro 29-29.5	-08

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Jerry D Larson	Fed. Express	7/28/95	1400	Quanterra Environmental Services 4955 Yarrow Street Arvada, CO 80002	Condition of Contents: good
	[illegible]	7/29/95	930	ph: (303) 421-6611	Contents Temperature: 3.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 43723

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 044268
SEPTEMBER 21, 1995

Reviewed by:

Mark D. Stella

Lindsay Breyer

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

I. OVERVIEW

On August 29, 1995 Quanterra Environmental Services, Denver received ten soil and two aqueous samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

At the request of Mr. Fred Gebhardt, all client sample identifications beginning with CAFBFA0358 were changed in our data system to CAFBFA0368 on September 1, 1995.

Samples 044268-0008-SA through -0011-SA could not be analyzed for moisture content. The only container submitted for these samples was the vial for GRO using the field methanol extraction method.

Gasoline Range Organics

Pre-weighed vials containing methanol spiked with the surrogate were supplied by Quanterra for sampling this parameter. The vial were re-weighed upon receipt in order to obtain the amount of sample actually collected and extracted. Labels placed on the containers at the time of sampling contributed to the measured sample weight, and may have caused a low bias in the results.

The surrogate recoveries for samples 044268-0008-SA and -0009-SA were outside QC limits. Review of the data indicated the presence of matrix interferences, and the data were accepted.

Sample 044268-0012-TB was a trip blank for GRO using the field methanol extraction method. It consisted of a vial containing methanol and was logged in as a soil sample. The results for this sample were calculated using a nominal sample weight of 10 grams.

Diesel Range Organics

The surrogate recovery for sample 044268-0005-SA was outside QC limits. Review of the data indicated the presence of matrix interferences, and the data were accepted.

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
044268-0001-EB	CAFBFAC0600-0801EB	AQUEOUS	23 AUG 95	16:20	29 AUG 95
044268-0002-SA	CAFBFAC0600-0802	SOIL	23 AUG 95	18:05	29 AUG 95
044268-0003-SA	CAFBFAC0600-0803	SOIL	23 AUG 95	19:05	29 AUG 95
044268-0003-MS	CAFBFAC0600-0803	SOIL	23 AUG 95	19:05	29 AUG 95
044268-0003-SD	CAFBFAC0600-0803	SOIL	23 AUG 95	19:05	29 AUG 95
044268-0004-SA	CAFBFAC3121-0106	SOIL	24 AUG 95	12:45	29 AUG 95
044268-0005-SA	CAFBFAC3121-0107	SOIL	24 AUG 95	15:20	29 AUG 95
044268-0006-SA	CAFBFAC3121-0108	SOIL	25 AUG 95	11:00	29 AUG 95
044268-0007-EB	CAFBFAC0368-1002EB	AQUEOUS	25 AUG 95	16:10	29 AUG 95
044268-0008-SA	CAFBFAC0368-1003	SOIL	25 AUG 95	18:10	29 AUG 95
044268-0009-SA	CAFBFAC0368-1004	SOIL	25 AUG 95	18:30	29 AUG 95
044268-0010-SA	CAFBFAC0368-1005	SOIL	26 AUG 95	09:55	29 AUG 95
044268-0011-SA	CAFBFAC0368-1006	SOIL	26 AUG 95	13:00	29 AUG 95
044268-0012-TB	CAFBFAC0368-1007TB	SOIL	26 AUG 95	13:30	29 AUG 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 044268	Group Code	Analysis Description	Custom Test?
0008 - 0012	A	Percent Water: ASTM D2216	N
		Gasoline Range Organics and Selected Components	N
0007	B	Gasoline Range Organics and Selected Components	N
0002 - 0006	C	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		Percent Water: ASTM D2216	N
0001	D	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1002EB
Lab ID: 044268-0007-EB
Matrix: AQUEOUS Sampled: 25 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 31 AUG 95

Parameter	Result	Units	Reporting Limit
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	0.50
Gasoline Range Organics	ND	ug/L	10

Surrogate	Recovery	
a,a,a-Trifluorotoluene	96	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1003
Lab ID: 044268-0008-SA
Matrix: SOIL Sampled: 25 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 05 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	2.5	t
Toluene	ND	mg/kg	2.5	
Ethylbenzene	7.4	mg/kg	2.5	
Xylenes (total)	270	mg/kg	2.5	
Gasoline Range Organics	1000	mg/kg	50	m

Surrogate	Recovery	
a,a,a-Trifluorotoluene	ND	%

Note t : Sample diluted due to the concentration of target compounds.

Note m : This sample has GC/FID characteristics that are similar to weathered gasoline.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1004
Lab ID: 044268-0009-SA
Matrix: SOIL Sampled: 25 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 05 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	2.0	t
Toluene	3.6	mg/kg	2.0	
Ethylbenzene	6.7	mg/kg	2.0	
Xylenes (total)	210	mg/kg	2.0	
Gasoline Range Organics	830	mg/kg	40	m

Surrogate	Recovery	
a,a,a-Trifluorotoluene	ND	%

Note t : Sample diluted due to the concentration of target compounds.

Note m : This sample has GC/FID characteristics that are similar to weathered gasoline.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1005
Lab ID: 044268-0010-SA
Matrix: SOIL Sampled: 26 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 31 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	0.50	t
Toluene	ND	mg/kg	0.50	
Ethylbenzene	ND	mg/kg	0.50	
Xylenes (total)	2.9	mg/kg	0.50	
Gasoline Range Organics	37	mg/kg	10	q

Surrogate	Recovery	
a,a,a-Trifluorotoluene	97	%

Note t : Sample diluted due to the concentration of target compounds.

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1006
Lab ID: 044268-0011-SA
Matrix: SOIL Sampled: 26 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 05 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Benzene	ND	mg/kg	0.050	
Toluene	ND	mg/kg	0.050	
Ethylbenzene	0.10	mg/kg	0.050	
Xylenes (total)	0.055	mg/kg	0.050	
Gasoline Range Organics	0.97	mg/kg	1.0	J

Surrogate	Recovery	
a,a,a-Trifluorotoluene	110	%

Note J : Result is detected below the reporting limit or is an estimated concentration.

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Gasoline Range Organics and Selected Components

Method API GRO

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0368-1007TB
Lab ID: 044268-0012-TB
Matrix: SOIL Sampled: 26 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: NA Analyzed: 31 AUG 95

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Surrogate	Recovery	
a,a,a-Trifluorotoluene	100	%

ND = Not detected
NA = Not applicable

Reported By: Corey Crooks Approved By: Karen Kuiken

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0801EB
Lab ID: 044268-0001-EB
Matrix: AQUEOUS Sampled: 23 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 30 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	94	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Karen Kuiken

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0802
Lab ID: 044268-0002-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	96	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Karen Kuiken

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0803
Lab ID: 044268-0003-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	7.9	mg/kg	4.0	q1
Surrogate	Recovery			
o-Terphenyl	91	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note 1 : Sample resembles a hydrocarbon product occurring within the n-alkane range of C18-C28.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Karen Kuiken

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0106
Lab ID: 044268-0004-SA
Matrix: SOIL Sampled: 24 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	97	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0107
Lab ID: 044268-0005-SA
Matrix: SOIL Sampled: 24 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 31 AUG 95 Analyzed: 06 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	9500	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Karen Kuiken

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0108
Lab ID: 044268-0006-SA
Matrix: SOIL Sampled: 25 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	89	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Karen Kuiken

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0802
Lab ID: 044268-0002-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	13	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC0600-0803
Lab ID: 044268-0003-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	16	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0106
Lab ID: 044268-0004-SA
Matrix: SOIL Sampled: 24 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	17	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0107
Lab ID: 044268-0005-SA
Matrix: SOIL Sampled: 24 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC3121-0108
Lab ID: 044268-0006-SA
Matrix: SOIL Sampled: 25 AUG 95 Received: 29 AUG 95
Authorized: 29 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	7.3	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is
charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
044268-0007-EB	AQUEOUS	8020-G-A	31 AUG 95-A	31 AUG 95-A
044268-0008-SA	SOIL	8020-F-S	05 SEP 95-L	05 SEP 95-L
044268-0009-SA	SOIL	8020-F-S	05 SEP 95-L	05 SEP 95-L
044268-0010-SA	SOIL	8020-F-S	31 AUG 95-A	31 AUG 95-A
044268-0011-SA	SOIL	8020-F-S	05 SEP 95-L	05 SEP 95-L
044268-0012-TB	SOIL	8020-F-S	31 AUG 95-A	31 AUG 95-A

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Category: 8020-G-A Matrix: AQUEOUS QC Lot: 31 AUG 95-A Concentration Units: ug/L								
Benzene	10.5	10.5	10.6	10.6	100	70-120	0.9	10
Toluene	22.4	21.0	21.2	21.1	94	71-126	0.9	10
Ethylbenzene	10.7	9.17	9.20	9.18	86	74-119	0.3	10
Xylenes (total)	52.1	48.8	48.2	48.5	93	72-122	1.2	10
Gasoline Range Organics	500	331	337	334	67	50-100	1.8	10
Category: 8020-F-S Matrix: SOIL QC Lot: 05 SEP 95-L Concentration Units: mg/kg								
Benzene	0.525	0.443	0.440	0.442	84	69-124	0.7	10
Toluene	1.12	1.19	1.17	1.18	105	65-139	1.7	11
Ethylbenzene	0.535	0.455	0.448	0.452	84	73-120	1.6	11
Xylenes (total)	2.605	2.24	2.21	2.22	85	50-128	1.3	10
Gasoline Range Organics	25.0	14.0	14.2	14.1	56	51- 99	1.4	10
Category: 8020-F-S Matrix: SOIL QC Lot: 31 AUG 95-A Concentration Units: mg/kg								
Benzene	0.525	0.525	0.530	0.528	100	69-124	0.9	10
Toluene	1.12	1.05	1.06	1.06	94	65-139	0.9	11
Ethylbenzene	0.535	0.458	0.460	0.459	86	73-120	0.4	11
Xylenes (total)	2.60	2.44	2.41	2.42	93	50-128	1.2	10
Gasoline Range Organics	25.0	16.5	16.8	16.6	67	51- 99	1.8	10

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8020-G-A				
Matrix: AQUEOUS				
QC Lot: 31 AUG 95-A QC Run: 31 AUG 95-A				
Concentration Units: ug/L				
a,a,a-Trifluorotoluene	30.0	28.3	94	81-120
Category: 8020-F-S				
Matrix: SOIL				
QC Lot: 05 SEP 95-L QC Run: 05 SEP 95-L				
Concentration Units: mg/kg				
a,a,a-Trifluorotoluene	1.50	1.48	99	89-117
Category: 8020-F-S				
Matrix: SOIL				
QC Lot: 31 AUG 95-A QC Run: 31 AUG 95-A				
Concentration Units: mg/kg				
a,a,a-Trifluorotoluene	1.50	1.42	95	89-117

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit
Test: 8020-GRO-AP			
Matrix: AQUEOUS			
QC Lot: 31 AUG 95-A QC Run: 31 AUG 95-A			
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	0.50
Gasoline Range Organics	ND	ug/L	10
Test: 8020-GRO-FIELD-S			
Matrix: SOIL			
QC Lot: 05 SEP 95-L QC Run: 05 SEP 95-L			
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0
Test: 8020-GRO-FIELD-S			
Matrix: SOIL			
QC Lot: 31 AUG 95-A QC Run: 31 AUG 95-A			
Benzene	ND	mg/kg	0.050
Toluene	ND	mg/kg	0.050
Ethylbenzene	ND	mg/kg	0.050
Xylenes (total)	ND	mg/kg	0.050
Gasoline Range Organics	ND	mg/kg	1.0

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
044268-0001-EB	AQUEOUS	8015M-D-A	30 AUG 95-N1	30 AUG 95-N1
044268-0002-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0003-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0003-MS	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0003-SD	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0004-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0005-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044268-0006-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 30 AUG 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.307	0.334	0.320	64	26-121	8.4	44
Category: 8015M-D-S Matrix: SOIL QC Lot: 31 AUG 95-N1 Concentration Units: mg/kg								
Diesel Range Organics	20.0	17.6	18.1	17.8	89	48-138	2.8	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 30 AUG 95-N1 QC Run: 30 AUG 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0185	92	47-137
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 31 AUG 95-N1 QC Run: 31 AUG 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.794	99	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 30 AUG 95-N1 QC Run: 30 AUG 95-N1			
Diesel Range Organics	ND	mg/L	0.10
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 31 AUG 95-N1 QC Run: 31 AUG 95-N1			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 31 AUG 95-N1 QC Run: 31 AUG 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

Quanterra
Environmental Services

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Semivolatile Organics by GC

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE DUPLICATE	8015M-DRO-FID-S	044268-0003-SD	31 AUG 95-N1
MATRIX SPIKE	8015M-DRO-FID-S	044268-0003-MS	31 AUG 95-N1

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Semivolatile Organics by GC
Project: 044268

Category: 8015M-D-S Diesel Range Organics in Solid Samples
Matrix: SOIL
Sample: 044268-0003
MS Run: 31 AUG 95-N1
Units mg/kg Units Qualifier: Wet wt.

Analyte	Sample Result	Concentration MS Result	Concentration MSD Result	Amount Spiked MS	Amount Spiked MSD	% Recovery MS	% Recovery MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Diesel Range Organics (C8-C32)	7.9	24	26	20	20	81	91	48-138	12	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (46353600 2)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITIES 600, 3121, 358,	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 033647
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436569975
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
8/23/95	1620	CAFBFAC0600-0801EB	WATER	1	SW8015 DRO -01	EQUIPMENT BLANK
8/23/95	1805	CAFBFAC0600-0802	SOIL	1	" -02	ENVIRONMENTAL SAMPLE
8/23/95	1905	CAFBFAC0600-0803	"	2	" -03 MSD	ENVIRONMENTAL SAMPLE AND MATRIX SPIKE + MSD
8/24/95	1245	CAFBFAC3121-0106	"	1	" -04	ENVIRONMENTAL SAMPLE
8/24/95	1520	CAFBFAC3121-0107	"	1	" -05	"
8/25/95	1100	CAFBFAC3121-0108	"	1	" -06	"
8/25/95	1610	CAFBFAC0358-1002EB	WATER	3	SW8015 GRO -07	EQUIPMENT BLANK
8/25/95	1810	CAFBFAC0358-1003	SOIL/METHANOL	1	" -08	ENVIRONMENTAL SAMPLE
8/25/95	1830	CAFBFAC0358-1004	"	1	" -09	"
8/26/95	0955	CAFBFAC0358-1005	"	1	" -10	"

Additional Comments: MAJORITY OF THESE SAMPLES HAD VERY HIGH READINGS ON FIELD G.C.

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick E. Gebhardt	TO FEDERAL EXPRESS	8/28/95	1530	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[illegible]	8/29/95	930	ph: (303) 421-6611	Contents Temperature: 2-6
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 44261

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (463536002)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITY 358	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 033647
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436569975
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
8/26/95	1300	CAFBFAC0358-1006	SOIL / METHANOL	1	SW8015 GRO -11	ENVIRONMENTAL SAMPLE
8/26/95	1330	CAFBFAC0358-1007TB	METHANOL	1	" -12	TRIP BLANK

Additional Comments

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick G. Gebhardt	TO FEDERAL EXPRESS	8/28/95	1530	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[illegible]	8/29/95	930	ph: (303) 421-6611	Contents Temperature: 26
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 4262

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 044301
SEPTEMBER 15, 1995

Reviewed by:

Mark D. Stella

Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On August 24, 1995 Quanterra Environmental Services, Denver received three soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

The samples in this project were originally logged in under Quanterra project 044197. In accordance with instructions from Mr. Bob Brock on August 30, 1995, they were re-logged under this project.

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
044301-0001-SA	CAFBFAC30601201	SOIL	23 AUG 95	10:30	24 AUG 95
044301-0002-SA	CAFBFAC30601301	SOIL	23 AUG 95	11:30	24 AUG 95
044301-0003-SA	CAFBFAC30601302	SOIL	23 AUG 95	11:45	24 AUG 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 044301	Group Code	Analysis Description	Custom Test?
0001 - 0003	A	Percent Water: ASTM D2216	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601201
Lab ID: 044301-0001-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	110	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601301
Lab ID: 044301-0002-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	94	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601302
Lab ID: 044301-0003-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: 31 AUG 95 Analyzed: 01 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	94	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Roxanne Sullivan

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601201
Lab ID: 044301-0001-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.7	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601301
Lab ID: 044301-0002-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC30601302
Lab ID: 044301-0003-SA
Matrix: SOIL Sampled: 23 AUG 95 Received: 24 AUG 95
Authorized: 30 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.1	%	0.10	D2216	NA	01 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is
charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \text{ X } 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \text{ X } 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
044301-0001-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044301-0002-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1
044301-0003-SA	SOIL	8015M-D-S	31 AUG 95-N1	31 AUG 95-N1

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S								
Matrix: SOIL								
QC Lot: 31 AUG 95-N1								
Concentration Units: mg/kg								
Diesel Range Organics	20.0	17.6	18.1	17.8	89	48-138	2.8	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 31 AUG 95-N1 QC Run: 31 AUG 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.794	99	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 31 AUG 95-N1 QC Run: 31 AUG 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (46353600~~X~~ 2)	PACKING AND SHIPPING DETAILS:
Sampling Location: FACILITY 3060	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 034021
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436570870
	Sampling Status: ☐ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks	
8/23/95	1030	CAFBFAC 3060 1201	SOIL	1	SW8015 DRO	ENVIRONMENTAL SAMPLE	-01
8/23/95	1130	CAFBFAC 3060 1301	"	1	"	"	-02
8/23/95	1145	CAFBFAC 3060 1302	"	1	"	"	-03

Additional Comments:

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Fredrick E. Gebhardt	TO FEDERAL EXPRESS	8/23/95	1200	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: ~~4.0~~ good
	[illegible]	8/24/95	930	ph: (303) 421-6611	Contents Temperature: 4.0
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: ~~44197~~ 44301

Quanterra
Environmental Services

ANALYTICAL RESULTS
FOR
U.S. GEOLOGICAL SURVEY
QUANTERRA ENVIRONMENTAL SERVICES, DENVER
PROJECT NUMBER: 044320
SEPTEMBER 22,1995

FYC
1400

Reviewed by:

Mark D. Stella

Lindsay Breyer

I. OVERVIEW

On August 31, 1995 Quanterra Environmental Services, Denver received one aqueous and six soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

Diesel Range Organics

Samples 044320-0004-SA through -0007-SA required dilution due to the concentrations of target analytes present. As a result of these dilutions, the surrogate concentrations were too low to be measured and were reported as ND (Not Detected).

With the exceptions noted above or on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra Environmental Services, Denver is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
044320-0001-SA	CAFBFAC1400-0801	SOIL	26 AUG 95	17:25	31 AUG 95
044320-0002-EB	CAFBFAC1400-0901EB	AQUEOUS	27 AUG 95	08:15	31 AUG 95
044320-0003-SA	CAFBFAC1400-0902	SOIL	27 AUG 95	11:05	31 AUG 95
044320-0004-SA	CAFBFAC1400-0302	SOIL	28 AUG 95	12:35	31 AUG 95
044320-0005-SA	CAFBFAC1400-0303	SOIL	28 AUG 95	13:00	31 AUG 95
044320-0006-SA	CAFBFAC1400-0304	SOIL	28 AUG 95	15:30	31 AUG 95
044320-0007-SA	CAFBFAC1400-0305	SOIL	28 AUG 95	19:10	31 AUG 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 044320	Group Code	Analysis Description	Custom Test?
0001 , 0003, 0004 - 0007	A	Percent Water: ASTM D2216	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
0002	B	Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra Environmental Services, Denver laboratory's reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Quanterra Environmental Services, Denver laboratory's QA/QC Program, which generates data which are independent of matrix effects, is given in Section IV.

Footnotes and Data Qualifiers

The data sheets included in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tentatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank . Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration.

This footnote indicates that the analyte was detected in the sample, but the measured concentration was below the reporting limit. When supported by the current laboratory Method Detection Limit study, J values are generally reported to 1/5 of the reporting limit for GC/MS Volatiles, 1/10 of the reporting limit for GC/MS Semivolatiles, 1/2 the reporting limit for GC and HPLC, or to the Instrument Detection Limit for metals.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction with footnote V.

V Secondary column result is the preferred value.

This footnote is used for GC tests in conjunction with the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multianalyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0801
Lab ID: 044320-0001-SA
Matrix: SOIL Sampled: 26 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 11 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	108	%	

ND = Not detected
NA = Not applicable

Reported By: Don Vieaux Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0901EB
Lab ID: 044320-0002-EB
Matrix: AQUEOUS Sampled: 27 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 01 SEP 95 Analyzed: 07 SEP 95

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		
o-Terphenyl	92	%	

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0902
Lab ID: 044320-0003-SA
Matrix: SOIL Sampled: 27 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 12 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	890	mg/kg	16	qlt
Surrogate	Recovery			
o-Terphenyl	126	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C14-C24.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0302
Lab ID: 044320-0004-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 12 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0303
Lab ID: 044320-0005-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 12 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	8000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0304
Lab ID: 044320-0006-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 12 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	11000	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0305
Lab ID: 044320-0007-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: 08 SEP 95 Analyzed: 12 SEP 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	5800	mg/kg	400	1t
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to Fuel Oil #2.
Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.

Note t : Sample diluted due to the concentration of target compounds.

ND = Not detected
NA = Not applicable

Reported By: Hai Wai Zhu Approved By: Audrey Cornell

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0801
Lab ID: 044320-0001-SA
Matrix: SOIL Sampled: 26 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	9.6	%	0.10	D2216	NA	06 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0902
Lab ID: 044320-0003-SA
Matrix: SOIL Sampled: 27 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	6.6	%	0.10	D2216	NA	06 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0302
Lab ID: 044320-0004-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	06 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0303
Lab ID: 044320-0005-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	06 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC1400-0304
Lab ID: 044320-0006-SA
Matrix: SOIL Sampled: 28 AUG 95 Received: 31 AUG 95
Authorized: 31 AUG 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	12	%	0.10	D2216	NA	06 SEP 95

ND = Not detected
NA = Not applicable

Reported By: Matt Hall Approved By: Matt Hall

IV. QUALITY CONTROL REPORT

Quanterra Environmental Services, Denver operates under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

Quanterra Environmental Services, Denver laboratory's QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is
charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \text{ X } 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{ Measured Concentration DCS1 - Measured Concentration DCS2 }|}{(\text{Measured Concentration DCS1 + Measured Concentration DCS2})/2} \text{ X } 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
044320-0001-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11
044320-0002-EB	AQUEOUS	8015M-D-A	01 SEP 95-N1	01 SEP 95-N1
044320-0003-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11
044320-0004-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11
044320-0005-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11
044320-0006-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11
044320-0007-SA	SOIL	8015M-D-S	08 SEP 95-N11	08 SEP 95-N11

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S Matrix: SOIL QC Lot: 08 SEP 95-N11 Concentration Units: mg/kg								
Diesel Range Organics	20.0	23.1	21.0	22.0	110	48-138	9.3	32
Category: 8015M-D-A Matrix: AQUEOUS QC Lot: 01 SEP 95-N1 Concentration Units: mg/L								
Diesel Range Organics	0.500	0.214	0.250	0.232	46	26-121	15	44

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 08 SEP 95-N11 QC Run: 08 SEP 95-N11				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.905	113	64-136
Category: 8015M-D-A				
Matrix: AQUEOUS				
QC Lot: 01 SEP 95-N1 QC Run: 01 SEP 95-N1				
Concentration Units: mg/L				
o-Terphenyl	0.0200	0.0166	83	47-137

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 08 SEP 95-N11 QC Run: 08 SEP 95-N11			
Diesel Range Organics	ND	mg/kg	4.0
Test: 8015M-DRO-FID-A			
Matrix: AQUEOUS			
QC Lot: 01 SEP 95-N1 QC Run: 01 SEP 95-N1			
Diesel Range Organics	ND	mg/L	0.10

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, NEW MEXICO DISTRICT
ANALYTICAL REQUEST/CHAIN OF CUSTODY

Project Name & Number: Cannon Air Force Base, Underground Storage Tank Sampling (46353600~~X~~ 2)	PACKING AND SHIPPING DETAILS
Sampling Location: FACILITY 1400	Packed and Sealed for Shipping by: FRED GEBHARDT — Seal Number: 001
Team Leader: Fred Gebhardt	Delivered to Shipper by: FRED GEBHARDT — Airbill Number: 3436569706
	Sampling Status: ☒ Done ☒ Continuing

Sample Date	Sample Time	Field Sample Number	Sample Type	No. of Containers	Analytical Methods (Parameters)	Remarks
8/26/95	1725	CAFBFAC1400-0801	SOIL	1	SW8015 DRO -1	ENVIRONMENTAL SAMPLE
8/27/95	0815	CAFBFAC1400-0901EB	WATER	1	" -2	EQUIPMENT BLANK
8/27/95	1105	CAFBFAC1400-0902	SOIL	1	" -3	ENVIRONMENTAL SAMPLE
8/28/95	1235	CAFBFAC1400-0302	"	1	" -4	"
8/28/95	1300	CAFBFAC1400-0303	"	1	" -5	"
8/28/95	1530	CAFBFAC1400-0304	"	1	" -6	"
* 8/28/95	1910	CAFBFAC1400-0305	"	1	" -7	"

Additional Comments: ALL SAMPLES EXCEPT -0901EB HAD HIGH READINGS ON FIELD G.C.
* DO NOT RUN SOIL MOISTURE ON THIS SAMPLE, MOISTURE DUE TO ~~SURFACE~~ ADDED SURFACE WATER.

CHAIN OF CUSTODY RECORD				LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Relinquished by (signed)	Received by (signed)	Date	Time	Analytical Laboratory	Seal Intact upon Receipt: ☒ Yes ☐ No
Frederick E. Gebhardt	TO FEDERAL EXPRESS	~~1440~~ 8-30-95	1440	Quanterra Environmental Services, 4955 Yarrow Street, Arvada, CO 80002	Condition of Contents: good
	[illegible]	8-31-95	930	ph: (303) 421-6611	Contents Temperature: 2.9
				Attention: Lindsay Breyer or Grant Wilton	Laboratory Project Number: 4320

Quanterra Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

ANALYTICAL RESULTS

FOR

U.S. GEOLOGICAL SURVEY

QUANTERRA NO. 046431

JANUARY 11, 1996

Prepared by: Mark D. Stella

Reviewed by: Lindsay Breyer

Quanterra
Environmental Services

I. OVERVIEW

On December 16, 1995, Quanterra Environmental Services, Denver received six soil samples from the U.S. Geological Survey.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information/Analytical Test Requests
III. Analytical Results
IV. Quality Control Report

With the exceptions noted on the data sheets, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. SAMPLE DESCRIPTION INFORMATION/ANALYTICAL TEST REQUESTS

Sample Description Information:

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Quanterra's Denver laboratory is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests:

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
U.S. Geological Survey

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
046431-0001-SA	CAFBFAC14001001	SOIL	12 DEC 95	10:45	16 DEC 95
046431-0002-SA	CAFBFAC14001101	SOIL	12 DEC 95	11:20	16 DEC 95
046431-0003-SA	CAFBFAC14001201	SOIL	12 DEC 95	12:00	16 DEC 95
046431-0004-SA	CAFBFAC14000306	SOIL	14 DEC 95	11:10	16 DEC 95
046431-0005-SA	CAFBFAC14000307	SOIL	14 DEC 95	11:40	16 DEC 95
046431-0006-SA	CAFBFAC14000308	SOIL	14 DEC 95	13:20	16 DEC 95

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
U.S. Geological Survey

Lab ID: 046431	Group Code	Analysis Description	Custom Test?
0001 - 0006	A	Percent Water: ASTM D2216	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N

III. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization date is the date when the project was defined by the client such that laboratory work could begin. The date prepared is typically the date an extraction or digestion was initiated. For volatile organic compounds in water, the date prepared is the date the screening of the sample was performed.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Quanterra reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

Quanterra does not routinely blank-correct analytical data. Uncorrected analytical results are reported, along with associated blank results, for all organic and metals analyses. Analytical results and blank results are reported for conventional inorganic parameters as specified in the method.

In addition, surrogate recovery data is presented for all GC analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method.

Footnotes and Data Qualifiers

The data sheets contained in this report may contain a variety of footnotes and data qualifiers. Those used to indicate the confidence level for Tenatively Identified Compounds (GC/MS methods) are described above. Other footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analysts judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that are not discussed in the Overview. These are described below:

B Compound is also detected in the blank.

The indicated compound was detected in the sample as well as the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to matrix interference.

Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

T Preferred values unless footnoted on secondary column test.

This footnote is used with GC tests to indicate the primary column results. The footnote will be listed only for the first compound but pertains to all analytes determined by the method. It is used in conjunction the footnote V.

V Secondary column is the preferred value.

•This footnote is used for GC tests in conjunction the T footnote. It indicates that the value from the second column is preferred over the primary column result and pertains only to the indicated compound.

t Sample diluted due to the concentration of target compounds.

Indicates that reporting limits were raised due to the presence of target analytes outside the calibration range of the method. For multi-analyte methods, the footnote will appear only for the first analyte but pertains to all analytes determined by the method.

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001001
Lab ID: 046431-0001-SA
Matrix: SOIL Sampled: 12 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 27 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	90	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001101
Lab ID: 046431-0002-SA
Matrix: SOIL Sampled: 12 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 27 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	91	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001201
Lab ID: 046431-0003-SA
Matrix: SOIL Sampled: 12 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 27 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	16	mg/kg	4.0	ql
Surrogate	Recovery			
o-Terphenyl	91	%		

Note q : This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Note l : Sample resembles a hydrocarbon product occurring within the n-alkane range of C16-C26.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000306
Lab ID: 046431-0004-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 30 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit	
Diesel Range Organics	9300	mg/kg	400	t1
Surrogate	Recovery			
o-Terphenyl	ND	%		

Note t : Sample diluted due to the concentration of target compounds.

Note 1 : Qualitative ID: This sample has GC/FID characteristics that are similar to fuel oil #2.

Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C24.

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000307
Lab ID: 046431-0005-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 27 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	98	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

Extractable Petroleum Hydrocarbons

Method 8015 Modified

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000308
Lab ID: 046431-0006-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: 21 DEC 95 Analyzed: 27 DEC 95

Parameter	Result	Wet wt. Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.0
Surrogate	Recovery		
o-Terphenyl	99	%	

ND = Not detected
NA = Not applicable

Reported By: Bret Collins Approved By: Roxanne Sullivan

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001001
Lab ID: 046431-0001-SA
Matrix: SOIL Sampled: 12 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.6	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham Approved By: Jeff Malecha

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001101
Lab ID: 046431-0002-SA
Matrix: SOIL
Sampled: 12 DEC 95
Received: 16 DEC 95
Authorized: 16 DEC 95
Prepared: See Below
Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	6.2	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham

Approved By: Jeff Malecha

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14001201
Lab ID: 046431-0003-SA
Matrix: SOIL Sampled: 12 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	7.6	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham Approved By: Jeff Malecha

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000306
Lab ID: 046431-0004-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	5.6	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham Approved By: Jeff Malecha

Quanterra Environmental Services

General Inorganics

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000307
Lab ID: 046431-0005-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	8.6	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham Approved By: Jeff Malecha

General Inorganics

Quanterra Environmental Services

Client Name: U.S. Geological Survey
Client ID: CAFBFAC14000308
Lab ID: 046431-0006-SA
Matrix: SOIL Sampled: 14 DEC 95 Received: 16 DEC 95
Authorized: 16 DEC 95 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Water	10	%	0.10	D2216	NA	20 DEC 95

ND = Not detected
NA = Not applicable

Reported By: Jamie Wickham Approved By: Jeff Malecha

IV. QUALITY CONTROL REPORT

The Quanterra laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

The Quanterra QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with surrogate compounds appropriate to the method being used. In cases where no surrogate is available, (e.g., metals or conventional analyses) a single DCS serves as the control sample. An SCS is prepared for each sample lot for which the DCS pair are not analyzed. The recovery of the SCS is charted in exactly the same manner as described for the DCS, and provides a daily check on the performance of the method.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\text{Measured Concentration DCS1} - \text{Measured Concentration DCS2}|}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
046431-0001-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1
046431-0002-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1
046431-0003-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1
046431-0004-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1
046431-0005-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1
046431-0006-SA	SOIL	8015M-D-S	21 DEC 95-N1	21 DEC 95-N1

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limit
Category: 8015M-D-S								
Matrix: SOIL								
QC Lot: 21 DEC 95-N1								
Concentration Units: mg/kg								
Diesel Range Organics	20.0	21.5	21.1	21.3	107	48-138	1.9	32

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015M-D-S				
Matrix: SOIL				
QC Lot: 21 DEC 95-N1 QC Run: 21 DEC 95-N1				
Concentration Units: mg/kg				
o-Terphenyl	0.800	0.764	96	64-136

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 8015M-DRO-FID-S			
Matrix: SOIL			
QC Lot: 21 DEC 95-N1 QC Run: 21 DEC 95-N1			
Diesel Range Organics	ND	mg/kg	4.0

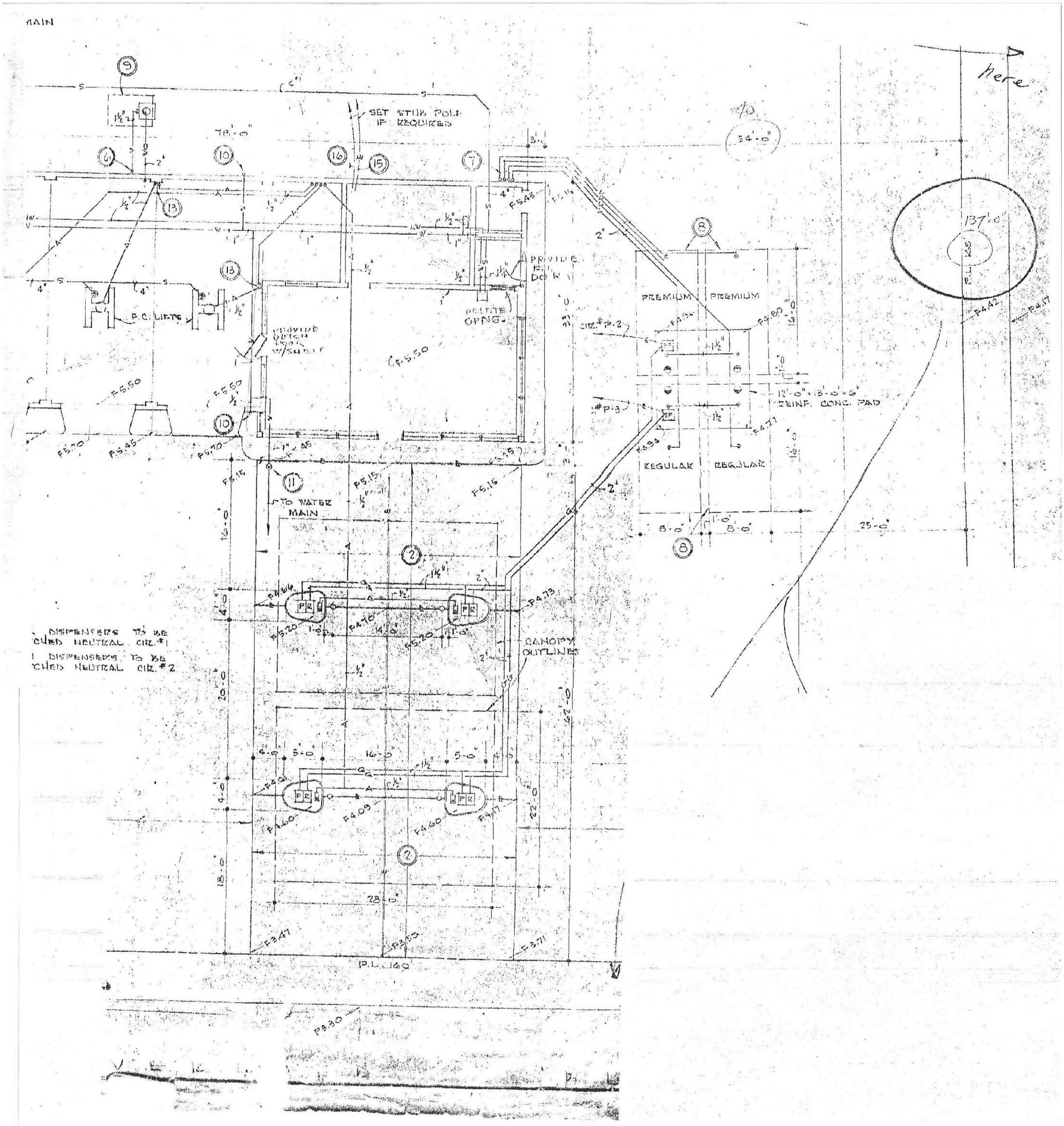
FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE

Former Gas Station Site (ST-C502)

As-built Drawing
Inspection Report


MAIN
here
SET STUB POLE IF REQUIRED
78'-0"
54'-0"
137'-0"
P.L. 135
PREMIUM
PREMIUM
REGULAR
REGULAR
12'-0" x 13'-0" x 6" REINF. CONC. PAD
F.C. LIGHTS
PROVIDE DUTCH DOOR W/SHELF
PROVIDE DOOR
DELETE OPNG.
TO WATER MAIN
CANOPY OUTLINES
DISPENSERS TO BE CHED NEUTRAL CIR. #1
DISPENSERS TO BE CHED NEUTRAL CIR. #2
P.L. 169

NM Environment Department
Underground Storage Tank Bureau
Prevention/Inspection Section
P.O. Box 26110
Santa Fe, New Mexico 87502-6110
(505) 827-0216

INSPECTION REPORT

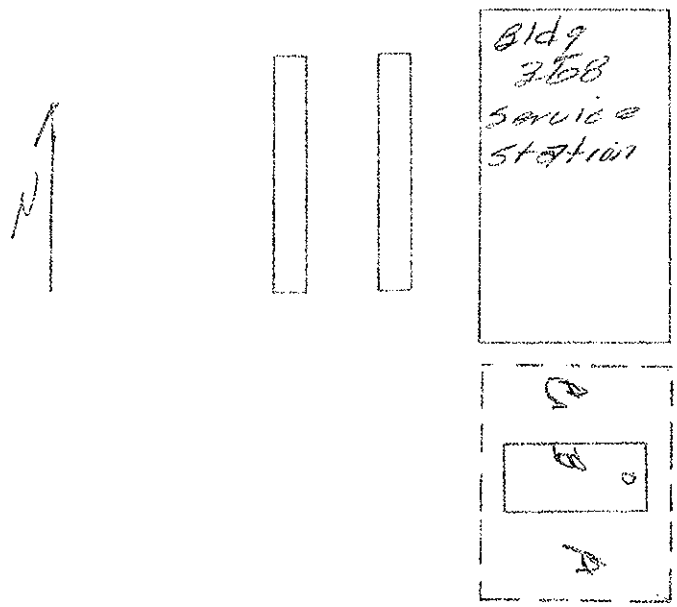
DATE	CASE NUMBER	OPENING CONFERENCE TIME
Jan 23 1995	0453	

INSPECTION TYPE: ☐ COMPLIANCE ☒ TANK CLOSURE ☐ REPAIR ☐ MODIFICATION ☐ REINSPECTION ☐ INSTALLATION ☐ COMPLAINT

Facility Name	Facility No.	Phone No.
1. BLDG 3688 Cannon AFB	6759015	
Address: 27 CES/CEV 111 Engineers Way Cannon AFB		ZIP Code: 88103-5136
Owner Name	Owner No.	Phone No.
2. U.S. Air Force FQ4855	6759	784-6022
Address: 27 CES/CEV 111 Engineers Way Cannon AFB		ZIP Code: 88103 5136
Facility Operator		Phone No.
3.		
Address		ZIP Code
Contractor Name	Installer No.	Phone No.
4. L.C.I. 2		763-1410
Address: P.O Box 1704 Clovis NM		ZIP Code: 88102-1704

TANK NO.	SIZE	CONTENTS	INSTALLATION DATE	TANK CONSTRUCTION	PIPING CONSTRUCTION	TANK RELEASE DETECTION	PIPING RELEASE DETECTION	TANK STATUS
(1) B	10,000	gasoline		steel	steel	yes	yes	Out of Service

SITE MAP



DISTRIBUTION: **WHITE** - Owner USTB **CANARY** - Operator **PINK** - ~~USTB~~ owner **GOLDENROD** - Compliance Officer

3683

		Yes	No	Unk.	N/A
1. All applicable tanks on site are registered.	1.	X			
2. Proper notification was made for the following:	2.				
a. Closure	a.	X			
b. Installation	b.				X
c. Modification	c.				X
d. Repair	d.				X
3. Tanks closed properly.	3.	X			
4. Tanks installed properly.	4.			X	
5. Tanks repaired/modified properly.	5.				X
6. Release detection — tanks.	6.	X			
7. Release detection — piping.	7.	X			
8. Record keeping:	8.				
a. Cathodic protection monitoring.	a.				X
b. Impressed current monitoring.	b.				X
c. Tank tightness test.	c.	X			
d. Line tightness test.	d.	X			
e. Line leak detector test.	e.	X			
f. Release detection performance claims, tests.	f.	X			
g. Release detection sampling/testing results.	g.	X			
h. Inventory records.	h.	X			
i. Permanent closure records.	i.	X			
j. Proof of financial responsibility.	j.	X			
9. Evidence of release/spill.	9.			X	

COMMENTS:

This 10,000 tank had no holes or holidays.
Backfilled with clean blow sand
Soil samples were taken and sent to a lab
for analysis

CLOSING CONFERENCE:	DATE	TIME
	Jan 26 1995	

Compliance Officer's Signature: [signature] Date: 1-26-95

On-site Representative's Signature: Robert L Chandler Date: 26 Jan 95

DISTRIBUTION: **WHITE** - Owner **CANARY** - Operator **PINK** - USTB **GOLDENROD**

Base Support/Operations Generator Former UST Site (ST-C503)

Photos of USGS Sample Locations

Hospital Abandoned UST Site (ST-C504)

Tank Closure Worksheet for 1400A
Tank Closure Worksheet for 1400B
Keers UST Report (August 1994)
Keers UST Report (October 1994)
Partial Utility Plan with USGS Sample Locations

TANK CLOSURE WORKSHEET
For UST at Building Number 1400 A

Tank Owner Cannon AFB Phone CEV office 505 784 4639
Address 27th Support Group, Cannon Air Force Base, 88103

Contractor Name LCI 2, INC. Phone 763-1410
Address P.O. BOX 1704 CLOVIS, NM 88102-1704

Contractor Name CHEYENNE BLDG. CONTRACTORS, INC Phone 763-1410
Address P.O. BOX 1704 ~~CLOVIS, NEW MEXICO 88101~~

Tank Closure Date 10-5-94

****

I. Tank Closure Initial Procedures (Check Measures Complied With):

- ✓ Obtain recommended safety equipment for all personnel.
- ✓ Contact Fire Marshall or other fire officials
- ✓ Bond or ground Equipment
- ✓ Drain product from piping and tank.
- ___ Disconnect, then cap or remove piping.
- ✓ Remove all residual product from tank.
- ✓ Excavate to tank top.
- ✓ Remove all tank fixtures.
- ___ Properly purge or inert tank of all flammable vapors using approved method.
- ✓ Continually monitor for explosive vapors while tank is being removed.

II. Tank Removal

- ___ Create vent hole.
- ___ Excavate tank using all safety precautions.
- ✓ Clean and inspect tank.
- ___ Check excavation for evidence of leaks and notify EID and other proper authorities if leak is found.
- ___ Check vapor levels in tank before transporting.
- ✓ Dispose of tank in approved manner.

Tank disposal location disposal in-place
How did you assess site for leakage Visual inspection and two soil tests.
Closure report kept at The base Environmental Management Office Bldg 250.
NOTE: Immediately report any evidence of leakage to EID at 827-0188

I hereby state that the above information is correct.

Signature of owner or contractor performing work.

****

FOR EID USE ONLY
Notification Received _____ Approved By _____
Inspection Date _____ Inspector _____

CHEYENNE
BUILDING CONTRACTORS INC.
P.O. BOX 1704
CLOVIS, NEW MEXICO 88102-1704
505-763-1410 FAX 505-769-0780

GB98
LIC. 30759

CERTIFICATE OF VAPOR TESTING

DATE 11-17-94

TANK OWNER Cannon AFB PHONE 784-4639

ADDRESS 27th Support Group Cannon AFB 88103

CONTRACTOR REMOVING TANK CCI, 2-INC

ADDRESS P.O.Box 1704 Clovis NM 88101 PHONE 763-1410

CHEYENNE BUILDERS IS CERTIFIED CONTRACTOR IN VAPOR TESTING.

I Troy Morales HEREBY CERTIFY THAT TANK _____ AT Bldg 1400, B _____, IS FREE FROM COMBUSTIBLE MATERIAL.

TROY MORALEZ

MIKE LANDGRAF

EXCAVATION SITE WORKSHEET
EXCAVATED SOIL VOLUME

Building/Tank Number 1400 B Date 11-17-94

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after TANK SOIL VOLUME removal.	L1 = 10 ft	W1 = 13 ft	D1 = 9 ft

TANK SOIL VOLUME YD^3 = (L1 10)x(W1 13)x(D1 9) = 43.5 YD^3

27 FT^3/YD^3

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after CONTAMINATED SOIL VOLUME removal.	L2 = 10 ft	W2 = 13 ft	D2 = 9 ft

TOTAL SOIL VOLUME YD^3 = (L2 10)x(W2 13)x(D2 9) = 43.5 YD^3

27 Ft^3/YD^3

TOTAL SOIL VOLUME YD^3 43.5 YD^3

minus TANK SOIL VOLUME YD^3 43.5 YD^3

= CONTAMINATED SOIL VOL. 0 YD^3 removed from site.

Verified by John J Barnett Contracting Officer's Representative.
(Signature)

EXCAVATION SITE WORKSHEET
SUMMARY OF ALL WORK COMPLETED AT A SITE

Building/Tank Number 1400 B Date 11-17-94

CONTRACT BID ITEM	AMOUNT OF UNIT ITEM COMPLETED	CONTRACT BID ITEM AMOUNT	TOTAL DOLLAR AMOUNT
Amount of asphalt pavement removed.	65 YD^2	$	$
Amount of asphalt pavement replaced.	0 YD^2	$	$
Amount of concrete sidewalk removed.	0 YD^2	$	$
Amount of concrete sidewalk replaced.	0 YD^2	$	$
Total Fluids purged.	0 gal	$	$
Total soil volume removed.	43.5 YD^3	$ /YD^3	$
Tank removal and disposal.	1000 GAL	$ EA	$
Soil samples and Lab results.	4 EA	$ EA	$
Jack Hammer two holes through concrete slab for soil sampling.	Lump 0 Sum	$ LS	$
Remove concrete slab.	0 YD^2	$ /YD^2	$

Type of back fill used; COMPACTED/UNCOMPACTED

Backfill as required by Appendix 1. 51.5 YD^3 $ /YD^3 $

Compact backfill in 8 inch lifts or install a loose backfill.

Verified by John J Barnett Contracting Officer's Representative.
(Signature)

TANK CLOSURE WORKSHEET
For UST at Building Number _____

Tank Owner Cannon AFB CLOVIS NM Phone CEV office 505 784 4639
Address 27th Support Group, Cannon Air Force Base, 88103

Contractor Name CHEYENNE BLDG. CONTRACTORS, INC. Phone 763-1410
Address P.O. BOX 1704 CLOVIS, NEW MEXICO 88101

Contractor Name _____ Phone _____
Address _____

Tank Closure Date 11-17-94

****

I. Tank Closure Initial Procedures (Check Measures Complied With):

- X Obtain recommended safety equipment for all personnel.
- X Contact Fire Marshall or other fire officials
- X Bond or ground Equipment
- X Drain product from piping and tank.
- X Disconnect, then cap or remove piping.
- X Remove all residual product from tank.
- X Excavate to tank top.
- X Remove all tank fixtures.
- X Properly purge or inert tank of all flammable vapors using approved method.
- X Continually monitor for explosive vapors while tank is being removed.

II. Tank Removal

- X Create vent hole.
- X Excavate tank using all safety precautions.
- X Clean and inspect tank.
- X Check excavation for evidence of leaks and notify EID and other proper authorities if leak is found.
- X Check vapor levels in tank before transporting.
- X Dispose of tank in approved manner.

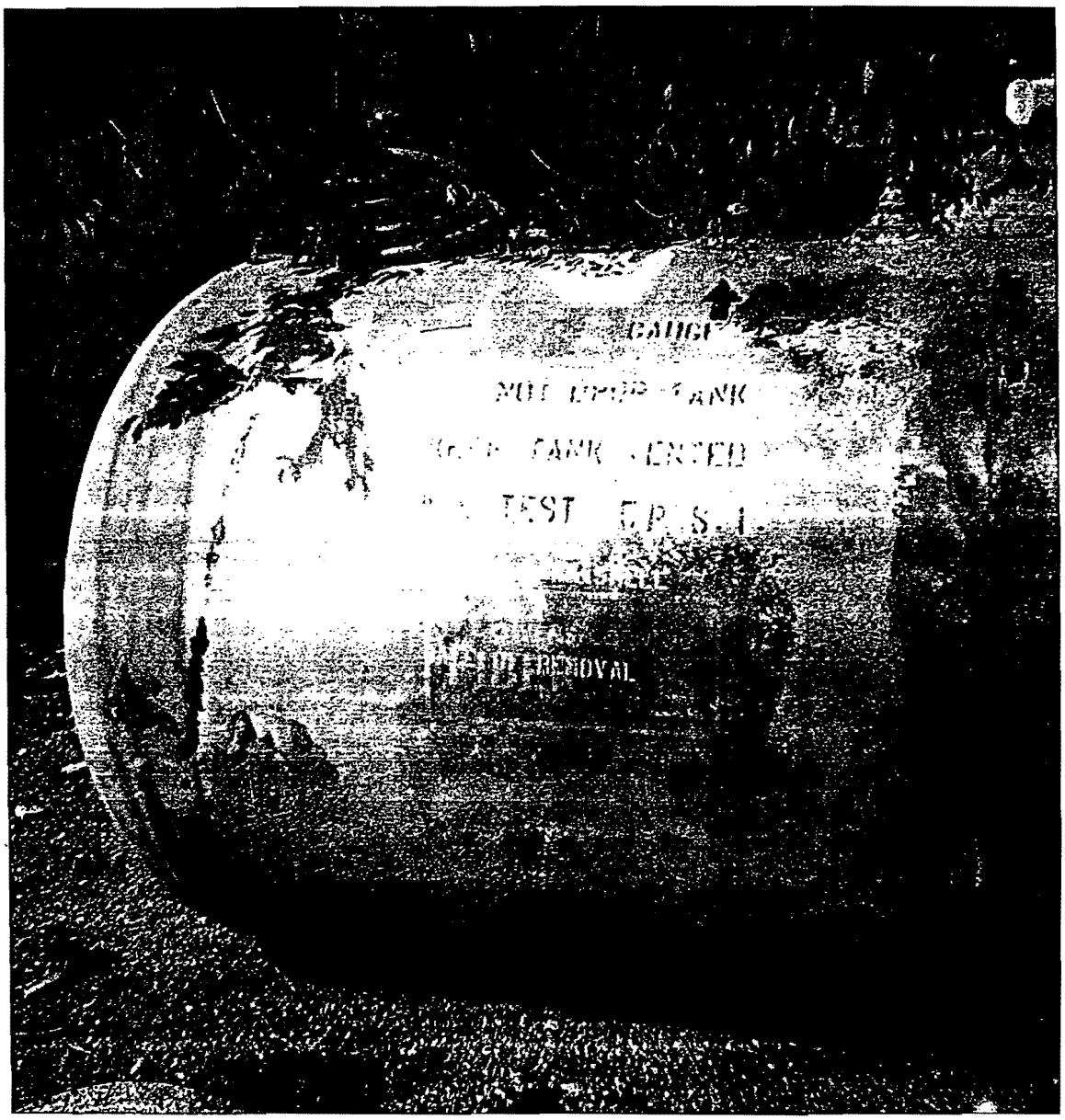
Tank disposal location 172 S Prince St CLOVIS NM 88101
How did you assess site for leakage Visual inspection and two soil tests.
Closure report kept at The base Environmental Management Office Bldg 250.
NOTE: Immediately report any evidence of leakage to EID at 827-0188

I hereby state that the above information is correct.

Signature of owner or contractor performing work.

****

FOR EID USE ONLY
Notification Received _____ Approved By _____
Inspection Date _____ Inspector _____



bldg 400 B

FACSIMILE ELECTRO MAIL TRANSMITTAL

(This information collection is not subject to OMB review under PL-96, The Paperwork Reduction Act.)

SECTION I - TO BE COMPLETED BY ORIGINATOR

CLASSIFICATION	TRANSMISSION	PAGE ONE OF 1 PAGES 7
☐ FOR OFFICIAL USE ONLY	☒ IMMEDIATE ☐ ROUTINE	

TO (Organization and Functional Address Symbol)	FAX NO. DSN	FAX NO. COMMERCIAL
27 CES		

ATTENTION	VOICE NO. DSN	VOICE NO. COMMERCIAL
John Barnett Pat Burns/Rick Chandler		

SUBJECT: UST Soil Contamination

FROM (Organization and Functional Address Symbol)	FAX NO. DSN	FAX NO. COMMERCIAL	VOICE NO. DSN	VOICE NO. COMMERCIAL
27 CONS		2959		2890

REMARKS

Please review and provide comments ASAP. Bid NLT 25 Aug 94.

RELEASER'S SIGNATURE	DATE	TIME
Brian C. Long	23 Aug	1539

SECTION II - TO BE COMPLETED BY ELECTRO MAIL OPERATOR

DATE TRANSMITTED	TIME TRANSMITTED	TRANSMITTER'S SIGNATURE

DATE ADDRESSEE CONTACTED	TIME ADDRESSEE CONTACTED	CONTACTOR'S SIGNATURE

AF Form 3535, SEP 91

Cheyenne
Building Contractors, Inc.

23 August 1994

27th Contracting Squadron CCC
100 N. Torch Blvd.
Cannon AFB, NM 88103-5131

RE: Upgrade Underground Storage Tanks, CAFB
Contract No. F29605-94-C0005

Dear Mrs. Pierce:

Please review the enclosed letter and test results from our subcontractor Keers Environmental, concerning the soil contamination around the 23,000 gallon tank located at the hospital.

This should be reviewed by both Pat Burns and Dick Chandler on what course needs to be taken.

Respectfully Submitted,

Mike Landgraf

ML:kc

enclosure:

23 AUG 1994 15 06

P.O. Box 1413 Ruidoso, New Mexico 88345 (505) 257-4212 FAX (505) 257-4243

CORPORATE OFFICE
[illegible] ALVARADO PLAZA NORTHEAST
ALBUQUERQUE, NEW MEXICO 87110
TELEPHONE: 505/ 883-9005
FACSIMILE: 505/ 883-9755

KEERS ENVIRONMENTAL

FACSIMILE

TO: Mike Lodge

COMPANY: Cheyenne Billing Contractors, Inc.

FROM: Don Keers

REGARDING: 25,000 gal UST - Cimarron

DATE: 8/23/94

TOTAL PAGES (INCLUDING COVER SHEET): 1 2 3 4 5 6

YOUR FAX NUMBER: 769-0760 OUR FAX NUMBER: 505/ 883-9755

YOUR PHONE NUMBER:

MESSAGE: See attached report & bill regarding. Please contact me if you have any questions or need to be informed of progress regarding this matter.

Thanks!

Don

IF YOU HAVE ANY PROBLEMS WITH THIS TRANSMISSION, PLEASE CALL OR FAX US.

Corporate Office
5904 Eubank Avenue Northeast
Albuquerque, New Mexico 87113
Telephone: 505/823-9006
Facsimile: 505/823-2766

August 23, 1994

Mr. Mike Landgraf
Cheyenne Building Contractors, Inc.
PO Box 1413
Ruidoso, NM 88345
(505) 763-1410

RE: Subsurface Investigation
25,000 Gallon UST
Cannon AFB

Dear Mr. Landgraf:

Keers Technical Services has completed a limited subsurface investigation at the above referenced site. This investigation was performed by Don Fernald with Keers on August 17, 1994. The following describes the events relating to this investigation.

KEERS
Technical Services

Upon arrival at the referenced site, Don Fernald met the Mr. Harry Gunn with the NMED - UST Bureau, Cheyenne Construction Personnel and Cannon AFB representatives to discuss sampling strategies and the approximate position/location of the 25,000 gallon UST.

Samples were obtained utilizing a hand driven auger that was fitted with extensions to advance soil samples to an appropriate depth below the UST (into native soils). After several failed attempts (due to encounters with the UST and/or caliche) to obtain soil samples on the north end of the UST, Cheyenne Building Contractors, Inc., utilized a back-hoe to remove several feet of soil from the north end of the UST to reveal the accurate position of the UST. A boring was advanced within the shallow excavation to a depth of 14 feet below ground surface. Hydrocarbon odors were noticeable. Prior to collecting a soil sample, the auger sampling device was decontaminated. The soil sample (sample #94600-081794-01) was collected and placed in a four (4) ounce sampling jar, labeled and stored in a cooler with ice for delivery to an analytical laboratory.

Soil samples were attempted to be collected from the south end of the UST, however, the auger was unsuccessful penetrating beyond three (3) feet in depth. Therefore, the back-hoe was utilized to remove several feet of soil from this end of the UST to reveal the end of the UST. During excavations, the back-hoe encountered UST piping and pulled it from the UST. Excavations were then terminated in this area.

A subsurface boring was then advanced on the west central portion of the UST. The hand auger was advanced to a depth of 14 feet and a soil sample (sample #94600-081794-02) was collected for analysis.

A final subsurface boring was advanced on the southwest portion of the UST. The hand auger was advanced to a depth of 14.5 feet and a soil sample (sample #94600-081794-03) was collected for analysis. All soil samples were collected utilizing standard quality assurance procedures.

Soils encountered during this subsurface investigation consisted of red fine silty clays and caliche. Caliche was encountered at approximately 14 feet at all of the boring locations.

All soil samples were sealed in jars, properly labeled and then placed into a cooler for overnight delivery to an accredited analytical laboratory (Analytical Technologies, Inc.). Since the final sample was obtained after 5:00 P.M. the samples were not sent to the laboratory until August 18, 1994. The laboratory received the samples on August 19, 1994. Soil samples were analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH) utilizing EPA Method 418.1. The following table depicts analytical results from the soil samples obtained for analysis:

Sample Number	Sample Location/Depth	Analytical Results
94600-081794-01	North side of UST/14'	2,800 *ppm
94600-081794-02	West-central side of UST/14'	640 ppm
94600-081794-03	Southwestern side of UST/14'	<20 ppm

*ppm - parts per million.

A draft of the laboratory results are attached to this report. A final draft of the results will be forwarded upon receipt by Keers Technical Services.

The NMED UST Bureau generally requires additional investigations and/or remediation for TRPH concentrations in excess of 100 ppm.

23 AUG 1994 15 07

Mr. Harry Gunn, with the NMED UST Bureau was notified of the analytical results on August 22, 1994. Mr. Gunn was questioned as to what sort of action would be required by the NMED, USTB. Mr. Gunn stated that additional investigations would be required including determining the vertical extent of contamination. Mr. Gunn was questioned as to whether the UST would be required to be removed. Mr. Gunn indicated that the UST may not necessarily be required to be removed and may possibly still be abandoned in-place.

Based on field investigations and analytical results, Keers Technical Services recommends that a 7 - day notification of spill or release be submitted to the NMED USTB as per Section 204 of the NMED UST Regulations. Additionally, Keers recommends that a subsurface investigation be initiated to determine the extent of contamination in relation to the 25,000 gallon UST present at this location. These activities should be conducted in accordance to applicable regulations and coordinated with approval from the NMED UST Bureau.

Keers Technical Services appreciates the opportunity to work with you on this project and we would be pleased to provide additional support. We look forward to providing our professional services to Cheyenne Building Contractors, Inc., on future projects. Please contact this office if you have any questions or additional requirements at (505) 823-9005 ext. 121 .

Sincerely,

Keers Environmental, Inc.

Don Fernald
Project Coordinator

Attachments: Draft Laboratory Results

Analytical Technologies, Inc., Albuquerque

Preliminary Results for Non-Aqueous Fluids Analysis

To: Dr. Ronald Company: Hess FAX #: 723-2726

From: Cecilia Rodewald, Project Manager

Comments:

Please contact your Project Manager regarding any questions or comments about this form.

Page ____ of ____ NCS Accession #: _____ Performed by: _____

Client Sample ID	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl-Benzene (mg/kg)	Total Xylenes (mg/kg)	Other (mg/kg)	TPHC (418.1) (mg/kg)
[illegible]						2700
[illegible]						640
[illegible]						< 20

Analytical Technologies, Inc. • 3708-A Pan American Freeway NE • Albuquerque, NM 87107 (505) 344-4413 Fax

Corporate Office
3904 Florence Avenue Northeast
Albuquerque, New Mexico 87109
Telephone: 505/824-9026
Facsimile: 505/824-2766

KEERS
Technical Services

Limited Subsurface Investigation for the Evaluation of Suspected Subsurface Contamination

at

Cannon AFB
Curry County, New Mexico

October 5, 1994

Prepared for:

Cheyenne Building Contractors, Inc.

Prepared by:

Keers Environmental, Inc.
Technical Services Group

Project Number 94-600

CORPORATE OFFICE
5904 FLORENCE AVENUE NORTHEAST
ALBUQUERQUE, NEW MEXICO 87113
TELEPHONE: 505/823.9006
FACSIMILE: 505/823.1766

October 5, 1994

Mr. Mike Landgraf
Cheyenne Building Contractors, Inc.
PO Box 1413
Ruidoso, New Mexico 88345

RE: Limited Subsurface Investigation
25,000 Gallon UST
Cannon AFB
Curry County, NM

Dear Mr. Landgraf:

Keers Technical Services Group has completed a limited subsurface soil investigation on the above referenced property. The findings of our work, together with conclusions and recommendations are presented in the attached report.

KEERS
TECHNICAL SERVICES

Thank you for the opportunity to serve you. We look forward to providing our professional services to Cheyenne Building Contractors on future projects. Please contact this office if you have any questions or additional requirements at (505)823-9006, ext. 121.

Sincerely,

Keers Environmental, Inc.

Don Fernald
Project Coordinator

Ronald K. Rhoades, CES, CEI
Technical Services & QA/QC Manager

Table of Contents

Limited Subsurface Investigation for the Evaluation of Suspected Subsurface Contamination

25,000 Gallon UST
Cannon AFB
Curry County, New Mexico

Project Number 94-800

Section I

PAGE NO.

1.0 Introduction/Scope of Work....1

2.0 Project Background....2

3.0 Field Investigation....2
Soil Sampling and Boring Descriptions

4.0 Laboratory Analysis....4

5.0 Geologic Information....4

6.0 Conclusions and Recommendations....5

7.0 Limitations....6

Section II

Analytical Reports

Section III

Site Plan of Boring Locations

Site Photographs

SECTION I

Limited Subsurface Investigation

at

Cannon AFB
Curry County, New Mexico

Keers Job # 94-600

1.0 : Introduction / Scope of Work

Keers Environmental, Inc., has completed a limited subsurface investigation of an area near the 25,000 gallon UST (diesel) located adjacent to the Base Hospital at Cannon AFB, Curry County, New Mexico. The drilling activities for this investigation were conducted on September 22, 1994. The purpose of this investigation was to determine the presence or absence of contaminants in subsurface soils on the subject site. The suspect contamination may have resulted from leak/spills from the 25,000 gallon underground storage tank (UST) previously utilized on the subject site. This UST was recently decommissioned and has been prepared for abandonment in place.

The subsurface investigation included the advancement four (4) soil borings to a depth of 20 feet. A total of four (4) subsurface soil samples were obtained from the borings at depths of 18 to 20 feet and analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH) utilizing EPA Method 418.1.

2.0 Project Background

The area of the subsurface investigation is located adjacent to the Cannon AFB Hospital. Mr. Don Fernald, with Keers Environmental, Inc. performed a subsurface investigation on August 17, 1994 in the area near a 25,000 gallon UST formerly utilized to store diesel fuel. This previous investigation included the advancement of three (3) subsurface samples from depths of 14 to 14.5 feet in areas surrounding the UST. Two (2) of the three (3) samples obtained for analysis indicated concentrations of Total Recoverable Petroleum Hydrocarbons (TRPH) of 2,800 and 640 parts per million (ppm). The New Mexico Environment Department, Underground Storage Tank Regulatory limits for TRPH are less than 100 ppm TRPH.

3.0 Field Investigations

On September 22, 1994, Mr. Don Fernald with Keers Environmental, Inc., performed a subsurface investigation of soils on the subject site. A total of four (4) samples were obtained from four (4) borings that were drilled in and around areas of the former tank location.

A CME 55 rotary drilling rig was used to advance the soil borings on the subject site. A hollow stem auger retrofitted with a split-spoon sampling device was used to advance soils to the surface for inspection and sampling. The two (2) foot split spoon sampling device was decontaminated between sampling events to prevent cross contamination of samples.

Soil Sampling and Boring Descriptions

The soil borings for each location were very similar in stratigraphy and composition and are described as follows: From a depth of zero (0) to approximately ten (10) feet the soils consisted of a reddish-brown colored, loose, fine, silty sandy soil. Some buff colored caliche material was encountered in some of these borings at depths of eight (8) to nine (9) feet. From a depth of approximately ten (10) to 13 feet the soil consisted of a buff colored caliche material. From 13 to 18.5 feet, the soil consisted of a reddish-brown fine, sandy silt. From 18.5 to 20 feet a tightly consolidated caliche was encountered.

Boring B-1, advanced adjacent to the northwest side of the UST was the only boring in which hydrocarbon odors were noted in during the subsurface investigation.

Soil samples were collected from each boring from a depth of 18 to 20 feet for analysis. All soil samples were placed in clean, four (4) ounce glass jars with Teflon-lined lids and placed in a cooler under ice for delivery to an accredited analytical laboratory.

4.0. Laboratory Analysis

A total of four (4) samples were submitted to an accredited laboratory for analysis. However, four (4) of the samples were not analyzed and were obtained for possible future analysis, pending the laboratory results of samples analyzed. Soil samples were tested for suspected contaminates in the soils. The soil samples were submitted to an accredited laboratory, for analysis of Total Recoverable Petroleum Hydrocarbons (TRPH) utilizing EPA Method 418.1.

The following Tables I summerizes the results from the analytical testing of the soils.

Table I

Analytical parameters of soil samples

Sample Number	Boring Number/ Depth of Sample	TRPH (PPM)
94600-092294-02	Boring B-1/18-20'	8,200
94600-092294-04	Boring B-2/18-20'	<20
94600-092294-06	Boring B-3/18-20'	<20
94600-092294-08	Boring B-4/18-20'	<20

<20 - Less than the Laboratory detectable limit.

Sample number 94600-092294-02 revealed elevated levels of TRPH.

Complete laboratory results and chain of custody forms are attached in Section II of this report.

5.0 Geologic Information

The Geology of the area is described briefly as follows:

The subject site lies within the High Plains Region above the Ogallala Formation. The Ogallala Formation was deposited during the Tertiary Period by deposition from sediment-laden streams. Near the end of the Pliocene Epoch (approximately one (1) million years ago), the climatic regime became more arid and stream capacity was greatly reduced. An extensive caliche (a calcareous deposit typical of arid climates) deposit probably formed on the Ogallala surface during this time. Cyclic caliche formation continued through the more humid transitional Pleistocene Epoch. Sand, silt, and clay were deposited on top of the caliche in some areas.

Today, the silts, sands, and gravel of the Ogallala Formation serve as an important aquifer which supplies water in Curry County and surrounding regions.

Surface Water

The subject site is located on the USGS Portair, New Mexico Quadrangle, 7.5 Minute Topographic Map. The topography of the subject site has a zero to one percent (0-2%) downward slope trending to the Northeast. Most surface water on the subject site is anticipated to flow to the Northeast.

Surface water is not located on or adjacent to UST, however, a man-made lake is situated within the golf course located several hundred yards to the north of the UST.

Ground Water

Ground water in the subject site area generally flows to the East southeast, according to information acquired from Mr. William Anderson with the New Mexico Environment Department (NMED) field office in Clovis. Depth to ground water in the subject area is approximately 285 feet according to the "Ground water Levels: Clovis Area, New Mexico" produced by the U. S. Geological Survey.

Soil Information

The soil on the subject site is characterized by the Amarillo Soils. Amarillo Soils have formed on medium texture to moderately coarse textured calcareous materials, probably alluvium reworked by wind. These soils have well-developed profiles. They resemble the Clovis soils but are deeper over lime and in may places their B horizon has a slightly stronger structure.

The Amarillo series is represented in Curry County by three soil types, Amarillo Loam, Amarillo fine sandy loam and Amarillo loamy fine sand. The Amarillo loams resemble the Pullman loams with which they merge, but the structure of their B horizon is not so strongly developed, and their profile is sandier throughout. Except that they are less sandy and their surface layers are thinner, the Amarillo loamy fine sands are like the Brownfield fine sands with which they merge. The Amarillo loamy fine sands are less sandy and are better developed structurally than the Springer loamy fine sands.

The soil on the subject site is classified as Amarillo fine sandy loam, 0 to 32 percent slopes. These soils generally have a moderate to rapid permeability.

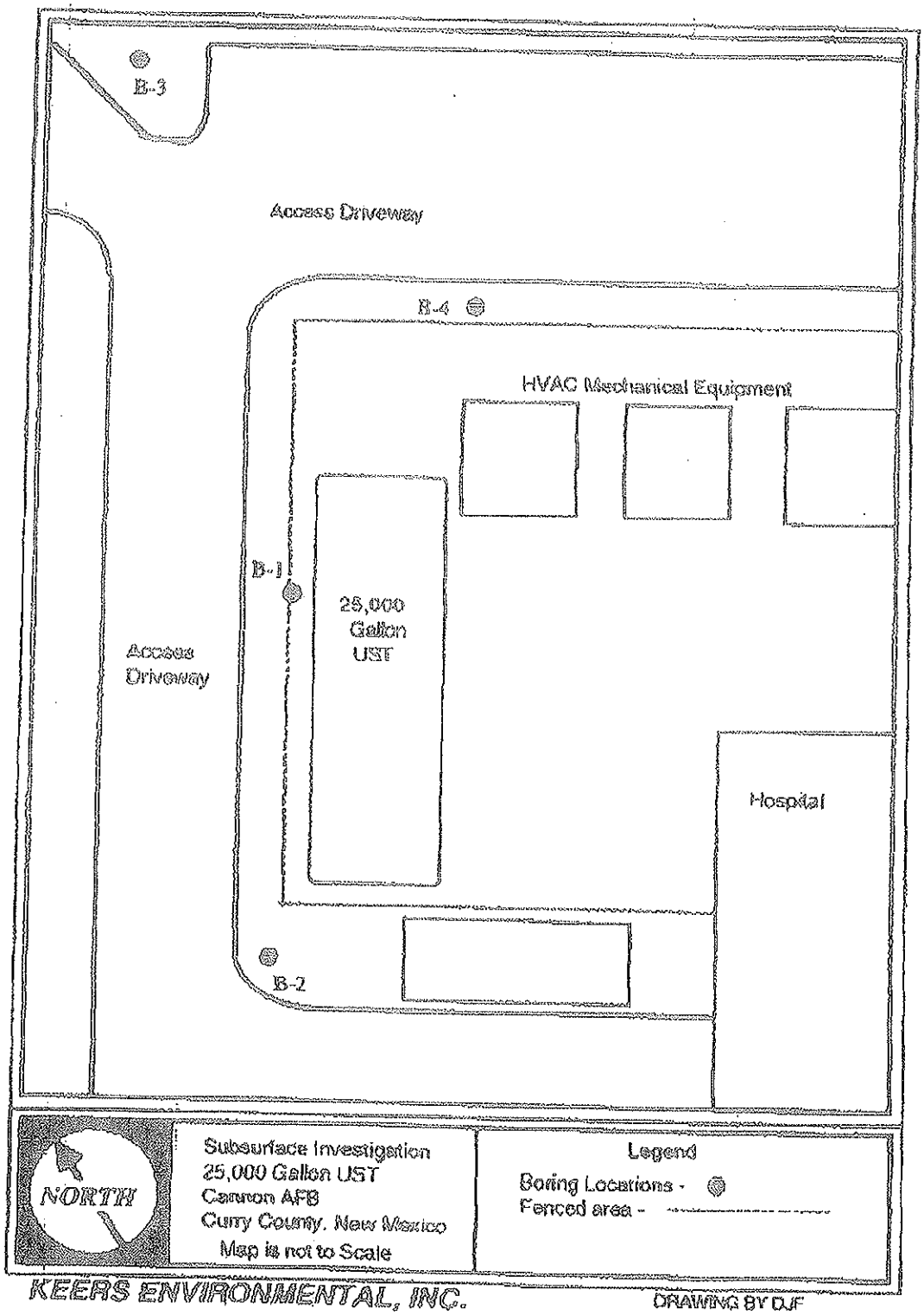
6.0 Conclusions and Recommendations

According to information gathered during field investigations, sample acquisition and laboratory reports, it appears that soils in the area of the UST has been adversely impacted by petroleum hydrocarbons. The laboratory analysis and field observations indicate that these contaminants are above current NMED UST Bureau regulations. Thus, Keers Environmental, Inc., recommends the following actions.

1. All NMED UST Bureau regulatory requirements should be followed. This includes all verbal and written notifications pertaining to the release of hydrocarbon products emanating from this 25,000 gallon UST.

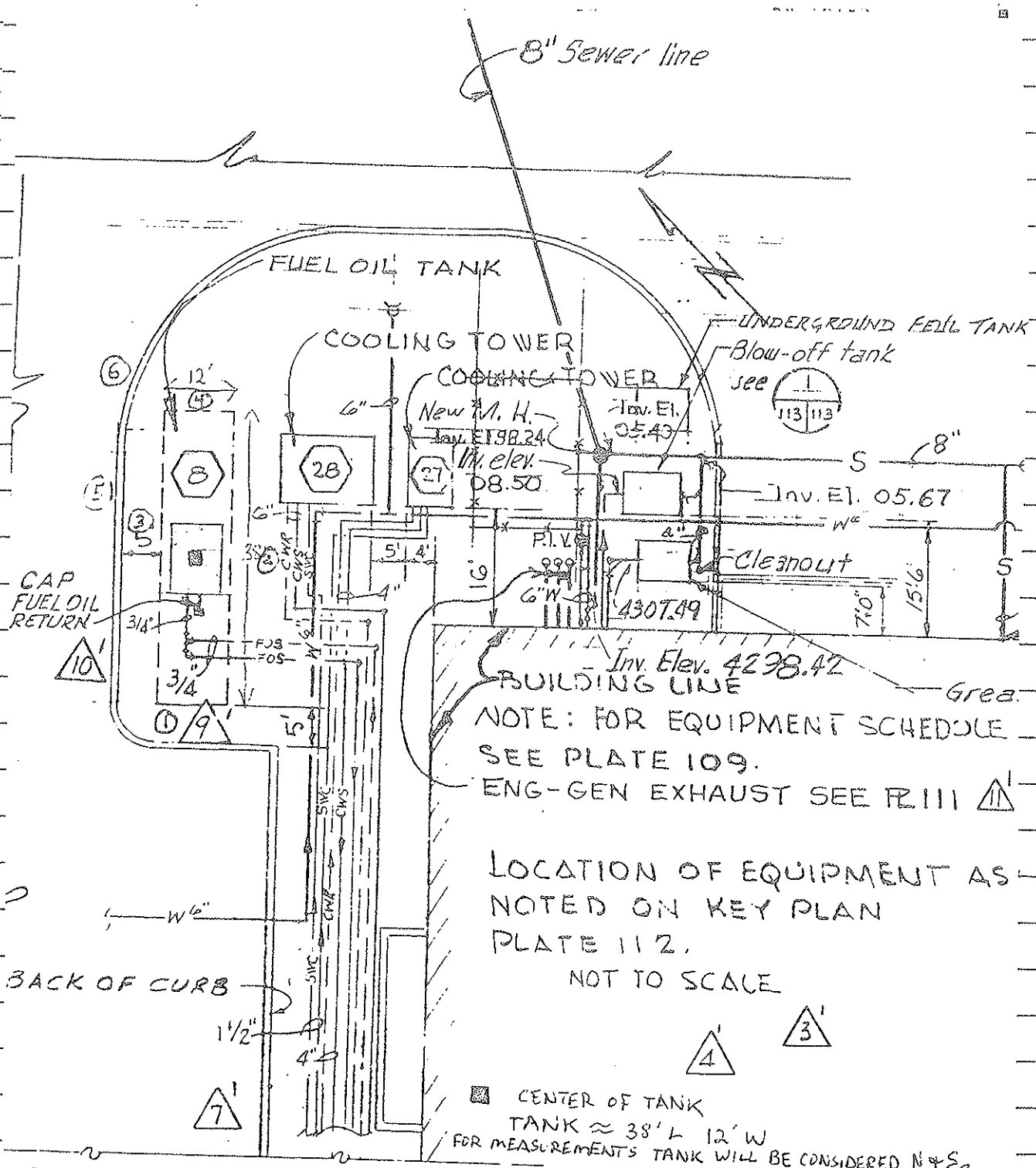
2. Keers Environmental recommends that a On-Site Investigation be performed in accordance to the NMED UST Regulations, Section 1205 and that the report to be submitted to the NMED UST Bureau in accordance to Section 1206 of the NMED UST Regulations.

In general, the On-Site Investigation includes the advancement of five (5) subsurface borings to a depth of 50 beyond contamination. Monitoring wells are required if ground water is encountered to determine any hydrocarbon impacts. This work is required to be completed within 30 days and report submittal within 45 days after the release has been reported. Time extensions may be granted by the NMED UST Bureau.


B-3
Access Driveway
B-4
HVAC Mechanical Equipment
B-1
25,000
Gallon
UST
Access
Driveway
Hospital
B-2
NORTH
Subsurface Investigation
25,000 Gallon UST
Cannon AFB
Curry County, New Mexico
Map is not to Scale
Legend
Boring Locations -
Fenced area -
KEERS ENVIRONMENTAL, INC.
DRAWING BY DJF

20

FACILITY 1400
PARTIAL UTILITY PLAN



① 2.5' N OF SOUTHERN CURB, 5.5' E OF WEST CURB
③ 3' E OF CURB 8' N OF CENTER OF TANK & 5' W OF CENTER
② 8' DUE E OF CENTER
④ 25' DUE N OF CENTER OF TANK
⑤ 5' N OF #1, 2.5' W OF CURB (ASPHALT)
⑥ 1.5' W OF CURB, 3' N OF #4 (ASPHALT)

~~6' DUE WEST OF #2~~
8' DUE N. OF #4

SAMPLE #	DATE TAKEN	DEPTH	RESULT mg/kg		
1400-0102	12-Apr-95	16' - 18'	51		
1400-0201	12-Apr-95	18' - 20'	6200		
1400-0301	12-Apr-95	18' - 20'	9900		
1400-0302	12-Apr-95	22' - 24'	370		
1400-0401	12-Apr-95	17' - 19'	16		
1400-0402	12-Apr-95	20' - 22'	2500		
1400-0403	12-Apr-95		N.D.		
1400-0602	12-Apr-95	20' - 22'	5.2		
	SAMPLE # IS LISTED AS SITE (1400), BORING (06), AND SAMPLE (02)				

Flightline Generator USTs Site (ST-C505)

Excavation Worksheet – UST A
Excavation Worksheet – UST B
7-day Notification with Sampling Results (December 1994)
Follow-up Sampling Results (January 1995)
Photos of USGS Sample Locations

EXCAVATION SITE WORKSHEET
EXCAVATED SOIL VOLUME

Building/Tank Number 3060 Tank A Date 12-15-94

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after TANK SOIL VOLUME removal.	L1 = 14 ft	W1 = 12 ft	D1 = 9 ft

TANK SOIL VOLUME YD^3 = (L1 14)x(W1 12)x(D1 9) = 56 YD^3

27 FT^3/YD^3

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after CONTAMINATED SOIL VOLUME removal.	L2 = 14 ft	W2 = 12 ft	D2 = 9 ft

TOTAL SOIL VOLUME YD^3 = (L2 14)x(W2 12)x(D2 9) = 56 YD^3

27 Ft^3/YD^3

TOTAL SOIL VOLUME YD^3 56 YD^3

minus TANK SOIL VOLUME YD^3 56 YD^3

= CONTAMINATED SOIL VOL. 0 YD^3 removed from site.

Verified by John O Barnett Contracting Officer's Representative.
(Signature)

EXCAVATION SITE WORKSHEET
EXCAVATED SOIL VOLUME

Building/Tank Number 306 OB Date 12-15-94

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after TANK SOIL VOLUME removal.	L1 = 11 ft	W1 = 10 ft	D1 = 9 ft

TANK SOIL VOLUME YD^3 = (L1 11)x(W1 10)x(D1 9) = 32 YD^3

27 FT^3/YD^3

	Length of Excavation	Width of Excavation	Depth of Excavation
Dimensions of Excavation after CONTAMINATED SOIL VOLUME removal.	L2 = 14 ft	W2 = 12 ft	D2 = 9 ft

TOTAL SOIL VOLUME YD^3 = (L2 14)x(W2 12)x(D2 9) = 56 YD^3

27 Ft^3/YD^3

TOTAL SOIL VOLUME YD^3 37 YD^3

minus TANK SOIL VOLUME YD^3 56 YD^3

= CONTAMINATED SOIL VOL. 48 YD^3 removed from site.

Verified by John J Barnett Contracting Officer's Representative.
(Signature)

STAFF SUMMARY SHEET

	TO	ACTION	SIGNATURE (Surname), GRADE AND DATE		TO	ACTION	SIGNATURE (Surname), GRADE AND DATE
1	27 FW/ JA	Coord		6			
2	27 SPTG/ CC	Sign		7			
3	27 CE/ CEV	Sign		8			
4				9			
5				10			

SURNAME OF ACTION OFFICER AND GRADE	SYMBOL	PHONE	TYPIST'S INITIALS	SUSPENSE DATE
Chandler GS-11	CEV	4-6022		

SUBJECT

7-Day Written Notification for a Petroleum Release at Facility 3060

DATE

SUMMARY

1. This SSS request the SPTG/CC sign the letter at Tab 1 to the New Mexico Environment Department Underground Storage Tank Bureau. This is the required 7-Day release notification for a petroleum release at Facility 3060 (building has no address). This release was discovered during the underground storage tank removal project.

2. NMED is aware of the release and requires written notification.

RECOMMENDATION

3. 27 SPTG/CC sign the notification letter.

1 Tab
1. Letter

Christopher S. Long
Commander, 27th Support Group
100 S DL Ingram Blvd.
Cannon AFB NM 88103-5217

Mr. Bill Skinner
New Mexico Environment Department
Underground Storage Tank Bureau
1190 St. Francis Drive
Santa Fe NM 87503

Dear Mr. Skinner

On 21 Dec 94, Susan Holmes, of the Underground Storage Tank Bureau, was notified of a petroleum release at facility 3060. The release was discovered while removing the underground tank. The release appeared to be from overflow of the tank. The site was excavated to remove any discolored soil. After the soil was removed, 4 soil samples were taken and sent to the laboratory for analysis. Mr. Harry Gunn , from the Clovis office of the UST Bureau, was on site during the tank removal. Upon the receipt of the laboratory samples (Attachment 1), a contaminated site was indicated. The contractor has returned to the site and removed additional soil. Soil samples were taken below the additional excavation. Analysis results are not available at this time.

Additional information regarding this site is as follows:

a. The tank had a capacity of 500 gallons and contained diesel.

b. The tank was constructed of fiberglass.

c. Two water wells are located within a mile radius of the contaminated site. Both wells are approximately 3/4 of a mile from the site. Recent water sampling did not indicate contamination.

d. No surface water is in the area.

e. The soil is of sandy clay content.

f. There was no visible free product in the excavation.

g. The time of the release is unknown.

If you have any questions or more information is needed, please contact Mr. Rick Chandler at (505) 784-6022. Please consider this written notification for this site. Thank you for your assistance.

Sincerely,

Christopher S. Long, Colonel, USAF
Commander, 27th Support Group

2 Attachment:
1. Laboratory results
2. Base map

CARDINAL LABORATORIES

PHONE (915) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240
PHONE (505) 326-4669 • 118 S. COMMERCIAL AVE. • FARMINGTON, NM 87401

TPH/BTEX ANALYSIS REPORT

Company: LCI-2, Inc.
Address: P.O. Box 1704
City, State: Clovis, NM 88102-1704

Date: 12/19/94
Lab #: H1899

Project Name: UST Removal
Location: Cannon AFB, Clovis, NM
Sampled by: not given — Date: 12/15/94 — Time: 9:15 and 11:30
Analyzed by: MF — Date: 12/16;12/19/94 — Time: various
Sample Type: Soil — Sample Condition: Cool, Intact

Units: mg/kg

Samp #	Field Code	TRPHC	BENZENE	TOLUENE	ETHYL BENZENE	PARA-XYLENE	META-XYLENE	ORTHO-XYLENE	MTBE
1	3060A NE Corner	15.9	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2	3060A SE Corner	10.8	<0.001	<0.001	<0.001	<0.001	<0.001	0.009	<0.001
3	3060A SW Corner	19.6	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
4	3060A NW Corner	6.3	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
5	3060B NE Corner	307.5	<0.001	0.034	0.040	<0.001	0.017	0.026	<0.001
6	3060B NW Corner	1,782	<0.001	0.011	0.074	<0.001	0.022	0.052	<0.001
7	3060B SE Corner	230.8	<0.001	<0.001	0.011	<0.001	0.005	0.018	<0.001
8	3060B SW Corner	118.9	<0.001	<0.001	<0.001	<0.001	0.003	0.011	<0.001
QC Recovery		428.1%	0.919	0.797	0.909	0.878	0.899	0.928	0.731
QC Spike		405.9	0.881	0.865	0.869	0.866	0.860	0.886	0.764
Accuracy		105.5%	104.3%	92.1%	104.6%	101.4%	104.5%	104.7%	95.7%
Air Blank		***	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Methods - GAS CHROMOTOGRAPHY; INFRARED SPECTROSCOPY
- EPA SW-846; 8020, 418.1, 3540 OR 3510

Michael R. Fowler

12/19/94
Date

R

PRIMARY DISTRIBUTION
39 - EN PRIMARY (1997 & 10,000) 4 ACT B
K 167 E (2000 & 2001) XLNOR AS - 4AT
BASE
NORTH

CARDINAL LABORATORIES

PHONE (915) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240
PHONE (505) 326-4669 • 118 S. COMMERCIAL AVE. • FARMINGTON, NM 87401

TPH/BTEX ANALYSIS REPORT

Company: LCI-2, Inc.
Address: P.O. Box 1704
City, State: Clovis, NM 88102

Date: 1/4/95
Lab #: H1911

Project Name: Cannon AFB
Location: Clovis, NM
Sampled by: TM
Analyzed by: MF
Sample Type: Soil

Date: 12/28/94 Time: 12:00
Date: 1/3-4/94 Time: various
Sample Condition: Intact

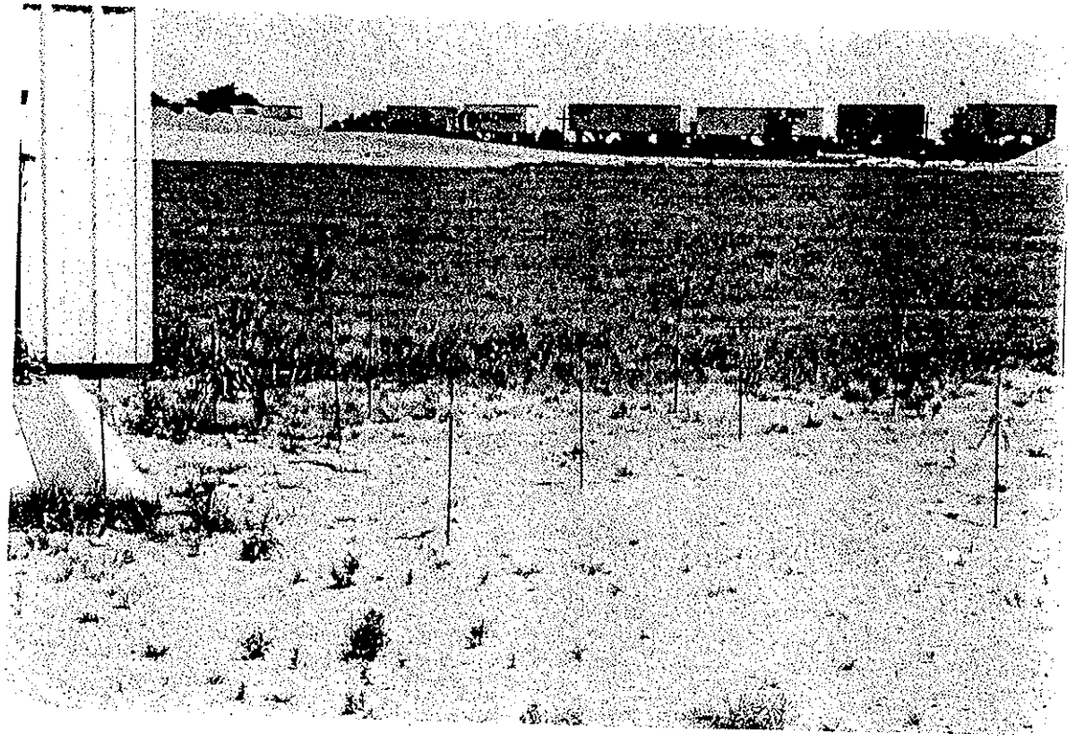
Units: mg/kg

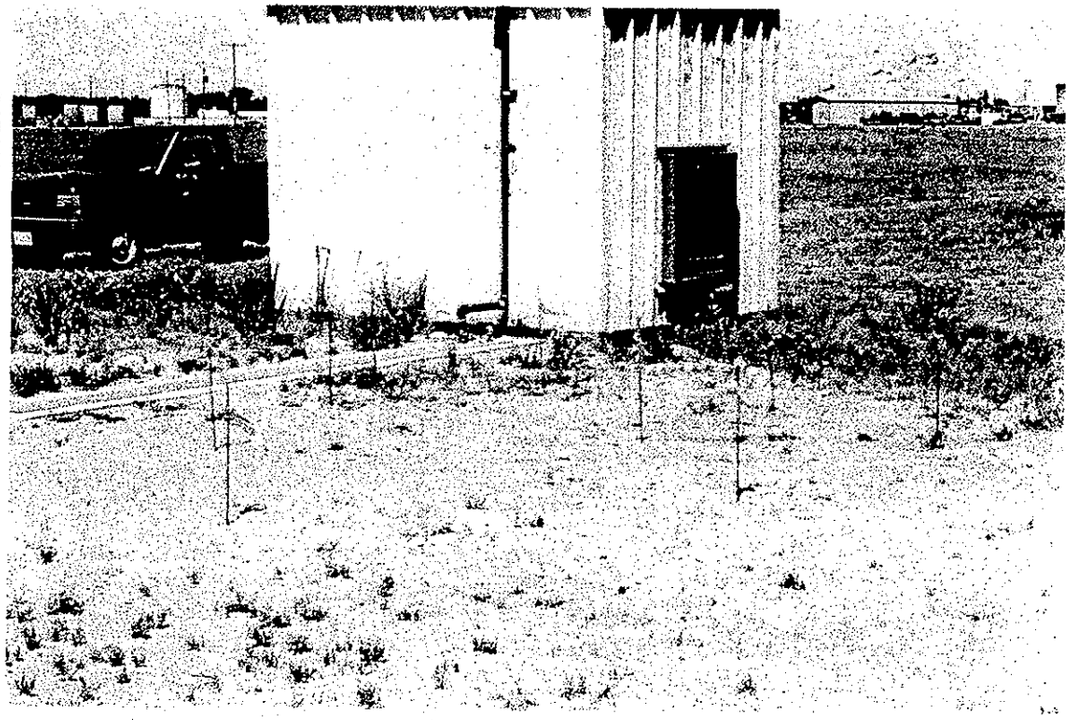
Samp #	Field Code	TRPHC	BENZENE	TOLUENE	ETHYL BENZENE	PARA-XYLENE	META-XYLENE	ORTHO-XYLENE	MTBE
1	Blg 3060 B East	106.9	<0.001	<0.001	<0.001	<0.001	<0.001	0.028	<0.001
2	Blg 3060 B West	1027.5	<0.001	0.029	0.045	0.017	0.031	0.042	<0.001
	QC Recovery	462.9	0.962	0.833	0.936	0.909	0.917	0.956	0.702
	QC Spike	405.9	0.881	0.865	0.869	0.866	0.860	0.886	0.764
	Accuracy	114.0%	109.2%	96.3%	107.7%	105.0%	106.6%	107.9%	91.9%
	Air Blank	***	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

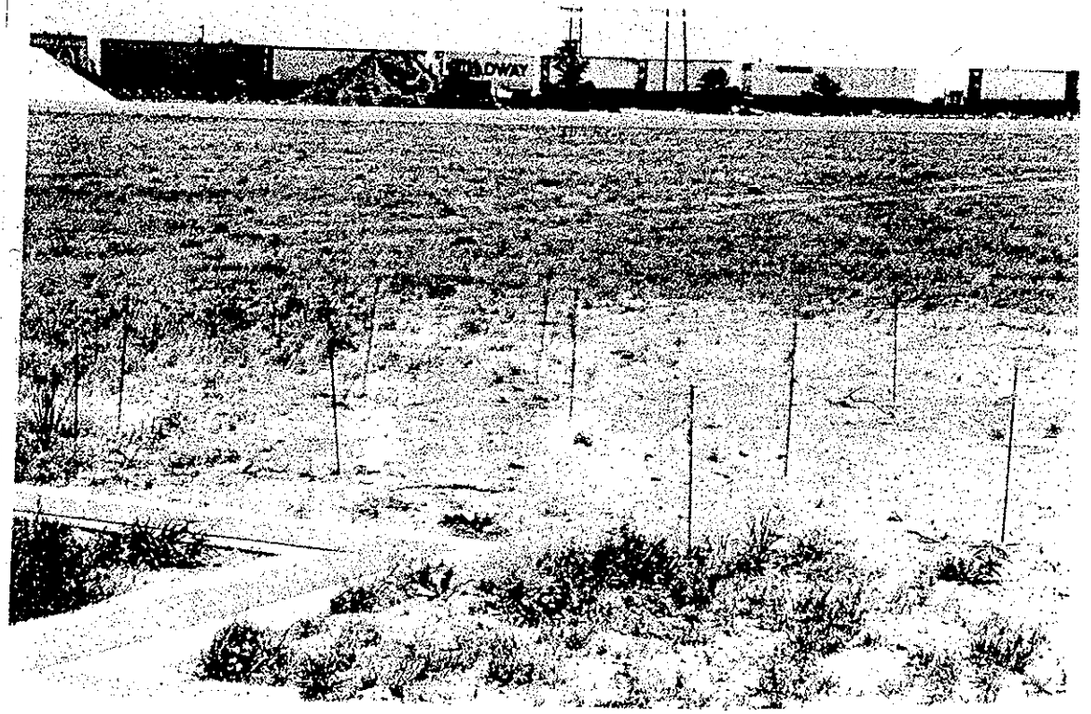
Methods - GAS CHROMOTOGRAPHY; INFRARED SPECTROSCOPY
- EPA SW-846; 8020, 418.1, 3540 OR 3510

Michael R. Fowler

1/4/95
Date






BROADWAY

THIS PAGE INTENTIONALLY BLANK

Waste Oil Storage Facility 244 and Leach Field Site (TA/AS-C129)

Parallax SWMU 129 Closeout Report (July 2000) (electronic [PDF] on CD only)
As-built Drawing (Sheet 7) (March 1986)
As-built Drawing (Sheet 8) (August 1986)
Letter from NMED dated September 14, 2009

FINAL

CLOSEOUT REPORT / CONTAMINATION ASSESSMENT
SWMU 129 - FACILITY 244
ABOVEGROUND TANK STORAGE AREA
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

July 19, 2000

Submitted to:
U. S. Army Corps of Engineers
Omaha District

Submitted by:
Parallax, Inc.
20201 Century Blvd
Germantown, MD 20874

Contract No.
DACW45-99-D-Q015
Delivery Order No. 0001

Parallax
INC.

Parallax
INC.

U.S. Army Corps of Engineers
Omaha District
Attn: CENWO-PM-HA (Tom Zink)
215 North 17th Street
Omaha, NE 68102-4978

ATL-00-157

July 21, 2000

Reference: Contract No. DACA45-99-D-0015
Delivery Order No. 0001

Subject: Revised Final Closeout Report/Contamination Assessment for SWMU 129 (Facility 244) at Cannon Air Force Base, Clovis, New Mexico

Dear Mr. Zink,

Enclosed is the subject report distributed as indicated below. This revision incorporates the comments provided by Mr. Sanford Hutsell of Cannon Air Force Base. Original copies under this cover will be submitted to yourself and Cannon Air Force base per your instructions. At your convenience, I would like to discuss final completion of the submittal register for this delivery order to facilitate closeout.

Parallax appreciates the opportunity to support the U.S. Army Corps of Engineers, Omaha District, and Cannon Air Force Base on this project. Please do not hesitate to contact me at 770/955-2008 if you have any questions or comments.

Sincerely,
Parallax, Inc.

William D. Keefer

W. David Keefer
Program Manager (Acting)

cc: Cannon Air Force Base (Mr. John Pike) – 8 copies
Debbie Molinary – Parallax w/o attachment
Project File

An Engineering and Environmental Management Company
320 Interstate North Parkway, Suite 230 • Atlanta, GA 30339 • Phone: (770) 955–2008 • FAX: (770) 955–2331

TABLE OF CONTENTS

LIST OF FIGURES 4

LIST OF PHOTOGRAPHS 4

LIST OF TABLES 5

ACRONYMS AND ABBREVIATIONS 6

EXECUTIVE SUMMARY 8

1.0 INTRODUCTION 10

1.1 Project Objective 10

1.2 Technical Scope of Work 10

1.3 Project Purpose 11

2.0 FACILITY DESCRIPTION 12

2.1 Cannon Air Force Base Location/History 12

2.2 SWMU 129, Facility 244 12

3.0 FACILITY DEMOLITION AND REMOVAL ACTIONS 13

3.1 Removal of Aboveground Storage Tanks and Associated Piping 13

3.2 Demolition of Concrete Saddles and Containment Pad 14

3.3 Removal of O/W Separator 14

3.4 Disposal of Construction Debris and Waste Water 15

4.0 PRELIMINARY SITE ASSESSMENT 16

4.1 Investigation Overview 16

4.2 Field Observations 16

4.3 Sampling and Analysis 16

4.4 Data Quality Assessment 18

4.4.1 Quality Assessment Summary 18

5.0 SUMMARY AND CONCLUSIONS.....20

APPENDIX A SOIL SAMPLE ANALYTICAL DATA A-1

APPE NDIX B SOIL SAMPLE VALIDATION QUALIFERS SUMMARY.....B-1

LIST OF FIGURES
(Attached at End of Text)

Figure 2-1 Location Map of Facility 244 and Adjacent Structures 21

Figure 2-2 Map of Cannon AFB and Surrounding Area 22

Figure 2-3 Diagram of Tank Locations and Associated Features 23

Figure 3-1 Map of Haul Route to Abandoned Airstrip/Rubble Storage Area 24

Figure 3-2 Copy of Receipt from Ed's Recycling Center for Scrap Metal 25

Figure 3-3 Weight Tally Sheet, Ed's Recycling Center, Showing 6070 Pounds . . . 26

Figure 3-4 Reproduction of Check # 3156 Received for Scrap Metal 27

Figure 4-1 Copy of Chain of Custody for Soil Samples Collected 12-14-99 28

Figure 4-2 Plan View of Facility 244 Showing Soil Sampling Locations 29

LIST OF PHOTOGRAPHS
(Attached at End of Text)

Photograph 1 View of Facility 244 Prior to Start of Dismantling Operations Showing Tank Locations and Fencing 30

Photograph 2 Alternate View of the Facility with Fence Fabric Removed and Orange Safety Webbing Stretched 30

Photograph 3 Associated Distribution Piping and Manual Valves 31

Photograph 4 Omegasys Personnel Pressure Washing Interior Surfaces of Tank and Using Drain Valve to Remove Sludges and Rinse Waters 31

Photograph 5 Removal of Tank Support Saddle with Trackhoe Bucket 32

Photograph 6 Stockpiling Concrete Support Saddles at the Designated Staging Area 32

Photograph 7 Removal of Remaining Portions of the Concrete Containment Pad and Retaining Curb 33

Photograph 8 View of Soil Surface after Removal of the Containment Pad 33

Photograph 9 Sheet Metal Cover, with Accessways, for the O/W Separator and Concrete Vault 34

Photograph 10 Omegasys Personnel Removing Top Plate of O/W Separator and Disconnecting Supply/Distribution Pipes 34
Photograph 11 View of O/W Separator Interior Structure Showing Thick Deposits of Sludge and Oil-Coated Baffles 35
Photograph 12 The Trackhoe Bucket Is Used to Lift the O/W Separator from the Concrete Vault 35
Photograph 13 Field Personnel Use Shovels and Scoops to Remove Sludge Prior to Pressure Washing Interior Surfaces 36
Photograph 14 The Concrete O/W Separator Vault and Associated Dump Pits Are Demolished after Removal of Piping 36
Photograph 15 View of Construction Rubble Stockpiled at the Designated Abandoned Airstrip 37
Photograph 16 Scrap Metal Loaded on Flatbed Truck Ready for Transport to the Scrap Metal Recycler 37
Photograph 17 Delivery of Scrap Metal to Ed's Recycle Center, Clovis, New Mexico 38
Photograph 18 Omegasys Personnel Unloading Drums of Decontamination And Rinse Waters, and Residual Sludges at the On-Base RCRA 90-Day Storage Facility 38
Photograph 19 View of Facility 244 Location upon Completion of Removal Activities; Light Tan Area in Foreground Is Backfilled Area . . 39
Photograph 20 View of Tanks Removed from Facility 244, Temporarily Staged Prior to Sale as Surplus Material 39

LIST OF TABLES

Table A-1 RCRA Metals - Analytical Data A-1
Table A-2 PCBs - Analytical Data A-2
Table A-3 Pesticides - Analytical Data A-3
Table A-4 Total Petroleum Hydrocarbons - Analytical Data. A-4

Table B-1 Data Validation Qualifers Summary B-1

ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
Base	Cannon Air Force Base
AOC	Area of Concern
CA	Corrective Action
COC	Contaminant of Concern
DMRO	Defense Reutilization and Marketing Office
Facility	Facility 244
ID	Identification
mg/Kg	Milligrams per Kilogram
MS/MSD	Matrix Spike/Matrix Spike Duplicate
N/A	Not Available
NMED	New Mexico Environment Department
OSHA	Office of Safety and Health Administration
O/W	Oil/Water
Parallax	Parallax, Inc.
PCB	Polychlorinated Biphenyl
PCS	Petroleum Contaminated Soil
PID	Photoionization Detector
PM	Project Manager
PSA	Preliminary Site Assessment
QAPjP	Quality Assurance Project Plan

QC	Quality Control
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RDL	Reported Detection Limit
SHSO	Site Health and Safety Officer
SOW	Statement of Work
TPH	Total Petroleum Hydrocarbon
TSD	Treatment, Storage, and Disposal
ug/Kg	Micrograms per Kilogram
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency

EXECUTIVE SUMMARY

Parallax, Inc. (Parallax) performed a voluntary corrective action (CA) at SWMU 129, Facility 244 (Facility), Cannon Air Force Base (AFB)(Base), Clovis, New Mexico, for the U.S. Army Corps of Engineers (USACE), Omaha District. Facility 244 contained five aboveground tanks dedicated to storage of used lubricating oils and other petroleum-based products (excluding fuels).

Implementation of the CA consisted of dismantling the storage tanks, disassembly and disposal of associated distribution piping, valves, an oil/water (O/W) separator, and demolition of concrete vaults, dump pits, and the concrete containment pad and retaining curb. The interior of the storage tanks were pressure-washed prior to being removed from their supports and set aside for disposal as surplus by the U.S. Air Force (USAF), Defense Reutilization and Marketing Office (DMRO). The piping, valves, O/W separator, and miscellaneous scrap metal were decontaminated and sold to a local (Clovis) recycled metal dealer. Any sludges remaining in the tanks and the O/W separator, pressure wash waters, and decontamination water were containerized in 55gallon drums. The drums were transported to the on-Base Resource Conservation and Recovery Act (RCRA) 90-day accumulation area. The USAF assumed responsibility for characterizing, manifesting, and shipping the wastes to an appropriate treatment, storage, and disposal (TSD) facility. The concrete rubble was stockpiled on a designated abandoned airstrip for subsequent crushing and use as backfill for other construction projects.

After the overlying containment pad and appurtenances were removed, Parallax performed a Preliminary Site Assessment (PSA) of the underlying soils to determine if petroleum hydrocarbon contamination was present. The site geologist visually inspected the soils for signs of petroleum staining or characteristic odors. No discoloration or odor was detected. The ambient atmospheres directly above the ground surfaces in areas most likely to exhibit contamination (e.g., soils under the O/W separator, dump pits, and areas surrounding the outside of the retaining curbs) were monitored with a photoionization detector (PID) and Draeger® contaminant-specific colormetric tubes. These instrumentation surveys did not indicate the presence of hydrocarbon contamination.

A total of ten soil samples, including eight representative grab and two quality control (QC) [i.e., field duplicate and matrix spike/matrix spike duplicate (MS/MSD)] samples, were collected and shipped to Accura Analytical Laboratory, Norcross, Georgia, for analyses. The analytical results of these samples indicated that there were no contaminants of concern (COCs) present in the soils underlying Facility 244. The laboratory results were validated by Parallax technical personnel to ensure QC reliability and proper instrumentation methodology. Based upon the field observations and laboratory analyses, the CA at Facility 244 resulted in a clean closure and therefore should require no further action.

The excavated areas were backfilled using crushed caliche, a local "hardpan" material formed in arid/semi-arid regions as a result of leaching calcium-rich salts from surface soils by percolating rainwater and other surface water and then precipitation of an impervious, coherent chalky layer at a shallow depth below grade. The caliche is used extensively in the region as a road sub-base material because of its reaction with water to form an extremely hard backfilled surface.

1.0 INTRODUCTION

Between December 10 and 15, 1999, Parallax performed a voluntary CA at SWMU 129, Facility 244, Cannon AFB, Clovis, New Mexico, for the USACE, Omaha District. The Facility was constructed in 1991, but due to design and operational problems (i.e., there were difficulties associated with the construction of the O/W separator and liquid transfer into the various tanks), it was infrequently used. The CA consisted of removal of the storage tanks from their support saddles; disassembly and disposal of associated distribution piping, valves, and an O/W separator; and demolition of concrete vaults, dump pits, and the surrounding concrete containment pad and retaining curb. The concrete rubble was stockpiled at a designated storage area on an abandoned aircraft runway, while the scrap metal was decontaminated and sold to a local scrap-metal dealer.

After demolition of the concrete containment pad, Parallax performed a PSA on the exposed soils to determine whether hydrocarbon contaminants had leaked through the pad or spilled onto the ground surface adjacent to the retaining curbs. The soils were visually inspected for discoloration and surveyed for the release of ambient volatile organic compounds using appropriate instrumentation (i.e., PID and Draeger® colormetric tubes). Representative grab soil samples were collected and submitted to Accura Analytical Laboratory, Norcross, Georgia, for analyses. The soils appeared to be contaminant-free. These observations were later substantiated by analytical results; therefore, the excavated areas were backfilled using caliche, a locally-available road base material.

1.1 Project Objective

The current CA/PSA project was designed to achieve closure of SWMU 129, Facility 244, in such a manner that any threat to human health and the environment was minimized and the site would require no further maintenance or monitoring.

1.2 Technical Scope of Work

The technical SOW provided to Parallax included two primary tasks: 1) removal of the aboveground oil storage tanks and other appurtenances, and demolition of all concrete structures; and 2) perform a PSA of the soils underlying the concrete containment pad to determine whether petroleum hydrocarbon contamination was present. In addition, after the exposed substrate was either determined to be contaminant-free or contaminated soils were removed, the SOW required the excavated area to be backfilled. The removal actions and PSA for Closure of Facility 244 were accomplished according to the following steps:

- Ensure that all utilities in close proximity to Facility 244 were properly identified, and that all electrical power servicing the Facility was disconnected at the nearest supply transformer and all fuses/circuit breakers were removed;

- Remove the perimeter chain-link fence and gates surrounding the Facility on three sides but leave the "back" or east segment which was common to the adjoining storage area;

- Pressure wash the five 5,000-gallon aboveground storage tanks, containerize sludges and rinse waters;

- Disassemble associated piping, hoist tanks from their support saddles, and set aside for subsequent disposal by the USAF DRMO;

- Demolish concrete saddles, containment pad, and retaining curb;

- Remove O/W separator from its vault, clean out sludge, and pressure wash;

- Demolish remaining concrete vaults and dump pits;

- Haul concrete construction rubble to the designated abandoned airstrip for stockpiling;

- Dispose of piping and scrap metal through a local scrap metal recycler;

- Perform a PSA on the exposed soil surfaces underlying the containment pad to determine the presence of petroleum hydrocarbon contamination, including: visual observations, instrumentation monitoring for volatile organic vapors, and soil sampling for laboratory analyses; and

- Backfill of excavated areas using locally-available caliche sub-base material.

1.3 Project Purpose

The removal action/PSA for Facility 244 was performed to achieve closure of the site as stipulated in the Base RCRA permit issued by the New Mexico Environment Department (NMED) on behalf of the U.S. Environmental Protection Agency (USEPA).

2.0 FACILITY DESCRIPTION

SWMU 129, Facility 244, was located at the Contractor Storage Facility/laydown yard, south of Perimeter Road, and northeast of Building 208, a maintenance hanger, at Cannon AFB, Clovis, New Mexico. Facility 244 was originally built in 1991 to store waste petroleum products generated during routine maintenance of aircraft and service vehicles. The Facility

was used infrequently due to design and operational problems. Historically, lubricating oils, hydraulic fluids, and solvents were reportedly stored in the tanks, at various times. Fuels were never present at Facility 244. Figure 2- 1 shows the location of Facility 244 relative to surrounding Base features.

2.1 Cannon AFB Location/History

Cannon AFB is located in Curry County, southeastern New Mexico, south of U.S. Highway 60/84, near the New Mexico/Texas border (Figure 2-2). The Base occupies approximately 4,000 acres, six miles west of Clovis, New Mexico. The adjacent land is used primarily for farming, feedlots, and ranching.

The Base was established in 1942 as the Clovis Army Air Base. B-17, B-24, and B-29 air crews trained there during World War II. The facility was renamed Cannon AFB in 1957. It currently maintains a combat-ready force providing training to F-16 fighter combat aircrews for tactical organizations worldwide.

2.2 SWMU 129, Facility 244

Facility 244 consisted of five 5,000-gallon aboveground storage tanks supported on reinforced concrete saddles. The tanks were surrounded by a 30-foot x 50-foot (approximate) concrete containment pad. A 9-inch retaining curb, designed to contain liquids released in the event of an accidental release or ruptured tank, surrounded the containment area. Photograph 1 is a view of Facility 244 prior to start of the removal action (tanks, saddles, and chain-link fence are intact). Photograph 2 is a view of the Facility with the fence fabric removed and temporary orange security webbing in place.

The storage tanks were filled through a network of supply pipes entering the tops of the tanks (Photograph 3 shows the distribution piping and valves). These pipes, controlled by manual gate valves, were connected to a central O/W separator located in the north end of the containment pad. Bulk waste oil was brought to Facility 244 and dumped into adjacent collection pits equipped with strainers. From the pits the oil drained into the O/W separator and was then pumped into the appropriate storage tanks. The water fraction, segregated by the O/W separator, exited through a port in the west-side of the structure.

The water flowed into a leach field, located to the southeast of the Facility. The leach field consisted of perforated plastic piping surrounded by crushed stone that allowed the water to be discharged into the subsurface and percolate into underlying soils without impacting the groundwater. Figure 2-3 is a plan view of Facility 244 showing the original locations of the storage tanks and temporary staging area after removal.

Each storage tank had an exterior fill gauge equipped with an indicator arrow connected to a float inside the tank. As the volume of liquid inside the tank fluctuated, the position of the float changed resulting in a corresponding change in the position of the indicator arrow on the fill gauge. This device provided a continuous indication of the quantity of liquid stored in each tank.

the fill gauge. This device provided a continuous indication of the quantity of liquid stored in each tank.

3.0 FACILITY DEMOLITION AND REMOVAL ACTIONS

Prior to site access, Base representatives located the various utilities and disconnected electrical service to pumps, valves, and facility lighting. The Parallax site health and safety officer (SHSO) accompanied the Base electrician to physically inspect electrical power disconnects at the nearest supply transformer and ensured that fuses and circuit breakers were removed from all junction boxes prior to commencement of demolition activities. Electricity was the only utility of concern. There was no active water service to the Facility. A telephone trunk line was located west of the site, in the parking lot, but was sufficiently separated from the work area to not pose a problem.

Facility demolition and removal actions were managed by the Parallax Project Manager (PM). Actual field actions (e.g., dismantling of the tanks and piping, and demolition of the concrete structures) were subcontracted to Omegasys, Inc., Tucker, Georgia. The subcontractor site superintendent reported directly to the Parallax PM. Omegasys used a trackhoe and backhoe to complete all removal and demolition activities. Construction rubble and scrap metal were transported using a flatbed dump truck. The Parallax SHSO observed all field activities to ensure safe work practices and compliance with all relevant Office of Safety and Health Administration (OSHA) laws.

Excavated areas were backfilled using crushed caliche, a local "hardpan" material formed in arid/semi-arid regions as a result of leaching calcium-rich salts from surface soils by percolating rainwater and other surface water and then precipitation of an impervious, coherent chalky layer at a shallow depth below grade. The caliche is used extensively in the region as a road sub-base material because of its reaction with water to form an extremely hard backfilled surface.

3.1 Removal of Aboveground Storage Tanks and Associated Piping

Omegasys used a trackhoe to complete all tank removals. A steel chain connected to lifting lugs on each tank-facilitated removal from its respective concrete support saddles. The tanks were staged in an adjacent area south of Facility 244 for disposal, as surplus, by the USAF DRMO. Before tank removals, associated fill pipes coming from the O/W sump distribution system were disconnected for later decontamination and disposal. Also, the interior of each storage tank was pressure-washed to remove scale/corrosion accumulation. Photograph 4 shows Omegasys personnel using the manway on top of a tank for access to pressure wash the interior walls, and recovery of sludges and rinse water at the tank drain. Sludges and rinse waters were containerized in 55-gallon drums for transfer to the designated on-Base RCRA waste accumulation facility.

3.2 Demolition of Concrete Saddles and Containment Pad

After dismantling the tanks, demolition began with removal of the concrete support saddles. There were two saddles per tank. Each support contained approximately one cubic yard of concrete. Saddles were dislodged by placing the trackhoe bucket on one end and lifting upward and backward. Photograph 5 shows a saddle being lifted from its foundation. Removal of the structures was hampered by the containrnent pad that surrounded each support, and the fact that the saddles had spread footings. The adjacent concrete had to be crushed so that each footing could be removed.

The saddles were generally removed intact, loaded directly onto the dump truck, and transported to the construction rubble storage area. Photograph 6 shows saddles stockpiled at the designated storage area. After removal of the saddles, the remaining portions of the containment pad and retaining curb were broken into manageable pieces by dropping the trackhoe bucket onto the concrete surface or lifting the edge of the pad until cracks developed (Photograph 7). Number 3 reinforcing steel rods were embedded in the pad and curb structures, but were readily snapped by creating tension with the trackhoe. The resulting construction debris was also transported to the rubble staging area. After removal of the O/W separator, the concrete vaults and dump pits were removed and transported to the storage area. Photograph 8 is a view of the exposed soil surface at Facility 244 after removal of the concrete containment pad and curb.

3.3 Removal of O/W Separator

The O/W separator consisted of a rectangular quarter-inch thick sheet metal box (approximately 7 feet long, 2 feet wide, and 4 feet high). The interior of the separator contained a series channels and baffles. Oil entered the separator at the north end of the structure and flowed toward a collection sump on the south end. As the oil flowed through the separator, over the baffles, any water present was skimmed-off due to its immiscibility and channeled through an exit port in the south end of the structure. The recovered water flowed into the leach field, located to the southeast, for release into the underlying soils.

The separator was located in a liquid-tight concrete vault below ground surface. The vault was covered by a quarter-inch thick sheet metal cover plate (Photograph 9). Supply and distribution pipes were disconnected from the separator, and capped if leading away from the Facility. The top panel was removed to allow inspection. Photograph 10 shows Omegasys personnel removing the O/W cover panel and piping. There was a large deposit of sludge in the bottom, approximately 12 inches thick, and the baffles were heavily coated with oily residues. Photograph 11 is a view of the interior of the O/W separator showing the thick sludge deposit and the oil-coated baffles. The entire separator was lifted from the vault to allow easy access for cleaning and decontamination (Photograph 12). Shovels, scoops, and similar tools were used to remove the sludge. Photograph 13 shows removal of the sludges and oil residues. The entire interior was then pressure washed, and the rinse water containerized for disposal. The O/W separator was sold to a local metal recycler. The

concrete O/W vault and dump pits were removed (Photograph 14) and transported to the rubble storage area.

3.4 Disposal of Construction Debris and Waste Water

The technical SOW required Parallax to transport all construction rubble to a designated staging area. Waste concrete was stockpiled on an abandoned aircraft runway, as directed. Figure 3-1 shows the haul route from Facility 244 to the debris storage area. Photograph 14 is a view of stockpiled construction rubble. Base representatives then assumed responsibility for disposal of the material. When sufficient quantities of waste concrete were accumulated, the rubble was scheduled to be crushed and used in backfilling projects on-Base. No hydrocarbon contamination was detected during the PSA; therefore, no soils were removed.

A large quantity of metal scrap resulted from the Facility 244 removal action. All metal surfaces were pressure washed/decontaminated, as necessary, prior to release for disposal. A total of 6,070 pounds of scrap metal consisting of piping, valves, the O/W separator, miscellaneous frames and metal shapes, and the chain-link fencing fabric, gates, and poles were sold to Ed's Recycling, Inc., Clovis, New Mexico, for $75.87. Photograph 16 is a view of the scrap metal loaded on the flatbed truck. Arrival at Ed's Recycling, Inc., with the metal is depicted in Photograph 17. Figures 3-2 and 3-3 are copies of the front and back of the receipt, showing value of the metal and weight tally stamps, respectively, from the metal recycler documenting disposal of the scrap metal. Check number 3156 was issued for this amount, payable to Parallax (Figure 3-4).

All pressure wash rinse/decontamination water, sludge and tank residues, used personnel protective equipment, and associated project-related wastes were containerized in 55gallon steel drums. The drums were sealed and transported to the on-Base RCRA 90-day waste accumulation facility. Approximately 15 drums were delivered to the collection facility. Photograph 18 shows subcontractor personnel unloading waste drums for storage. Base representatives then assumed responsibility for drum labeling, characterization of contents through sampling and analysis, manifesting, and shipping to an appropriate disposal facility.

Photograph 19 shows the former site of Facility 244 after completion of removal and investigation activities. The backfilled portion is identified by the light tan area of compacted caliche, in the foreground. The storage tanks temporarily staged in an area southeast of the Facility are shown in Photograph 20.

4.0 PRELIMIINARY SITE ASSESSMENT

The current project consisted of two tasks: 1) removal of the aboveground storage tanks and associated concrete structures; and 2) a PSA. This section addresses the site characterization that involved field observations, instrumentation surveys for volatile organic vapors, and collection of representative soil samples along with requisite QC duplicate samples for laboratory analyses.

4.1 Investigation Overview

Prior to demolition of the containment pad, the entire Facility was inspected for indications of spills on the concrete pad and ground surfaces outside of the retaining curb. No discoloration was observed. Due to the infrequent use of the storage facility, the non-availability of historical operational records, and the apparent integrity of the containment structure, no significant subsurface contamination was anticipated.

After removal of the containment pad, the exposed soil surfaces were examined visually and representative grab soil samples collected from each corner, the center, and in selected areas with highest potential to exhibit petroleum contaminated soils (PCSs) (e.g., adjacent to and underlying the O/W separator vault, oil dump pits, and surface areas adjacent to the retaining curbs at ground level). Through both field screening and laboratory analyses, the soils underlying Facility 244 were thoroughly characterized and therefore permitted a clean closure with a high degree of confidence.

4.2 Field Observations

After removal of the overlying containment pad and appurtenances, the field geologist inspected the underlying exposed soils to determine the indication of petroleum hydrocarbon contamination. The soils were visually examined for the presence of discoloration due to petroleum staining or characteristic odors. No staining or odors were detected. The ambient atmospheres directly above the ground surfaces in areas most likely to exhibit contamination (e.g., soils under the O/W separator, dump pits, and areas surrounding the outside of the retaining curbs) were monitored for volatile organic vapors by the SHSO using a PID and Draeger® contaminant-specific (benzene) colormetric tubes. None of these instrumentation surveys indicated concentrations of volatile hydrocarbon contaminants exceeding USEPA risk-based concentrations (RBCs).

4.3 Sampling and Analysis

A total of ten representative soil samples, including eight grab from various locations throughout the Facility and two requisite QC samples (i.e., field duplicate and MS/MSD), were collected and shipped to Accura Analytical Laboratory for analyses. Each sample

consisted of 250 milligrams of soil placed in a pre-cleaned glass jar furnished by the laboratory. This quantity was sufficient to perform all required analyses. Each sample container was assigned a unique identification (ID) number; labeled indicating location, date, and time; and placed on ice for preservation. The samples were entered on the chain-of-custody along with required analytical parameters. Figure 4-1 is a copy of the chain of custody. The samples and custodial documentation were shipped by overnight express carrier to the analytical laboratory.

Eight sampling locations were selected to represent the entire surface of the Facility 244 soils. Figure 4-2 is a plan view of the Facility showing sarnpling locations. When the samples were collected, an error was made in interpreting the geographic orientation of Facility 244. The front fence segment, containing the gates, was recorded as facing north. Instead, the proper orientation was west; therefore, all sample location notations will be rotated 90 degrees clock-wise (e.g., a sample point originally recorded as the southeast corner is actually the northeast corner. The former and corrected sample locations, and ID numbers are presented in the following table:

Sample ID	Former Sample Location	Corrected Sample Location
244SS001	Southeast corner of pad	Northeast corner of pad
244SS002	Southwest corner of pad	Southeast corner of pad
244SS003	Center of pad	Center of pad
244SS004	Northeast corner of pad	Northwest corner of pad
244SS004-FD	Northeast corner of pad	Northwest corner of pad
244SS004-MS	Northeast corner of pad	Northwest corner of pad
244SS005	Northwest corner of pad	Southwest corner of pad
244SS006	East of O/W separator	North of O/W separator
244SS007	West of O/W separator	South of O/W separator
244SS008	South of O/W separator	East of O/W separator

As stipulated in the *Facility 244 Scope of Services,* Site-Specific Requirements, line item 11, "Sampling and Analysis," the soil samples were analyzed for the following COCs: total petroleum hydrocarbons (TPHs), metals, pesticides, and polychlorinated biphenyls (PCBs). The samples were analyzed according to the following laboratory methods:

Method	Description
SW 7471A	Mercury in Solid or Semi-Solid Waste (Manual Cold-Vapor Technique)
SW 6010B	Inductively Coupled Plasma-Atomic Emission Spectrometry - RCRA Metals
SW 3050B	Acid Digestion of Sediments, Sludges, and Soils
SW8081A	Organochlorine Pesticides by Gas Chromatography
SW 8082	PCBs by Gas Chromatography
USEPA 418.1	Total Recoverable Petroleum Hydrocarbons

The analytical data received from Accura Laboratory for the various parameters are attached in Appendix A, Tables A- 1 through A-4. The analytical results of these samples indicated that there were no COCs present in the soils underlying Facility 244 that exceeded USEPA RBCs.

The analytical data received from Accura Laboratory for the various parameters are attached in Appendix A, Tables A- 1 through A-4. The analytical results of these samples indicated that there were no COCs present in the soils underlying Facility 244 that exceeded USEPA RBCs.

4.4 Data Quality Assessment

Data review and validation were performed by applying the QC limits defined in the quality assurance project plan (QAPjP). Data validation consisted of a review of holding times, method blanks, field duplicates, surrogates spikes, MS/MSDs, and a case narrative review including sample receipt forms and chain of custody. Validation guidelines from the National Functional Guidelines for Organic Data Review (USEPA 1994a) and the National Functional Guidelines for Inorganic Data Review (USEPA 1994b) were used as reference resources to define the validation criteria.

4.4.1 Quality Assessment Summary

Data accuracy and precision were within control guidelines and therefore were considered acceptable, with one exception. Samples were collected and analyzed according to specifications provided in the project-specific QAPjP. The relative recovery differences in analyses between a sample and the respective sample replicate were outside the method specified limit for arsenic, cadmium, chromium, and lead. Sample results associated with non-compliance QC data were qualified in accordance with the QAPjP. Sample results flagged as estimated (J or UJ) were useable for the intended purpose of this project. No sample results were flagged as unusable (R) thereby indicating that all sample data generated during this project are usable. A summary of qualified sample results is presented in Appendix B, Table B-1. Data flags used in the data validation process are listed at the end of Table B-1. Specific data validation considerations are presented in the following sections.

A. Holding Times

Due to limited information concerning retention times for non-aqueous samples, a period of 14 days was selected as a maximum allowable holding time for soil samples from collection to analysis during this project. The 14-day limitation was not exceeded for any sample.

B. Method SW 8082, PCBs

There were no problems associated with the sample analyses for PCBs; therefore, these data are fully useable for the purposes of this project.

C. Method SW 8081A, Organochlorine Pesticides

Sample 244SS006 required dilution due to matrix interference resulting in elevated detection limit for organochlorine pesticides. The target compounds analyzed for in this sample were not detected. The sample quantitation limits for the target compounds were estimated quantities; however, this was considered to be a minor problem. The results are fully useable for the purposes of this project.

D. Method EPA 418.1, Total Recoverable Petroleum Hydrocarbons

Samples 244SS006 and 244SS007 required dilution due to high analyte concentrations resulting in elevated detection limits for TPHs. The quantity of TPH measured in each of the two samples was significantly above the elevated detection limit; therefore, this is not considered to be a problem. The results are fully useable for the purposes of this project.

E. Method SW 7471A, Mercury in Solid or Semi-Solid Waste

There were no problems encountered during sample analyses for mercury. These data are fully useable for the purposes of this project.

F. Method SW 6010B, Metals RCRA/Method SW 3050B, Acid Digestion of Soil

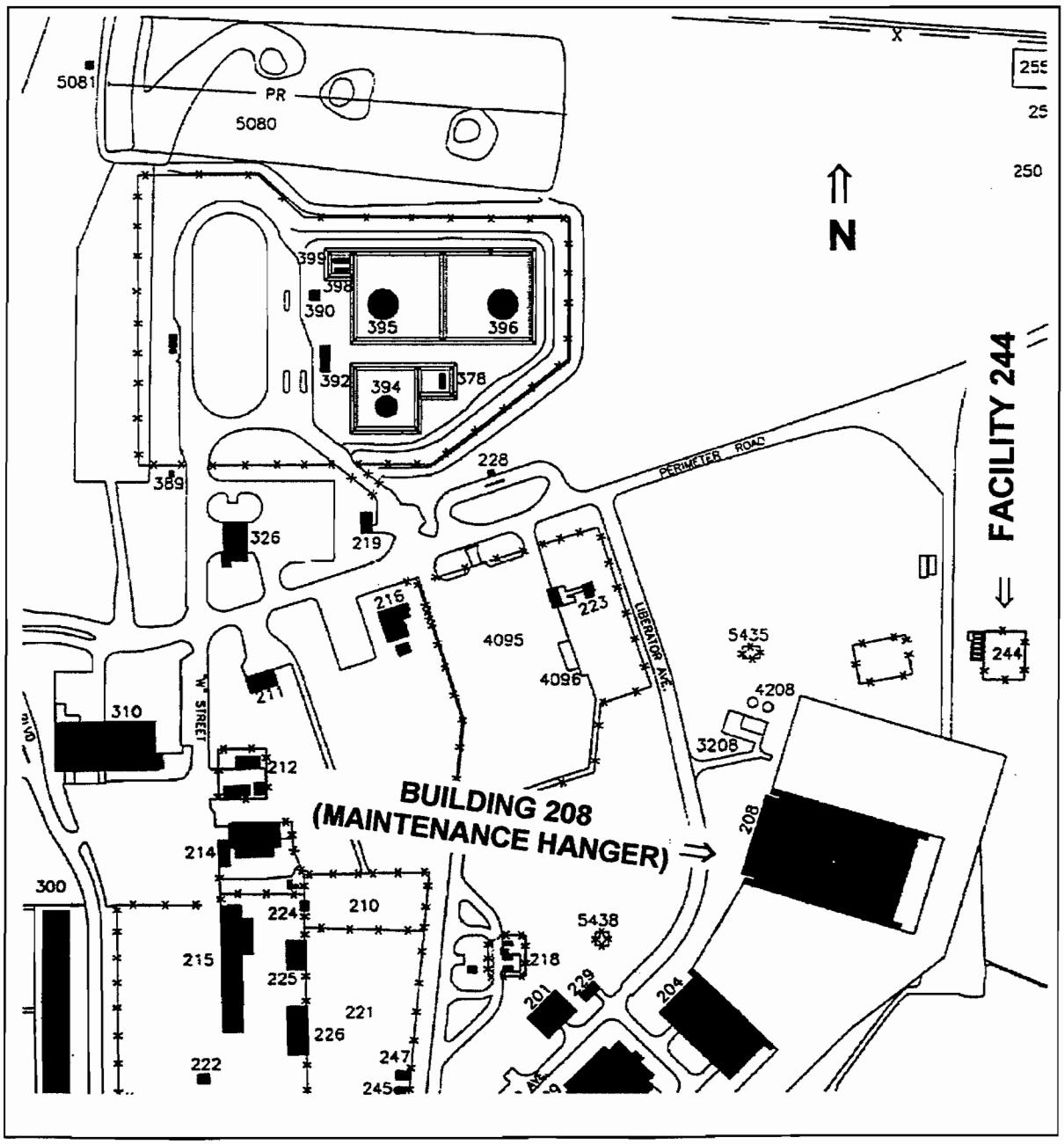
A duplicate for sample 244SS004 was analyzed. The relative difference in percentage of recovery between the sample and duplicate sample analyses was outside of method specified limits for arsenic, cadmium, chromium, and lead. This relative difference in recovery was attributed to sample heterogeneity. These results were considered to be a minor problem, and were therefore flagged as estimated (J or UJ). The data are useable for the intended purpose of this project.

G. Field Duplicate Precision

Field sampling precision was determined from the results of the field duplicate QC sample 244SS004. With the exception of the metals discussed in the above section, overall instrumentation method replication was within precision limits.

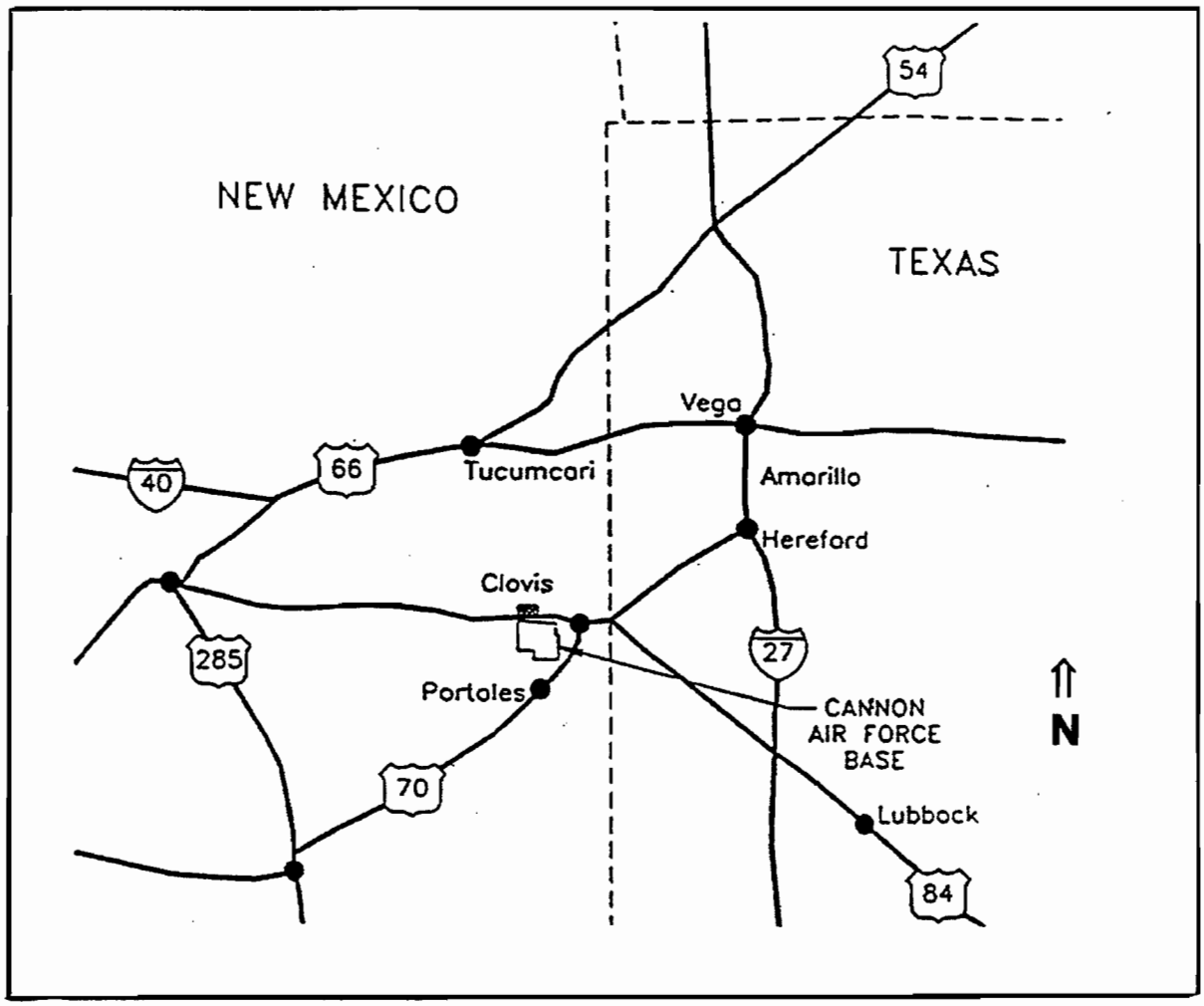
5.0 SUMMARY AND CONCLUSIONS

Based upon field observations and laboratory analyses, the removal action at Facility 244 resulted in a clean closure, as indicated by the PSA; therefore, no further action is anticipated.



- NOT TO SCALE -

Figure 2-1: Location Map of Facility 244 and Adjacent Structures.



- NOT TO SCALE -

Figure 2-2: Map of Cannon AFB and Surrounding Area.

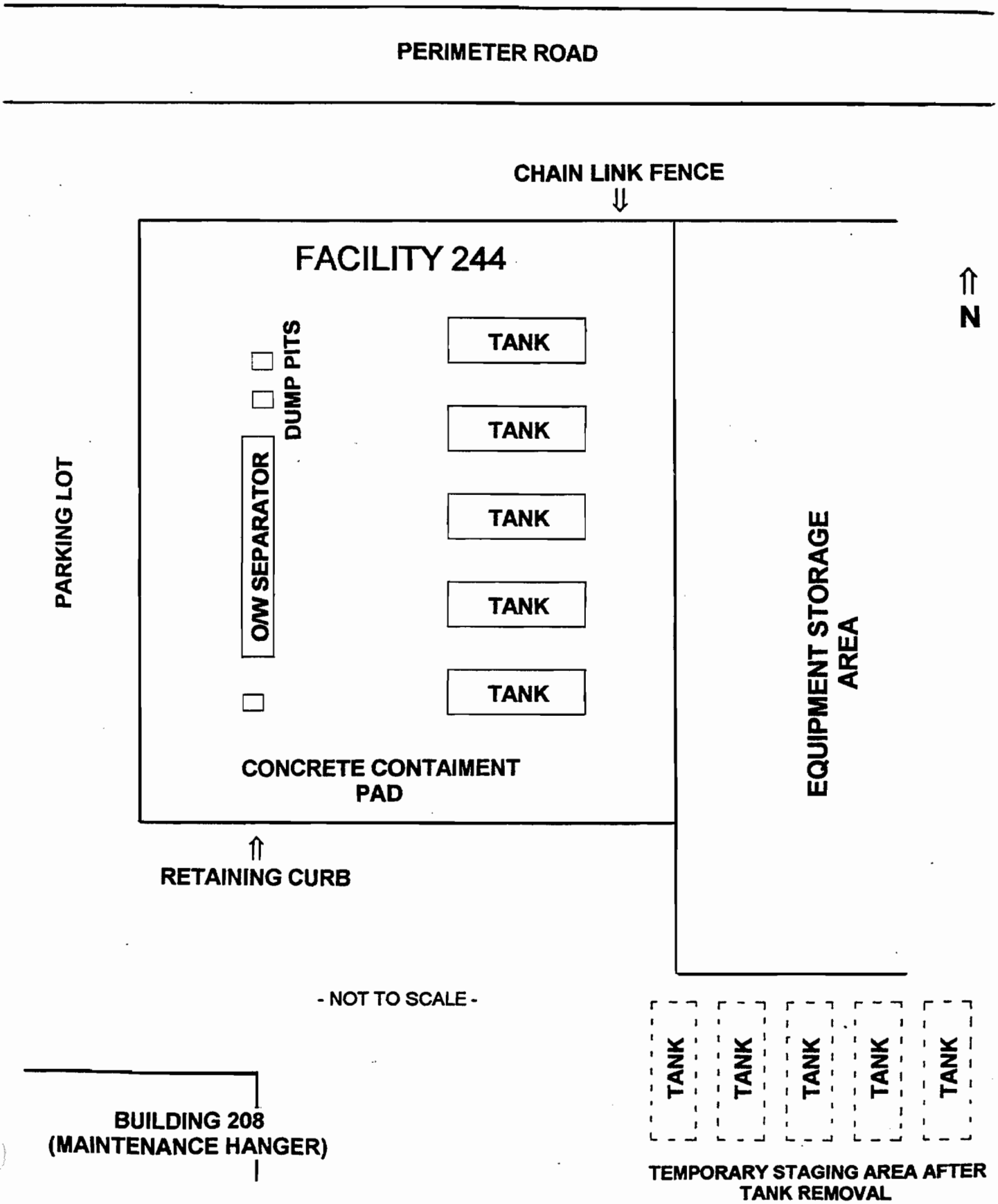
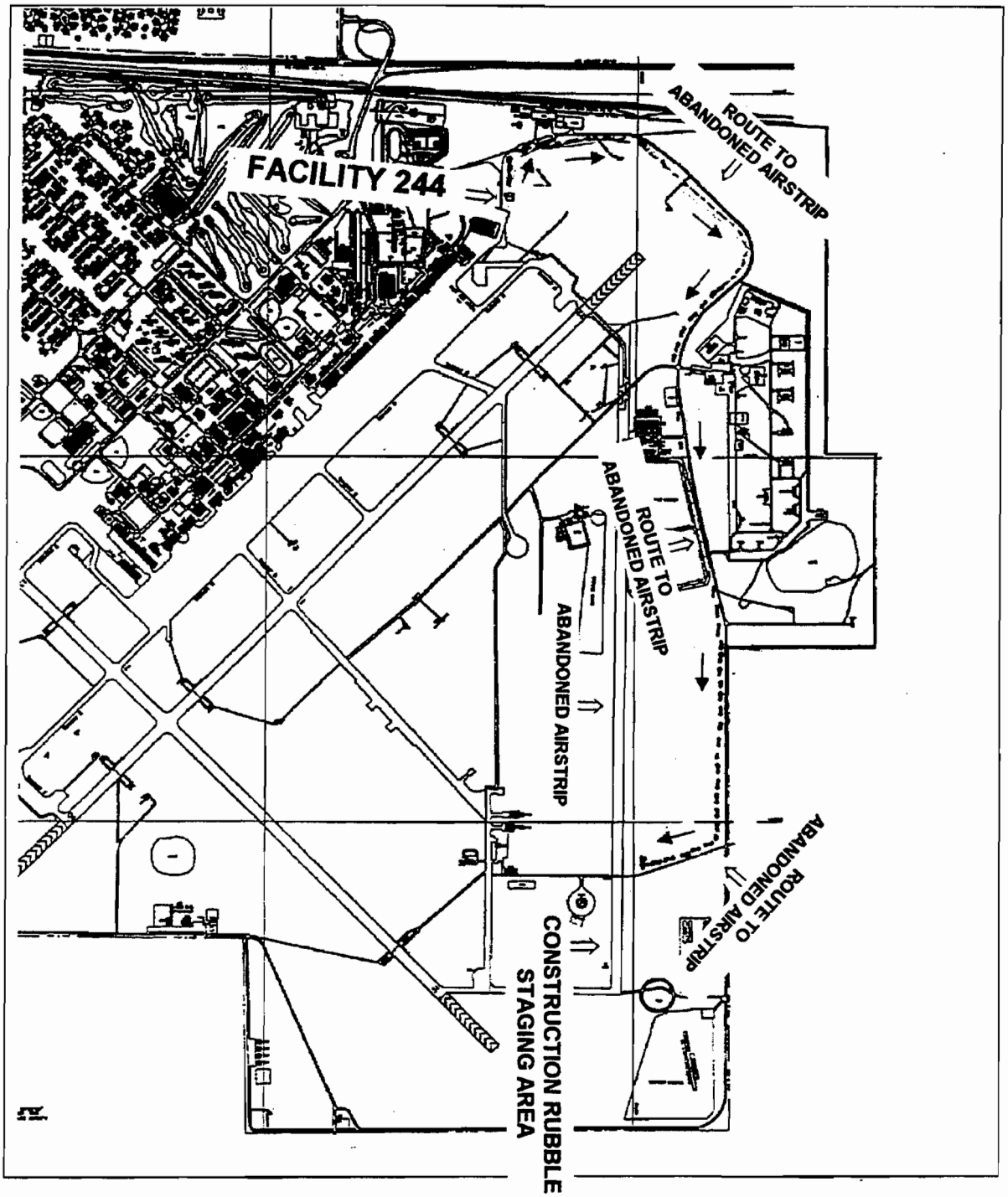


Figure 2-3: Diagram of Tank Locations and Associated Features.



- NOT TO SCALE -

Figure 3-1: Map of Haul Route to Abandoned Airstrip/Rubble Storage Area.

ED's RECYCLING CENTER

605 South Prince
Clovis, NM 88101
Phone (505) 762-7699 • Fax (505) 762-7607

Date 12-15 19 99

Name

Address

City State

Quantity	Description		
	Alum. Cans		
	Alum. Clean		
	Alum. Dirty		
	Alum. Breakage		
	Alum. Cast		
	Alum. Pipe		
	#1 Copper		
	#2 Copper		
	Ins. Copper		
	Red Brass		
	Yellow Brass		
	Radiators		
	Lead		
	Die Cast		
	Stainless Steel		
	Batteries		
6070	Iron	75	87
	Motors		
	Cast Iron		
	Tin		
	Cardboard		

Received By

Figure 3-2: Copy of Receipt from Ed's Recycling Center for Scrap Metal.

ED'S
RECYCLING CENTER

605 South Prince
Clovis, NM 88101
Phone (505) 762-7699 • Fax (505) 762-7607

Date 12-15 19 97

Name

Address

City State

Quantity	Description		
	Alum. Cans		
	Alum. Clean		
	Alum. Dirty		
	Alum. Breakage		
	Alum. Cast		
	Alum. Pipe		
	#1 Copper		
	#2 Copper		
	Ins. Copper		
	Red Brass		
	Yellow Brass		
	Radiators		
	Lead		
	Die Cast		
	Stainless Steel		
	Batteries		
6070	Iron	75	87
	Motors		
	Cast Iron		
	Tin		
	Cardboard		

Received By

Figure 3-3: Weight Tally Sheet, Ed's Recycling Center, Showing 6070 Pounds.

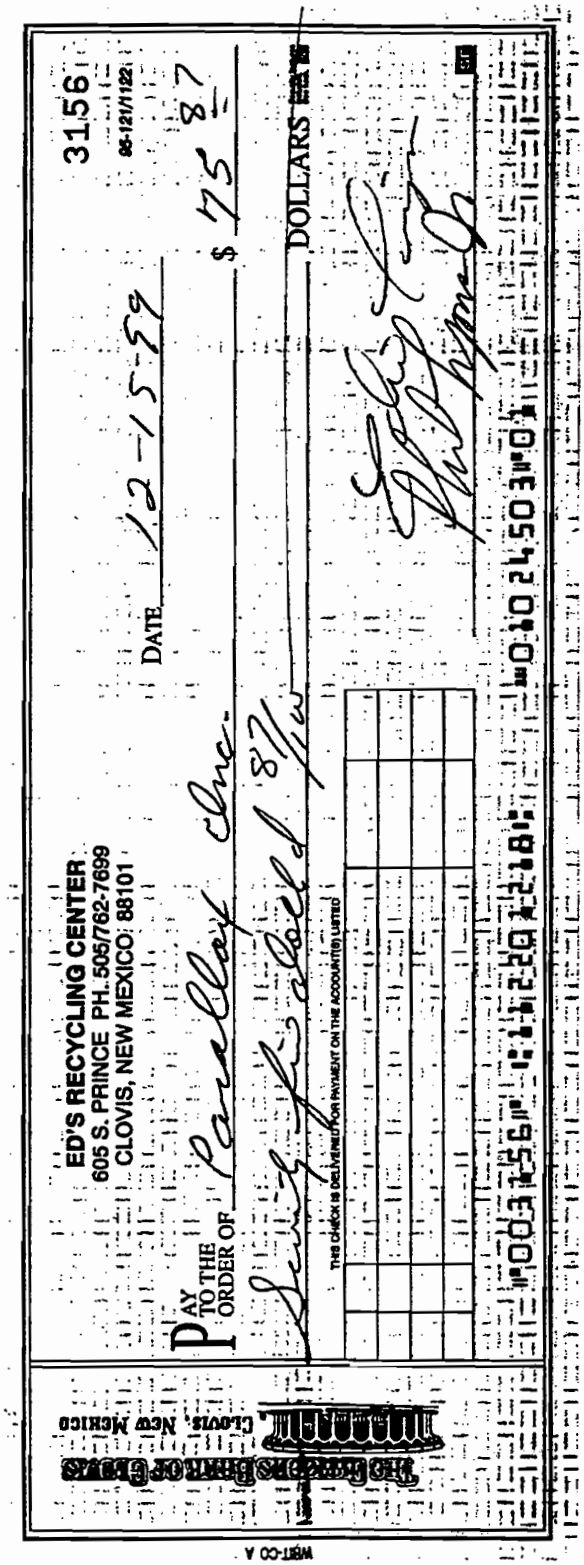


Figure 3-4: Reproduction of Check # 3156 Received for Scrap Metal.

23808

ACCURA ANALYTICAL LABORATORY, INC.

Environmental Analytical Services

6017 Financial Drive, Norcross, GA 30071
Phone # (770) 449-8800 Fax # (770) 449-5477

CHAIN OF CUSTODY

Company Name: Parallax, Inc.
Address: 795 W. Main St., Oak Ridge, TN 37830
Report Sent to: (Client Contact): David R. Finney
Contact Phone # (423) 481-8285 Fax # (423) 481-
Project Name: Cannon AFB – AOCJ, Facility 244
Project Number: 2829-001

Billing address:
Client P.O. #

For Laboratory Use Only
Custody Seal: Y N Page 1 OF
QC Level: N 1 2 3 4 Int/Temp: 4°C
Sample Condition: AAL Lab Project: 23176

Samplers: (signature) David R. Finney
Samplers: (printed) All Soil RF David R. Finney

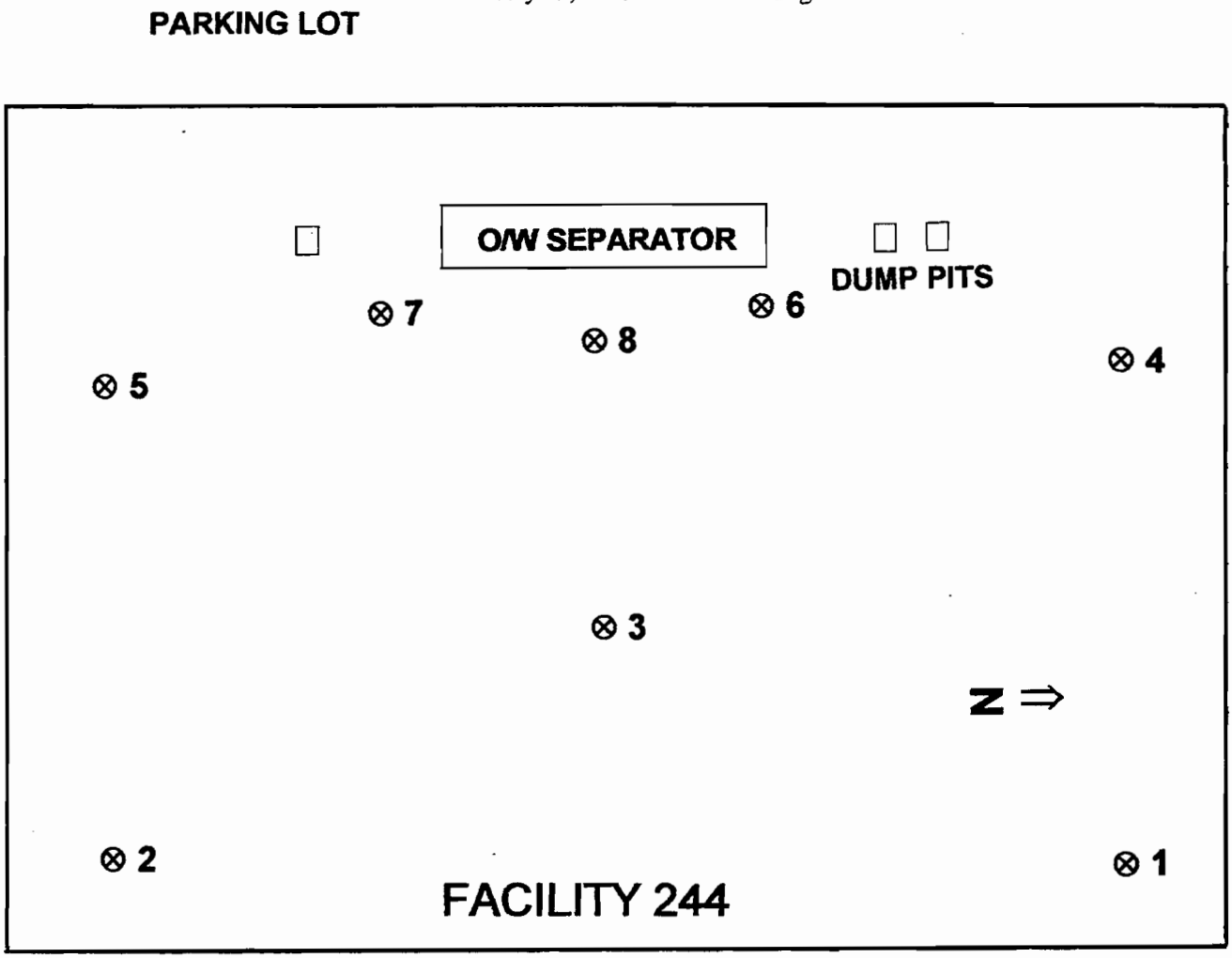
Sample ID #	Sample Date / Time	Comp	Grab	Matrix	Preserved	Sample Location:	No. of Containers	Metals	PCB	Pesticides	Herbicides					Remarks	Accura Sample ID No. AB
24455001	12-14-99 1320MST		✓			SE Corner	1	✓	✓	✓	✓						83221
24455002	12-14-99 1328MST		✓			SW Corner	1	✓	✓	✓	✓						83222
24455003	12-14-99 1313MST		✓			Center	1	✓	✗	✓	✓						83223
24455004	12-14-99 1335MST		✓			NE Corner	1	✓	✓	✓	✓						83224
24455004*	12-14-99 1335MST		✓			NE Corner	1	✓	✓	✓	✓					*Field Duplicate	83225
24455004**	12-14-99 1335MST		✓			NE Corner	1	✓	✓	✓	✓					**MS/MSD	83226
24455005	12-14-99 1355MST		✓			NW Corner	1	✓	✓	✓	✓						83227
24455006	12-14-99 1420MST		✓			E of QWSD	1	✓	✓	✓	✓						83228
24455007	12-14-99 1430MST		✓			W of QWSD	1	✓	✓	✓	✓						83229
24455008	12-14-99 1445MST		✓			S of QWSD	1	✓	✓	✓	✓						83230

Relinquished By:	Date / Time	Received By:	Date / Time	Special Requirements Or Remarks:
David R. Finney	12-14-99 1630MST	Fedex	12/15/99 09:30	
Relinquished By:	**Date / Time**	**Received By:**	**Date / Time**	**Turnaround Time Requested:**

Matrix Guide: (S = Soil) (W = Water) (L = Liquid) (C = Cartridge) (SL = Sludge) (A = Air Sample) (F = Foods) (M = Miscellaneous)

CC097.2 VLS

Figure 4-1: Copy of Chain of Custody for Soil Samples Collected 12-14-99.



⊗ SAMPLE LOCATION

- NOT TO SCALE -

SAMPLE LOCATIONS:

Sample 1: Northeast corner of pad - 5 feet south of north fence; 6 feet, 9 inches west of east fence. Depth - surface of excavation. Time: 1320 MST.

Sample 2: Southeast corner of pad - 3 feet north of south fence; 4 feet, 3 inches west of east fence. Depth - surface of excavation. Time: 1328 MST.

Sample 3: Center of pad - 25 feet south of north fence; 17 feet west of east fence. Depth - surface of excavation. Time: 1313 MST.

Sample 4: Northwest corner of pad - 6 feet, 4 inches south of north fence; 29 feet west of east fence. Depth - surface of excavation. Time: 1335 MST. (Field Duplicate and MS/MSD.)

Sample 5: Southwest corner of pad - 6 feet, 6 inches north of south fence; 22 feet, 6 inches west of east fence. Depth - surface of excavation. Time: 1358 MST.

Sample 6: Adjacent to northeast corner of O/W separator vault - 18 feet south of north retaining curb; 7 feet, 9 inches east of asphalt parking lot. Depth - surface of excavation (in 4-foot deep pit). Time: 1420 MST.

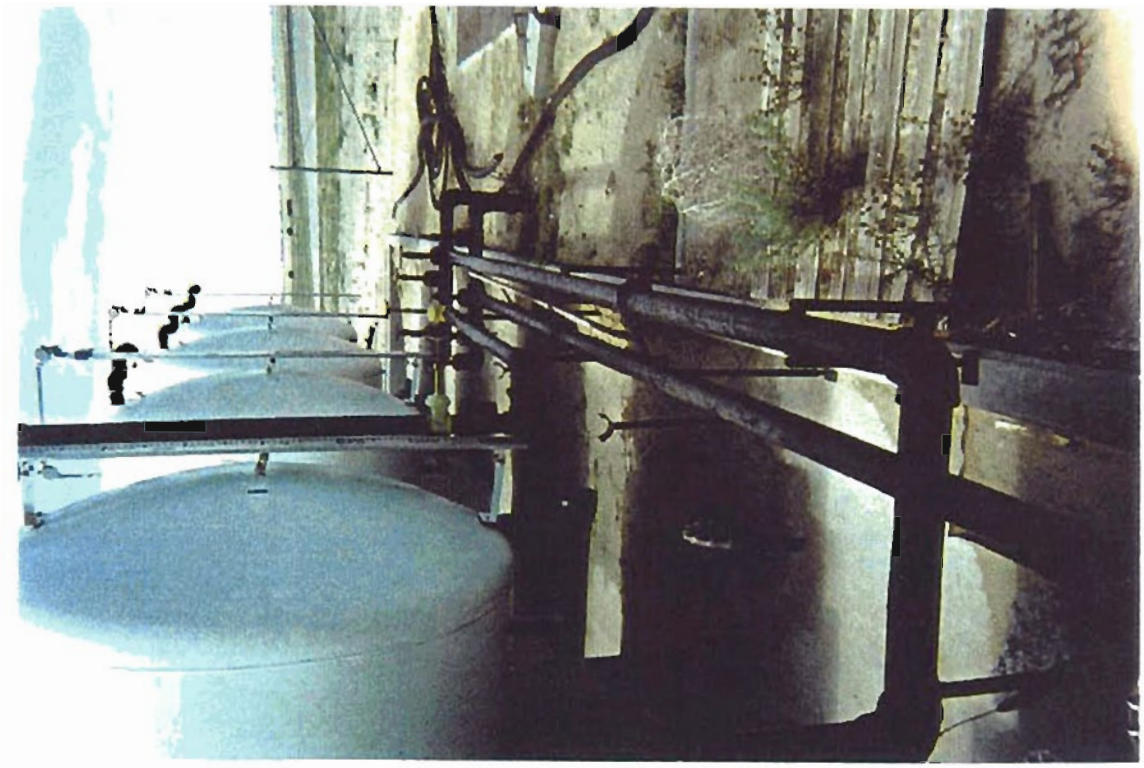
Sample 7: Adjacent to southeast corner of O/W separator vault - 6 feet south of south wall of O/W separator vault; 8 feet, 6 inches east of asphalt parking lot. Depth - surface of excavation (in 2-foot, 6-inch deep pit). Time: 1430 MST.

Sample 8: East of mid-line of O/W separator vault - 5 feet south of north end of O/W separator vault; 5 feet, 6 inches east of east wall of vault. Depth - surface of excavation (3-foot, 6-inch deep pit). Time: 1445 MST.

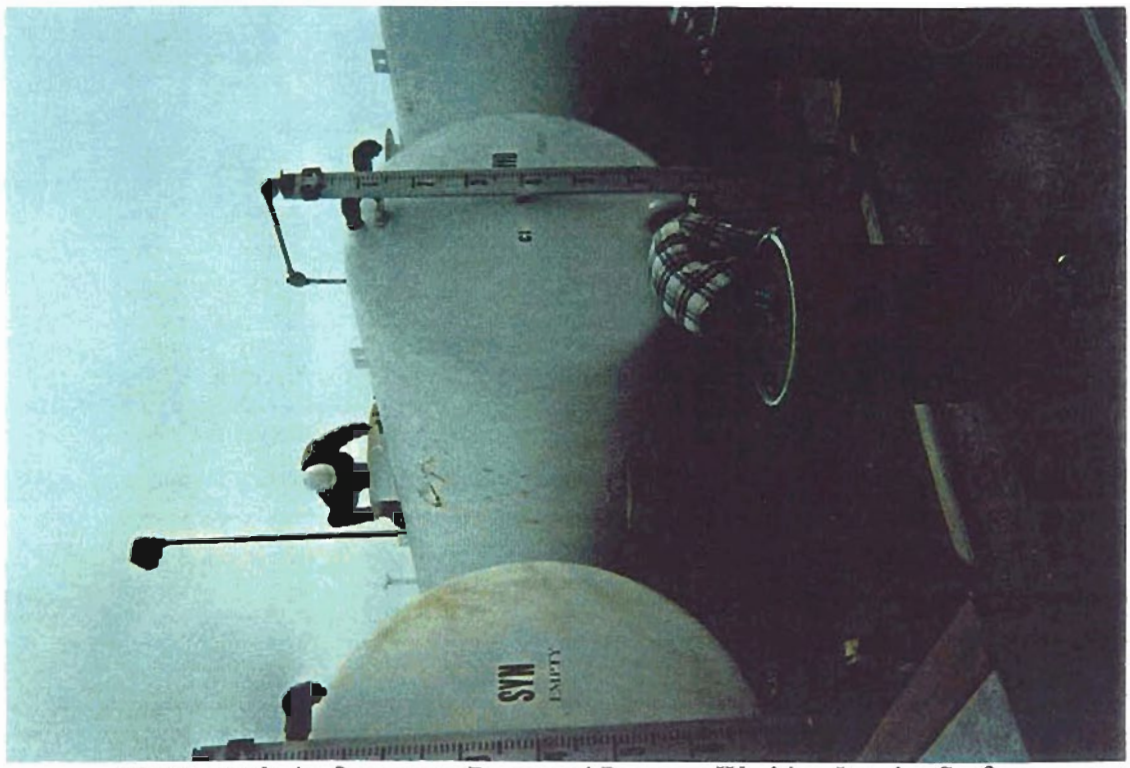
Figure 4-2: Plan View of Facility 244 Showing Soil Sampling Locations.

Photograph 1: View of Facility 244 Prior to Start of Dismantling Operations Showing Tank Locations and Fencing.

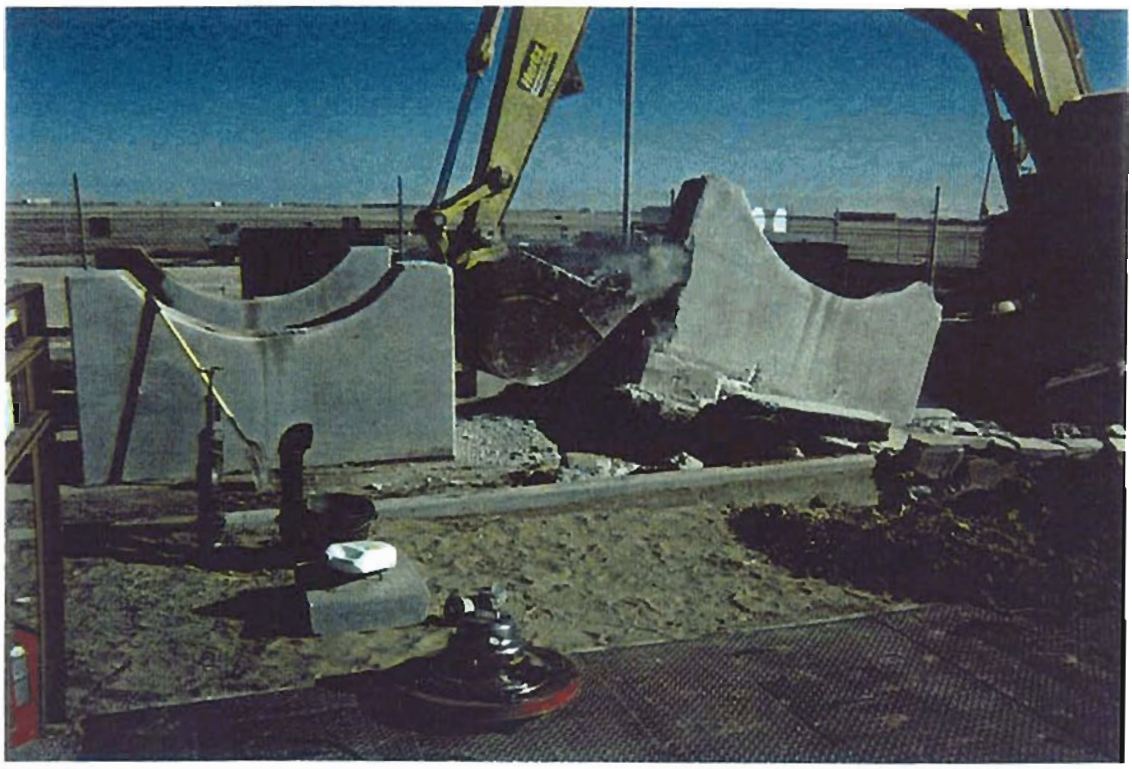
Photograph 2: Alternate View of the Facility with Fence Fabric Removed and Orange Safety Webbing Stretched.



Photograph 3: Associated Distribution Piping and Manual Valves.



Photograph 4: Omegasys Personnel Pressure Washing Interior Surfaces of Tank and Using Drain Valve to Remove Sludges and Rinse Water.

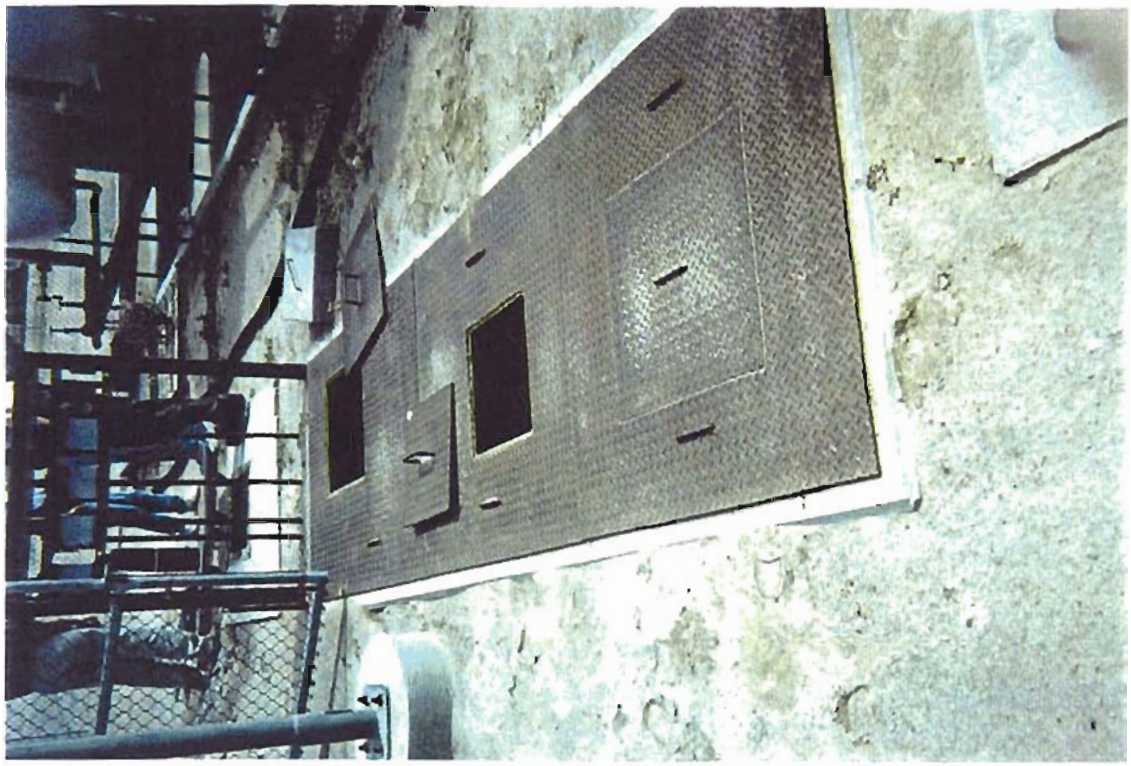


Photograph 5: Removal of Tank Support Saddle with Trackhoe Bucket.

Photograph 6: Stockpiling Concrete Support Saddles at the Designated Staging Area.

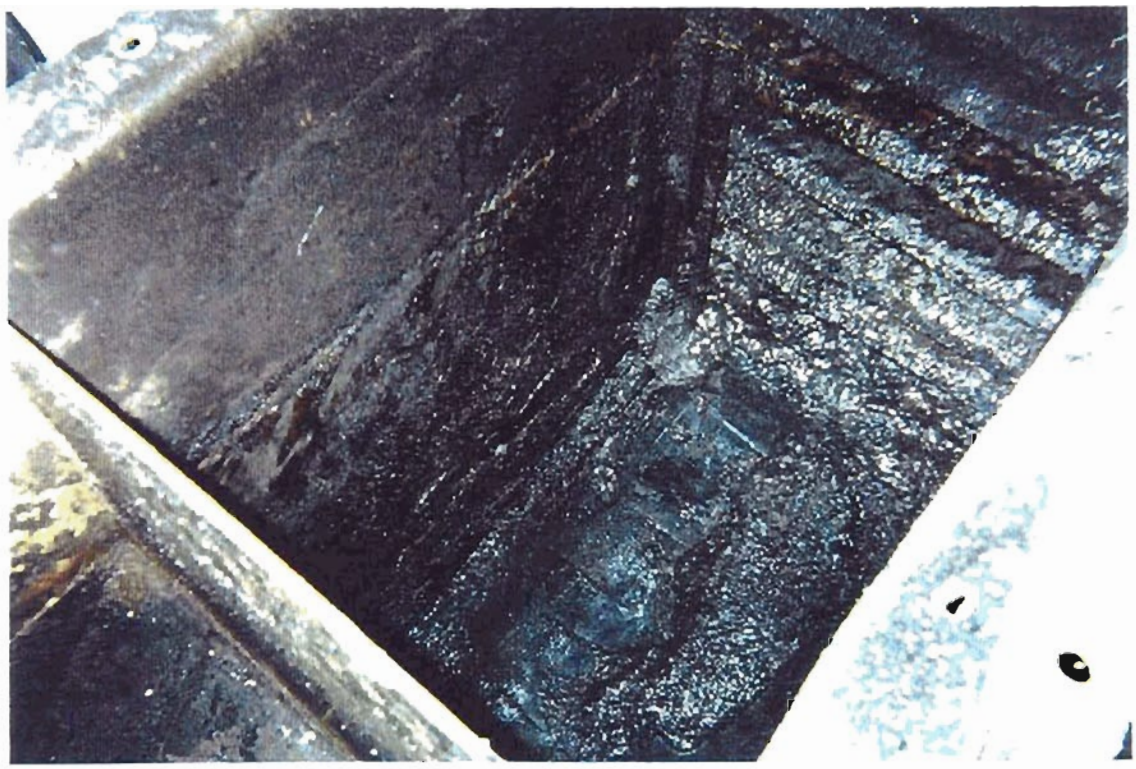
Photograph 7: Removal of Remaining Portions of the Concrete Containment Pad and Retaining Curb.

Photograph 8: View of Soil Surface after Removal of the Containment Pad.



Photograph 9: Sheet Metal Cover, with Accessways, for the O/W Separator and Concrete Vault.

Photograph 10: Omegasys Personnel Removing Top Plate of O/W Separator and Disconnecting Supply/Distribution Pipes.



Photograph 11: View of O/W Separator Interior Structure Showing Thick Deposits of Sludge and Oil-Coated Baffles.

Photograph 12: The Trackhoe Bucket Is Used to Lift the O/W Separator from the Concrete Vault.

Photograph 13: Field Personnel Use Shovels and Scoops to Remove Sludge Prior to Pressure Washing Interior Surfaces.

Photograph 14: The Concrete O/W Separator Vault and Associated Dump Pits Are Demolished after Removal of Piping.

Photograph 15: View of Construction Rubble Stockpiled at the Designated Abandoned Airstrip.

Photograph 16: Scrap Metal Loaded on Flatbed Truck Ready for Transport to the Scrap Metal Recycler.

Photograph 17: Delivery of Scrap Metal to Ed's Recycle Center, Clovis, New Mexico.

Photograph 18: Omegasys Personnel Unloading Drums of Decontamination and Rinse Waters, and Residual Sludges at the On-BaseRCRA 90-Day Storage Facility.

Photograph 19: View of Facility 244 Location upon Completion of Removal Activities; Light Tan Area in Foreground Is Backfilled Area.

Photograph 20: View of Tanks Removed from Facility 244, Temporarily Staged Prior to Sale as Surplus Material.

APPENDIX A

SOIL SAMPLE ANALYTICAL DATA

PRELIMINARY SITE ASSESSMENT
SWMU 129, FACILITY 244
CANNON AFB, CLOVIS, NEW MEXICO

Table A-1
Facility 244, Cannon AFB, Clovis, New Mexico
Soil Sample Results
RCRA Metals

Medium	Sample ID	Sample Date	Mercury (mg/Kg)	Arsenic (mg/Kg)	Barium (mg/Kg)	Cadmium (mg/Kg)	Chromium (mg/Kg)	Lead (mg/Kg)	Selenium (mg/Kg)	Silver (mg/Kg)
Soil	244SS001	12/14/99	<0.58	7.8	79	1.2	7.7	7.3	<5.8	<5.8
Soil	244SS002	12/14/99	<0.55	7.0	46	0.85	<5.5	5.9	<5.5	<5.5
Soil	244SS003	12/14/99	<0.59	12	130	1.6	9.6	10	<5.9	<5.9
Soil	244SS004	12/14/99	<0.56	5.8	48	0.9	<5.6	6.2	<5.6	<5.6
Soil	244SS004 FD	12/14/99	<0.56	8	61	0.99	6.7	6.4	<5.6	<5.6
Soil	244SS004 MS	12/14/99	<0.56	6.3	52	1.1	6.2	7.4	<5.6	<5.6
Soil	244SS005	12/14/99	<0.56	8.4	55	1.1	6.9	9.4	<5.6	<5.6
Soil	244SS006	12/14/99	<0.55	7.6	380	1.1	5.6	13	<5.5	<5.5
Soil	244SS007	12/14/99	<0.57	11	170	1.8	8.5	13	20	<5.7
Soil	244SS008	12/14/99	<0.56	6.6	120	1.6	7.3	9.4	17	<5.6
	Total Detects	----	0	10	10	10	8	10	2	0
	Total Analyses	----	10	10	10	10	10	10	10	10
	Average Result	----	<RDL	8.05	114.1	1.224	7.3125	8.8	18.5	<RDL
	Maximum Detect	----	<RDL	12	380	1.8	9.6	13	20	<RDL
	Minimum Detect	----	<RDL	5.8	46	0.85	5.6	5.9	17	<RDL
	Industrial RBC	----	61	3.8	140000	1000	610	1,200	10,000	10000
	Residential RBC	----	2.3	0.43	5500	39	23	400	390	390

Table A-2
Facility 244, Cannon AFB, Clovis, New Mexico
Soil Sample Results
PCBs

Medium	Sample ID	Sample Date	Aroclor-1016 (ug/Kg)	Aroclor-1221 (ug/Kg)	Aroclor-1232 (ug/Kg)	Aroclor-1242 (ug/Kg)	Aroclor-1248 (ug/Kg)	Aroclor-1254 (ug/Kg)	Aroclor-1260 (ug/Kg)
Soil	244SS001	12/14/99	<19	<38	<38	<19	<19	<19	<19
Soil	244SS002	12/14/99	<19	<36	<36	<19	<19	<19	<19
Soil	244SS003	12/14/99	<20	<39	<39	<20	<20	<20	<20
Soil	244SS004	12/14/99	<19	<37	<37	<19	<19	<19	<19
Soil	244SS004-FD	12/14/99	<19	<37	<37	<19	<19	<19	<19
Soil	244SS004-MS/MSD	12/14/99	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Soil	244SS005	12/14/99	<19	<37	<37	<19	<19	<19	<19
Soil	244SS006	12/14/99	<19	<36	<36	<19	<19	<19	<19
Soil	244SS007	12/14/99	<19	<38	<38	<19	<19	<19	<19
Soil	244SS008	12/14/99	<19	<37	<37	<19	<19	<19	<19
	Total Detects	----	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Total Analyses	----	**10**	**10**	**10**	**10**	**10**	**10**	**10**
	Average Result	----	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**
	Maximum Detect	----	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**
	Minimum Detect	----	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**	**<RDL**
	Industrial RBC	----	**82000**	**2900**	**2900**	**2900**	**2900**	**2900**	**2900**
	Residential RBC	----	**5500**	**320**	**320**	**320**	**320**	**320**	**320**

RDL – Reported Detection Limit

Figure A-3
Facility 244, Cannon AFB, Clovis, New Mexico
Soil Sample Results
Pesticides

MEDIUM	Sample ID	Sample Date	4,4'-DDD (ug/Kg)	4,4'-DDE (ug/Kg)	4,4'-DDT (ug/Kg)	Aldrin (ug/Kg)	alpha-BHC (ug/Kg)	alpha-Endosulfan (ug/Kg)	beta-BHC (ug/Kg)	beta Endosulfan (ug/Kg)	delta-BHC (ug/Kg)	Dieldrin (ug/Kg)	Endosulfan sulfate(ug/Kg)	Endrin (ug/Kg)	Endrin aldehyde (ug/Kg)	GammaBHC(Lindane)(ug/Kg)	Heptachlor (ug/Kg)	Heptachlor epoxide (ug/Kg)	Methoxychlor (ug/Kg)	Total Chloradane (Technical) (ug/Kg)	Toxaphene (ug/Kg)
Soil	244SS001	12/14/99	<1.9	<1.9	<3.8	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.4	<19	<94
Soil	244SS002	12/14/99	<1.9	<1.9	<3.6	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.1	<19	<91
Soil	244SS003	12/14/99	<2.0	<2.0	<3.9	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<9.8	<20	<98
Soil	244SS004	12/14/99	<1.9	<1.9	<3.7	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.2	<19	<92
Soil-FD	244SS004	12/14/99	<1.9	<1.9	<3.7	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.2	<19	<92
Soil-MS	244SS004	12/14/99	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Soil	244SS005	12/14/99	<1.9	<1.9	<3.7	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.3	<19	<93
Soil	244SS006	12/14/99	<19	<19	<36	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<91	<190	<910
Soil	244SS007	12/14/99	<1.9	<1.9	<3.8	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.5	<19	<95
Soil	244SS008	12/14/99	<1.9	<1.9	<3.7	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<9.2	<19	<92
	Industrial RBC		**24000**	**17000**	**17000**	**340**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**360**	**N/A**	**610000**	**N/A**	**N/A**	**1300**	**630**	**1xE⁴**	**N/A**	**52000**
	Residential RBC		**2700**	**1900**	**1900**	**38**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**40**	**N/A**	**23000**	**N/A**	**N/A**	**0.14**	**70**	**3.9XE⁴**	**N/A**	**580**

N/A – Not Available

Figure A-4
Facility 244, Cannon AFB, Clovis, New Mexico
Soil Sample Results
Total Petroleum Hydrocarbons

Medium	Sample ID	Sample Date	Total Petroleum Hydrocarbons (mg/Kg)
Soil	244SS001	12/14/99	<10
Soil	244SS002	12/14/99	<10
Soil	244SS003	12/14/99	<10
Soil	244SS004	12/14/99	<10
Soil	244SS004 FD	12/14/99	<10
Soil	244SS004 MS/MSD	12/14/99	<10
Soil	244SS005	12/14/99	<10
Soil	244SS006	12/14/99	300
Soil	244SS007	12/14/99	100
Soil	244SS008	12/14/99	40
	Soil Cleanup Standard TPH-gasoline *		600
	Soil Cleanup Standard TPH-diesel *		800

* *Journal of Soil Contamination*, 2 (2): (1993)

APPENDIX B
SOIL SAMPLE VALIDATION QUALIFIERS SUMMARY
PRELIMINARY SITE ASSESSMENT
SWMU 129, FACILITY 244
CANNON AFB, CLOVIS, NEW MEXICO

Table B-1
Facility 244, Cannon AFB, Clovis, New Mexico
Data Validation Qualifiers Summary
Soil Samples

Sample Identification	Metals RCRA 3050B/6010B	Mercury 7471A	PCBs 8082	Pesticides 8081A	TPH 418.1
244SS001	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS002	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS003	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS004	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS004 FD	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS004 MS/MSD	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS005	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS006	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	All - UJ	----
244SS007	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----
244SS008	Arsenic, Cadmium, Chromium, and Lead – J or UJ	----	----	----	----

Table B-1 (Continued)

Data Qualifiers:

U - The material was analyzed for, but was not, detected. The associated numerical value is the sample quantitation limit.

J - The associated numerical value is an estimated quantity.

R - The data are unusable (compound may or may not be present). Re-sampling and reanalysis is necessary for verification.

N - Presumptive evidence of presence of material.

NJ - Presumptive evidence of the presence of the material at an estimated quantity.

UJ - The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.

JN - Tentatively identified with estimated concentrations.

CC - Chain of custody irregularities that impact the legal defensibility of the analytical results.

ND - Non-detect

Comment / Response Form

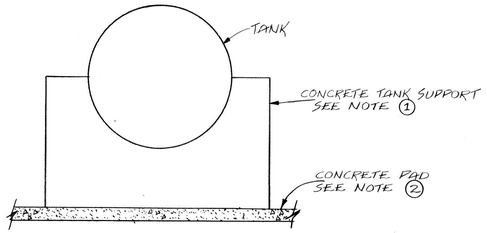
Parallax INC.

Comments made by: Sanford Hutsell
Company: Cannon Air Force Base

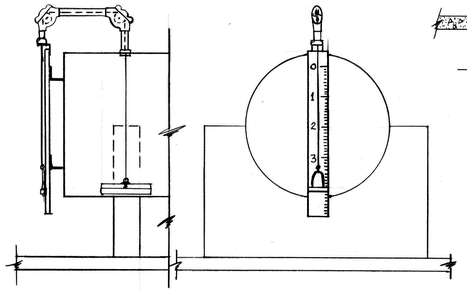
No	Section	Comments	Response
1	All	The facility was Area of Concern I, not J. It has now been designated as SWMU 129 so change AOC J throughout to SWMU 129.	The change in facility identification to SWMU 129 has been made throughout the report.
2	1.1	Delete reference to removal of monitoring wells associated with Facility 244. There are no monitoring wells associated with Facility 244 and I don't want any reference in the literature to confuse the issue.	Reference to monitoring well removal has been deleted.
3	2.2	In tact should have space removed. Intact is one word.	Change made as indicated.
4	3.2	Intact is one word. Remove space between in and tact.	Change made as indicated.
5	Figure 3-3	Photocopy is reversed.	The copy has been corrected.

TANK SUPPORT NOTES:

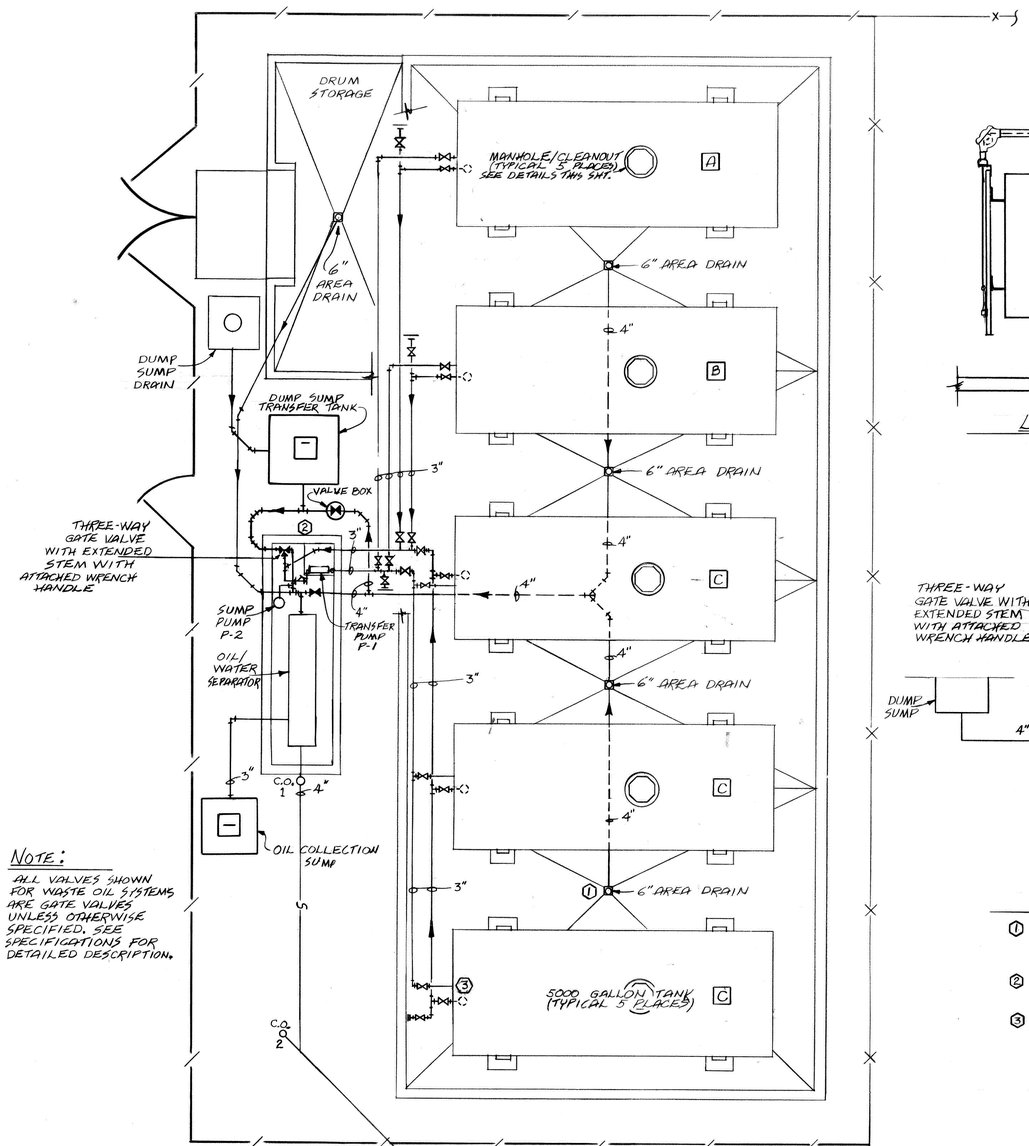
1. TANK TO BE SUPPLIED COMPLET WITH SADDLES AND CONCRETE SUPPORTS AS REQUIRED. TANK SADDLES AND SUPPORTS TO BE SPECIFICALLY DESIGNED FOR THE TANKS SUBMITTED SEE SPECIFICATIONS SECTION 10 D - STORAGE TANKS FOR DETAILS.
2. CONCRETE TANK SUPPORTS TO BE IN PLACE PRIOR TO POURING CONCRETE DRAINAGE PAD.

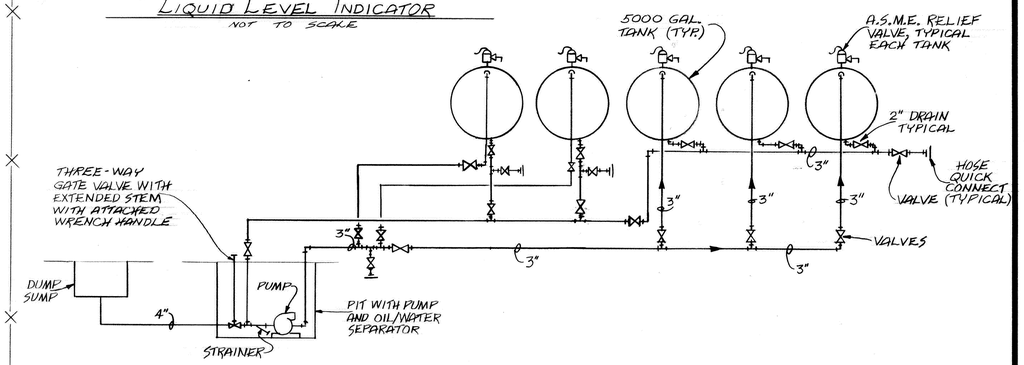


TANK SUPPORT DETAIL
NOT TO SCALE

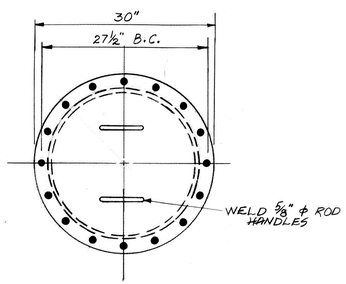


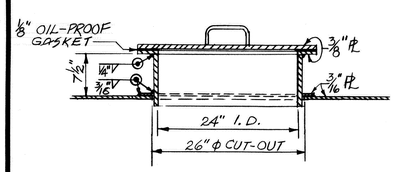
LIQUID LEVEL INDICATOR
NOT TO SCALE





WASTE OIL PIPING DIAGRAM
NOT TO SCALE





TANK ACCESS MANHOLE FOR SINGLE DECK

24" BOLTED COVER TYPE MANHOLE
NOT TO SCALE

NOTE:

ALL VALVES SHOWN FOR WASTE OIL SYSTEMS ARE GATE VALVES UNLESS OTHERWISE SPECIFIED. SEE SPECIFICATIONS FOR DETAILED DESCRIPTION.

KEY NOTES:

1. PROVIDE SURFACE AREA DRAIN PLUGS AT EACH DRAIN (5 REQUIRED). SAID DRAIN PLUGS SHALL BE SUFFICIENT TO TRAP ALL LIQUIDS AT SURFACE.
2. A COMPLETE SET OF COLOR CODED VALVE SCHEMATIC AND PUMP INSTRUCTIONS ARE TO BE ATTACHED TO PUMP STATION. SAID INSTRUCTIONS SHALL BE WEATHERPROOF.
3. PROVIDE LIQUID LEVEL INDICATORS AS SPECIFIED. (5 REQUIRED)

SEWER LINE TO PASS EXISTING FENCE LINE APPROXIMATELY 5 FEET FROM CORNER POST

TO NEW ABSORPTION FIELD - SEE SHEET 8 FOR DETAILS 95' FROM CLEAN-OUT 2 TO DISTRIBUTION BOX

ALL VALVES TO BE COLOR CODED AS FOLLOWS:

ALL VALVES ASSOCIATED WITH TANK A SHALL BE PAINTED GREEN
ALL VALVES ASSOCIATED WITH TANK B SHALL BE PAINTED YELLOW
ALL VALVES ASSOCIATED WITH TANKS C SHALL BE PAINTED RED
ALL OTHER VALVES SHALL BE PAINTED BLACK

SPECIAL NOTE:

EACH COLOR CODED VALVE SHALL BE IDENTIFIED WITH A BRASS OR ALUMINUM TAG NOT LESS THAN 1 3/8" IN DIAMETER, CORRECTLY STAMPED TO EXPLAIN THE VALVE FUNCTION, AND WITH A NUMBER FOR IDENTIFICATION. TAGS SHALL BE SECURED TO THE VALVE WITH 18 GAGE COPPER OR BRASS WIRE.

PLUMBING PLAN AND DETAILS
SCALE — 1/4" = 1'-0"

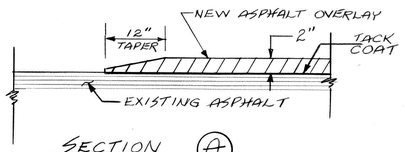
REV	DATE	DESCRIPTION	BY	APPROVED
	15 MAY 90	As-Built	RMD	MRC

DEPARTMENT OF THE AIR FORCE
TACTICAL AIR COMMAND
CANNON AFB, NM
CIVIL ENGINEER OFFICE
USED PETROLEUM MANAGEMENT FACILITY

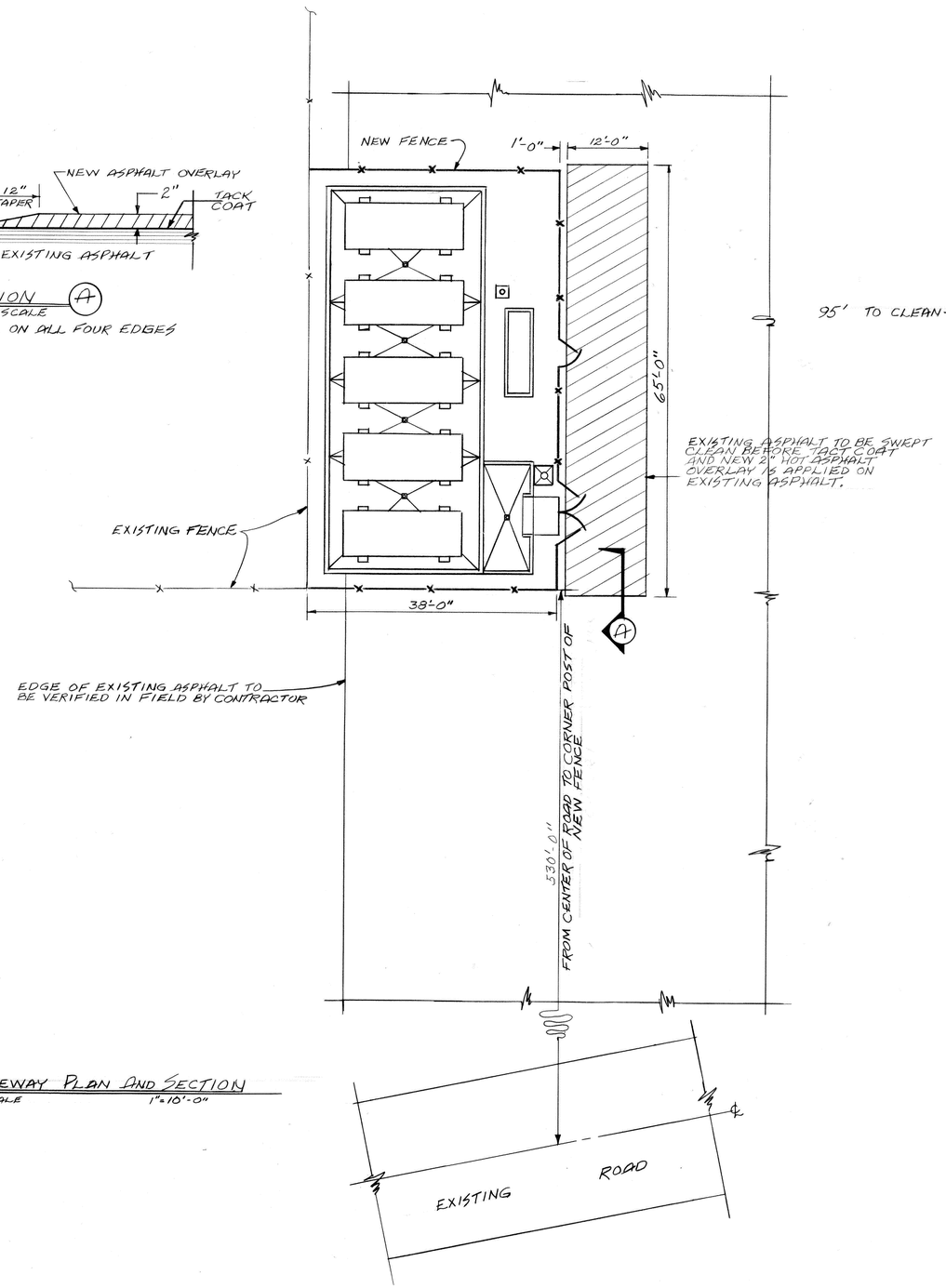
PLUMBING PLAN AND DETAILS

CHECKED BY	DRAWN BY	DATE	SCALE
J. McCLAIN	R. D. CREERY	5 MAR 86	AS NOTED
PROJECT NO. 82-0078	DRAWING NO. 2020.07	SHEET 7 of 8	

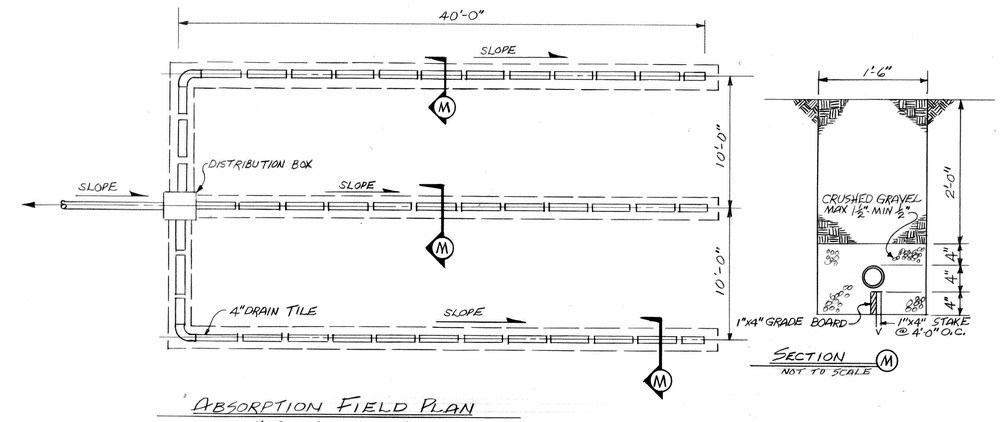
82314
OZALID



SECTION (A)
NOT TO SCALE
TYPICAL ON ALL FOUR EDGES



DRIVEWAY PLAN AND SECTION
SCALE 1"=10'-0"



ABSORPTION FIELD PLAN
NOT TO SCALE

SECTION (M)
NOT TO SCALE

REV	DATE	DESCRIPTION	BY	APPROVED
	15 MAY 90	AS-BUILT	[illegible]	[illegible]

DEPARTMENT OF THE AIR FORCE
TACTICAL AIR COMMAND

CANNON AFB, NM
CIVIL ENGINEER OFFICE

USED PETROLEUM MANAGEMENT FACILITY

DRIVEWAY PLAN, ABSORPTION FIELD PLAN AND SECTIONS

CHECKED BY	DRAWN BY	DATE	SCALE
LT DORAN	R. D. CREERY	7 AUG 86	AS NOTED
PROJECT NO. 82-0078	DRAWING NO. 2020.08		SHEET 8 of 8

82314
OZALID

CANNON AFB
NEW MEXICO

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 1473

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

September 14, 2009

Mr. Ronald A. Lancaster
27 SOCES/CEA
506 N DL Ingram Blvd
Cannon Air Force Base, New Mexico 88103-5003

RE: REQUIREMENT FOR FURTHER CORRECTIVE ACTION, CORRECTIVE ACTION COMPLETE PROPOSALS, JULY 2008 CANNON AIR FORCE BASE, EPA ID NO. NM7572124454 HWB-CAFB-08-004

Dear Mr. Lancaster:

The New Mexico Environment Department (NMED) has completed its review of Cannon Air Force Base's (Permittee) *Corrective Action Completion Proposals,* dated July 2008. Based on the review, one Solid Waste Management Unit (SWMU 129) and one Area of Concern (AOC A) proposed by the Permittee are not appropriate for Corrective Action Complete (CAC) status.

AOC A, MOGAS Spill Site (SS-19)

AOC A is the site of two motor gasoline (MOGAS) spills that occurred in the early 1960s. The site is relatively flat and much of it is paved with asphalt. The portion not paved is a drainage swale extending to the southeast through a grassy area in the southern portion of the site. Construction of a gymnasium and associated pavement along Argentia Avenue changed the physical features of the spill area. Part of the drainage swale where the spills occurred is now located beneath pavement and a portion of the area exists as a small depression along the side of Argentia Avenue.

The Permittee's proposal that AOC A is appropriate for CAC status is based on results of investigations conducted in 1985 and in 2005. Results of the investigations were reported in the Permittee's *Decision Document, MOGAS Spill AOC A/IRP No. SS-19, Cannon Air Force Base, HARZA Environmental Services, January 1997* and in *Supplemental Assessment of Areas of Concern A, B, & C, Cannon Air Force Base, URS Group, Inc. December 2005*. Results of both investigations indicate that lead and various volatile organic compounds (VOCs) were detected at concentrations below NMED soil screening levels (SSLs) for a residential land use scenario. However, no ecological risk screening was conducted by the Permittee.

Since the Permittee does not have eco risk screening values for the facility, NMED compared the maximum concentrations of detected lead and VOCs to the Los Alamos National Laboratory Ecorisk Database (Version 2.3, October 2008) and determined that lead detected in surface soil in 1985 exceeds the risk-based ecological screening level (range of 14 to 21 mg/kg). The surface soil sample where an elevated lead concentration was detected was collected in the drainage swale that runs alongside Argentia Avenue and is not covered by asphalt. The Permittee must conduct ecological risk screening for AOC A.

The lead contamination was a result of a surface spill, but only one surface soil sample (0-1.0 feet below ground surface) was collected in 1985 and no surface soil samples were collected in the 2005 investigation. The Permittee did not define the lateral extent of lead contamination for surface soil. It is not clear if lead-contaminated soil was removed and/or diluted by construction activities conducted subsequent to the 1985 investigation.

Further, analyses of soil samples collected in 2005 indicated that chloroform concentrations exceed the New Mexico generic Migration to Groundwater Dilution Attenuation Factor (DAF) of 20 SSL. Use of the SSL listed for a DAF of 20 for comparison is advised unless site-specific data on hydrologic conditions are available indicating that the DAF of 20 is not representative of site conditions. The Permittee must generate and compare a site-specific DAF for chloroform.

Until such time that (1) the surface soil in the drainage swale alongside Argentia Avenue is sampled and results indicate that lead is not present in concentrations exceeding the risk-based ecological screening level for lead or until the Permittee provides documentation indicating that lead-contaminated soil was removed or substantially disturbed during construction activities since 1985, and (2) comparison of chloroform concentrations to a site-specific DAF indicates that site conditions are protective of ground water, AOC A will not be considered for Corrective Action Complete status.

SWMU 129, Reported Oil/Water Separator and Associated Leach Field

Bulk waste oil was dumped into collection pits equipped with strainers at SWMU 129. From the pits, oil drained into the oil/water (O/W) separator which was then pumped through supply pipes into five above ground storage tanks. The water fraction, segregated by the O/W separator, exited through a port in the west side of the structure and flowed into a leach field located to the southeast of the facility. The leach field consisted of perforated plastic piping surrounded by crushed stone that allowed the water to be discharged into the subsurface and percolate into underlying soils.

The Permittee's proposal that SWMU 129 is appropriate for CAC status is based on results presented in its *Closeout Report / Contamination Assessment, SWMU 129 – Facility 244, Aboveground Tank Storage Area, Cannon Air Force Base, Clovis, New Mexico, July 19, 2000.* The NMED reviewed the cited report and could not determine if the leach field was sampled for presence of potential contaminants. The report described soil sample locations as: northeast corner of pad, southeast corner of pad, center of pad, northwest corner of pad, southwest corner of pad, north of O/W separator, south of O/W separator and east of O/W separator. The soil sample location nearest the leachfield appears to be Sample Number 2, Southeast Corner of Pad. Sample Number 2 was further described in Figure 4-2, Plan View of Facility 244 Showing Soil Sampling Locations, as "3 feet north of south fence, 4 feet, 3 inches west of east fence". Figure 4-2 indicates that it is not to scale. Figure 4-2 does not indicate the location of the referenced south fence or east fence nor does it indicate the position of the leach field.

It is unclear whether or not the leach field was sampled. If the leach field was not sampled or was not adequately investigated, the NMED considers the investigation of SWMU 129 incomplete. Until such time that the Permittee provides documentation that the leach field was adequately sampled and the results of such sampling demonstrate that contaminants are not present at concentrations exceeding appropriate cleanup criteria, SWMU 129 will not be considered for Corrective Action Complete status.

NMED will proceed with preparation of a Statement of Basis and Public Notice to change the status of the other twelve sites proposed for Corrective Action Complete in the Permittee's July 2008 submittal.

If you have any questions regarding the content of this letter, please call Pat Stewart at (505) 476-6059.

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

cc: P. Stewart, NMED HWB
N. Dhawan, NMED HWB
D. Cobrain, NMED HWB
H. Hanson, CAFB
File: CAFB 2009 and Reading
CAFB-08-004

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE

RESPONSE TO COMMENTS
REVISED SITE INVESTIGATION AT EIGHT SITES
PROJECT ACTIVITIES WORK PLAN
CANNON AIR FORCE BASE, NEW MEXICO
CURRY COUNTY, NEW MEXICO
EPA ID NO. NM7572124454
HWB-CAFB-11-005

Comments by John E. Kieling, Chief Hazardous Waste Bureau, NMED dated November 30, 2012.

The New Mexico Environment Department (NMED) has received Cannon Air Force Base (Permittee) *Site Investigation at Eight Sites Project Activities Work Plan* (IWP), dated April 2012 and received April 18, 2012. NMED has completed review of the IWP and approves the IWP with the following modifications.

Modifications:

Comment 1. Section 4.4.1, Site Description and Background (ST-C504), second paragraph, page 4-6:

Permittees' Statement: "A UST (1400B) was removed from an area to the northeast of ST-C504 on November 17, 1994. No signs of leakage were recorded during tank removal; therefore, UST 1400B does not present a potential source of contamination to ST-C504."

NMED Comment: As written, this statement is misleading since subsequent paragraphs in the same section indicate that chemical analyses of various subsurface soil samples associated with the underground storage tank (UST) indicated evidence that a release had occurred from the UST. The Permittee must either remove the paragraph from the IWP or revise it to reflect actual site conditions.

Provide a substitute page containing appropriately revised language.

> **Response:** Agree. UST (1400B) is located outside of ST-C504. NMED identified this location based on as-built drawings and requested a description of UST 1400B in previously provided Specific Comment 28 (provided by NMED on 02 February 2012). The paragraph will be revised as follows to clarify, "A UST (1400B) was removed from an area to the northeast of ST-C504 on November 17, 1994. *This UST was not located at ST-C504. Since this UST was not located at ST-C504 and* ~~N~~no signs of leakage were recorded during tank removal~~; therefore~~, UST 1400B does not present a potential source of contamination to ST-C504." A substitute page will be provided.

Comment 2. Section 4.8.1, Site Description and Background (TA/AS-C129), fourth paragraph, last sentence, page 4-17:

Permittees' Statement: "The leach field consisted of perforated plastic piping surrounded by crushed stone that allowed the water to be discharged into the subsurface and percolate into underlying soils without impacting the groundwater (Parallax 2000)."

NMED Comment: According to the referenced report, all soil samples collected by Parallax in December 1999 were surface samples collected from beneath the removed concrete containment pad. No evidence (positive or negative) was collected to determine potential groundwater impacts associated with the site.

Revise the statement to remove the speculative information and provide a replacement page to reflect site conditions.

> **Response:** Agree. The paragraph will be revised as follows, "The leach field consisted of perforated plastic piping surrounded by crushed stone ~~that allowed the water to be discharged into the subsurface and percolate into underlying soils without impacting the groundwater~~ (Parallax 2000)." A replacement page will be provided.

Comment 3. Section 5.2.3, Surface Soil Analytical Sample Collection, fourth paragraph, page 5-5:

Permittees' Statement: "Surface soil sample submitted to EMAX will be analyzed for analytical parameters on a 21-day turnaround time."

NMED Comment: Several of the analyte groups listed in this section have extraction or analytical (or both) holding times that are less than 21 days. Review the analytical methods to ensure that all samples (including quality assurance/quality control samples) are analyzed within recommended holding times and revise the sentence accordingly. The same comment applies to the last sentence of the third paragraph of Section 5.3.3 (*Subsurface Soil Analytical Sample Collection*).

Provide replacement pages that reflect current recommended sample extraction/analysis holding times.

> **Response:** Agree. The paragraph will be modified as follows, "Surface soil samples submitted to EMAX will be *extracted and* analyzed for analytical parameters *within maximum hold times* ~~on a 21-day turnaround time~~. *A complete list of maximum hold times for each analyte is provided in the UFP-QAPP (Appendix A) Worksheet 19*."
>
> Additionally, the text in the last sentence of the third paragraph of Section 5.3.3, page 5-7 will be revised as follows, "Subsurface soil samples submitted to EMAX will be *extracted and* analyzed for analytical parameters *within maximum hold times* ~~on a 21-day turnaround time~~. *A complete list of maximum hold times for each analyte is provided in the UFP-QAPP (Appendix A) Worksheet 19*." Replacement pages will be provided.

Additional Notes:

Ongoing review of the document has revealed a few typographical errors, which will be corrected as follows:

1. Section 4.6.1, third paragraph, first sentence, page 4-11, "Historical site activities included delivery~~, storage,~~ and dispensing…"

2. Table 5-2. RCRA Metals and PCBs were inadvertently marked for analysis at soil boring locations CA502-SB01 through CA502-SB11 and CA502-SB14 through CA502-SB16. In accordance with the text in Section 5.10.2, page 5-15, soil boring locations CA502-SB12 and CA502-SB13 (vehicle service station area borings) should have been the only borings marked for RCRA Metals and PCBs. Table 5-2 will also be revised to show a quantity of "6" in the bottom "Totals" row instead of "87" for RCRA Metals and PCBs.

3. Table 5-8. The text in the "Technical Rationale" column for CA129-SB07, on page 2 of the table, will be modified as follows, "Boring will be completed near the center of the drain pipe between the former location of the ~~OWS~~ *leach field* and the cleanout…"