DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 49TH WING (ACC)
HOLLOMAN AIR FORCE BASE NEW MEXICO

6 July 2016

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Hazardous Waste Bureau

ADAM M. KUSMAK, GS-13, USAF
Chief, Installation Management Flight (49 CES/CEI)
49th Civil Engineer Squadron (49 CES)
Holloman Air Force Base, NM

New Mexico Environment Department
Attn: Mr. John Kieling, Chief
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6063

Re: **TS851a Former Skeet Range**
Non-Time Critical Removal Action Work Plan
Uniform Federal Policy Quality Assurance Project Plan
EPA ID# NM6572124422, HWB-HAFB-12-001
Holloman Air Force Base, Alamogordo, NM
Contract No. FA8903-13-C-0008

Dear Mr. Kieling,

Holloman AFB is pleased to submit the Non-Time Critical Removal Action Work Plan - Uniform Federal Policy Quality Assurance Project Plan for the TS851a Former Skeet Range Munitions Response Site.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions regarding this submittal, please contact me at (575) 572-6675 or by email at adam.kusmak@us.af.mil.

Sincerely,

Digitally signed by KUSMAK.ADAM.M.1263331806
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USAF, cn=KUSMAK.ADAM.M.1263331806
Date: 2016.07.11 10:37:17 -06'00'

ADAM M. KUSMAK, GS-13, USAF

Attachment(s): *TS851a Non-Time Critical Removal Action Work Plan Uniform Federal Policy Quality Assurance Project Plan.* Hard copy and CD.

cc: Mr. Dave Strasser, NMED HWB (w/Atch)
Mr. Cornelius Amindyas, NMED HWB (w/o Atch)
Mr. Chuck Hendrickson, USEPA (w/CD)
Ms. DeAnna Rothhaupt, HAFB (w/Atch)
Mr. Charles Schick, HAFB (w/Atch)
Mr. Brian Renaghan, AFCEC (w/CD)
Mr. Wayne Bittner, Kirtland AFB (w/Atch, 2 CDs)

TS851a - FORMER SKEET RANGE

NON-TIME CRITICAL REMOVAL ACTION WORK PLAN

UNIFORM FEDERAL POLICY QUALITY ASSURANCE PROJECT PLAN

HOLLOMAN AIR FORCE BASE
NEW MEXICO

Performance Based Remediation
Contract Number: FA8903-13-C-0008

Prepared for

AIR FORCE CIVIL ENGINEER CENTER
2261 Hughes Ave., Suite 155
Joint Base San Antonio Lackland, Texas 78236-9853

July 2016

Prepared by:

FPM Remediations, Inc.
181 Kenwood Avenue
Oneida, NY 13421

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UFP-QAPP TS851a - Former Skeet Range

Remedial Investigation

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Site:

Former Skeet Range TS851a
Holloman Air Force Base
New Mexico

Submitted to:
Mr. Chuck Hendrickson
USEPA, Region 6 (6PD-F)
1445 Ross Ave, Suite 1200
Dallas, TX 75202-2733

Prepared for:

Air Force Civil Engineer Center (AFCEC)
2261 Hughes Ave., Suite 155
Joint Base San Antonio Lackland,
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Prepared by:
FPM Remediations, Inc.
181 Kenwood Avenue, Oneida, NY 13421

July 2016

Author: _____
Peter Corigliano

Title: Site Manager
Date: _____

Reviewer: _____
Ivana Raicevic, Ph.D.

Title: Holloman AFB MMRP Installation Manager, FPM
Date: _____

Reviewer: _____
Jeffrey B. Hackworth, PGp, PG

Title: MMRP Manager
Date: _____

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LIST OF ABBREVIATIONS AND ACRONYMS

amsl	above mean sea level
AFCEC	Air Force Civil Engineer Center
AFCEE	Air Force Center for Environmental Excellence
bgs	below ground surface
BNA	Base, Neutral, and Acid
°C	degrees Celsius
CA	Corrective Action
CAS	Chemical Abstracts Service
CCV	Continuing Calibration Verification
CEIE	Civil Environmental and Infrastructure Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	Civil Engineer Squadron
CFR	Code of Federal Regulations
CO	Contracting Officer
CoC	Chain of Custody
COD	Coefficient of Determination
COR	Contracting Officer Representative
CSE	Comprehensive Site Evaluation
CV	Calibration Verification
CZRX	Environmental Center of Excellence Restoration - Execution
DD	Decision Document
DERP	Defense Environmental Restoration Program
DFTPP	Decafluorotriphenylphosphine
DGPS	Differential Global Positioning System
DL	Detection Limit
DMM	Discarded Military Munitions
DoD	Department of Defense
DQI	Data Quality Indicator
DQO	Data Quality Objective
EICP	Extracted Ion Current Profile
ERPIMS	Environmental Restoration Program Information Management System
ESS	Enterprise Sourcing Squadron
°F	Fahrenheit
FPM	FPM Remediations, Inc.
ft	foot or feet
H&S	Health and Safety
HAFB	Holloman Air Force Base
HDR	HDR Environmental, Operations and Construction, Inc.
HGL	HydroGeoLogic, Inc
HSP	Health and Safety Plan
ICAL	Initial Calibration
JBSA Lackland	Joint Base San Antonio Lackland
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection

LOQ	Limit of Quantitation
LTM	Long Term Monitoring
MC	Munitions Constituents
MEC	Munitions and Explosives of Concern
mg/kg	milligram(s) per kilogram
mm	millimeter
MMRP	Military Munitions Response Program
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Not Applicable
NFA	No Further Action
NMED	New Mexico Environment Department
No.	Number
NTCRA	non-time critical removal action
O&M	Operation and Maintenance
PAH	Polycyclic Aromatic Hydrocarbons
PBR	Performance Based Remediation
PDS	Post Digestion Spike
PE	Performance Evaluation
%	percent
PKB	Environmental Contracting
PM	Project Manager
POC	point of contact
ppm	parts per million
PT	Proficiency Testing
QA	Quality Assurance
QC	Quality Control
QSM	Quality Systems Manual
r	Correlation Coefficient
RF	Response Factor
%R	Percent Recovery
RPD	Relative Percent Difference
RPM	Restoration Program Manager
RRT	Relative Retention Time
RSL	Residential Screening Level
SARA	Superfund Amendments and Reauthorization Act
SC	Site Closeout
Shaw	Shaw Environmental, Inc.
SIM	Selective Ion Monitoring
SOP	Standard Operating Procedure
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
TBD	To Be Determined

TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TO	Task Order
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
UXO	Unexploded Ordnance
WP	Work Plan
XRF	X-ray fluorescence

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Executive Summary

Introduction

This Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Work Plan (WP) is prepared to outline the Non-Time Critical Removal Action (NTCRA) of polycyclic aromatic hydrocarbons (PAHs)-impacted soils to achieve site closeout (SC) at Site TS851a Former Skeet Range at Holloman Air Force Base (HAFB) (**Figure 1**).

FPM Remediations, Inc. (FPM) has been contracted by the Air Force Civil Engineer Center (AFCEC) under Contract FA8903-13-C-0008 to conduct Performance Based Remediation (PBR), in compliance with U.S. Environmental Protection Agency (USEPA) and New Mexico Environment Department (NMED) regulatory requirements, at certain sites at HAFB. Signatures for the AFCEC (lead organization) Contracting Officer's Representative Project Manager and the Contracting Officer's Representative Alternate Quality Manager, along with the USEPA (federal regulatory agency) Project Manager, and the HAFB Environmental Restoration Manager are provided on Worksheet #1 and #2 (Title and Approval Page).

The United States Air Force (USAF) defines a site as having achieved SC when all active management and monitoring at the environmental cleanup site have been completed, no additional environmental cleanup funds will be expended at the site, and the USAF has obtained regulatory concurrence. SC occurs when cleanup goals have been achieved in accordance with the final Decision Document (DD) (if regulatory structure[s] require a DD for the site) that allow unrestricted use of the property. That is, no further long term monitoring (LTM) and/or institutional controls (ICs) are required by either the regulator or the USAF and that all site decommissioning has been completed. Achieving SC may include, but not be limited to, the dismantling, removal, recycling, reclamation and/or disposal of all remedial activity systems and ancillary equipment above and underground to return the site to its natural state. Well abandonment and site restoration is to be completed in accordance with Base and regulatory requirements. Regulatory concurrence may include variations such as "no further active remediation", "regulatory closure with restrictions", "conditional site closure" or other functional equivalents. These variations would involve requirements for LTM and would therefore not allow for unrestricted use, and as such is not SC.

The NTCRA for the TS851a Former Skeet Range Site is being performed under the USAF Military Munitions Response Program (MMRP) under the authority of the Defense Environmental Restoration Program (DERP) and in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. The Department of Defense (DoD) has established the MMRP under the DERP to address DoD sites with unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on current and former military installations.

Site Background

The TS851a Former Skeet Range was originally part of TS851 Munitions Response Area (MRA) (comprised of the TS851, TS851a, and TS851b Munitions Response Sites [MRSs]) and consists

of 3.1 acres, located in the southeastern portion of HAFB. Based on the Modified Comprehensive Site Evaluation (CSE) Phase I Report (Shaw Environmental, Inc. [Shaw], 2010), the outline of what appeared to be a two-position skeet range was visible at this location in a historical U.S. Army Corps of Engineers (USACE) aerial photograph from 1972. The skeet range was used for small arms training and practice with moving targets, and the firing direction of the range appeared to be oriented to the northeast. Typically, skeet ranges were used for training and/or recreational target shooting. Information collected during the Modified CSE Phase I indicated that there is no potential for munitions impacts from the Former Skeet Range beyond the installation boundaries, because the site lies within the boundary of HAFB. No further documentation has been provided regarding the history of munitions-related activities in this area.

During the CSE Phase II visual surveys (HDR Environmental, Operations and Construction, Inc. [HDR], 2013), small arms debris associated with 12-gauge shotgun, 9 millimeter (mm), .38-caliber, and .45-caliber weapons were observed during the visual reconnaissance. Small arms debris associated with 9mm, .38-caliber, and .45-caliber are not typical to skeet range activity. Areas with dense clay target debris were also documented within the typical target fall-out zone for the skeet range. Based on a review of the Final Modified CSE Phase I and CSE Phase II reports, lead shot was observed on the ground surface during the visual survey for the Modified CSE Phase I, and the highest concentration was noted within 500 feet (ft) of the firing points. There was no indication that Munitions and Explosives of Concern (MEC) larger than small arms were present, and the CSE Phase II X-ray fluorescence (XRF) results for lead in the soil were all below the NMED Soil Screening Levels (SSL) and USEPA Residential Screening Levels (RSL) of <400 milligram per kilogram (mg/kg). During the active time period for the MRA, clay targets contained various PAH compounds. It was found during the CSE Phase II that the PAH concentrations in soils exceeded USEPA RSLs in 9 of the 28 samples.

Based on the CSE Phase II findings, it was recommended that the Former Skeet Range MRA be split into three MRSs (**Figure 2**). TS851 Former Skeet Range MRS (30.8 acres) was recommended for no further action (NFA) due to the lack of MEC and MC exceeding USEPA RSLs. TS851a Former Skeet Range MRS (3.1 acres) was recommended for further munitions response action based on elevated PAH concentrations and visual confirmation of clay target debris. The boundary of TS851a MRS was also adjusted to extend slightly beyond the original MRA boundary to the southwest based on PAH contamination outside the original MRA boundary. TS851b Former Skeet Range MRS was not accessed during the CSE Phase II since the site was occupied by a contaminated soil remediation area and recommended to be administratively closed out of the MMRP. Based on the CSE Phase II results, this NTCRA UFP-QAPP WP addresses the TS851a Former Skeet Range MRS.

The TS851a Former Skeet Range MRS exhibits relatively flat topography (Shaw, 2010). Site features for Site TS851a Former Skeet Range are provided on **Figure 2.**

The vegetation at HAFB is consistent with that of the Tularosa Basin and includes mesquite, creosote bush, and grasses. Succulents such as cactus, agave, and yucca are also present. There are sensitive species that currently receive no federal protection and include: lichen (A. *clauzadeana*), proposed for rare and endangered listing and the grama grass cactus, included due to its former candidate status (HDR, 2013).

There are no structures within the TS851a Former Skeet Range MRS and the area consists of desert scrubland and roads. However, the Fourth Space Command Complex is adjacent to the MRS and

is covered entirely by buildings or pavement, and is encompassed by fencing. Due to the neighboring Fourth Space Command Complex being a high security area, authorization to work in the surrounding areas requires coordination with base security forces and the Fourth Space Command Complex security (Shaw, 2010).

There is no fencing or other access control to the MRS, but access to HAFB requires admittance through the security gate and there is a fence around the entire installation. Therefore, access to the TS851a Former Skeet Range MRS is restricted to the general public, but is open to base personnel, contractors, and base residents. Trespasser access is unlikely due to the security for the Fourth Space Command Complex (Shaw, 2010).

Depth to groundwater in the area ranges from 5 ft to 50 ft below ground surface (bgs). Groundwater flow is generally toward the southwest with localized influences from the variations in base topography with shallower groundwater found on the southern end of the base (HDR, 2013).

Project Organization

This UFP-QAPP is organized into thirty-seven worksheets as specified by Uniform Federal Policy for QAPPs (AFCEE, 2006). The Policy is intended to insure in an orderly fashion, the problem definition, approach to resolving the problem, and quality assurance/quality control (QA/QC) activities to insure that the data collected is usable. The table of contents for this document presents a listing of all the UFP-QAPP Worksheets. The field sampling and reporting portions of the UFP-QAPP will be implemented by qualified FPM staff as identified in UFP-QAPP Worksheets #5, 6 and 7. The laboratory analyses will be conducted by SGS Accutest – Laboratories Inc. Orlando according to DoD Quality Systems Manual (QSM) Version 5.0, July 2013 (DoD, 2013) (UFP-QAPP Worksheet #23).

Scope of Work / Sampling and Analysis

The specific objective of the NTCRA is to eliminate residual PAH contamination above the USEPA RSLs at the TS851a Former Skeet Range MRS. As the USEPA RSLs are more stringent than the NMED SSLs, these values will be used as the project action limits for removal criteria. The scope of work is as follows and as presented in Worksheet 17.

- Review of available background data concerning historical site activities and investigations.
- Based on the results of the previous investigations (summarized in **Figures 3** and **4**), collect up to an estimated 20 soil samples at the site from shallow soil borings (up to an estimated depth of 2 ft bgs) advanced using a hand auger. Detailed soil sampling methodology is described in Standard Operating Procedure (SOP) Number (No.) 2 (**Appendix A**). Analyze for PAHs using an off-site fixed base laboratory by USEPA SW-846 Method 8270D Selective Ion Monitoring (SIM). Proposed soil sample locations are illustrated in **Figure 5**.
- Analyze up to 10 soil samples from within the proposed excavation area for Toxicity Characteristic Leaching Procedure (TCLP) analysis for disposal characteristics (USEPA SW-846 Method 1311).
- Compare the results to USEPA RSLs (USEPA, 2015) to determine the excavation boundaries.
- Excavate soil with PAH concentrations exceeding USEPA RSLs. The anticipated Haul Route is illustrated in **Figure 6**.

- Collect confirmatory samples (analyze for PAHs using an off-site fixed base laboratory by USEPA SW-846 Method 8270D SIM) and backfill/restore site. **Figure 7** illustrates proposed confirmatory sample locations.
- Prepare the After Action Report detailing the removal action, excavated boundaries, all NTCRA field activities, and confirmatory sampling results. The After Action Report will include updated Munitions Response Site Prioritization Protocol (MRSPP) scoring elements.

Project Records and Data Management Plan

FPM will maintain field records sufficient to recreate all sampling and field measurement activities and to meet all Environmental Restoration Program Information Management System (ERPIMS) data loading requirements. The requirements listed in UFP-QAPP Worksheet #18 will apply to all measuring and sampling activities.

Investigation and Interim Measure Soil Removal Waste Management

Investigation and Interim Measure Soil Removal Waste Management is outlined in Worksheet #14. Described activities will be completed in accordance to the Project Health and Safety Plan (HSP) (FPM, 2014).

Introduction

The primary purpose of this Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP) Work Plan (WP) is to present the excavation, site restoration and field sampling activities for the Non-Time Critical Removal Action (NTCRA) at the TS851a Former Skeet Range (**Figure 2**). This NTCRA WP is prepared using the Optimized UFP-QAPP format http://www.epa.gov/fedfac/pdf/ufp_qapp_worksheets.pdf. The scope of work to be completed for this project is summarized in **Table 1**.

Table 1
Holloman AFB PBR
TS851a Former Skeet Range
Scope of Work

Work Element	Monitoring Matrix	Preliminary Site Chemical of Concern	Site Objective
polycyclic aromatic hydrocarbons (PAHs) Contamination Delineation	Soil	PAHs	Establish Excavation Boundaries
NTCRA Field Activities (Soil Removal and Confirmatory Sampling)	Soil	PAHs	Site Closeout

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QAPP Worksheet #1 & #2 – Title and Approval Page

1. Project Identifying Information

    a. Site name/project name: Holloman Air Force Base (HAFB)/Performance Based Remediation (PBR) NTCRA

    b. Site location/number:

    TS851a – Former Skeet Range

    c. Contract/work assignment number: FA8903-13-C-0008; Task Order (TO): Not Applicable (NA)

2. Lead Organization

    a. Lead Organization Project Manager:

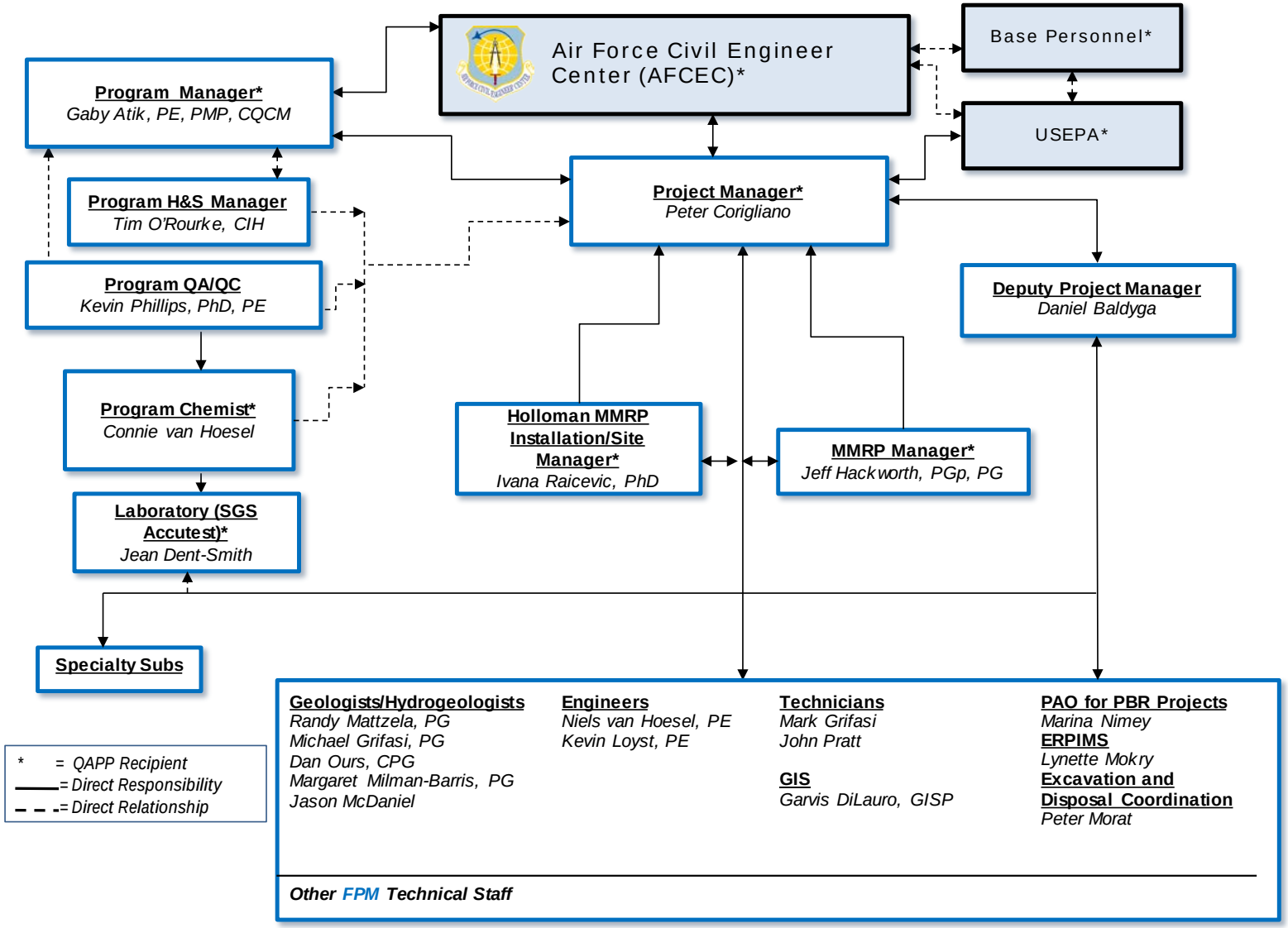
    _____ _____

    Brian Renaghan
    Date
    AFCEC/CZRX

3. Plans and Reports from previous investigations relevant to this project:

Date	Title	Site
2010	Final Report - Modified Comprehensive Site Evaluation (CSE) Phase I, Holloman Air Force Base, New Mexico	Former Skeet Range
2011	Holloman Air Force Base, New Mexico – CSE Phase II Final Work Plan, Military Munitions Response Program.	Former Skeet Range
2011	Basewide Background Study Report, Holloman Air Force Base, NM.	Former Skeet Range
2013	Final Report - CSE Phase II, Holloman Air Force Base, NM.	TS851

QAPP Worksheet #3 & #5 – Project Organization and QAPP Distribution



QAPP recipients' contact information is provided below:

QAPP Recipients	Title	Organization / Address	Telephone Number (No.)	E-mail Address
Naomi Alvarado	Contracting Officer (CO)	772 Enterprise Sourcing Squadron/Environmental Contracting (ESS/PKB)/2261 Hughes Ave., Suite 163, Joint Base San Antonio Lackland (JBSA-Lackland), Texas 78236-9856	210-395-8151	Naomi.alvarado@us.af.mil
Brian Renaghan	Contracting Officer Representative (COR)	AFCEC/Environmental Center of Excellence Restoration - Execution (CZRX)/2261 Hughes Ave., Suite 155, (JBSA Lackland), Texas 78236-9856	210-395-0710	Brian.renaghan@us.af.mil
Rita Leal	Contract Specialist	772 ESS/PKB/2261 Hughes Ave., Suite 163, (JBSA Lackland), Texas 78236-9856	210-395-8228	Rita.leal@us.af.mil
David Griffin	Chief Holloman AFB Environmental	49 Civil Engineer Squadron (CES)/Civil Environmental and Infrastructure Engineering (CEIE)/550 Tabosa Ave Holloman AFB, NM 8830	575-572-5395	David.griffin.5@us.af.mil
Wayne Bitner	Holloman AFB, Acting Restoration Project Manager (RPM)	377 MSG/CEIR	505-853-3484	ludie.bitner@us.af.mil
Charles Schick	Holloman Contract RPM	USAF	505-280-1786	cschick@ideals-inc.com charles.schick@us.af.mil
John Kieling, Chief	NMED Project Manager	NMED	505-827-1603	John.kieling@state.nm.us

QAPP Recipients	Title	Organization / Address	Telephone Number (No.)	E-mail Address
Chuck Hendrickson	United States Environmental Protection Agency (USEPA) Region 6 Project Manager (PM)	USEPA, RCRA Corrective Action Section (6MM-RC)/ 1445 Ross Ave, Suite 1200, Dallas, TX 75202-2733	214-665-2196	
Gaby Atik, PE, PMP, CQCM	Program Manager	FPM/181 Kenwood Ave, Oneida, NY 13421	315-336-7721	g.atik@fpm-remediations.com
Jeff Hackworth PG	MMRP Manager	FPM/5811 University Heights BLVD., Suite 101, San Antonio, TX 78249	210-495-7744	j.hackworth@fpm-remediations.com
Ivana Raicevic, PhD.	Holloman AFB MMRP Installation Manager	FPM/5811 University Heights BLVD., Suite 101, San Antonio, TX 78249	210-495-7744	i.raicevic@fpm-remediations.com
Jean Dent-Smith	SGS Accutest Laboratories Inc.– Orlando PM	4405 Vineland Road Suite C-15 Orlando, FL 32811	407-425-6700	jeans@accutest.com

QAPP Worksheet #4, #7, & #8 – Personnel Qualifications and Sign-Off Sheet

Organization: AFCEC

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Naomi Alvarado	CO			
Brian Renaghan	AFCEC/CZRX – COR			

Organization: Holloman AFB

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
David Griffin	Chief Holloman AFB Environmental			

Organization: FPM

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Gaby Atik, PE, PMP, CQCM	Program Manager	B.S.C.E., Master in Engineering, Engineering Management / Environmental Systems, 20+ years of environmental experience.		
Kevin Phillips Ph.D., PE	Quality Assurance (QA) / Quality Control (QC) Officer	Ph.D. Environmental Engineering, M.S. Hydrodynamics, B.C.E., Civil Engineering. 30+ years of experience	Licensed Professional Engineer in New York, New Jersey, Pennsylvania, Connecticut, Maryland, Massachusetts, Alabama, and Texas	

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Jeff Hackworth, PGp, PG	MMRP PM	B.S. Geophysics PG 26+ years of environmental experience	Registered Geophysicist: California Registered Professional Geologist: Tennessee	
Tim O'Rourke, CIH	Health and Safety (H&S) Manager	Certified Industrial Hygienist 15 years' experience		
Connie van Hoesel	Program Chemist/ Chemical QC Manager	M.S. Environmental Engineering, B.A. Chemistry, 12 years' experience		
NTCRA Field Team[1]	NTCRA Field Team Personnel	Various	H&S Training per 29 Code of Federal Regulations 1910.120 Tailgate meeting to discuss daily plans and procedures	

Organization: Laboratory

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Jean Dent-Smith	SGS Accutest Laboratory Inc. PM		SGS Accutest Laboratory Inc. is a Department of Defense (DoD) Accredited laboratory. Accreditation certificate is provided in **Appendix B**.	

Notes:
All sampling personnel will be trained using sampling techniques described in the Standard Operating Procedures (SOPs) (**Appendix A**). All field personnel (including sub-contractors) certifications will be electronically retained by FPM for review.

QAPP Worksheet #6 – Communication Pathways

Communication Drivers	Organization	Name	Contact Info	Procedure (timing, pathways, etc.)
Point of contact (POC) with USEPA Region 6	49 CES/CEIE	David Griffin	575-572-5395	Mr. Griffin is the Chief HAFB Environmental
	AFCEC/CZRX - COR	Brian Renaghan	210-395-0710	Mr. Renaghan is the AFCEC COR PM.
Overall Project Management	AFCEC/CZRX - COR	Brian Renaghan	210-395-0710	Mr. Renaghan is the AFCEC COR PM.
Program and Project Activities and Issues	FPM Program Manager	Gaby Atik, PE, PMP, CQCM	315-336-7721	Is the primary interface with AFCEC and ensures performance objectives are met.
Daily Field Progress Reports	Holloman AFB MMRP Installation Manager	Ivana Raicevic, PhD	210-495-7744	Supervises field sampling and Operation and Maintenance (O&M) activities. Authors status and completion reports. Reports to PM and/or AFCEC and HAFB within three days of the change. Once approved, the UFP-QAPP recipients will receive a copy of the change.
Sampling and Remediation Activities	Holloman AFB MMRP Installation Manager	Ivana Raicevic, PhD	210-495-7744	Responsible for all sampling and remediation activities to assure goals are attained. Reports to AFCEC and HAFB daily during field efforts.

Communication Drivers	Responsible Entity	Name	Phone No.	Procedure (timing, pathways, etc.)
Project QA/QC	QA/QC Officer	Kevin Phillips PhD., PE	631-737-6200	Will determine corrective action for field, data interpretation, and reporting issues
Reporting Lab Data Quality Issues	Chemical QC Manager	Connie van Hoesel	315-336-7721	Will determine corrective action for lab data quality issues
Field and Analytical Corrective Actions	Chemical QC Manager	Connie van Hoesel	315-336-7721	Will determine corrective action for field and analytical issues
Release of Analytical Data	Chemical QC Manager	Connie van Hoesel	315-336-7721	No analytical data can be released until it has been reviewed by the Chemical QC Manager and data validation has been completed.
QAPP Amendments	AFCEC/CZRX - COR	Brian Renaghan	210-395-0710	Any major changes to the QAPP must be approved by Brian Renaghan before the changes can be implemented.

QAPP Worksheet #9 – Project Planning Session Summary

No site-specific planning sessions have been held to date, however one will be planned two weeks after the document is submitted for review. Two meetings have been held discussing PBR contract objectives. If any meetings are held with USEPA Region 6, AFCEC, and/or HAFB regarding scoping and/or elements specifically relating to this UFP-QAPP, this worksheet will be revised accordingly.

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QAPP Worksheet #10 – Conceptual Site Model

Site Background

The TS851 Former Skeet Range Munitions Response Area (MRA) (comprised of the TS851, TS851a, and TS851b Munitions Response Sites [MRSs]) consists of 33.9 acres, and is located in the southeastern portion of Holloman AFB. Based on the Modified CSE Phase I report (Shaw Environmental, Inc. [Shaw], 2010), the outline of what appeared to be a two-position skeet range was visible at this location in a historical US Army Corps of Engineers (USACE) aerial photograph from 1972. The skeet range was used for small arms training and practice with moving targets, and the firing direction of the range appeared to be oriented to the northeast. Typically, skeet ranges were used for training and/or recreational target shooting. Information collected during the Modified CSE Phase I indicated that there is no potential for munitions impacts from the Former Skeet Range to be located beyond the site boundaries, because the site lies within the boundary of HAFB. No further documentation has been provided regarding the history of munitions-related activities in this area.

During the CSE Phase II visual surveys (HDR Environmental, Operations and Construction, Inc. [HDR], 2013), small arms debris associated with 12-gauge shotgun, 9mm, .38-caliber, and .45-caliber weapons were observed during the visual reconnaissance. Small arms debris associated with 9mm, .38-caliber, and .45-caliber are not typical to skeet range activity. Areas with dense clay target debris were also documented within the typical target fall-out zone for the skeet range. Based on a review of the Final Modified CSE Phase I and CSE Phase II reports, lead shot was observed on the ground surface during the visual survey for the Modified CSE Phase I, and the highest concentration was noted within 500 feet (ft) of the firing points. There was no indication that Munitions and Explosives of Concern (MEC) was present, and the CSE Phase II X-ray fluorescence (XRF) results for lead in the soil were all <400 milligram per kilogram (mg/kg). During the active time period for the MRA, clay targets contained various PAH compounds. It was found during the CSE Phase II that the PAH concentrations in soils exceeded USEPA Residential Screening Levels (RSLs) in nine of the 28 samples.

Based on the CSE Phase II findings, it was recommended that the Former Skeet Range MRA be split into three MRSs (**Figure 2**). TS851 Former Skeet Range MRS (30.5 acres) was recommended for no further action (NFA) due to the lack of MEC and munitions constituents (MC) exceeding USEPA RSLs. TS851a Former Skeet Range MRS (3.1 acres) was recommended for further munitions response action based on elevated PAH concentrations and visual confirmation of clay target debris. The boundary of TS851a MRS was also adjusted to extend slightly beyond the original MRA boundary to the southwest based on PAH contamination outside the original MRA boundary. TS851b Former Skeet Range MRS was not accessed during the CSE Phase II since the site was occupied by a contaminated soil remediation area and recommended to be administratively closed out of the MMRP. Based on the CSE Phase II results, this NTCRA WP addresses the TS851a Former Skeet Range MRS only and not the TS851 or TS851b MRSs or TS851 MRA.

Physical and Environmental Setting

Structures

There are no structures within the TS851a Former Skeet Range MRS and the area consists of desert scrubland and roads. However, the Fourth Space Command Complex is adjacent to the MRS and contains multiple buildings. Due to the neighboring Fourth Space Command Complex being a high security area, authorization to work in the surrounding areas requires coordination with base security forces and the Fourth Space Command Complex security (Shaw, 2010).

There is no fencing or other access control to the MRS, but access to HAFB requires admittance through the security gate and there is a fence around the entire installation. Therefore, access to the TS851a Former Skeet Range MRS is restricted to the general public, but is open to base personnel, contractors, and base residents. Trespasser access is unlikely due to security for the Fourth Space Command Complex (Shaw, 2010).

Climate

HAFB is located in a semi-arid region within the northern Chihuahuan Desert. The climate is similar to other semi-arid regions with warm to hot summer days, cool nights, and mild winters. Monthly mean high temperatures range from 55 degrees Fahrenheit (°F) in January to 93.6 °F in August. Monthly mean low temperatures range from 29 °F in January to 66 °F in July. Evapotranspiration is usually high due to dry air, large daily solar radiation totals, seasonally high winds, and warm temperatures. Prevailing wind directions lead to seasonal fluctuations in precipitation, and can result in frontal storms from the north, the Pacific, or Caribbean cyclonic systems. HAFB receives an average annual rainfall of 13.20 inches, and approximately half of this falls during the summer monsoons between the months of July and September. These monsoon thunderstorms are usually short and intense, and occurrences are highly variable from year to year. One or two short-term events may account for a large percentage of the net annual precipitation. Average annual snowfall is approximately 4.5 inches (HydroGeoLogic, Inc. [HGL], 2007).

Topography

HAFB lies within the Tularosa basin of south-central New Mexico. The basin is considered a closed basin, because no surface water can run from it. This area is part of the Mexican Highland section of the Basin and is characterized by fault block mountains interspersed with low desert plains and basins. The base lies on relatively flat alluvial plains below the Sacramento Mountains. The White Sands dune field borders the plain on the west. Elevations range from 4,000 to 4,250 ft above mean sea level (amsl) (HDR, 2013).

The location of the TS851a Former Skeet Range MRS exhibits relatively flat topography (Shaw, 2010).

Soil and Vegetation Types

The U.S. Department of Agriculture Soil Conservation Service identified three primary soil types associated with HAFB: several associations and complexes of Holloman, Gypsum Land, and Yesum soils, located in the flats; Dune Land, found in the White Sands dunes; and Mead silty clay loam soil, found in the alluvial floodplains (HGL, 2007). None of the soil types are very productive, due to high gypsum and salt content, and all are highly susceptible to both wind and water erosion when the vegetation is sparse or the soil is exposed (HDR, 2013).

The vegetation at HAFB is consistent with that of the Tularosa Basin and includes mesquite, creosote bush, and grasses. Succulents such as cactus, agave, and yucca are also present. There are sensitive species that currently receive no federal protection and include: lichen (*A. clauzadeana*), proposed for rare and endangered listing and the grama grass cactus, included due to its former candidate status (HDR, 2013).

Geology and Hydrogeology

HAFB is located in the Tularosa Basin, a downfaulted, closed, intermountain basin associated with the southern portion of the Rio Grande Rift. The Sacramento Mountains to the east, San Andres Mountains, and the White Sands National Monument to the west are the prominent features. The Tularosa Basin is thought to have formed approximately 35 million years ago as a result of faulting, with the most recent formational activity having occurred as recently as 10,000 years ago. Erosion of the uplifted material and fluvial deposits from the Rio Grande River resulted in the fill found in the Tularosa Basin, and consist of coarse- to fine-grained alluvial fan deposits along the rims of the basin that gradually become finer-grained alluvial, fluvial, and lacustrine deposits in the basin interior. Extensive evaporate deposits within the interior basin, such as selenite, are also present (HDR, 2013).

Streams that are sustained by groundwater which discharges within the basin include Salt Creek and Malpais Spring. It is estimated that the groundwater resources of the Tularosa Basin contain over 100 million-acre feet of brackish groundwater. A wide range of water chemistries including sodium chloride, carbonate, and sulfate-based brine waters exist in the basin and water with salinity from 1,000 parts per million (ppm) Total Dissolved Solids (TDS), approximately equal to fresh water, to over 20,000 ppm TDS, approximate to sea water, can be found within the basin. The predominance of groundwater occurs as an unconfined aquifer in the unconsolidated deposits of the central basin. The primary source of groundwater recharge is percolation of rainwater and a minor contribution from stream run-off along the western edge of the Sacramento Mountains (HDR, 2013).

Depth to groundwater in the area ranges from 5 ft. to 50 ft. below ground surface (bgs). Groundwater flow is generally toward the southwest with localized influences from the variations in base topography with shallower groundwater found on the southern end of the base (HDR, 2013).

Hydrology

The only permanent water in the Tularosa Basin is found in small streams between Alamogordo and Three Rivers, New Mexico. There are no perennial streams within HAFB or in the nearby surrounding landscape; however, a set of perennial pools exist within the base. They are the final one-third of the Lost River, a set of pools near the confluence of Ritas and Malone Draws, and the Salt Lakes just south of the Lost River and Camera Pad Road Pond. There are at least nine prominent east-west drainages that receive flows during seasonal thunderstorms. The largest of these drainages is the Lost River drainage system, including Malone Draw, Carter Draw, and Ritas Draw. Construction activities have disrupted the natural flow of this wetland ecosystem (HDR, 2013).

There are no wetlands within the TS851a Former Skeet Range MRS (Shaw, 2010).

Sensitive Ecosystems

As of 2010 when the Modified CSE I Report was published, no federally listed species covered under the Endangered Species Act resided at HAFB. Several federally listed species, however, have been observed at the base in the past. Mountain plover (proposed federally threatened) nested at Lake Holloman during the 1980s. Brown pelicans (federally endangered) are occasionally observed at Lake Holloman and associated constructed wetlands. Peregrine falcons (recently delisted) regularly forage at Lake Holloman. Five other sensitive species currently receive no federal protection: a lichen (*A. clauzadeana*), proposed for rare and endangered listing; the grama grass cactus, included due to its former candidate status; the White Sands pupfish, a state-endangered species; the western burrowing owl, a species of concern; and the western snowy plover, also a species of concern.

According to the 2011 Integrated Natural Resource Management Plan, White Sands Pupfish (*Cyprinodon tularosa*) habitat exists at HAFB. This species is considered a Federal Species of Concern (formerly a Federal Category 2 species) and is listed by the State of New Mexico as 'threatened'. The species is managed under the jurisdiction of the New Mexico Department of Game and Fish. There is no potential White Sands Pupfish habitat areas associated with the TS851a Former Skeet Range MRS (HDR, 2013). The MRS does not support suitable habitat for ecologically sensitive species and there are no known ecologically sensitive areas identified within the MRS.

Current and Future Land Use

As previously mentioned the Fourth Space Command Complex is located to the northwest of the TS851a Former Skeet Range MRS, is covered entirely by buildings or pavement, and is encompassed by fencing. The TS851a Former Skeet Range MRS is open space consisting of desert scrubland and dirt roads (HDR, 2013). No future land use changes are anticipated.

Previous Investigations

Two previous investigations, a Modified CSE Phase I Report (USACE, 2010) and an MMRP CSE Phase II Report (HDR, 2013), have been completed at the former TS851 Skeet Range MRA (and subsequently the TS851a Former Skeet Range MRS).

Modified Comprehensive Site Evaluation Phase I - 2010

In support of the MMRP at HAFB, the CSE Phase I was performed to characterize the site; evaluate actual or potential release(s) of hazardous substance(s), pollutant(s), or contaminant(s) to migration/exposure pathways (groundwater, soil, and air) from MRAs; and evaluate associated targets of concern. The Modified CSE Phase I accumulated and evaluated information on HAFB relating to the possible presence of MEC, site physical conditions, and current and future land uses and activities. Information sources included archival records from HAFB, interviews with HAFB personnel, additional archival information collected from public sources, and observations made during the visual surveys. This information was reviewed and used to evaluate the extent of MEC and/or potential for MC exposure at the site (Shaw, 2010).

The TS851 Former Skeet Range MRA was identified using an aerial photograph from 1972, and a visual survey revealed lead shot from small arms, clay target debris typical to the time period, and the remains of at least one firing point. Based on the Phase I findings, a CSE Phase II was recommended (Shaw, 2010).

Comprehensive Site Evaluation Phase II – 2013

The CSE Phase II (HDR, 2013) activities compiled and evaluated information on HAFB relating to the possible presence of MEC and associated soil contamination from MC. The CSE Phase II field investigation occurred from October 2011 to March 2012. During the field investigation visual survey transects were completed within the TS851 Former Skeet Range MRA boundary (**Figure 2)**. The northwestern portion of the MRA was not surveyed due to the Fourth Space Command Complex which is entirely paved and fenced-in. A controlled 30-ft buffer zone was maintained around the fenced area. Additionally, a small portion of the MRA on the eastern range fan was not surveyed due to a fenced petroleum contaminated soil remediation area (HDR, 2013).

Clay target debris was observed within 300 ft of the historical firing points. Two firing points were still discernible; however, all other range infrastructure has been removed. Lead shot was also observed within the area (HDR, 2013). The lead shot and clay target debris observed are consistent with historical skeet range usage. In addition to the aforementioned debris, pistol bullets of 9mm, .38, and .45 calibers were also documented, these are not typically associated with skeet range activities. It was determined that the total area impacted by clay target debris was approximately 3.1 acres.

Surface and subsurface soil sampling was also performed to evaluate potentially impacted environmental media from range related MC. The CSE Phase II Report recommended splitting the MRA into the three following MRSs which were scored individually utilizing the Munitions Response Site Prioritization Protocol (MRSPP). TS851 MRS (30.5 acres) encompasses the portion of the MRA not impacted by PAH or lead contamination. The TS851 MRS received a Priority of 8 (Priority 1 being the highest potential hazard and Priority 8 being the lowest potential hazard). This MRS was recommended for NFA. The TS851a MRS (3.1 acres), delineated based on the visual extent of clay target debris, is defined as the portion of the MRA impacted by MC impacted soil. **TS851a was given a Priority of 5, and is the only MRS that was recommended for further munitions response action.** TS851b MRS (0.3 acres) was not investigated during the CSE Phase II due to access restrictions and an ongoing petroleum contaminated soil staging area. The TS851b Former Skeet Range MRS was administratively closed out of the USAF MMRP (HDR, 2013).

Source, Nature, and Extent of Contamination

Land associated with the TS851a Skeet Range MRS was used as a skeet range. During the use of the site, lead shot, small arms bullets and debris, and clay targets (potentially containing PAH compounds) were deposited on the surface of the skeet range. PAH compounds are considered the primary range-related contaminant which may have been released directly to the soil during the initial deposition activity or through weathering. No MEC was discovered and there were no explosive safety concerns identified during previous investigations. Surface soil sampling for lead during the CSE Phase II showed that lead from small arms ammunition does not pose a risk under any potential land use scenarios.

Previous studies report that the upper limit for background lead concentration at HAFB is 10.87 mg/kg, and the statewide background lead concentrations for New Mexico soils ranges from 7.0 to 21 mg/kg. Of the 68 samples analyzed by the XRF screening during the CSE Phase II (**Figure 3**): 12 samples yielded results below the limit of detection (12 mg/kg); 23 samples yielded results within the state background range, and all other samples (33 samples) yielded results above

background screening limits. The highest reported XRF value was 154 mg/kg. All samples analyzed were below the NMED SSL and USEPA RSL of 400 mg/kg (HDR, 2013).

In addition, at the conclusion of the XRF sampling at MMRP sites during the CSE Phase II, twelve correlation samples were selected and sent to the analytical laboratory to determine whether XRF results can be considered definitive and can be used for decision making purposes. The results of the linear regression analysis for HAFB yield a correlation coefficient of 0.99, indicating that the XRF data may be considered definitive and as a result may be used for remedial decision-making. Therefore, XRF analysis have shown that lead was not a concern for human health or the environment at the MRA (HDR, 2013).

Based on visual locations within the clay target debris area, a total of twenty-eight soil samples were collected for laboratory analysis of PAHs at a fixed-base laboratory. Samples included 20 surface soil, two subsurface soil from the 6-12 inch depth interval, two subsurface soil samples from the 12-18 inch depth interval, and four background surface soil samples. PAHs in soils exceeded the USEPA human health screening levels for at least one of the following analytes; benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene in nine of the 28 samples analyzed.

QAPP Worksheet #11 – Project/Data Quality Objectives

1. State the Problem

What are the nature and extent of PAH contamination in the soil at the TS851a Former Skeet Range? Is further action necessary to address residual concentrations of PAHs that may pose a threat to human health or is NFA appropriate?

2. Identify the Goals of the Study

The specific objective of this investigation is to develop a refined and updated understanding of the extent (vertical and horizontal) and distribution of PAHs in soil at the TS851a Former Skeet Range. This information will be used to support a NTCRA.

3. Identify Information Inputs

Soil samples will be collected (locations will be based on previous investigations) and soil samples will be analyzed at an off-site laboratory (SGS Accutest Laboratories, Inc.) for PAHs (USEPA SW-846 Method 8270D Selective Ion Monitoring [SIM]).

4. Define the Boundaries of the Study

The spatial limits of work at TS851a are illustrated in **Figure 2.** Sampling locations (surface soils and subsurface soils to 3 ft bgs) for PAHs are shown in **Figures 4, 5 and 7**.

5. Develop the Analytical Approach

The following decision rules will be utilized to link potential results with conclusions or future actions.

Decision Rule 1. Soil samples from 0 to 3 ft bgs will be collected for PAH analysis to determine the presence of contamination, as follows:

- ***If*** PAHs are detected above the Limit of Detection (LOD) (see Worksheet #15) in a sample, ***then*** it will be determined that the corresponding compound is present and included as a detect in the existing analytical dataset for the site (see Decision Rule 2).
- ***If*** PAHs are not detected above the LOD (see Worksheet #15) in a sample, ***then*** it will be determined that the compound is not present and included as a non-detect in the existing analytical dataset for the site (see Decision Rule 2).

Decision Rule 2. The site will be reassessed based on the existing dataset (comprised of historical and new data) to determine if further action is necessary, as follows:

- ***If*** the concentration of PAHs in soil are less than the respective project action limits (see Worksheet #15), ***then*** it will be determined that no further remedial action is needed.
- ***If*** the concentration of PAHs in soil exceeds the project action limits (see Worksheet #15), ***then*** it will be determined that the associated location will be included with the soil removal delineated boundary (see Decision Rule 3).

Decision Rule 3. Removal of contaminated soil that exceeds the project action limits (see Worksheet #15) with confirmation soil sampling data to determine if additional action is necessary, as follows:

- ***If*** the excavation confirmation concentrations of PAHs in soil are less than the respective project action limits (see Worksheet #15), ***then*** it will be determined that no further remedial action is needed.
- ***If*** the excavation confirmation concentrations of PAHs present in soil are greater than the respective project action limits (see Worksheet #15), ***then*** it will be determined that removal will be required of the material that exceeds the project action limits (see Worksheet #15) (repeat Decision Rule 3).

6. Specify Performance or Acceptance Criteria

Sample analytical results will be compared to the project action limits as shown in Worksheet #15. Worksheet #37 describes the usability assessment of the data. Decision criteria include data quality and usability. To ensure the quality of the data, all data will be reviewed, verified, and validated in accordance with this QAPP. To ensure usability of laboratory data, appropriate laboratory methods have been selected to provide the necessary laboratory detection limits (DLs). Acceptance criteria for the analytical data are listed in Worksheet #28.

7. Develop the Detailed Plan for Obtaining Data

The sampling design and rationale are presented in Worksheet #17. Worksheets #16, #17, and #18 describe the details of the sampling. Worksheets #19, #20, #24-28, and #30 specify analysis design requirements.

QAPP Worksheet #12 – Measurement Performance Criteria

Matrix	**Soil**	**Data qualifier definitions, and full data review/validation criteria are listed in Tables 12-2 and 12-3**			
Analytical Group	**PAHs**				
Conc. Level	**Low to High**				
Sampling Procedure[1]	**Analytical Method/SOP[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), and/or Analytical (A)**
SOPs No. 1 and No. 2	USEPA 8270D by SIM/SOP MS008	Precision – Lab	RPD <20 percent (%) Proficiency Testing (PT) sample criteria determined independently by reference laboratory	Matrix Spike (MS)/Matrix Spike Duplicate (MSD), Laboratory Control Sample (LCS)/ Laboratory Control Sample Duplicate (LCSD), and/or Proficiency Testing (PT) Sample	A
			Refer to Worksheet #24	Calibration – Initial and Continuing	
		Precision – Field/Laboratory	If both the parent and duplicate values are > 5x limit of quantification (LOQ), then 30% RPD for aqueous samples, 50% 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 12-1	LCS, MS/MSD Surrogate spike	A
			Refer to Worksheet #24	Calibration – Initial and Continuing	

QAPP Worksheet #12 – Measurement Performance Criteria

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1 and No. 2 (continued)	USEPA 8270D by SIM/SOP MS008	Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
				Equipment blanks	S&A
		Representativeness	Holding time compliance per 40 Code of Federal Regulations (CFR) 136 and/or method	Holding time	A
		Quantitation Limit	LOQ > LOD LOD & LOQ must be verified quarterly. LODs are verified quarterly per method, matrix, and instrument by analyzing a sample at the LOD concentration.	Standard that is at or below the LOQ as the lowest point on the calibration curve.	A
		Sensitivity	Sample results will be reported to the DL.	Sample results that are less than the LOQ, but greater than the DL, will be reported with a **J**-flag. Quarterly LOD verification.	A
		Completeness	90% for aqueous samples and 95% for soil samples.	Data Completeness Check	S&A

Notes:
[1] Reference No. from QAPP Worksheet #21
[2] Reference No. from QAPP Worksheet #23

Table 12-1
Accuracy and Precision Criteria for Chemical Analysis

Spiking Compound	Accuracy (%R)		Precision (RPD)	
	Aqueous	Soil	Aqueous	Soil
PAHs				
Acenaphthene	48-114	44-111	20	20
Acenaphthylene	35-121	39-116	20	20
Anthracene	53-119	50-114	20	20
Benzo(a)anthracene	59-120	54-122	20	20
Benzo(a)pyrene	53-120	50-125	20	20
Benzo(b)fluoranthene	53-126	53-128	20	20
Benzo(g,h,i)perylene	44-128	49-127	20	20
Benzo(k)fluoranthene	54-125	56-123	20	20
Chrysene	57-120	57-118	20	20
Dibenz(a,h)anthracene	44-131	50-129	20	20
Fluoranthene	58-120	55-119	20	20
Fluorene	50-118	47-114	20	20
Indeno(1,2,3-cd)pyrene	48-130	49-130	20	20
1-Methylnaphthalene	41-115	43-111	20	20
2-Methylnaphthalene	39-114	39-114	20	20
Naphthalene	43-114	38-111	20	20
Phenanthrene	53-115	49-113	20	20
Pyrene	53-121	55-117	20	20
Surrogates:				
Nitrobenzene-d5	55-111	44-125		
2-Fluorobiphenyl	53-106	46-115		
Terphenyl-d14	58-132	58-133		

Notes:
%R – Percent Recovery
RPD – Relative Percent Difference

Table 12-2
Data Qualifier Definitions

Qualifier	Description
J	Estimated. The analyte was positively identified; the quantitation is an estimation due to discrepancies in meeting certain analyte-specific QC criteria, or the concentration is less than the sample limit of quantitation.
UJ	The analyte was not detected. The result is estimated due to discrepancies in meeting certain analyte-specific QC criteria.
B	Blank contamination. The analyte was found in the sample at a concentration similar to that observed in a blank.
R	Rejected. The data are rejected due to deficiencies in meeting QC criteria and may not be used for decision-making.

Table 12-3
Data Review/Validation Criteria for USEPA Method 8270D SIM

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LOD determination and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOD verification checks shall be performed.	See DoD QSM v 5. LOD verification checks must produce a signal at least 3 times the instrument's noise level.	Repeat detection limit determination and LOD verification check at higher level and set LOD.	LOD is 2-4x the detection limit.	Apply **R**-flag to data without a valid LOD verification
LOQ establishment and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOQ verification checks shall be performed.	See DoD QSM v 5. LOQ must be set within the calibration range prior to sample analysis.	N/A	N/A	N/A
Holding time	Every sample	Soil Semivolatile Organic Compounds (SVOCs): 14 days to extract, 40 days to analysis. Groundwater SVOCs: 7 days to extract, 40 days to analysis.	Contact FPM as to additional measures to be taken.	None	Apply **J**-flag to detects and **UJ**-flag to non-detects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to non-detects to samples > 2X holding time criteria.
Sample temperature	Every cooler	4±2 degrees Celsius (°C)	Contact FPM as to additional measures to be taken.	None	Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to non-detects. Samples received at temperature > 10°C, **R**-flag all results.
Tuning	Prior to calibration and every 12 hours during sample analysis	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Problem must be corrected. No samples may be accepted without a valid tune.	Apply **R**-flag to data without a valid tune
Breakdown check (DDT method 8270C only)	At the beginning of each 12-hour period, prior to analysis of samples	Degradation ≤ 20% for DDT.	Correct problem then repeat breakdown check		Apply **R**-flag to data analyzed if DDT degradation is not met.

Minimum five point initial calibration for all analytes (ICAL)	ICAL prior to sample analysis	Each analyte must meet one of the three options below:	Correct problem then repeat initial calibration	Problem must be corrected. No samples may be run until ICAL has passed	Apply **R**-flag to data without a valid ICAL
		Option 1: RSD for each analyte $\leq$ 15%		Minimum 5 levels for linear and 6 levels for quadratic.	Apply **R**-flag to data without a valid ICAL
		Option 2: linear least squares regression $r^2 \geq 0.99$		If the specific version of a method requires additional evaluation (e.g., RFs or low calibration standard analysis and recovery criteria) these additional requirements must also be met.	
		Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$.			
Second source calibration verification	Once after each ICAL	Value of second source for all analytes within ± 20% of expected value (initial source)	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration.	Problem must be corrected. No samples may be run until calibration has been verified.	Apply **R**-flag to data without second source verification.
Evaluation of relative retention times (RRTs)	Each sample	RRT of each target analyte in each calibration standard within ± 0.06 RRT units.	Correct problem, then rerun ICAL	Laboratories may update the retention times based on the continuing calibration verification (CCV) to account for minor performance fluctuations or after routine system maintenance.	Apply **R**-flag to data outside retention time window

Manual Integration	All	Acceptance by FPM Chemist	Provide justification for each instance of manual integration	Laboratory will provide chromatograms before and after each manual integration	Apply **R**-flag to all compounds with improper integration
Calibration verification (CV)	Daily before sample analysis; after every 12 hours of analysis time; and at the end of the analytical batch run.	All reported analytes and surrogates within ± 20% of true value. All reported analytes and surrogates within ± 50% for end of analytical batch CCV.	Recalibrate, and reanalyze all affected samples since the last acceptable CCV; or immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Flag all results for the specific analyte(s) in all samples since last acceptable calibration verification.	Apply **J**-flag to detects and **UJ**-flag to non-detects if average RF not met High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to non-detects
Internal standards verification	In all field samples and standards	Retention time ± 10 seconds from retention time of the midpoint standard in the ICAL; Extracted ion current profile (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.	Sample results are not acceptable without a valid IS verification.	If corrective action fails in field samples, apply **J**-flag to detects and **UJ**-flag to non-detects to analytes with IS recoveries between 30%-50% or > 150%. Apply **R**-flag to samples with IS recoveries < 30%.
LCS	One per preparatory batch	QC acceptance criteria specified in UFP-QAPP Table 12-1.	Correct, re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes, if sufficient material is available.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to non-detects. Very low bias (%R<30%): Apply **J**-flag to detects and **R**-flag to non-detects.

MS/MSD	One per preparatory batch per matrix	QC acceptance criteria specified in UFP-QAPP Tables 12-1.	Examine the project-specific Data Quality Objectives (DQOs). Contact FPM as to additional measures to be taken.	For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	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.
Laboratory sample duplicate	One per preparatory batch per matrix (if MS/MSD is not performed)	RPD $\leq$ 20% (sample and sample duplicate)	Examine the project-specific DQOs. Contact FPM 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.	Data shall be evaluated to determine the source of difference. Apply **J**-flag to detects if acceptance criteria are not met.
Surrogate spike	All field and QC samples	QC acceptance criteria specified in UFP-QAPP Table 12-1.	For QC and field samples, correct problem, then re-prep 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.	Analytes identified in UFP-QAPP Table 12-1.	High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to non-detects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to non-detects. For SVOCs, no qualification when only one surrogate is outside QC criteria.
Results reported between DL and LOQ	N/A	N/A	N/A	N/A	Apply **J**-flag to all results between DL and LOQ.
Field Duplicate	One per 10 field samples	See UFP-QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2).	N/A	N/A	Apply **J**-flag to detects and **UJ**-flag to non-detects.

QAPP Worksheet #13 – Secondary Data Uses and Limitations

Data Type	Data Source	How Data Will Be Used	Limitations on Data Use
Soil Data	Holloman Air Force Base, Basewide Background Study Report, 2011, NationView, LLC., NMED.	To assess potential areas of contamination and focus data collection activities in specific site areas where contamination is most likely. To determine if further soil sample collection appears warranted or to establish contamination/excavation boundaries.	Secondary data may not meet all DQOs, and, therefore, may not be able to be used without limitation.
Soil Data	Holloman Air Force Base, Comprehensive Site Evaluation Phase II Report, September 2013, HDR. Historical maps, records, and various documents relating to historic site use, CSE Phase I information, soil sample collection and contamination delineation. USACE and HDR Environmental, Operations and Construction, Inc.		

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QAPP Worksheet #14 and #16 – Project Tasks & Schedule

The project schedule is provided in **Appendix C.**

Summary of Project Tasks

Sampling Tasks (Performed by FPM)**:**

- Specific discussion of the sampling approach and sampling design and rationale is provided in Worksheet #17.
- Soil sampling will assess the absence or presence of contamination. Soil sampling will assess the effectiveness of excavations removing residual contamination. Sample locations will be surveyed using Differential Global Positioning System (DGPS) equipment.
- Samples will be collected using the SOPs attached as **Appendix A** of this UFP-QAPP.

Analysis Tasks (Performed by SGS Accutest Laboratories, Inc):

- SGS Accutest Laboratories, Inc. will analyze samples for PAHs using USEPA SW-846 Method 8270D SIM.

QC Tasks – All Projects:

1. MS/MSDs will be collected at an approximate frequency of 5%.
2. Duplicates will be collected at a rate of 10% and analyzed by SGS Accutest Laboratories, Inc. to assess field and laboratory precision.
3. Equipment blanks will be collected from each type of non-disposable, decontaminated sampling device.
4. Laboratory performance evaluation samples will be collected at each site to assess the laboratory's ability to provide defensible data of a known quality.
5. Data validation will be conducted on 100% of all analytical data collected.

Secondary Data – All Projects:

Previously collected data will be evaluated. Secondary data may not meet all DQOs, and, therefore, may not be able to be used without limitation. See Worksheet #13.

Summary of Project Tasks

Data Management Tasks – All Projects: Data will be delivered in an ERPIMS database compatible format after data verification/validation have been performed and data qualifiers have been added.
Waste Management Tasks – All Projects: 1. Soils sampled but not used for laboratory analysis will be containerized in 55 gallon Department of Transportation approved drums. Soils contained in 55 gallon drums will be characterized for proper disposal off site. Decontamination water (if non disposable sampling equipment is used) will also be collected in drums and analyzed for disposal off site.
Documentation and Records – All Projects: 1. All field documentation will be recorded in indelible ink in bound field books. These will summarize all daily field activities, weather conditions, personnel present, visitors, etc. All samples collected will be documented as to their location, which will be measured using a DGPS. Each day's samples and associated field measurements shall be recorded on field sampling forms. Chain of Custody (CoC) forms, bills of lading, airbills, and sample logs will be prepared and retained for each sample. 2. A copy of the final UFP-QAPP will be retained in a central project file (electronically on a server) and in print form in the onsite office, as well as in the Administrative Record.
Data Packages – All Projects: SGS Accutest Laboratories, Inc. will provide data packages in accordance with those identified in DOD QSM 5.0, Appendix A, Stage 4 or CLP-Like deliverables, which contain the information necessary for independent, third-party data validation.
Assessment / Audit Tasks – All projects: Field Sample Collection and Documentation Audits: to be determined (TBD)

Summary of Project Tasks

Data Review Tasks – All projects

1. For the samples, SGS Accutest Laboratories, Inc. will verify that all data are complete for samples received. All data package deliverable requirements will be met. Data will be 100% verified by FPM in accordance with this UFP-QAPP. A data verification report will be prepared for each lab work order (lab data package).

2. Verified and validated 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 and required Action Limits. Corrective Action will be completed as necessary. Final validated data are placed in the ERPIMS database, with any necessary qualifiers and tables, charts and graphs generated.

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QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soils
Analytical Group: PAHs (SW-846 Method 8270D SIM)
Concentration Level: Low to Medium

Analyte	Chemical Abstracts Service (CAS) No.	USEPA Screening Levels[1] Residential Soil (mg/kg)	NMED Hazardous Waste Bureau Residential Soil SSL (mg/kg)[2]	Achievable Laboratory Limits[3]	
				Level of Detection (LOD) (mg/kg)	Limit of Quantitation (LOQ) (mg/kg)
Acenaphthene	83-32-9	360	3,480	0.033	0.067
Acenaphthylene	208-96-8	NA	NA	0.033	0.067
Anthracene	120-12-7	1800	17,400	0.033	0.067
Benzo(a)anthracene	56-55-3	0.16	1.48	0.007	0.013
Benzo(a)pyrene	50-32-8	0.016	1.53	0.007	0.013
Benzo(b)fluoranthene	205-99-2	0.16	1.53	0.007	0.013
Benzo(g,h,i)perylene	191-24-2	NA	NA	0.007	0.013
Benzo(k)fluoranthene	207-08-9	1.6	15.3	0.007	0.013
Chrysene	218-01-9	16	153	0.007	0.013
Dibenz(a,h)anthracene	53-70-3	0.016	0.153	0.007	0.013
Fluoranthene	206-44-0	240	2,320	0.033	0.067
Fluorene	86-73-7	240	2,320	0.033	0.067
Indeno(1,2,3-cd)pyrene	193-39-5	0.16	1.53	0.007	0.013
1-methylnaphthalene	90-12-0	18	NA	0.007	0.013
2-methylnaphthalene	91-57-6	24	NA	0.007	0.013
Naphthalene	91-20-3	3.8	49.7	0.007	0.013
Phenanthrene	85-01-8	NA	1,740	0.007	0.013
Pyrene	129-00-0	180	1,740	0.007	0.013

Notes:
[1] May 2016 USEPA Regional Residential Screening Levels.
[2] NMED Soil Screening Levels February 2012 (updated July 2015).
[3] Achievable LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
NA - Not Applicable

QAPP Worksheet #17 – Sampling Design and Rationale

The Holloman TS851a Former Skeet Range proposed pre-excavation and confirmation sampling locations are shown in **Figures 5 and 7**, respectively. Site specific details are provided below. All field parameter measurements will be documented in the daily chemical QC reports which will be included as part of the After Action Report.

Soil samples will be collected to further delineate soil contamination above USEPA residential screening levels for PAHs. Toxicity Characteristic Leaching Procedure (TCLP) samples will also be collected and analyzed to determine disposal characterization. Results will be used to determine if additional actions are necessary at the site. Previously collected background soil sample data will be used during data evaluation to determine potentially impacted soil areas. This information will be provided in the After Action Report.

Former Skeet Range TS851a

Utilizing historical data, approximately 1 shallow soil sample will be collected from areas previously identified as containing clay target debris and areas containing PAH contamination based on skeet range lead shot dispersion. Proposed sample locations are shown on **Figures 5** (pre-excavation) **and 7** (confirmation) and historical sample locations and associated data is shown on **Figures 3** (lead sampling locations) **and 4** (PAH sampling locations). Results will be used to delineate impacted areas at the site.

Soil Sampling

Soil samples will be collected at depth intervals ranging from 0 to 36 inches bgs depending on the location and historical sample data from the adjacent area. Samples will be analyzed for PAHs by USEPA Method 8270D SIM. Results from laboratory analysis will be used to determine if the areal extent of contamination has been determined, or if further delineation is necessary.

QAPP Worksheet #18 – Sampling Locations and Methods

Sampling Location	Matrix	Depth (inches)	Analytical Group	Concentration Level	No. of Samples[1]	Sampling SOP Reference	Rationale for Sampling Location
TS851a Former Skeet Range – Pre-excavation	Soil	0 – 36	PAHs	Low-to-Medium	11	SOP No. 1 and No. 2	To determine the vertical and areal extent of residual soil contamination.
TS851a Former Skeet Range – Post-excavation[2]	Soil	0 – 36	PAH	Low-to-Medium	17	SOP No. 1 and No. 2	Confirmatory sampling to ensure residual contamination has been excavated.
TS851a Former Skeet Range	Soil	0 – 36	TCLP	Low-to-Medium	5	SOP No. 1 and No. 2	Disposal Characteristics

Notes:
[1] Proficiency Testing and split samples will be collected as specified by AFCEC.
[2] The number of post excavation confirmatory samples may vary based on the boundary and volume of the excavations.

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QAPP Worksheet #19 & #30 – Sample Containers, Preservation, and Hold Times

Laboratory: SGS Accutest Laboratories, Inc., 4405 Vineland Road, Suite C-15 Orlando, FL 32811, Jean Dent-Smith jeans@accutest.com,
407-425-6700.

List any required accreditations/certifications: DoD Environmental Laboratory Accreditation Program accreditation, compliant with the most recently published version of the DoD QSM Version 5.

Backup-up Laboratory: None

Sample Delivery Method: FedEx

Data Package Turnaround: 20 Days

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Sample Volume[2]	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[3] (preparation / analysis)
Soil	PAH	SW-846 8270D SIM/MS008/OP007	30 grams	(1) 8 ounce jar	Cool, 4 °C	14 days to extraction / 40 days for analysis
Soil	TCLP PAHs	SW-846 1311/OP040/MS008	30 grams	(1) 8 ounce jar	Cool, 4 °C	180 days to TCLP extraction / 180 days for analysis

Notes:
[1] Refer to the Analytical SOP References table (Worksheet #23).
[2] The minimum sample size is based on analysis allowing for sufficient sample for reanalysis. Additional volume is needed for the laboratory MS/MSD sample analysis.
[3] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

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QAPP Worksheet #20 – Field QC Summary

Matrix	Analytical Group	No. of Field Samples[2]	No. of Field Duplicate Samples[3]	No. of Matrix Spikes[4]	No. of Matrix Spike Duplicates[4]	No. of Blanks (Trip)[5]	No. of Equipment Blanks[6]	No. of Proficiency Testing Samples	Total No. of Samples
Soil	PAH	11	1	1	1	0	0	As specified by AFCEC	14
	PAH	17	2	1	1				21
	TCLP	20	0	0	0				20
							0		55
								Total[7]	55

Notes:
[1] Specify the appropriate reference letter or No. from the Analytical SOP References table (Worksheet #23).
[2] The No. of samples collected may vary depending on field conditions.
[3] Total No. of field duplicate samples will meet project goal of 10%.
[4] Total MS/MSD Samples will meet project goal of 5%.
[5] Trip blank samples are not required for coolers containing PAH samples.
[6] Equipment blanks will be collected from non-disposable decontaminated sampling devices at a rate of 1 per day of field sampling only if non-disposable equipment is used.

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QAPP Worksheet #21 – Field SOPs

SOPs are located in **Appendix A**.

Reference No.[1]	Title, Revision Date and / or No.	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP No. 1	Surface and Near Surface Soil Sampling	FPM	Grab/hand auger	N	Includes descriptions and procedures for surface soil sampling.
SOP No. 2	Sub-Surface Soil Sampling	FPM	Hand Auger or Direct Push Rig	N	Includes descriptions and procedures for sub-surface soil sampling.
SOP No. 3	Sediment Sampling	FPM	Grab/hand auger	N	Includes descriptions and procedures for sediment sampling.
SOP No. 4	Surface Water Sampling	FPM	Grab	N	Includes descriptions and procedures for surface water sampling.
SOP No. 5	Sample Handling, Documentation, and Tracking	FPM	N/A	N	Includes sample packaging, shipping, and CoC requirements.
SOP No.6	Decontamination	FPM	N/A	N	Includes descriptions and procedures for decontamination of personnel and equipment.
SOP No. 7	Global Positioning System (GPS) Measurements	FPM	GPS units	N	Includes description and procedures for marking data points using GPS units.
SOP No. 8	Equipment Calibration	FPM	Various field parameter measuring equipment	N	Includes descriptions and procedures or calibrating field parameter measuring equipment.

Notes:
[1] FPM SOPs are not project specific, as such the SOP document may include SOPs that are not relevant to the immediate project and/or tasks.

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QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Calibration Activity	SOP Reference[1]	Responsible Person	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action
Trimble XRT2 and Nomad DGPS	No daily calibration activity. Initial receiver settings are programmed by manufacturer	SOP No. 7	Field personnel	Verify real-time location with base map on receiver and determine accuracy	Observe displayed location and actual location.	Daily	Within 0.5ft if static.	Manufacturer service

Notes:
[1] The Project Sampling SOP References table is found on Worksheet #21.

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QAPP Worksheet #23 – Analytical SOPs

Laboratory SOPs are located in **Appendix B**.

SOP Reference No.	Title, Revision Date, and / or No.	Definitive or Screening Data	Matrix/Analytical Group	SOP Option or Equipment Type	Modified for Project Work? (Y/N)
OP007	Extraction of Semi-volatile Organics (BNAs) from Solid Samples, Aug 2013	Definitive	Soil/Prep Method	Sonic Disruptor	No
OP040	Toxicity Characteristic Leaching Of Semivolatile Organics And Metals (TCLP), Aug 2014	Definitive	Soil Leachate/TCLP Procedure Metals SW-846 1311	TCLP Tumbler	No
MS008	Analysis of Semivolatile Organics by method 8270D SIM, November 2015	Definitive	Semivolatiles SW-846 8270D SIM	HP6890/5973, HP6890/5975	No

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QAPP Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person	SOP[1]
HP6890/5973HP6890/5975	Semivolatiles, SW-846 8270D SIM, 5 points minimum	Major maintenance (per method) or second consecutive failure of opening CCV warrants recalibration	Each analyte must meet one of the three options: Option 1: CAL %RSD for each analyte ≤ 15%; Option 2: linear least squares regression for each analyte: r2 ≥ 0.99; Option 3: non-linear least squares regression (quadratic) for each analyte: r2 ≥ 0.99.	Instrument maintenance, standard inspection, retuning and recalibration Reanalyze samples affected by failing CCVs	Laboratory Analyst	MS008

Notes:
[1] The Analytical SOP References table is found on Worksheet #23.

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QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	Reference SOP[1]
HP5890/5973 HP6890/5975	Injector port, column maintenance, source cleaning	SW-846 8270D SIM	Leak test, column and injector port inspection, source insulator integrity	Need for maintenance determined by passing calibration and Decafluorotri-phenylphosphine (DFTPP) – see MS008	Passing DFTPP and CCV, passing Internal Standard response	Column clipping and/or reconditioning, seal and liners replacement, filaments and insulators as needed	Laboratory Analyst	MS008

Notes:
[1] The Analytical SOP References table is found on Worksheet #23. Laboratory Standard Operating Procedures are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis.

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QAPP Worksheet #26 & #27 – Sample Handling, Custody, and Disposal

Sampling Organization: FPM Remediations, Inc.

Laboratory: SGS Accutest Laboratories, Inc.

Method of sample delivery: FedEx

Number of days from reporting until sample disposal: 30

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample Labeling	FPM Remediations Inc., Field Personnel	SOP #5
CoC Form Completion	FPM Remediations Inc., Field Team Leader	SOP #5
Packaging	FPM Remediations Inc., Field Personnel	SOP #5
Shipping Coordination	FPM Remediations Inc., Field Personnel	SOP #5
Sample Receipt, Inspection, & Log-in	SGS Accutest Laboratories Inc., Randy Shields	SGS Accutest Laboratories Inc., SOPs MS008 and OP040
Sample Preparation and Determinative Analysis	SGS Accutest Laboratories Inc., Mark Erstling (Organics)	SGS Accutest Laboratories Inc., SOPs MS008 and OP040
Sample Custody and Storage	SGS Accutest Laboratories Inc., Randy Shields	SGS Accutest Laboratories Inc., SOPs MS008 and OP040
Sample Disposal	SGS Accutest Laboratories Inc., Randy Shields	SGS Accutest Laboratories Inc., SOPs MS008 and OP040

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QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix	Leachate
Analytical Group	PAHs
Analytical Method / SOP Reference	EPA SW-846 8270D SIM/MS008

QC Sample	Frequency / No.	Method / SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	1 per extraction batch	<1/2 RL	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: 1.-Samples ND – report with qualification 2.-Samples >10X contamination level – report with qualification 3.-Samples <10x contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote	Analyst/Prep analyst	Absence of interference/ contamination	No target compounds > ½ LOQ

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Laboratory Control Sample (LCS)	1 per extraction batch	%Recovery = (Calculated Value/True Value) *100%; acceptance limits listed in Table 12-1	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1. Biased high, samples ND – report with qualifications. 2. Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%Recovery = (Calculated Value/True Value) *100%; acceptance limits listed in Table 12-1
Matrix Spike (MS)	1 per 20 samples or one for each extraction batch	%Recovery = (Calculated Value - Sample Value/True Value) *100%; acceptance limits listed in Table 12-1	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix. The project Chemist will be contacted and a decision will be made to either report the data as is with a notation in the analytical narrative or if the samples should be re-extract and re-analyzed.	Analyst/Prep analyst	Precision and Accuracy in field samples	%Recovery = (Calculated Value - Sample Value/True Value) *100%; acceptance limits listed in Table 12-1

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix Spike Duplicates (MSD)	1 per 20 samples or one for each extraction batch	%Recovery = (Calculated Value – Sample Value/True Value) *100%; acceptance limits listed in Table 12-1 RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2 acceptance limits listed in Table 12-1	See above	Analyst/Prep analyst	Precision and Accuracy in field samples	%Recovery = (Calculated Value – Sample Value/True Value) *100%; acceptance limits listed in Table 12-1 RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2 acceptance limits listed in Table 12-1
Surrogate Spikes	Every sample	%Recovery = (Calculated Value/True Value) *100%; acceptance limits listed in Table 12-1	Reason for poor recoveries is investigated and eliminated before further analytical activities. Corrective actions are: 1.-High bias, samples ND – report with qualification. 2.-Low bias – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Individual sample preparation efficiency control	%Recovery = (Calculated Value/True Value) *100% acceptance limits listed in Table 12-1

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Internal standards (IS)	Every sample	IS Area = -50% to +100% of CCV	If failure is due to instrument performance issues, the problem must be identified, corrected, and the sample must be re-analyzed. If no instrument problem is found the sample must be re-analyzed. If upon re-analysis the responses are still not within limits, the problem may be considered sample matrix interference	Analyst	Instrument sensitivity control	Detector Stability

QAPP Worksheet #29 – Project Documents and Records

Project Documents and Records:

Record	Generation	Verification	Storage location/archival
Field logbook and data collection sheets	FPM Field Team Leader	FPM Site Manager, Peter Corigliano	Project file and Electronic Storage, FPM office
Daily field reports			Electronic storage in project files, FPM office
Chain of Custody form	FPM Field Staff	FPM Site Manager, Peter Corigliano and SGS Accutest Laboratories Inc., Randy Shields	Project file and Electronic storage, FPM office and SGS Accutest Laboratories, Inc. permanent project records folder
Custody seals			Not stored; condition upon cooler receipt recorded on Sample Receiving Checklist
Sample labels			Not stored
Air bills	FPM Field Staff and Shipper (FedEx)	FPM Field Team Leader	Project file, FPM office
Deviations	FPM Field Team Leader and FPM Site Manager, Peter Corigliano	FPM Project Manager	Project file and Electronic Storage, FPM office
Corrective Action Reports	FPM Project Manager, Peter Corigliano	COR	Project file, FPM office
Correspondence among project team	Various	N/A	Electronic storage in project files, FPM office

Project Assessments:

Record	Generation	Verification	Storage location/archival
Field audit checklists	FPM Site Manager, Peter Corigliano	FPM Project ManagerJeff Hackworth	Project files and electronic storage, FPM office
Data Packages	SGS Accutest Laboratories, Inc. analytical personnel, Mark Erstling (Organics), Dave Metzgar (Metals)	SGS Accutest Laboratories, Inc. Project Manager, Jean Dent-Smith	
Data verification checklists	FPM Chemical QC Manager, Connie van Hoesel	FPM Project/Site Manager, Peter Corigliano	
Data validation report			
Data usability assessment report			

Laboratory Records

Record	Generation	Verification	Storage location/archival
Shipping Receipt or Freight Bill	SGS Accutest Laboratories, Inc. Sample Receiving personnel, Randy Shields	SGS Accutest Laboratories, Inc. Project Manager, Jean Dent-Smith	Initially stored in SGS Accutest Laboratories, Inc. permanent project records folder; after job completion & invoicing, stored in ERPIMS
Sample Receiving Checklist			
Condition Upon Receipt Anomaly Form			
Priority form			
Chain of Custody form	FPM Field staff	SGS Accutest Laboratories, Inc. Sample Receiving personnel, Randy Shields	Stored in SGS Accutest Laboratories, Inc. permanent project records folder and in the Project file and Electronic Storage at FPM's office
Internal Chain of Custody Report	SGS Accutest Laboratories, Inc. Sample Receiving personnel, Randy Shields	SGS Accutest Laboratories, Inc. Project Manager, Jean Dent-Smith	SGS Accutest Laboratories, Inc. electronic storage and ERPIMS

Record	Generation	Verification	Storage location/archival
Raw data files	SGS Accutest Laboratories, Inc. analytical personnel, Mark Erstling (Organics), Dave Metzgar (Metals)		
Final analytical report			
Other vital records (*e.g.*, instrument maintenance records, QA records)	SGS Accutest Laboratories, Inc.	SGS Accutest Laboratories, Inc.	SGS Accutest Laboratories, Inc. Warehouse

Laboratory Data Deliverables

Record	SVOCs
Cover sheet, Table of Contents, and Case Narrative	x
CoC	x
Analytical Results and Sample Management Records	x
QA/QC Results, Instrument QA/QC Information, Instrument Preparation logs	x
Instrument Quantitation Reports	x
Instrument Chromatograms and Spectra	x

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QAPP Worksheets #31, #32, & #33 – Assessments and Corrective Action

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Review field documentation (log book, field forms, COC forms, etc.)	FPM Project Manager, Peter Corigliano	As work progresses	Will be included in the After Action Report	Marked-up copy of document provided to Field team leader; notify FPM Project Manager	See Worksheet #16
Field sampling audit	FPM Project Manager, Peter Corigliano	Once	TBD	Email or verbal report to describe the deviation from QAPP	Within 2 days of finding deficiency
Internal laboratory assessment	SGS Accutest Laboratories, Inc. Project Manager, Jean Dent-Smith	Once	TBD	Documented in the laboratory report	2 weeks
External AFCEC laboratory audit	AFCEC	Once	TBD	AFCEC report on laboratory assessment	Within 7 days of assessment

QAPP Worksheets #31, #32, & #33 – Assessments and Corrective Action

Assessment Response and Corrective Action:

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 Documents (Logbooks, Sampling Logs, and CoC forms)	Marked up copy of document	Peter Corigliano, FPM	Within 24 hours of finding deficiency	Review of corrected documentation	Field Team Leader, FPM, and Peter Corigliano, FPM	24 hours after notification
Field Sampling Audit	E-mail or verbal report to detail the deviation from QAPP	Peter Corigliano, FPM	Within 2 days of the start of sampling	E-mail and/or phone log	Field Team Leader, FPM, and Peter Corigliano, FPM	2 days
Internal Laboratory Assessment	Lab Report to detail project deviations	SGS Accutest Laboratories, Inc. PM	Within 5 days of sample analysis	Documented in the lab report	SGS Accutest Laboratories, Inc. QA Manager	2 weeks
External AFCEC Laboratory Assessment	AFCEC findings of Laboratory project deviations	Project Chemist, FPM and SGS Accutest Laboratories, Inc. Laboratory Manager	Within 7 days of analysis	AFCEC Report on Laboratory Assessment	Peter Corigliano, FPM, AFCEC, and SGS Accutest Laboratories, Inc. Laboratory	4 weeks

QAPP Worksheet #34 – Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (Conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	X	
2	Contract	X	
3	Field SOPs	X	
4	Laboratory SOPs	X	
Field Records			
5	Field log books	X	X
6	Chain-of-custody forms	X	
7	Groundwater purge logs	X	X
8	Equipment calibration records	X	X
9	Relevant correspondence	X	X
10	Field audit reports	X	X
11	Field corrective action reports	X	X
Analytical Data Package			
12	Cover sheet (laboratory identifying information)	X	X
13	Case narrative	X	X
14	Internal laboratory chain-of-custody	X	X
15	Sample receipt records	X	X
16	Sample chronology	X	X
17	Communication records	X	X
18	LOD/LOQ establishment and verification	X	X
19	Standards traceability	X	X
20	Instrument calibration records	X	X
21	Definition of laboratory qualifiers	X	X
22	Results reporting forms	X	X
23	QC sample results	X	X
24	Corrective action reports	X	X
25	Raw data	X	X
26	Electronic data deliverable	X	X

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QAPP Worksheet #35 – Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field log book	QAPP	Verify that records are present and complete for each day of field activities. Verify that all planned samples including QC samples were collected and that sample collection locations are documented. Verify that changes or exceptions were documented and reported.	Daily – Site Manager
CoC forms	QAPP	Verify the completeness of chain-of-custody forms. Examine entries for consistency with the field logbook. Verify that the required volume of sample has been collected. Verify that sample IDs and analytes are correct and legible. Verify that all required signatures and dates are present.	Daily – Field team leader At conclusion of sampling event – Site Manager and Project Manager
Laboratory deliverable	QAPP	Verify that the laboratory deliverable contains all records specified in the QAPP. Compare the data package with the chain-of-custody forms to verify that results were provided for the correct analytes for all the collected samples. Check the sample receipt records to ensure sample condition upon receipt was noted. Review the narrative to ensure that all QC exceptions are described	Before sending to FPM – Laboratory QA Manager Upon receipt –Chemical Project QA Manager
Audit Reports, Corrective Action Reports	QAPP	Verify that all planned audits were conducted. Examine any audit reports. For any deficiencies noted, verify that corrective action was implemented according to plan.	Project QA Manager

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QAPP Worksheet #36 – Data Validation Procedures

Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator
Soil	PAHs and TCLP	Low-to-High	DoD QSM 5	Connie van Hoesel, FPM Chemical QC Manager
Soil	PAHs and TCLP	Low-to-High	QAPP Worksheets #12, #15 and #24. QAPP Tables 12-1 through 12-3	Connie van Hoesel, FPM Chemical QC Manager

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QAPP Worksheet #37 – Data Usability Assessment

A complete (100%) data review will be performed on the samples collected during the sampling event. The review will consist of verification and validation based on completeness and compliance checks of sample receipt conditions and both sample-related and instrument-related QC results, as addressed in Worksheet #12. Any flags that limit the usability of the data shall be applied to all associated samples; flags are listed in Table 12-2.

The Data Usability Assessment will be performed by FPM personnel (Connie van Hoesel, FPM Chemical QC Coordinator). Note that the Data Usability Assessment will be conducted on verified/validated data. After the Data Usability Assessment is completed, data deemed appropriate for decision-making purposes will be used to assess contaminant extents at this site at HAFB. The results of the Data Usability Assessment will be presented in the After Action 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 each sample pair when results are reported above the LOD. For each field duplicate pair, the results will be assessed as stated in Table 12-3. MS/MSD RPDs are calculated by the laboratory and those with RPDs outside the criteria established in Table 12-1 will be listed in tabular form in the data verification 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 verification report. Laboratory data will be qualified based on the criteria listed in Table 12-3. 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 data verification reports. The results will be checked versus the criteria listed in Table 12-1. 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.

Performance Evaluation: PE samples will be evaluated and if discrepancies are discovered they will be investigated and the effect on field sample results will be determined and discussed with FPM, SGS Accutest Laboratories, Inc., and AFCEC. A discussion of PE sample results will be included with QC sample discussion and aid in data defensibility. If results from PE samples are outside the expected values, an investigation will be completed to determine the source of the discrepancy. A corrective action report will be prepared to document the results of the investigation and to address whether re-sampling or reanalysis is required. If the cause is determined to also affect all samples that were collected, then an evaluation of the reliability of the field sample results will be made and reported in the data usability assessment and After Action Report.

Representativeness: Representativeness is a qualitative measure of the degree to which data accurately and precisely represent a characteristic of a population, and is mainly addressed in the

sample design. A measure of representativeness can also be obtained by assessing holding times and blank data. Any conclusions about the representativeness of the samples will be drawn and any limitations on the use of the data will be described.

Comparability: In accordance with this UFP-QAPP, the data are comparable when collection techniques, measurement method and reporting procedures are the same for each data set.

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 No. of data points for each analyte that is deemed usable (not rejected) divided by the total No. 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. Data completeness addresses only those samples that are collected and only data that is analyzed by the laboratory.

Graphics: Figures and maps will be prepared showing the site specific sampling locations and results.

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 verification/validation, DQIs 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.

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FIGURES

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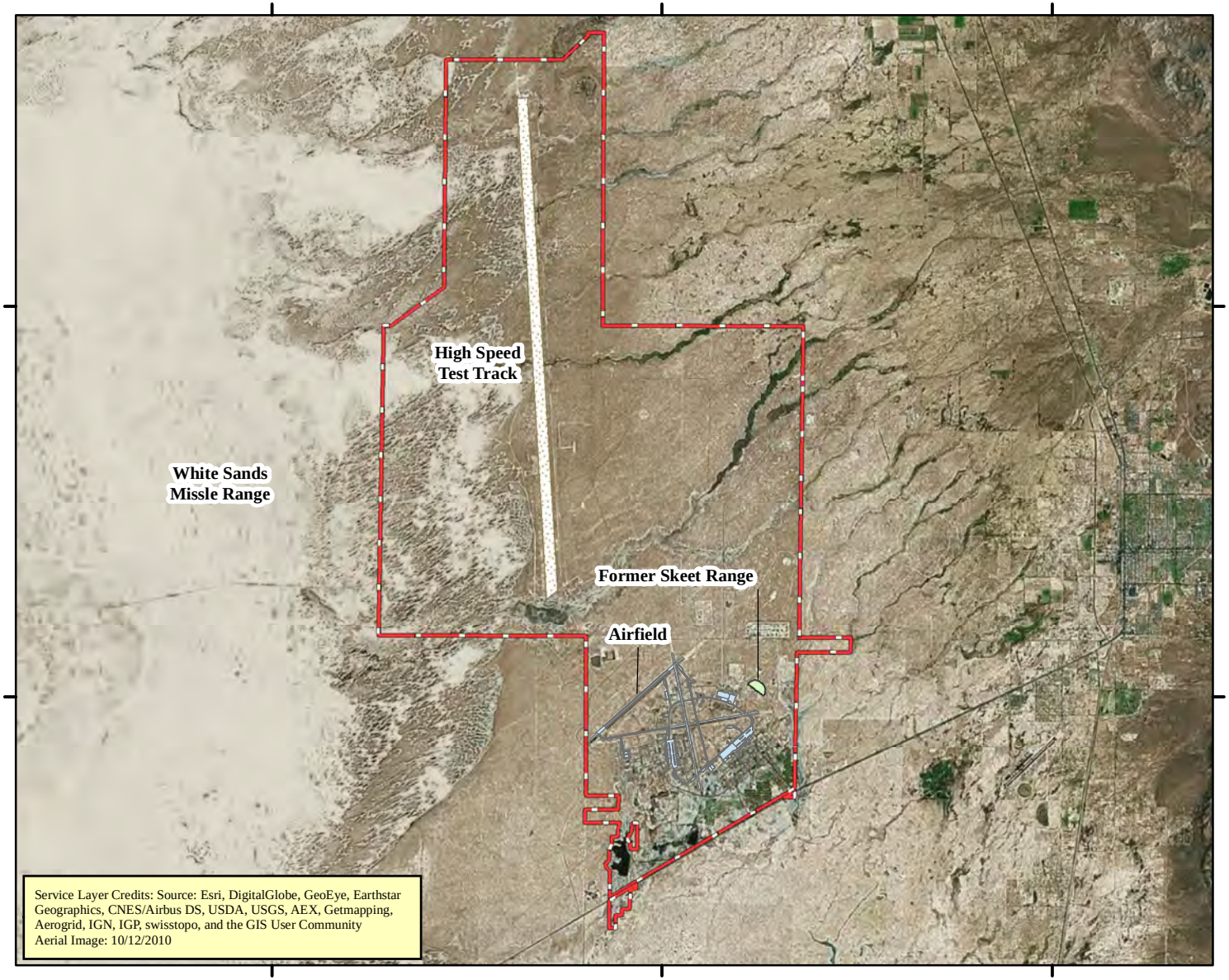

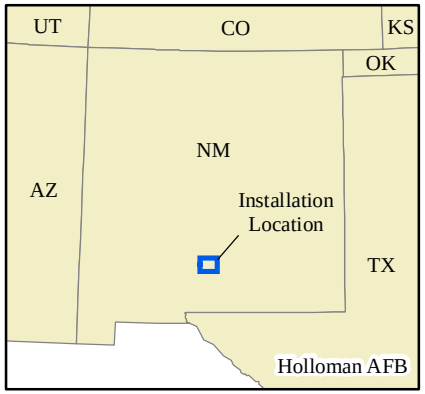

Legend

- MRA 851
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 1

Holloman AFB

FPM Remediations, Inc.

2016

NOTES:
Revision Date: 4/15/2016

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
False Easting: 500,000.0000
Central Meridian: -105.0000
Latitude Of Origin: 0.0000
Horizontal Datum: North American 1983
False Northing: 0.0000
Scale Factor: 0.9996
Units: Meter

1 inch = 16,000 feet

0 2.5 5 Kilometers

0 1.5 3 Miles

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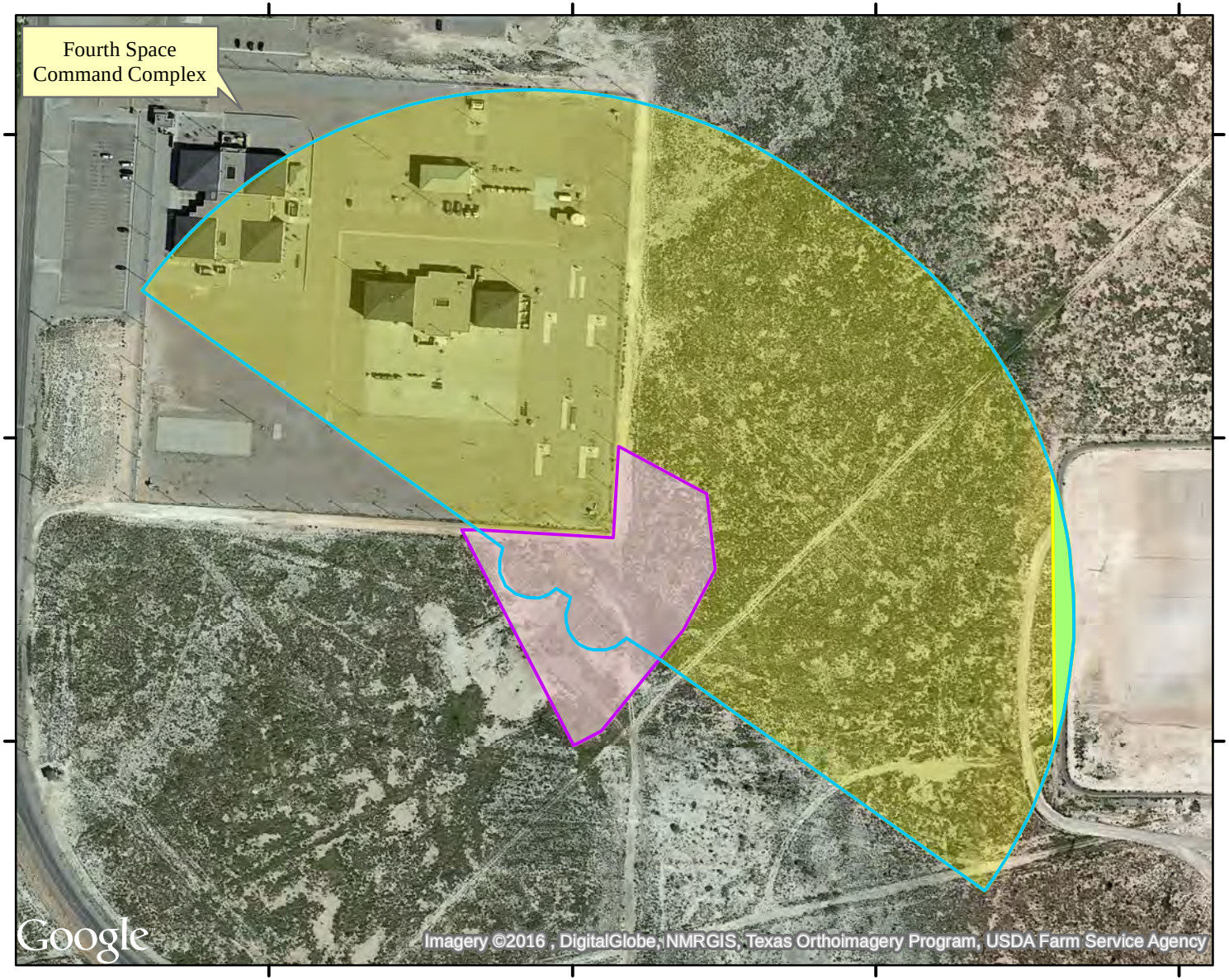

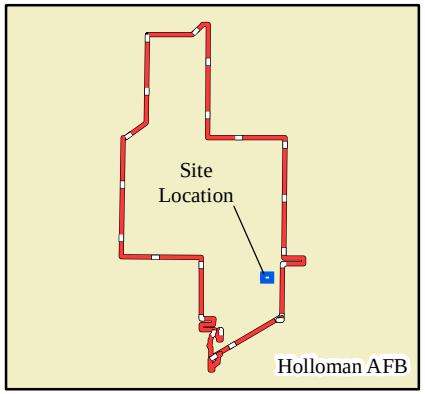

Legend

- Former Skeet Range (TS851)
- Former Skeet Range (TS851a) - NTCRA
- Former Skeet Range (TS851b)
- Former Skeet Range (MRA 851)
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 2

Former Skeet Range MRSs

FPM Remediations, Inc.

2016

NOTES:
1. Boundary based on CSE Phase II findings.
2. Revision Date: 4/15/2016

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

1 inch = 300 feet

0 45 90 Meters

0 150 300 Feet

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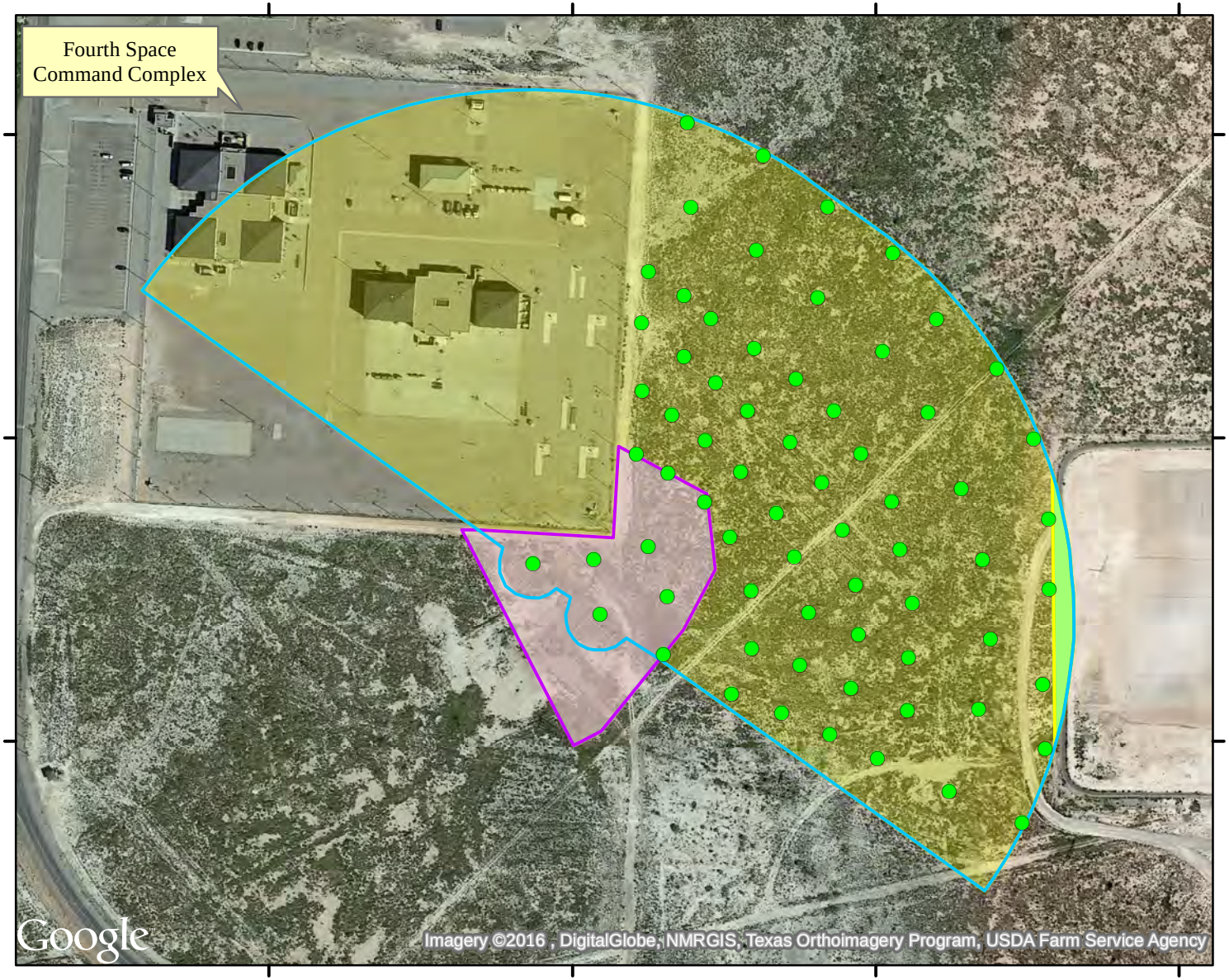

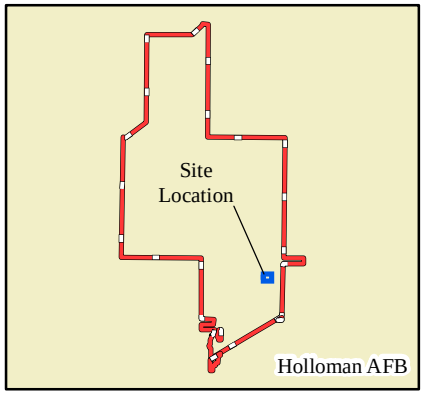

Legend

- Pb < 400 mg/kg
- Former Skeet Range (TS851)
- Former Skeet Range (TS851a) - NTCRA
- Former Skeet Range (TS851b)
- Former Skeet Range (MRA 851)
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 3

Former Skeet Range
Lead Sample Locations

FPM Remediations, Inc.

2016

NOTES:
1. Boundary based on CSE Phase II findings.
2. Revision Date: 4/15/2016

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
False Easting: 500,000.0000
Central Meridian: -105.0000
Latitude Of Origin: 0.0000
Horizontal Datum: North American 1983
False Northing: 0.0000
Scale Factor: 0.9996
Units: Meter

1 inch = 300 feet

0 45 90 Meters

0 150 300 Feet

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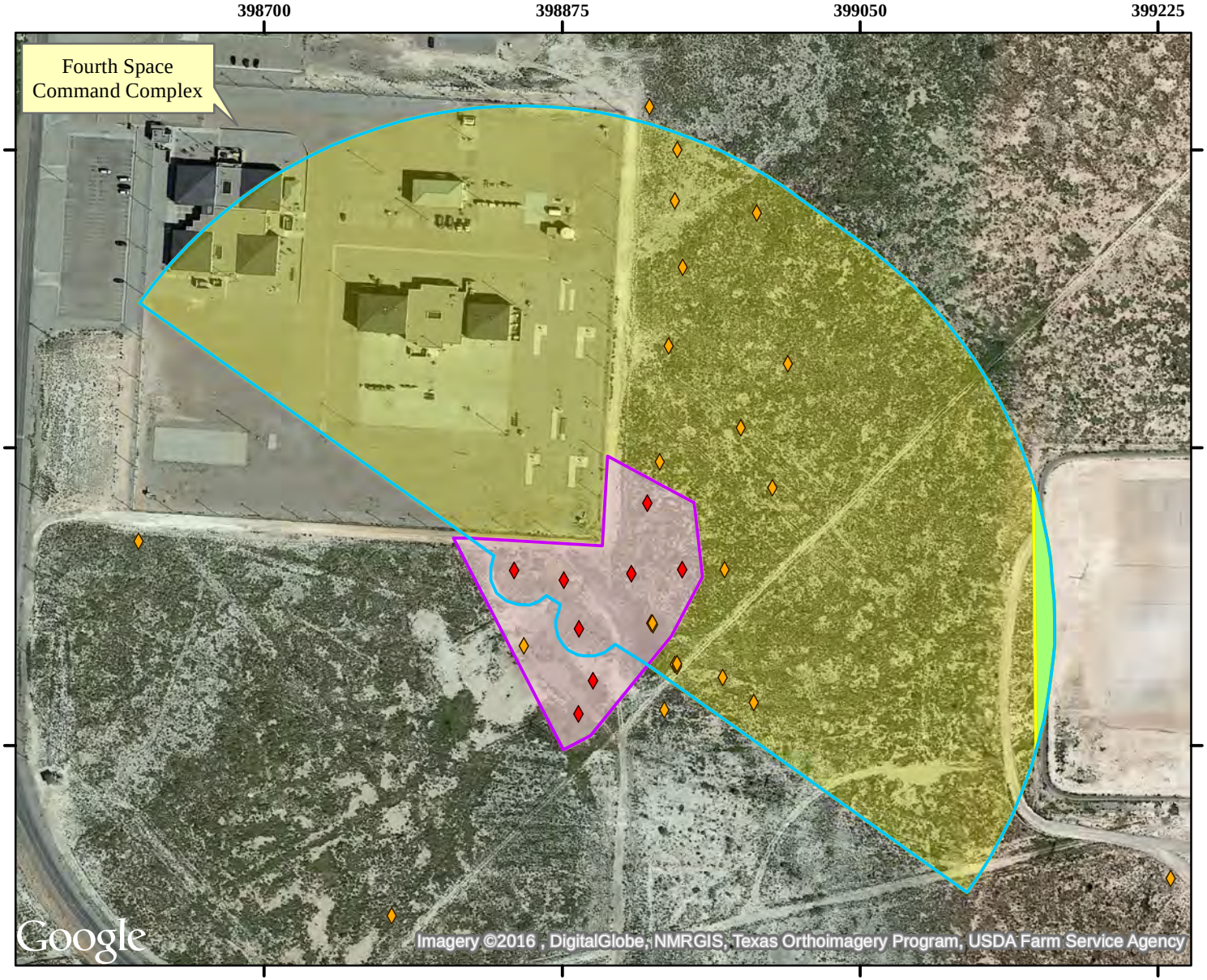

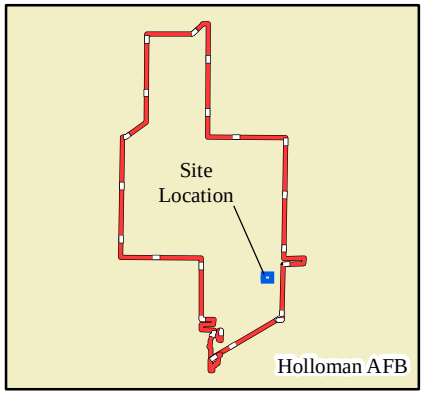

Legend

- PAH Sample Location Below HHSL
- PAH Sample Location Above HHSL
- Former Skeet Range (TS851)
- Former Skeet Range (TS851a) - NTCRA
- Former Skeet Range (TS851b)
- Former Skeet Range (MRA 851)
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 4

Former Skeet Range
PAH Sample Locations

FPM Remediations, Inc.

2016

NOTES:
1. Boundary based on CSE Phase II findings.
2. Revision Date: 4/15/2016

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
False Easting: 500,000.0000
Central Meridian: -105.0000
Latitude Of Origin: 0.0000
Horizontal Datum: North American 1983
False Northing: 0.0000
Scale Factor: 0.9996
Units: Meter

1 inch = 300 feet

0 45 90 Meters

0 150 300 Feet

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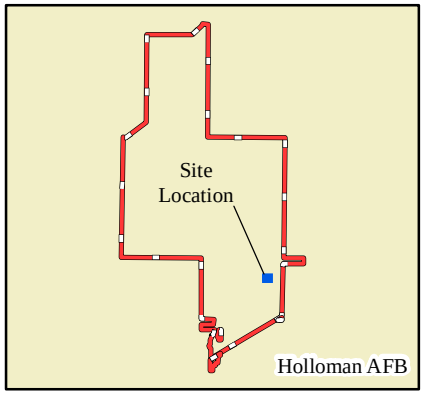

Legend

- Proposed Pre-Excavation Sampling Location
- Former Skeet Range (TS851a)
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 5

Proposed
Removal Area at TS851a MRS

FPM Remediations, Inc.

2016

NOTES:
1. Boundary based on CSE Phase II findings.
2. Revision Date: 4/15/2016

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

1 inch = 200 feet

0 30 60 Meters

0 100 200 Feet

N W E S

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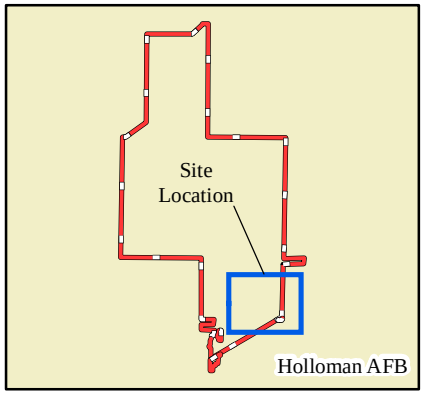

Legend

- Truck Route
- Former Skeet Range (TS851a)
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 6

Proposed Excavation
Truck Haul Route

FPM Remediations, Inc.

2016

NOTES:
1. Boundary based on CSE Phase II findings.
2. Revision Date: 4/15/2016

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

1 inch = 2,500 feet

0 381 762 Meters

0 1,250 2,500 Feet

N W E S

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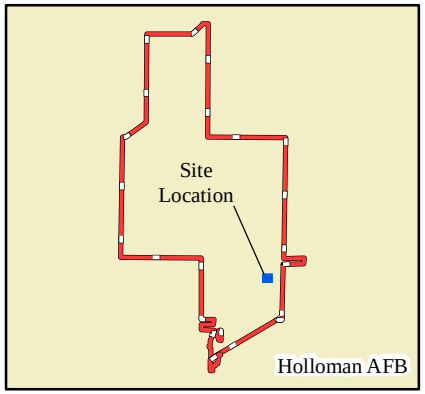

Legend

- Excavation Floor Sample Location (Proposed)
- Excavation Sidewall Sample Location (Proposed)
- Former Skeet Range (TS851a)
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 7

Proposed Confirmation
Sample Location at TS851a MRS

FPM Remediations, Inc.

2016

NOTES:
1. Boundary based on CSE Phase II findings.
2. Revision Date: 4/15/2016

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

1 inch = 200 feet

0 30 60 Meters

0 100 200 Feet

N W E S

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APPENDIX A
FPM Standard Operating Procedures

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1.0 SOP NO. 1 – SURFACE AND NEAR SURFACE SOIL SAMPLING

1.1 PURPOSE AND SCOPE

The purpose of this document is to define the Standard Operating Procedure (SOP) for collecting soil/sediment/groundwater/surface water samples at Holloman AFB using hand tools. This SOP describes the equipment, field procedures, and Quality Assurance/Quality Control (QA/QC) procedures implemented for sample collection.

This SOP is intended to be used together with the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) and other appropriate SOPs. Health and safety procedures and equipment for the investigation are detailed in the project Health and Safety Plan (HSP).

Applicable SOPs are listed below:

- SOP No. 5 – Sample Handling, Documentation, and Tracking
- SOP No. 6 – Decontamination
- SOP No. 7 – Global Positioning System (GPS) Measurements

1.2 EQUIPMENT AND MATERIALS LIST

The following equipment and materials should be on site for soil sampling:

- Stainless steel hand auger or hand trowel
- Surveyor's stakes and flags
- Pick
- Field logbook
- Sample Collection Field Sheets
- Nitrile gloves
- Hard plastic disposable tools (i.e., polyethylene [PE] scoop)
- Sample containers
- Sample container labels
- Label tape (clear)
- Disposable sealed zip-type PE bag
- Paper towels
- Digital camera
- 100 foot hand tape
- Waterproof and permanent marking pens
- Plastic sheeting
- Trash bags
- Cooler with sufficient ice to maintain a temperature of 4°C
- Appropriate health and safety equipment, as specified in the HSP
- Appropriate decontamination supplies, as specified in SOP No. 6

Other materials and equipment may be needed based on field conditions.

1.3 LOCATING THE SAMPLING POINTS

Sampling locations will be determined in the field. At the time of locating each sampling point, the sampling point identification will be entered in the field logbook and the GPS coordinates recorded. Information concerning nearby landmarks, or other information that will help to re-locate the point in the future will be recorded. The sample locations will be marked using surveyor's stakes and flags (or lath), and the flags (or lath) will be labeled using indelible ink with the sample point identification. A field map will be prepared as the sampling points are laid out to identify locations and tie the locations into site landmarks if available (such as foundations). If the surveyor's stake is offset from the sample location, the offset will be noted on the field map or field logbook.

1.4 SURFACE AND NEAR SURFACE SOIL DISCRETE SAMPLING PROCEDURES

Discrete samples consist of soil collected for chemical analysis from a single location. Sampling sites will be located and marked using surveying stakes or flags. Discrete surface soil and subsurface soil samples will be collected as follows:

- At each location, clear an area approximately 12 inches in diameter of surface vegetation and debris from the vicinity where a sample is to be collected.
- Use a decontaminated stainless steel spoon or disposable spoon to collect the surface soil to a depth interval of 0 to 2 inches. A steel pick may be used as needed to loosen the soil prior to sampling.
- Use a decontaminated hand auger or direct push technology to collect the shallow soil from a depth of 2 inches to 3 feet below ground surface (bgs). When proper sample depth is reached, remove the cuttings from the borehole while keeping the core intact.
- To the extent possible, eliminate gravel size or larger particles or debris based on visual observation.
- Immediately fill the appropriate sample containers. Label and handle the containers as specified in SOP No. 5, Sample Handling, Documentation, and Tracking.
- Decontaminate the sampling equipment in accordance with SOP No. 6, Decontamination.
- Once the sample is collected, the location will be documented and photographed; and GPS coordinates will be recorded.

1.5 INCREMENT SAMPLING PROCEDURES

The goal of Increment Sampling (IS) is to obtain an unbiased and reproducible estimate of the average concentration of analytes through the collection of soil sample increments distributed evenly throughout the decision unit/sampling area. Ideally, the target weight of an IS sample is approximately 1 kilogram (kg) and is comprised of 30 (minimum) to 100 increments within the decision unit. IS samples will be collected as follows:

- Determine the appropriate size of the decision unit to fit the investigation objective. Decision unit size recommendations range from 33-ft x 33-ft to 165-ft x 165-ft and consist of 30 increments to 100 increments, respectively. The location and size of individual decision units are to be based on previous investigations, visual evidence of

Munitions and explosives of concern (MEC) or Munitions Debris (MD), and/or type of MEC present.

- Using survey flags, delineate a decision unit boundary at each corner of the selected area. Note that the size and shape of the decision unit will be largely determined by the terrain features and the data quality objectives set forth in the UFP-QAPP.
- Once the boundary of the decision unit is defined, place nine flags at evenly spaced intervals along two opposite sides of the decision unit to define 10 lanes. Flags can then be used to fill in the remaining sides to create a visual sub-grid pattern. Additional flags can be placed within the interior of the decision unit if visual obstructions impede the visualization of evenly spaced increments throughout.
- With 100 increments established throughout the grid area, IS locations can then be selected. For 50-increment samples, every other flag will act as a sampling location. For 33-increment samples, every third flag will act as a sampling location. This pattern can be adjusted to satisfy the desired quantity of increments, as needed.
- Working in a team of two, one person will collect each increment while the other holds the sample container (clean plastic bag) and keeps track of the number of increments collected. The increments are sampled in a snake-like pattern from one corner of the decision unit to the corner adjacent to the starting corner.
- For the collection of QA/QC samples, the replicate samples should be collected from a sub-grid collection point offset from the original starting position and followed in the same snake-like pattern walked during the collection of the primary sample.
- Recommended sampling depths range from 1 inch to 4 inches at each increment location and are based on the overall depth distribution of anticipated analytes. The diameter of the sampling tool and the volume collected at each increment location will need to be adjusted to satisfy the 1 kg sample mass as it pertains to the selected quantity of increments in each decision unit.
- Once collected, the sample will be containerized as per the analytical laboratories requirements and labeled as specified in SOP No. 5, Sample Handling, Documentation, and Tracking.
- Once the sample collection is completed, the location will be documented and photographed; and GPS coordinates will be recorded at each of the four corners of the decision unit.

1.6 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

1.6.1 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. The initial sample containers for a particular parameter or set of parameters will be filled first, and then the duplicate sample containers for the same parameter(s) will be filled, and so on until

all necessary sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. Duplicate samples will be blind to the laboratory. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

1.6.2 Matrix Spike and Matrix Spike Duplicates

Matrix spikes (MS) and matrix spike duplicates (MSD) are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the chain of custody (COC) form and on the containers. It may be necessary to increase the sample volume for samples where the MS/MSD designation is to be made. If additional volume is necessary, the additional sample container will be filled immediately after the initial sample. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

1.7 SAMPLE HANDLING

Sample containers, preservatives and analysis are specified in Worksheet #19. Samples will also be labeled and handled as described in SOP No. 5, Sample Handling, Documentation, and Tracking.

1.8 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on the activities concluded and also 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, and on field data sheets.

1.8.1 Field Sampling Data Sheet

A field sampling data sheet will be completed at each sampling location. Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Sampling location (and depths)
- Date and time of sampling
- Person(s) performing sampling
- Type of sample (grab or IS/Composite)
- Color (describe), odor (describe)
- Sample description
- Sample identification number
- Analyses required
- Number of sample bottles taken for each analyses
- Preservation of samples, if any
- Record of any QC samples from site
- Any irregularities or problems which may have a bearing on sample quality.

1.8.2 Field Notes

Field notes will also be kept during sampling activities. The following information will be recorded in the bound field logbook using waterproof ink:

- Names of personnel
- Weather conditions
- Date and time of sampling
- Locations, depths, and sample station numbers
- Times that procedures and measurements are completed
- Decontamination times
- Calibration information
- Calculations, if required.

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2.0 SOP NO. 2 - SUB-SURFACE SOIL SAMPLING

2.1 PURPOSE AND SCOPE

This SOP describes the equipment, materials, field procedures, and documentation procedures for collecting sub-surface soil samples using direct push or auger methods for soil characterization and chemical analysis.

Health and safety procedures and equipment to be used during soil sampling are described in a separate site-specific HSP. These SOPs are intended to be used with the Holloman AFB UFP-QAPP and with other SOPs listed below:

- SOP No. 5, Sample Handling, Documentation, and Tracking
- SOP No. 6, Decontamination

2.2 EQUIPMENT AND MATERIALS LIST

One of the following drilling equipment:

- Direct push rig (e.g., Geoprobe® rig or similar) with appropriate drilling and sampling tools (sub-surface soil)
- Hollow Stem Auger Kit and electric drill
- Hand Auger

The following equipment and materials should be on site for sub-surface soil sampling regardless of the drilling equipment used:

- Photoionization Detector (PID) (with 10.2 eV lamp)
- Weighted tape measure and ruler with 0.01-foot increments
- Surveyor's stakes and flags
- Field logbook
- Drilling Log form
- Sample Collection Field Form
- Stainless-steel bowl and spoon
- Sample containers
- Sample container labels
- Label tape (clear)
- Ziploc® bags
- Paper towels
- Digital Camera
- Waterproof and permanent marking pens
- Plastic sheeting
- Trash bags
- Ice chest with ice
- Appropriate health and safety equipment, as specified in the HSP
- Appropriate decontamination supplies, as specified in SOP No. 6

- Granular bentonite and potable water

2.3 LOCATING THE SAMPLING POINTS

The facilities designated for sampling are shown on figures provided in the UFP-QAPP. The approximate soil sampling locations will be identified on site figures before field work commences. The exact soil sampling locations will be determined in the field. Sampling coordinates will be mapped on the front of the Drilling Log in the Location Sketch/Comments Area. The sampling locations will be defined in the investigation specific work plan (WP) similar to previous investigation and long term monitoring locations.

When each soil sampling location is identified in the field, the sampling point identification will be entered in the field logbook and on the Drilling Log. Include any information concerning nearby landmarks, or other information that will help to re-locate the point in the future. Mark the sample locations using surveyor's stakes and flags, and label the flag using indelible ink with the sample point identification. A field map will be prepared as the sampling points are laid out to identify locations and tie the locations to site landmarks (such as foundations) if available. If the surveyor's stake is offset from the sample location, the offset will be noted on the field map and the field logbook.

2.4 SOIL SAMPLING PROCEDURES

At several sampling sites, the sampling locations may be in concrete or asphalt covered areas. Therefore, at these locations, cores will be drilled through the concrete or asphalt at areas most likely to contain contamination (significant cracks or low points). Direct push technology will be utilized after the concrete has been cored. Direct push samples will be collected using a dual tube sampling system or a discrete interval, piston-type sampler (Geoprobe®, MacroCore®, or equivalent). With a dual tube system, the outer rods remain in the ground while the inner rod and sample liner are extracted to retrieve a soil sample from the desired interval. Soil samples may be collected continuously throughout the depth of the direct push boring or from discrete intervals. The direct push rods will be decontaminated between boring locations, but not between samples at the same boring since a new acetate liner is used for each sample.

With a piston-type sampler, a four-foot or five-foot-long stainless steel sampler with an acetate liner is advanced to the top of the desired sampling interval. The sampler is closed to soil during advancement of the sampler to the desired sampling interval. When the top of the desired sampling interval is reached, a piston rod inside the sampler is unlocked through the drill rods, and the sampler is advanced to the bottom of the sampling interval. The sampler and all drill rods are then removed from the ground, and the acetate liner is removed from the piston sampler. Aside from the cutting shoe, the soil sampler never comes in contact with the soil sample. The cutting shoe is decontaminated after each sample is collected, and a new acetate liner is used for every sample interval. The outer sampling barrel is decontaminated after each boring is completed. The sampling will be documented in the field logbook and drill log.

With a hand auger or hollow stem auger kit, the auger head will be advanced manually to the depth. Auger extensions will be used when sampling at depths exceeding 4 feet. Once the desired depth is achieved, the auger is removed for sample collection as described below.

Following collection, the hand auger or hollow stem auger kit will be decontaminated. When using manual samplers, the sampling will be documented in the field logbook and Soil/Sediment sampling form.

At each sampling location, the sampler will be advanced by a combination of hydraulic vertical pressure and percussion hammering. Once the target depth is achieved, the sample will be withdrawn and the liner filled with the soil sample is retrieved.

The following procedures will be followed once the soil sample has been retrieved:

- Don a clean pair of nitrile gloves.
- Cut acetate sleeve to provide access to the soil sample (direct push sampling only).
- Measure the recovery. Record the sampling interval and recovery on the drilling log.
- Remove soil smear from the outside of the acetate sleeve and examine the sample, with particular attention for visible evidence of staining, odors, or other evidence of contamination. Record the soil description on the Drilling Log or Soil/Sediment Sampling Form.
- Conduct PID screening of the soil. The soil with the highest PID levels will be collected for a sample.
- The soil from the sampling interval will be removed from the liner and homogenized in a stainless-steel bowl. Once the soil has been homogenized, fill the appropriate sample containers as specified in the UFP - QAPP (Worksheet #19). Record the sample interval and analysis requested on the Drilling Log or Soil/Sediment Sampling Form and the COC.
- Label, store, transport, and document the samples (depending on the use of the sample) according to SOP No. 5. The parameters for analysis and preservation are specified in UFP QAPP Worksheet #19. All analyltical data obtained from each environmental soil sample boring shall be submitted within 30 days of receipt of laboratory results unless another schedule has been approved.
- If no other samples will be collected from the boring, abandon the boring within five days of completion by backfilling the hole with hydrated granular bentonite. Pour the granular bentonite down the hole in approximate 1-foot to 2-foot lifts, and then pour approximately 0.5 gallon of potable water down the hole to hydrate the bentonite. Continue this from the bottom of the hole to the surface. Borings greater than five feet in depth shall be completely filled from the bottom of the borehole to the ground surface with bentonite, neat cement, or 20% high solids sodium bentonite grout. The boring shall be abandoned by forced injection of grout or pouring through a tremie pipe starting at the bottom of the borehole and proceeding to the surface in one continuous operation.
- A Water Well Record Form 1903 or other form provided and/or approved document shall be completed and submitted within 30 days after abandonment.

2.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

2.5.1 Field Blanks

Field blanks are QC samples collected to evaluate potential external contamination of samples and will consist of trip, ambient, and equipment blanks. The sample collection coordinator or the project QA/QC coordinator will designate these blanks. The blanks will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory with the other samples.

A trip blank serves as a check on sample contamination originating from the container or sample transport. A trip blank consists of a VOA vial which was filled with VOA-free water at the lab, transported to the site, kept in the same cooler as the normal samples throughout the entire sampling day, and shipped back to the laboratory with the normal samples. One trip blank will be sent with each cooler containing water samples for volatile organic analyses.

The ambient blank serves as a check on sample contamination originating from ambient air during volatile organic compounds (VOCs) sample collection. An ambient blank consists of an empty VOA vial which is filled in the field with VOA free water. While pouring the sample, the water is given ample contact with ambient air conditions. The ambient blank is typically collected at the sampling location that potentially exhibits the largest ambient influence (near a busy road, airfield, etc.).

The equipment blank serves as a check on sample contamination originating from sampling equipment reuse during sample collection. The equipment blank consists of a set of sample bottles identical to the normal sample, which is filled with lab-grade water that is flushed over a decontaminated, reusable piece of equipment.

2.5.2 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. All sampling containers will be filled in the following order: volatile or gaseous analyses first, then semi-volatile organic compounds (SVOCs), including polynuclear aromatic hydrocarbons (PAHs); metals; mercury; cyanide; total organic carbon; anions; other remaining analytes (no specific order). The initial sample containers will be filled first, and then the duplicate sample containers for the same parameter(s) and so on until all sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

2.5.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) analyses are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the COC form and on the containers. It may be necessary to increase the sample volume for MS/MSD samples. If additional volume is necessary, the additional sample containers will be filled in the identical fashion as described above in the duplicate sample section. MS/MSD samples will be handled,

preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

2.6 FIELD DOCUMENTATION

Field documentation for sub-surface soil sampling includes field logbooks and field forms. The most important aspect of field documentation is thorough, organized, and accurate record keeping. Two forms are used in the field during sub-surface soil sampling. These forms include the Drill Log and the Soil/Sediment Sampling Form. Each form is described in Section 1.6.2. An important factor of record keeping is the proper preservation and storage of all field documentation. To preserve the field documentation, the field notes and field forms are scanned and the electronic record of the field notes is stored in the project folder and backed up on additional hard drives to prevent data loss.

Additional forms including Health and Safety Meeting forms, Health and Safety Inspection forms, and COCs used during the sampling event are detailed in SOP No. 5.

2.6.1 Field Logbook

All information pertinent to soil sampling and not documented on the field forms will be recorded in a bound field logbook with consecutively numbered pages. The field logbook notes will be recorded in indelible ink. The field logbooks notes are entered to create an accurate record of the work performed so that the sampling activity can be reconstructed without relying on the memory of field personnel. Information documented in the field logbook may include information on date of notes, weather conditions, field personnel, site, mobilization, work performed including location and time, etc. After each day, field notes are reviewed by the field team leader or site responsible person for accuracy. Refer to SOP No. 5 for detailed procedures regarding documentation in the field logbook.

2.6.2 Field Forms

<u>Surface Water Sampling Form</u>

- Field personnel
- Project name and number
- Site Identifier
- Sample Location Identifier
- Sizes and types of sampling equipment
- Date of sample
- Water parameters
- A description of the color and odor.
- Comments or Observations
- Sample Identifier
- Sample Collection Time

Soil/Sediment Sampling Form

The Soil/Sediment Sampling Form contains the following minimum information:

- Field personnel
- Project name and number
- Site Identifier
- Sample Location Identifier
- Sizes and types of sampling equipment
- Date of sample
- Sampling depth.
- A description of the recovered soil sample. The descriptions should include origin, grain size, texture, structure, color, and odor.
- Comments or Observations
- Sample Identifier
- Sample Collection Time

3.0 SOP NO. 3 – SEDIMENT SAMPLING

3.1 PURPOSE AND SCOPE

This SOP describes composite and point sampling procedures to be used in the collection of surface and near surface sediment samples.

This SOP is intended to be used together with the UFP-QAPP and other appropriate SOPs. Health and safety procedures and equipment for the investigation are detailed in the project HSP. Applicable SOPs are listed below:

- SOP No. 5, Sample Handling, Documentation, and Tracking
- SOP No. 6, Decontamination
- SOP No. 7, GPS Measurements

3.2 EQUIPMENT AND MATERIALS LIST

General equipment used for collecting sediment samples includes:

- Laboratory provided sample containers and labels
- Bound field logbook
- Sample data sheets
- Plastic flagging
- Stainless steel hand auger and/or hand trowel
- Surveyor's stakes and flags
- Shovel (if sampling rocky areas)
- Nitrile gloves
- Stainless steel mixing bowl and spoon
- Waterproof, permanent marking pens
- Plastic sheeting
- Trash bags
- Label tape (clear)
- Ziploc® bags
- Paper towels
- Digital camera
- Cooler with sufficient ice to maintain a temperature of 4°C
- Appropriate health and safety equipment, as specified in the HSP
- Appropriate decontamination supplies, as specified in SOP No. 6

3.3 LOCATING THE SAMPLING POINTS

Sampling locations will be determined in the field. At the time of locating each sampling point, the sampling point identification will be entered in the field logbook and the GPS coordinates recorded. Information concerning nearby landmarks, or other information that will help to re-locate the point in the future will be recorded. The sample locations will be marked using surveyor's stakes and flags (or lath), and the flags (or lath) will be labeled using indelible ink with the sample point identification. A field map will be prepared as the sampling points are laid

out to identify locations and tie the locations into site landmarks if available (such as foundations). If the surveyor's stake is offset from the sample location, the offset will be noted on the field map or field logbook.

3.4 SEDIMENT SAMPLING PROCEDURES

Section 3.4.1 describes the procedures for sample collection, compositing of samples, and for collecting grab samples.

3.4.1 Grab and Composite Sediment Sampling

Grab sediment samples will be collected at sampling locations determined by the results of the visual survey and geophysical program. The grab samples will, in most cases, be co-located with surface water sample locations. When this occurs, the grab sediment sample location should also be suitable for surface water sampling, if possible. Once identified, the grab sample point should be marked for sample collection and surveying.

The grab sediment sample will be collected from the interval between the mud line surface and 6 inches below the surface following these procedures:

- Decontaminate all sediment sampling equipment prior to sample collection and between samples in accordance with SOP No. 6, Decontamination.
- Collect representative sediments from the 0 to 6 inch interval below the mud line using a stainless steel coring tool or trowel and transfer into the stainless steel mixing bowl. Grab samples will consist of sediment collected from a single location. For composite sample collection, sediment will be collected from five or more "grab" locations (ie. "spoke and hub" method), and added to the stainless steel mixing bowl. The remaining procedure will be followed identically for both grab and composite sampling.
- If sediments are to be sampled at locations where surface water samples are to be collected, the surface water sample should be collected first to avoid disturbance of the mud line.
- Remove any cobbles, large pebbles, vegetation, or other material from the sediment.
- Scrape the sediment from the sides, corners, and bottom of the stainless steel mixing bowl with a stainless steel spoon or disposable spoon and roll the sediment to the center of the bowl.
- Thoroughly mix the sediment sample until the mixture is as homogeneous as possible. Note: if water is present in the sample mixture that is obtained by use of a stainless steel spoon or disposable spoon, an attempt will be made to preserve the water-to-solid ratio by including the water as part of the sample.
- Use the stainless steel spoon or disposable spoon to place the homogeneous sample/water mixture into each sample container.
- Remix the sample/water mixture remaining in the mixing bowl after each scoop of material is placed in a sample container. This approach is used to evenly distribute the liquid into the sample container, while attempting to maintain the solid-to-liquid ratio present in the sample collected.

- If the mixture is high in liquid content, pour the mixture into a stainless steel beaker to more efficiently transfer the mixture into the sample containers. Continue mixing with a spoon to maintain homogeneity of the sample mixture during filling of sample containers.
- Decontaminate the outside surface of all sample containers.
- Place the samples in sealable freezer bags.
- Place the samples on ice in the cooler.
- Complete field documentation and chain-of-custody form(s).
- Decontaminate sampling equipment in accordance with SOP No. 6, Decontamination.

3.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

3.5.1 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. The initial sample containers for a particular parameter or set of parameters will be filled first, and then the duplicate sample containers for the same parameter(s) will be filled, and so on until all necessary sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. Duplicate samples will be blind to the laboratory. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

3.5.2 Matrix Spike and Matrix Spike Duplicates

MS and MSDs are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the COC form and on the containers. It may be necessary to increase the sample volume for samples where the MS/MSD designation is to be made. If additional volume is necessary, the additional sample container will be filled immediately after the initial sample. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

3.6 SAMPLE HANDLING

Sample containers, preservatives and analysis are specified in Worksheet #19. Samples will also be labeled and handled as described in SOP No. 5, Sample Handling, Documentation, and Tracking.

3.7 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on the activities concluded and also 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, and on field data sheets.

3.7.1 Field Sampling Data Sheet

A field sampling data sheet will be completed at each sampling location. Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Sampling location (and depths)
- Date and time of sampling
- Person(s) performing sampling
- Type of sample (grab or composite)
- Color (describe), odor (describe)
  Sample description
- Sample identification number
- Analyses required
- Number of sample bottles taken for each analyses
- Preservation of samples
- Record of any QC samples from site
- Any irregularities or problems which may have a bearing on sample quality.

3.7.2 Field Notes

Field notes will also be kept during sampling activities. The following information will be recorded in the bound field logbook using waterproof ink:

- Names of personnel
- Weather conditions
- Date and time of sampling
- Locations, depths, and sample station numbers
- Times that procedures and measurements are completed
- Decontamination times
- Calibration information
- Calculations, if required.

4.0 SOP NO. 4 – SURFACE WATER SAMPLING

4.1 PURPOSE AND SCOPE

This SOP describes procedures to be used in the collection of water samples from water bodies, ponds, and seeps. This procedure sets forth the methods for collection of samples at any site based upon physical characteristics and dimensions of the water body.

This SOP addresses the collection of representative ambient water quality samples that meet applicable regulations and appropriate sampling protocols and is intended to be used with the UFP-QAPP, and with other SOPs listed below:

- SOP No. 5, Sample Handling, Documentation, and Tracking
- SOP No. 6, Decontamination

4.2 EQUIPMENT AND MATERIALS LIST

Sample containers will be obtained from the analytical laboratory. Several extra bottles will be obtained in the event of breakage, use for temporary storage of samples to be filtered, or for solving other sampling issues.

Equipment that may be used during surface water sample collection includes:

- Long-handled PE, or glass sample cup
- PE, or glass surface water grab sampler
- Multi-parameter water quality meter (Horiba U-52 or YSI 556 or equivalent). Parameters shall include: pH/temp, electrical conductivity, DO, oxidation reduction potential, and turbidity
- PE or glass jar for field measurement samples
- Surveyor's stakes and flags
- Nitrile gloves
- Measuring tape with weighted end (for lake/pond sampling only)
- Field logbook
- Field Sampling Forms
- Sample containers (with preservatives if required)
- Sample container labels
- Plastic squeeze bottle filled with deionized or distilled water
- Label tape (clear)
- Ziploc® bags
- Paper towels
- Digital camera
- Waterproof, permanent marking pens
- Trash bags
- Cooler with sufficient ice to maintain a temperature of 4°C
- Appropriate health and safety equipment, as specified in the HSP

- Appropriate decontamination supplies, as specified in SOP No. 6

4.3 LOCATING THE SAMPLING POINTS

Sampling locations will be determined in the field. At the time of locating each sampling point, the sampling point identification will be entered in the field logbook and the GPS coordinates recorded. Information concerning nearby landmarks, or other information that will help to re-locate the point in the future will be recorded. The sample locations will be marked using surveyor's stakes and flags (or lath), and the flags (or lath) will be labeled using indelible ink with the sample point identification. A field map will be prepared as the sampling points are laid out to identify locations and tie the locations into site landmarks if available (such as foundations). If the surveyor's stake is offset from the sample location, the offset will be noted on the field map or field logbook.

4.4 PROCEDURES FOR SURFACE WATER AND STREAM SAMPLING

4.4.1 General Sampling Procedures

The following general procedures will be followed to collect surface water samples:

- Decontaminate sampling equipment according to SOP No. 6
- Don a clean pair of nitrile gloves.
- Collect water quality measurements using a multi-parameter water quality system prior to sampling. Measurements will include pH, temperature, specific conductivity, DO, ORP, and turbidity. Measurements will be recorded on the field sampling form immediately.
- Collect surface water sample utilizing methods described in Sections 6.4.2 and 6.4.3.
- Individual sample bottles should be filled in the order given below:

    1. VOC
    2. Alkalinity
    3. SVOC (includes explosives)
    4. Metals
    5. Mercury
    6. Cyanide
    7. Total Organic Carbon
    8. Anions
    9. Other remaining analytes

- VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space remains in the vial. Turn the vial over and tap it to check for bubbles in the vial, which indicate air space. If air bubbles are observed in the sample vial, discard the sample vial and repeat the procedure until no air bubbles appear.
- Alkalinity sample bottles are also collected so that no air space remains in the vial. Turn the vial over and tap it to check for bubbles in the vial, which indicate air space. If air bubbles are observed in the sample vial, add additional water until no air bubbles appear.
- Fill bottles for SVOCs, metals and other analytes until almost full.

- Record time of sample collection on the associated field form.

4.4.2 Pond Sampling Procedures

A primary objective of sampling a pond or other lentic body of water is to collect a water sample that is representative of current water quality conditions. Additionally, when sampling in a pond, the sample should be representative of the sampled depth and location. To collect a sample from depth, a water-sampling bottle that can be triggered from the surface is essential.

The equipment listed in Section 6.2 should be available for use when sampling from a pond. When selecting a sampling bottle, always consider the following: 1) what analytes and levels of detection are included in the analysis program, and 2) what total volume of water is needed for all anticipated analysis. Use a non-metallic sampling bottle to avoid contamination of metals analyses.

Samples will be collected by the "container immersion" method or the "dip and transfer" method. Water samples will be collected by filling the collection container or transfer device held just beneath the surface of the water, unless deeper samples are required. If a transfer device is used, the sample will be poured directly from the beaker or dipper into the sample collection container. If volatile analysis is to be performed, deliver water to the volatiles container very slowly to minimize potential volatile loss. If field meters used to measure field parameters do not have cords long enough to reach the sampling depth, deliver water into a clean beaker and measure the required field parameters. Fill out the appropriate field sampling forms being sure to include the sampling depth.

Label the laboratory sample bottles appropriately, decontaminate all sample bottle exteriors, and immediately transfer to the cooler containing ice. Move to the next sampling location and repeat aforementioned sampling procedures.

4.4.3 Stream and Seep Sampling Procedures

The field sampling team will obtain samples from steams and seeps by placing the sample containers near the center of flow taking care to minimize solid matter being transferred into the containers. The "dip and transfer" method or "container immersion" method will be utilized when sufficient sample volume is present. However, if the flow conditions are slow and volume is limited, a PE or glass bowl or pan can be placed near the center of flow until sufficient volume has accumulated for analysis (for slow seep conditions).

If slow flow conditions are present and adequate sample volume cannot be collected immediately using a sample container but can be obtained within 2 hours, the following procedure may be used:

1. Dig a small depression in the soil within the flow path, if necessary.
2. Place the rim of a PE or glass bowl or pan below the discharge point.
3. Allow the bowl or pan to fill.
4. Transfer the water into an appropriate laboratory container.

5. Repeat steps 2 through 5 until adequate sample volume is obtained (includes field parameter measurements).

Alternatively, the following procedure may be used for low flow seeps and should be used for circumstances in which adequate sample volume cannot be collected within 2 hours:

1. A funnel or similar sample collection device is placed within the flow path.
2. The stem of the funnel is positioned such that flow of water passes directly into a relatively closed sample collections device such as a sample bottle. The funnel stem may also be connected to tubing which in turn transfers the water into a relatively closed sample collection device such as a sample bottle.
3. If the sample collection device is a sample bottle containing a preservative, do not allow the sample bottle to overflow.

Field parameters will be measured on an aliquot of sample and recorded for each sample location.

If flow conditions are so low that a sample cannot be collected, the sampler should record on the field sampling form that seep flow conditions prevented sample collection at that location.

Label the laboratory sample bottles appropriately, decontaminate all sample bottle exteriors, and immediately transfer to the cooler containing ice. Move to the next sampling location and repeat aforementioned sampling procedures.

4.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

4.5.1 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. The initial sample containers for a particular parameter or set of parameters will be filled first, and then the duplicate sample containers for the same parameter(s) will be filled, and so on until all necessary sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. Duplicate samples will be blind to the laboratory. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

4.5.2 Matrix Spike and Matrix Spike Duplicates

MS and MSDs are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the COC form and on the containers. It may be necessary to increase the sample volume for samples where the MS/MSD designation is to be made. If additional volume is necessary, the additional sample container will be filled immediately after the initial sample. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the

primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

4.6 SAMPLE HANDLING

Sample containers, preservatives and analysis are specified Worksheet #19. Samples will also be labeled and handled as described in SOP No. 5, Sample Handling, Documentation, and Tracking.

4.7 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on the activities concluded and also 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, and on field data sheets.

4.7.1 Field Sampling Data Sheet

A field sampling data sheet will be completed at each sampling location. Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Sampling location (and depths)
- Date and time of sampling
- Person(s) performing sampling
- Type of sample (grab or composite)
- Water quality parameters
- Color (describe), odor (describe)
- Sample description
- Sample identification number
- Analyses required
- Number of sample bottles taken for each analyses
- Preservation of samples
- Record of any QC samples from site
- Any irregularities or problems which may have a bearing on sample quality.

4.7.2 Field Notes

Field notes will also be kept during sampling activities. The following information will be recorded in the bound field logbook using waterproof ink:

- Names of personnel
- Weather conditions
- Date and time of sampling
- Locations, depths, and sample station numbers
- Times that procedures and measurements are completed
- Decontamination times
- Calibration information
- Calculations, if required

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5.0 SOP NO. 5 – SAMPLE HANDLING, DOCUMENTATION, AND TRACKING

5.1 PURPOSE AND SCOPE

This SOP describes the procedures for sample handling, documentation, and tracking. This SOP is intended to be used with the UFP-QAPP, and with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Sub-Surface Soil Sampling
- SOP No. 3 – Sediment Sampling
- SOP No. 4 – Surface Water Sampling

5.2 SAMPLE IDENTIFICATION

The sampling locations, sample types, and naming conventions will be established prior to field activities for each sample to be collected. On-site personnel will obtain assistance in defining any special sampling requirements from the FPM Project Manager or designated Task Manager. Each sample will have a discrete, alpha-numeric sample identification (ID). A unique sample ID is needed to track each of the samples collected for analysis during the life of this project. In addition, the sample IDs will be used in the database to identify and retrieve the analytical results received from the laboratory. Each sample ID will be assigned at the time of sampling.

Sample ID

The sample ID will be designated as follows: Site Code, Sample Type and Sampling Location Indicator, Sample Location Number, Sample Depth Identifier, and Sample Type Qualifier.

Site Code

The first segment consists of two to five alphanumeric characters that designate the site code. Examples of site codes include:

- SR for 1940's Skeet Range

For the surface sample designated "SRSS0101AA", The "SR" indicates that the site from which the sample is collected.

Sample Type and Sampling Location Indicator

The second segment consists of one or two alphanumeric characters that indicate the sample type and sampling location indicator. Sample types are as shown below:

SO – Surface Soil (0 to 2 inches)
SS – Subsurface Soil (2 inches or greater)

IS – Increment Soil Sample
SD – Sediment
M – Groundwater from monitoring well sampling locations
T – Groundwater from direct-push groundwater samples that were not completed as permanent monitoring wells (i.e., temporary well point
SW – Surface Water

For the surface soil sample designated "SRSO0101AA", The "SO" indicates that the sample is collected from a surface soil location. For a soil sample designated "SRSS0101AA", "SS" indicates the sample is collected from subsurface soil.

Sample Location Number

The two-digit number following the sample indicator completes the identification of the sampling location at a specific site.

For the sample designated "SRSO0101AA", The "01" indicates that the sample is collected from location 1.

Sample Depth Identifier

The fourth segment consists of two numerical characters that will be used to identify the depth in feet below top of inner casing in wells and feet bgs for soil samples.

For a soil sample designated "SRSO0101AA", "01" indicates the sample is collected 1 foot bgs.

Sample Type Qualifier

The fifth segment is two alphabetic characters used to designate the type of sample. The first letter denotes the round of sampling completed (e.g., "A" for first quarterly sampling round, "B" for second quarterly sampling round, etc.). The sample types will be identified by the second character as listed below:

- A = Primary sample
- B = Primary sample
- C = Field duplicate groundwater sample
- D = Matrix Spike Duplicate (MSD)
- E = Equipment blank
- F Ambient blank
- R = Trip blank
- S Matrix Spike (MS)

The letter A or B appearing at the end of a sample number indicates that the sample is a primary sample. These letters will be selected randomly to mask the predominance of primary samples over QA/QC samples. This system was devised to minimize the likelihood that the laboratory

personnel can distinguish the primary samples from the QA/QC samples using the sample identification.

5.3 SAMPLE LABELS

Sample labels will be filled out as completely as possible by a designated member of the sampling team prior to beginning field sampling activities each day. All sample labels will be filled out using waterproof ink. At a minimum, each label will contain the following information:

- Sampler's company affiliation
- Site location
- Sample ID
- Date and time of sample collection
- Analyses required
- Method of preservation (if any) used
- Sample matrix (i.e., soil, surface water)
- Sampler's signature or initials

5.4 SAMPLE HANDLING PROCEDURES

This section discusses proper sample containers, preservatives, and handling and shipping procedures. The UFP-QAPP summarizes the information contained in this section and also includes the sample holding times for each analyte.

5.4.1 Sample Containers

Certified, commercially clean sample containers will be obtained from the contract analytical lab. The contract laboratory will label the containers to indicate the type of sample to be collected. Required preservatives will be prepared and placed in the containers at the laboratory prior to shipment to the site. Appropriate sample containers for the specific analyses required will be listed in the UFP-QAPP.

5.4.2 Sample Preservation

Sample preservation efforts will commence at the time of sample collection and will continue until analyses are performed. Samples will be stored on ice at 4°C in coolers immediately following collection. The ice will be double bagged in plastic storage bags. Additional sample preservation requirements are listed in the UFP-QAPP. Chemical preservatives, if necessary, will be added to the sample containers by the laboratory prior to shipment to the field, unless otherwise specified in the UFP-QAPP.

5.4.3 Sample Handling and Shipping

The sample containers will be wiped clean of all sample residue and then wrapped in protective packing material (bubble wrap) and taped. Samples will be double-bagged with plastic bags and then placed upright in an iced cooler. Additional packing material will be placed around the samples as necessary to protect them from damage and to keep them upright. A COC form will accompany each cooler. The COC will be placed in a plastic bag and attached to the inside lid of the cooler. The cooler lid will be taped closed with a custody seal.

Coolers will be hand delivered or shipped by overnight express carrier to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses within specific holding times. This may require daily shipment of samples with short holding times. The condition of all samples as received and temperature of all coolers will be reported by the laboratory.

5.4.4 Holding Times and Analyses

The holding time is specified as the maximum allowable time between sample collection and analysis and/or extraction, based on the analyte of interest and stability factors, and preservative (if any) used. Allowable holding times are listed in the UFP-QAPP.

5.5 SAMPLE DOCUMENTATION AND TRACKING

This section describes documentation required in the field notes, on the sample collection field sheets, on the daily quality control reports, and on the sample COC forms.

5.5.1 Field Logbook

All entries in logbooks will be made in waterproof ink and corrections will consist of line-out deletions that are initialed and dated. Field investigation situations vary widely. No general rules can include each type of information that must be entered in a logbook for a particular site. A site-specific logging procedure will be developed to include sufficient information so that the sampling activity can be reconstructed without relying on the memory of field personnel. The logbooks will be kept in the field team member's possession or in a secure place during the investigation. Following the investigation, the logbooks will become a part of the final project file.

The following information (as applicable) shall be recorded in the field log book:

- Sampler’s printed name and signature
- Names of other field personnel (FPM and any FPM subcontractors) and site visitors
- Date (month, day, year)
- General weather conditions

- Time and location of sampling (including approximate distance to adjacent landmarks if possible)
- Level of personal protective equipment (PPE) used
- Brief description of sampling method with references to appropriate SOPs and site-specific WP
- Sample ID (includes location and matrix)
- Any QA/QC sample
- Number and volume of sample containers and requested analysis
- Sample handling and preservation
- Results of any field measurements, equipment used, and equipment calibration information
- Decontamination information
- Brief discussion of any field decisions, unusual conditions, problems encountered and corrective action taken, and/or changes required by field conditions
- Signature and date by person responsible for writing the field notes

5.5.2 Daily Quality Control Report

Each sampling crew will also maintain DQCRs to supplement the information recorded in the field logbook. DQCRs will be maintained by members of the field sampling team and cross-checked for completeness at the end of each day by the sampling team members and/or Field Manager. They will be signed and dated by individuals making entries and initials by the reviewer upon completion. Copies of the DQCR will be forwarded to the Quality Assurance Officer for review. The DQCR will include the following information:

- Project name
- Project number
- Personnel on site
- Visitor on site
- Subcontractors on site
- Equipment on site
- Weather conditions
- Field work performed
- Quality control and health and safety activities
- Problem, down time, and standby time
- Name and title of person completing the DQCR

5.5.3 Sample Chain of Custody

During field sampling activities, traceability of the sample must be maintained from the time that the samples are collected until laboratory data are issued. Initial information concerning collection of the samples will be recorded in the field logbook as described above. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. The COC form used in the field is a one-page form.

The sampler will be responsible for initiating and filling out the COC form. The sampler will sign the COC when the sampler relinquishes the samples to anyone else. One COC form will be completed for each cooler of samples collected daily. The COC will contain the following information:

- Sampler's signature and affiliation
- Project number
- Date and time of collection
- Sample identification number
- Sample type
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times
- Method of shipment
- Shipping air bill number (if appropriate)

The person responsible for delivery of the samples to the laboratory will sign the COC form, and retain a copy of the COC form, document the method of shipment, and send the original and the second copy of the COC form with the samples. Upon receipt at the laboratory, the person receiving the samples will sign the COC form and return the second copy to the FPM Chemical Quality Control Coordinator. Copies of the COC forms documenting custody changes and all custody documentation will be received and kept in the central files. The original COC forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting. After sample disposal, a copy of the original COC will be sent by the laboratory to the FPM Chemical Quality Control Coordinator to be incorporated into the central files.

6.0 SOP NO. 6 – DECONTAMINATION

6.1 PURPOSE AND SCOPE

This SOP describes the equipment, materials, field procedures, and documentation procedures for decontaminating sampling equipment and personnel. The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Subsurface Soil Sampling
- SOP No. 3 – Sediment Sampling
- SOP No. 4 – Surface Water Sampling

The overall objective of an environmental 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 to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

6.2 EQUIPMENT AND MATERIALS LIST

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs
- Buckets
- Scrapers, flat bladed
- Hot water – high-pressure sprayer
- Sponges or paper towels
- Alconox detergent (or equivalent)
- Potable tap water or distilled water
- Laboratory-grade de-ionized water
- Garden-type water sprayers
- Appropriate Health and Safety equipment (i.e., nitrile gloves, safety glasses, etc.)
- Appropriate containers for Investigative Derived Waste (IDW)

6.3 DECONTAMINATION PROCEDURES

Site activities should be conducted with the general goal of preventing the contamination of personnel and equipment. FPM sampling personnel contaminated and, therefore, reduce the need and extent of decontamination. However, some type of decontamination will always be required on site. A sample personnel decontamination will use remote sampling techniques, bag monitoring instruments, avoid contact with obvious contamination, and employ dust suppression methods as necessary to reduce the probability of becoming set-up guideline and a sample decontamination equipment and supplies list are included in the HSP.

6.3.1 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 should be decontaminated by washing with hand soap and water. The decontamination solution must be changed when it no longer foams or when it becomes extremely dirty. Rinse water must be changed when it becomes discolored, begins to foam, or when the decontamination solution cannot be removed.

6.3.2 Personnel Decontamination

A temporary personnel decontamination line will be set up in the Contamination Reduction Zone, which is outside of the Exclusion Zone where intrusive work is being performed. If contamination is not encountered, a dry decontamination station may be established which consists of an area where disposable PPE can be donned and discarded. It is anticipated that all work at Holloman AFB will be completed in Level D.

6.3.3 Sampling Equipment Decontamination

The following steps will be used to decontaminate sampling equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure as required by the HSP.
- 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 or distilled 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 or distilled water. Care will be taken to prevent equipment damage.

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.

6.3.4 Equipment Leaving the Site

Vehicles used for activities in non-contaminated areas shall be cleaned on an as-needed basis, as determined by the UXO Site Safety Officer/QC Supervisor (UXOSO/QCS), using soap and water on the outside and vacuuming the inside. On-site cleaning will be required for very dirty vehicles leaving the area.

6.3.5 Responsible Authority

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

6.3.6 Investigation Derived Waste

Liquid wastewater from decontamination will be left on the temporary decontamination pads and allowed to evaporate. Solid waste, including sample liners and PPE, will be removed from the site and properly disposed of.

6.4 EMERGENCY DECONTAMINATION

Emergency decontamination procedures should be followed if necessary to prevent the loss of life or severe injury. In the case of threat to life, decontamination should be delayed until the victim is stabilized; however, decontamination should always be performed first, when practical, if it can be done without interfering with essential lifesaving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life. During an emergency, provisions must also be made for protecting medical personnel and disposing of contaminated clothing or equipment.

6.5 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 will include the following:

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

7.0 SOP NO. 7 - GLOBAL POSITIONING SYSTEM MEASUREMENTS

7.1 PURPOSE AND SCOPE

This SOP provides technical guidance and methods that will be used to perform GPS measurements at the field site.

GPS surveying at the field site is used to record:

- Locations of MEC or MD
- Excavation footprints
- Sampling locations
- Injection locations
- Other surface and subsurface feature locations and elevations

The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Sub-Surface Sampling
- SOP No. 3 – Sediment Sampling
- SOP No. 4 – Surface Water Sampling

7.2 PERSONNEL QUALIFICATIONS

GPS measurements at the field site will be performed by qualified field personnel. All personnel engaged in recording GPS measurements will be knowledgeable and experienced in methods and equipment use.

7.3 GPS SURVEYING

GPS equipment capable of achieving measurement precision of equal to or less than the specified accuracy without correction will be used. GPS equipment should collect data such that post-processing of spatial data can be performed to increase measurement precision, if needed. The equipment will be operated in accordance with manufacturer's specification, operations manual, and generally accepted surveying practices.

Surveying equipment will be field-verified each day before beginning surveying by establishing the coordinates of a known location (ie, temporary benchmark) using the GPS unit. The benchmark identification (or description) and measured coordinates will be recorded in the survey logbook.

7.3.1 Survey Points

GPS equipment will be used to record the grid corner and center-point coordinates, that will be marked for future reference during the investigation. GPS will be used to record other pertinent site feature data, for example the location of MEC or MD and anthropogenic material, if encountered. Prior to collecting the center-point sampling location coordinates, each location will be marked with a survey flag. The sample location ID will be recorded on each survey flag. Sample locations will be measured from the center of the grid cell or grab location. For each GPS location recorded an identifier and the coordinates will be stored in the data logger.

If the coordinates at a survey location cannot be determined due to the presence of tree cover or other obstacles which prohibit adequate signal reception, coordinates will be obtained at a minimum of two alternate locations (offsets) close to the original survey location. The distance and bearing from each of the alternate locations to the original survey location will then be determined using a measuring tape and compass.

7.3.2 Coordinate Systems

It is assumed all GPS measurements will be recorded in the UTM coordinate system in a zone consistent with the longitudinal boundaries of the given site location. The horizontal datum will be North American Datum of 1983 (NAD83). The vertical datum will be North American Vertical Datum of 1988 (NAVD88). The site-specific grid will be referenced to known National Geodetic Survey (NGS) benchmarks, if possible.

7.3.3 Required Accuracy

At a minimum, surveyed location coordinates will be determined to an accuracy of ±0.5 foot. Vertical elevations measured by GPS are suspect due to limited system accuracy. Accuracy will be assessed using the FGDC Geospatial Positioning Accuracy Standards. Data may be post-processed to increase accuracy, if required.

7.4 DOCUMENTATION

The field team is responsible for documenting all survey measurements. A complete and accurate record correlating the sample IDs to the instrument assigned stations IDs will be kept in the field logbook. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook with consecutively numbered pages, and on field data sheets as applicable. Upon completion of each day's fieldwork, the electronic record will be downloaded from the instrument, correlated with the sample IDs, and uploaded into the project database.

8.0 SOP NO. 8 - EQUIPMENT CALIBRATION

8.1 PURPOSE AND SCOPE

This SOP describes the procedures for equipment calibration and documentation. This SOP is intended to be used with the UFP-QAPP, FSP and with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Sub-Surface Soil Sampling
- SOP No. 3 – Sediment Sampling
- SOP No. 4 – Surface Water Sampling

8.2 EQUIPMENT AND MATERIALS LIST

The following section provide a list of equipment that may be needed to perform equipment calibration.

Horiba U-22 and Horiba U-52:

- Horiba U-22
- Horiba U-52
- Auto calibration solution pH 4
- Calibration cup
- Calibration log for Horibas

YSI 556

- YSI 556
- Calibration cup
- Calibration log for YSI
- DI water
- Conductivity solution (1.413 µS/cm)
- pH 4 solution
- pH 7 solution
- ORP solution (240 mV)
- PID, miniRAE
- PID, miniRAE
- Tedlar bag
- Isobutylene (100 ppm)
- Calibration log for PID

8.3 EQUIPMENT CALIBRATION PROCEDURES

The following provides the procedures for the calibration of the Horiba U-22 and U-52, YSI 556, and PID miniRAE.

Horiba U-22:

- Turn on Horiba.
- Place probe in auto calibration solution (pH 4.00).
- Press Cal button.
- Press Ent button, calibration begins.
- END appears when calibration is complete.
- Press MEAS button and collect pH reading.
- The acceptable pH range is 3.96 to 4.04.
- If any errors appear, refer to Horiba U-22 manual.

Horiba U-52:

- Turn on Horiba.
- Place probe in auto calibration solution (pH 4.00).
- Press Cal button.
- Press Ent button, calibration begins when the parameters on screen start to blink.
- When parameters stop blinking, calibration is complete.
- Collect pH reading.
- The acceptable pH range is 3.96 to 4.04.
- If any errors appear, refer to Horiba U-52 manual.

YSI 556:

- Turn on YSI 556.
- Press ESC which will lead to main menu.
- Scroll to Calibrate and press ENT.
- Scroll to DO, press enter, scroll to DO%
- Enter barometric pressure.
- Place probe in DI water (in calibration cup) and loosely tighten probe to calibration cup.
- Press enter, and then enter again.
- DO% is instantly calibrated.
- Acceptable range is 95% to 105%.
- Press ESC to return to calibration menu.
- Scroll to Conductivity, press enter, scroll to Conductivity in list and press enter
- Enter standard, 1.413 µs/cm.
- Fill calibration cup with conductivity solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.

- Conductivity is instantly calibrated.
- Acceptable range is 1.408 to 1.418 µs/cm.
- Press ESC to return to calibration menu.
- Scroll to pH, press enter, scroll to 2-point calibration and press enter
- Enter 1st standard, 4.00.
- Fill calibration cup with pH 4.00 solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- pH is instantly calibrated.
- Acceptable range is 3.95 to 4.05.
- Press enter.
- Enter 2nd standard, 7.00.
- Fill calibration cup with pH 7.00 solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- pH is instantly calibrated.
- Acceptable range is 6.95 to 7.05.
- Press ESC to return to calibration menu.
- Scroll to ORP, press enter
- Enter standard, 240 mV.
- Fill calibration cup with ORP solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- Conductivity is instantly calibrated.
- Acceptable range is 235 to 245 mV.
- If any errors appear, refer to YSI 556 manual.

PID miniRAE:

Zero Calibration

- Turn on PID to Zero Calibration menu.
- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.
- Zero calibration starts.
- When Zero calibration is complete, you see this message: Zeroing is done!, Reading = 0.000 ppm.

Span Calibration

- Turn on PID to Scan Calibration menu.
- The span gas is first be filled into a Tedlar bag.
- Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.
- Press [Y/+] to enter Span calibration.
- Turn on your span calibration gas.

- Press [Y/+] to initiate calibration.
- Span calibration starts and displays this message: Calibrating...
- When Span calibration is complete, you see this message: Span 1 is done!, Reading = 100.0 ppm.

Per the Mini RAE manual, there is no set range of what is allowed above or below 100 ppm. The Manual simply states that the "reading should be very close to the span gas value".

8.4 DOCUMENTATION:

Documentation for equipment calibration forms which are included in Daily CQCRs. The calibration forms include:

- Equipment model and number
- Date
- Calibration personnel
- Standard calibration values
- Scan gas concentration for PID calibration
- Standard calibration solution parameters for water quality

APPENDIX B
Laboratory Certifications and Standard Operating Procedures (CD only)

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LABORATORY ACCREDITATION BUREAU a division of A-S-B

Certificate of Accreditation

ISO/IEC 17025:2005 Certificate Number L2229

SGS Accutest - Orlando

4405 Vineland Road, Suite C-15
Orlando FL 32811

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 valid through: December 15, 2018

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 14th of January 2016

*See the laboratory's Scope of Accreditation for details of accredited parameters
**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).
Form 403.14 – Rev 1 7/3/13

LABORATORY ACCREDITATION BUREAU

Certificate # L2229

Scope of Accreditation
For
SGS Accutest - Orlando

4405 Vineland Road, Suite C-15
Orlando, FL 32811
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In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (LABPR 403 DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM V5) based on the TNI Standard - Environmental Laboratory Sector, Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis, Sept 2009 (EL-V1-2009); accreditation is granted to **SGS Accutest - Orlando** to perform the following tests:

Accreditation granted through: **December 15, 2018**

Testing – Environmental

Drinking Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537	Perfluorohexanoic Acid
LC/MS/MS	EPA 537	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537	Perfluorooctanoic Acid
LC/MS/MS	EPA 537	Perfluorononanoic Acid
LC/MS/MS	EPA 537	Perfluorodecanoic Acid
LC/MS/MS	EPA 537	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537	Perfluorododecanoic Acid
LC/MS/MS	EPA 537	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537	N-Ethyl perfluorooctanesulfonamidoacetic acid

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/PID	EPA 602; EPA 8021B	Benzene
GC/PID	EPA 602; EPA 8021B	Ethylbenzene
GC/PID	EPA 602; EPA 8021B	Chlorobenzene
GC/PID	EPA 602; EPA 8021B	Toluene
GC/PID	EPA 602; EPA 8021B	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/PID	EPA 602; EPA 8021B	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/PID	EPA 602; EPA 8021B	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/PID	EPA 602; EPA 8021B	m,p-Xylene
GC/PID	EPA 602; EPA 8021B	o-Xylene
GC/PID	EPA 602; EPA 8021B	Methyl-tert-Butyl Ether
GC/ECD	EPA 608; EPA 8081B	4,4`-DDD
GC/ECD	EPA 608; EPA 8081B	4,4`-DDE
GC/ECD	EPA 608; EPA 8081B	4,4`-DDT
GC/ECD	EPA 608; EPA 8081B	Aldrin
GC/ECD	EPA 608; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 608; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608; EPA 8081B	delta-BHC
GC/ECD	EPA 608; EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 608; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608; EPA 8081B	alpha-Chlordane
GC/ECD	EPA 608; EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608; EPA 8081B	Dieldrin
GC/ECD	EPA 608; EPA 8081B	Endosulfan I
GC/ECD	EPA 608; EPA 8081B	Endosulfan II
GC/ECD	EPA 608; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608; EPA 8081B	Endrin
GC/ECD	EPA 608; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 608; EPA 8081B	Endrin ketone
GC/ECD	EPA 608; EPA 8081B	Heptachlor

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 608; EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 608; EPA 8081B	Methoxychlor
GC/ECD	EPA 608; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	RSK-175	Acetylene
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/FID	RSK-175	Propane
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	WI-DRO	Diesel range organics (DRO)
GC/FID	AK-101	Gasoline range organics (GRO)
GC/FID	AK-102	Diesel range organics (DRO)
GC/FID	OK-GRO	Gasoline range organics (GRO)
GC/FID	OK-DRO	Diesel range organics (DRO)
GC/FID	TX-1005	Total Petroleum Hydrocarbons (TPH)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1,1-Trichloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1-Dichloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1-Dichloroethylene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 624; EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2,3-Trichlorobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2,3-Trichloropropane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2,4-Trichlorobenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2-Dichloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 624; EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 624; EPA 8260B/C	Acrolein (Propenal)
GC/MS	EPA 624; EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl Chloride
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Bromobenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Bromochloromethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Bromoform
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	sec-Butylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Carbon disulfide
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Chlorobenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Chloroethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Chloroform

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 624; EPA 8260B,C	Cyclohexane
GC/MS	EPA 8260B/C	Cyclohexanone
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	cis-1,2-Dichloroethylene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	trans-1,2-Dichloroethylene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	cis-1,3-Dichloropropene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Di-isopropylether (DIPE)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Dibromomethane (Methylene Bromide)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 624, EPA 8260B/C, EPA 8260B/C SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C	Ethyl acetate
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethylene Oxide
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Isopropylbenzene
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 624; EPA 8260B/C	Methyl Acetate
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 624; EPA 8260B,C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Methylene chloride
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	n-Propylbenzene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Styrene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	tert-Amyl alcohol (TAA)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	tert-Butyl alcohol (TBA)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	tert-Butyl formate (TBF)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Toluene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Vinyl acetate
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Vinyl chloride
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	Xylene (total)
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	m,p-Xylene
GC/MS	EPA 624; SM 6200B-11; EPA 8260B/C	o-Xylene
GC/MS	EPA 625; EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625; EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 625; EPA 8270D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 625; EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 625; EPA 8270D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 625; EPA 8270D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D	1,4-Dithiane
GC/MS	EPA 8270D	1,4-Oxathiane
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1,4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	1-Methylnaphthalene
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 625; EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625; EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 625; EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 625; EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 625; EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 625; EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 625; EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 625; EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 625; EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 625; EPA 8270D	2-Chlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625; EPA 8270D	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	2-Methylnaphthalene
GC/MS	EPA 625; EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 625; EPA 8270D	2-Nitroaniline
GC/MS	EPA 625; EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 625; EPA 8270D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 625; EPA 8270D	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 625; EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 625; EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 625; EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 625; EPA 8270D	4-Chloroaniline
GC/MS	EPA 625; EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 625; EPA 8270D	4-Nitroaniline
GC/MS	EPA 625; EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4,4’-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Acenaphthene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 625; EPA 8270D	Acetophenone
GC/MS	EPA 625; EPA 8270D	Aniline
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 625; EPA 8270D	Atrazine
GC/MS	EPA 625; EPA 8270D	Benzaldehyde
GC/MS	EPA 625; EPA 8270D	Benzidine
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 625; EPA 8270D	Benzoic acid
GC/MS	EPA 625; EPA 8270D	Benzyl alcohol
GC/MS	EPA 625; EPA 8270D	Biphenyl (1,1’-Biphenyl)
GC/MS	EPA 625; EPA 8270D	bis(2-Chloroethoxy)methane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625; EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 625; EPA 8270D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 625; EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625; EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 625; EPA 8270D	Carbazole
GC/MS	EPA 625; EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 625; EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 625; EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenz(a,j)acridine
GC/MS	EPA 625; EPA 8270D	Dibenzofuran
GC/MS	EPA 625; EPA 8270D	Diethyl phthalate
GC/MS	EPA 625; EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Fluoranthene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Fluorene
GC/MS	EPA 625; EPA 8270D	Hexachlorobenzene
GC/MS	EPA 625; EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 625; EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 625; EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 625; EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 625; EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 625; EPA 8270D	n-Nitrosodi-n-propylamine

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 625; EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 625; EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Phenanthrene
GC/MS	EPA 625; EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 625; EPA 8270D; EPA 8270D SIM	Pyrene
GC/MS	EPA 625; EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Simazine
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
HPLC	EPA 610; EPA 8310	1-Methylnaphthalene
HPLC	EPA 610; EPA 8310	2-Methylnaphthalene
HPLC	EPA 610; EPA 8310	Acenaphthene
HPLC	EPA 610; EPA 8310	Acenaphthylene
HPLC	EPA 610; EPA 8310	Anthracene
HPLC	EPA 610; EPA 8310	Benzo(a)anthracene
HPLC	EPA 610; EPA 8310	Benzo(a)pyrene
HPLC	EPA 610; EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 610; EPA 8310	Benzo(g h i)perylene
HPLC	EPA 610; EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 610; EPA 8310	Chrysene

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 610; EPA 8310	Dibenz(a,h)anthracene
HPLC	EPA 610; EPA 8310	Fluoranthene
HPLC	EPA 610; EPA 8310	Fluorene
HPLC	EPA 610; EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 610; EPA 8310	Naphthalene
HPLC	EPA 610; EPA 8310	Phenanthrene
HPLC	EPA 610; EPA 8310	Pyrene
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B; EPA 8332	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B; EPA 8332	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	2,2’,6,6’-Tetranitro-4,4’-azoxytoluene
HPLC	EPA 8330A/B	2-amino-6-Nitrotoluene
HPLC	EPA 8330A/B	4-amino-2-Nitrotoluene
HPLC	EPA 8330A/B	2-amino-4-Nitrotoluene
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
HPLC	EPA 8330A	Nitroguanidine
HPLC	EPA 8330A	Guanidine Nitrate
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	EPA 537 MOD	Perfluorobutanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluoropentanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorooctanoic Acid

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537 MOD	Perfluorononanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 MOD	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 MOD	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 537 MOD	Perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD	Perfluoro-1-octanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD	6:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 537 MOD	8:2 Fluorotelomer sulfonate
ICP	EPA 200.7; EPA 6010C	Aluminum
ICP	EPA 200.7; EPA 6010C	Antimony
ICP	EPA 200.7; EPA 6010C	Arsenic
ICP	EPA 200.7; EPA 6010C	Barium
ICP	EPA 200.7; EPA 6010C	Beryllium
ICP	EPA 200.7; EPA 6010C	Cadmium
ICP	EPA 200.7; EPA 6010C	Calcium
ICP	EPA 200.7; EPA 6010C	Chromium
ICP	EPA 200.7; EPA 6010C	Cobalt
ICP	EPA 200.7; EPA 6010C	Copper
ICP	EPA 200.7; EPA 6010C	Iron
ICP	EPA 200.7; EPA 6010C	Lead
ICP	EPA 200.7; EPA 6010C	Magnesium
ICP	EPA 200.7; EPA 6010C	Manganese
ICP	EPA 200.7; EPA 6010C	Molybdenum
ICP	EPA 200.7; EPA 6010C	Nickel
ICP	EPA 200.7; EPA 6010C	Potassium
ICP	EPA 200.7; EPA 6010C	Selenium
ICP	EPA 200.7; EPA 6010C	Silver

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 200.7; EPA 6010C	Sodium
ICP	EPA 200.7; EPA 6010C	Strontium
ICP	EPA 200.7; EPA 6010C	Thallium
ICP	EPA 200.7; EPA 6010C	Tin
ICP	EPA 200.7; EPA 6010C	Titanium
ICP	EPA 200.7; EPA 6010C	Vanadium
ICP	EPA 200.7; EPA 6010C	Zinc
ICP/MS	EPA 200.8; EPA 6020A	Aluminum
ICP/MS	EPA 200.8; EPA 6020A	Antimony
ICP/MS	EPA 200.8; EPA 6020A	Arsenic
ICP/MS	EPA 200.8; EPA 6020A	Barium
ICP/MS	EPA 200.8; EPA 6020A	Beryllium
ICP/MS	EPA 200.8; EPA 6020A	Cadmium
ICP/MS	EPA 200.8; EPA 6020A	Calcium
ICP/MS	EPA 200.8; EPA 6020A	Chromium
ICP/MS	EPA 200.8; EPA 6020A	Cobalt
ICP/MS	EPA 200.8; EPA 6020A	Copper
ICP/MS	EPA 200.8; EPA 6020A	Iron
ICP/MS	EPA 200.8; EPA 6020A	Lead
ICP/MS	EPA 200.8; EPA 6020A	Magnesium
ICP/MS	EPA 200.8; EPA 6020A	Manganese
ICP/MS	EPA 200.8; EPA 6020A	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A	Nickel
ICP/MS	EPA 200.8; EPA 6020A	Potassium
ICP/MS	EPA 200.8; EPA 6020A	Selenium
ICP/MS	EPA 200.8; EPA 6020A	Silver
ICP/MS	EPA 200.8; EPA 6020A	Sodium
ICP/MS	EPA 200.8; EPA 6020A	Strontium
ICP/MS	EPA 200.8; EPA 6020A	Thallium
ICP/MS	EPA 200.8; EPA 6020A	Tin
ICP/MS	EPA 200.8; EPA 6020A	Titanium
ICP/MS	EPA 200.8; EPA 6020A	Vanadium
ICP/MS	EPA 200.8; EPA 6020A	Zinc
CVAA	EPA 7470A	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 300; EPA 9056A	Bromide
IC	EPA 300; EPA 9056A	Chloride
IC	EPA 300; EPA 9056A	Fluoride
IC	EPA 300; EPA 9056A	Nitrate
IC	EPA 300; EPA 9056A	Nitrite
IC	EPA 300; EPA 9056A	Sulfate

Non-Potable Water		
Technology	**Method**	**Analyte**
IC	EPA 300; EPA 9056A	Total nitrate-nitrite
Automated Colorimetry	EPA 350.1	Ammonia
Automated Colorimetry	EPA 351.2	Total Kjeldahl Nitrogen
Automated Colorimetry	EPA 420.4	Total Phenolics
Automated Colorimetry	EPA 353.2	Nitrate
Automated Colorimetry	EPA 353.2	Nitrite
Automated Colorimetry	EPA 353.2	Nitrate+Nitrite
Manual Colorimetry	EPA 365.3	Orthophosphate
Manual Colorimetry	EPA 365.3	Total Phosphorus
Titrimetric	SM 2320B-11	Alkalinity, Total
Titrimetric	SM 4500-S2 F-11	Sulfide, Iodometric
Gravimetric Methods	EPA 1664A; EPA 9070A	Oil and Grease
Gravimetric Methods	SM 2540B-11	Total Residue (Total Solids)
Gravimetric Methods	SM 2540C-11	Filterable Residue (Total Dissolved Solids)
Gravimetric Methods	SM 2540D-11	Non-Filterable Residue (Total Suspended Solids)
Electrometric Methods	SM 4500H+B-11; EPA 9040C	Hydrogen Ion (Ph)
Electrometric Methods	EPA 120.1	Specific conductivity
Combustion	EPA 9060A	Total Organic Carbon
Ignitability	EPA 1010A	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide

Non-Potable Water		
Preparation	**Method**	**Type**
Organic Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction
Organic Preparation	EPA 3511	Micro-extraction
Organic Preparation	EPA 3535A; EPA 3535A MOD	Solid Phase Extraction
Organic Preparation	EPA 8015C/D	Non-Halogenated Organics (Alcohols), direct injection
Organic Preparation	EPA 8151A	Chlorinated Herbicides, Liquid-Liquid Extraction
Organic Preparation	EPA 608; EPA 610; EPA 625	Separatory Funnel Liquid-Liquid Extraction
Volatile Organic Preparation	SW836 5030B	Closed System Purge and Trap
Volatile Organic Preparation	EPA 624	Closed System Purge and Trap
Volatile Organic Preparation	SM 6200B-11	Closed System Purge and Trap
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010C	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/ECD	EPA 8081B	4,4`-DDD
GC/ECD	EPA 8081B	4,4`-DDE
GC/ECD	EPA 8081B	4,4`-DDT

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	AK-101	Gasoline range organics (GRO)
GC/FID	AK-102	Diesel range organics (DRO)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/FID	AK-103	Residual range organics (RRO)
GC/FID	OK-GRO	Gasoline range organics (GRO)
GC/FID	OK-DRO	Diesel range organics (DRO)
GC/FID	TX-1005	Total Petroleum Hydrocarbons (TPH)
GC/MS	EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethylene
GC/MS	EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 8260B/C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B/C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B/C	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8260B/C	1,2-Dichloroethane
GC/MS	EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/C	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 8260B/C	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 8260B/C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 8260B/C	4-Methyl-2-pentanone (MBK)
GC/MS	EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 8260B/C	Acrolein (Propenal)
GC/MS	EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B/C	Benzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C	Benzyl Chloride
GC/MS	EPA 8260B/C	Bromobenzene
GC/MS	EPA 8260B/C	Bromochloromethane
GC/MS	EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 8260B/C	Bromoform
GC/MS	EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 8260B/C	sec-Butylbenzene
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 8260B/C	Carbon disulfide
GC/MS	EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 8260B/C	Chlorobenzene
GC/MS	EPA 8260B/C	Chloroethane
GC/MS	EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Cyclohexanone
GC/MS	EPA 8260B/C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B/C	trans-1,2-Dichloroethylene
GC/MS	EPA 8260B/C	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Di-isopropylether (DIPE)
GC/MS	EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 8260B/C	Dibromomethane (Methylene Bromide)
GC/MS	EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 8260B/C; EPA 8260B/C SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8260B/C	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C	Ethyl acetate
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethylene Oxide
GC/MS	EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 8260B/C	Isopropylbenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 8260B/C	Methyl Acetate
GC/MS	EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 8260B/C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B/C	Methylene chloride
GC/MS	EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B/C	n-Propylbenzene
GC/MS	EPA 8260B/C	Styrene
GC/MS	EPA 8260B/C	tert-Amyl alcohol (TAA)
GC/MS	EPA 8260B/C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 8260B/C	tert-Butyl alcohol (TBA)
GC/MS	EPA 8260B/C	tert-Butyl formate (TBF)
GC/MS	EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 8260B/C	Toluene
GC/MS	EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate
GC/MS	EPA 8260B/C	Vinyl chloride
GC/MS	EPA 8260B/C	Xylene (total)
GC/MS	EPA 8260B/C	m,p-Xylene
GC/MS	EPA 8260B/C	o-Xylene
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 8270D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 8270D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D	1,4-Dithiane
GC/MS	EPA 8270D	1,4-Oxathiane
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1,4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 8270D; EPA 8270D SIM	1-Methylnaphthalene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 8270D; EPA 8270D SIM	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4,4’-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D; EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D; EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anilazine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D; EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D; EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenz(a,j)acridine
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D; EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D; EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D; EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D; EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D; EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D; EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 8270D; EPA 8270D SIM	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Simazine
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g h i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenz(a h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B; EPA 8332	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B; EPA 8332	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	2,2',6,6'-Tetranitro-4,4'-azoxytoluene
HPLC	EPA 8330A/B	2-amino-6-Nitrotoluene
HPLC	EPA 8330A/B	4-amino-2-Nitrotoluene
HPLC	EPA 8330A/B	2-amino-4-Nitrotoluene
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
HPLC	EPA 8330A	Nitroguanidine
HPLC	EPA 8330A	Guanidine Nitrate
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	EPA 537 MOD	Perfluorobutanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluoropentanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorononanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 MOD	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 MOD	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 MOD	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 537 MOD	Perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD	Perfluoro-1-octanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD	6:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 537 MOD	8:2 Fluorotelomer sulfonate

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010C	Aluminum
ICP	EPA 6010C	Antimony
ICP	EPA 6010C	Arsenic
ICP	EPA 6010C	Barium
ICP	EPA 6010C	Beryllium
ICP	EPA 6010C	Cadmium
ICP	EPA 6010C	Calcium
ICP	EPA 6010C	Chromium
ICP	EPA 6010C	Cobalt
ICP	EPA 6010C	Copper
ICP	EPA 6010C	Iron
ICP	EPA 6010C	Lead
ICP	EPA 6010C	Magnesium
ICP	EPA 6010C	Manganese
ICP	EPA 6010C	Molybdenum
ICP	EPA 6010C	Nickel
ICP	EPA 6010C	Potassium
ICP	EPA 6010C	Selenium
ICP	EPA 6010C	Silver
ICP	EPA 6010C	Sodium
ICP	EPA 6010C	Strontium
ICP	EPA 6010C	Thallium
ICP	EPA 6010C	Tin
ICP	EPA 6010C	Titanium
ICP	EPA 6010C	Vanadium
ICP	EPA 6010C	Zinc
ICP/MS	EPA 6020A	Aluminum
ICP/MS	EPA 6020A	Antimony
ICP/MS	EPA 6020A	Arsenic
ICP/MS	EPA 6020A	Barium
ICP/MS	EPA 6020A	Beryllium
ICP/MS	EPA 6020A	Cadmium
ICP/MS	EPA 6020A	Calcium
ICP/MS	EPA 6020A	Chromium
ICP/MS	EPA 6020A	Cobalt
ICP/MS	EPA 6020A	Copper
ICP/MS	EPA 6020A	Iron
ICP/MS	EPA 6020A	Lead
ICP/MS	EPA 6020A	Magnesium
ICP/MS	EPA 6020A	Manganese
ICP/MS	EPA 6020A	Molybdenum

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP/MS	EPA 6020A	Nickel
ICP/MS	EPA 6020A	Potassium
ICP/MS	EPA 6020A	Selenium
ICP/MS	EPA 6020A	Silver
ICP/MS	EPA 6020A	Sodium
ICP/MS	EPA 6020A	Strontium
ICP/MS	EPA 6020A	Thallium
ICP/MS	EPA 6020A	Tin
ICP/MS	EPA 6020A	Titanium
ICP/MS	EPA 6020A	Vanadium
ICP/MS	EPA 6020A	Zinc
CVAA	EPA 7471B	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Gravimetric Methods	SM 2540G	% solids
Gravimetric Methods	EPA 9071B	Oil and Grease
Electrometric Methods	EPA 9045D	Hydrogen Ion (pH)
Combustion	EPA 9060A	Total Organic Carbon
Ignitability	EPA 1010A	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	**Method**	**Type**
Organics Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction; Leachates
TCLP Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
SPLP Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Organics Preparation	EPA 8011	Microextraction

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Organics Preparation	EPA 3546	Microwave Extraction
Organics Preparation	EPA 3550C	Ultrasonic Extraction
Organics Preparation	EPA 3580A	Waste Dilution for Extractable Organics
Organics Preparation	EPA 8330A; EPA 8332	Ultrasonic Extraction
Organics Preparation	EPA 8330B	Shaker Table Extraction
Volatile Organics Preparation	EPA 3585	Waste Dilution for Volatile Organics
Volatile Organics Preparation	EPA 5030A	Closed System Purge and Trap; Bulk Soils
Volatile Organics Preparation	EPA 5030B	Closed System Purge and Trap; Leachates and Methanol Extracts
Volatile Organics Preparation	EPA 5035; EPA 5035A	Closed System Purge and Trap
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010C	Metals Acid Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 3050B	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 3060A	Alkaline Digestion, Cr6+
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 7471B	CVAA Digestion by Hotblock

Notes:
1) This laboratory offers commercial testing service.

Approved by: _____ Date: January 14, 2016

R. Douglas Leonard
Chief Technical Officer

Re-Issued: 1/14/16

ANALYSIS OF SEMIVOLATILE ORGANICS BY GC/MS SELECT ION MONITORING (SIM)

Prepared by: Norm Farmer Date: 10/29/15

Approved by: Mark Erstling Date: 10/30/15

Annual Review

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TEST NAME: ANALYSIS OF SEMIVOLATILE ORGANICS BY GC/MS SELECT ION MONITORING (SIM)

METHOD REFERENCE: SW846 8270D

DEPT: MS

Revised Sections: 1.1.3, 4.3, 6.1.2, 6.2, 6.4, 7.2, 7.4.1.2, 7.4.1.3, 7.4.2.6, 7.4.2.7 and 12.0

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of various semivolatile organic compounds in water and solid matrices utilizing a gas chromatograph equipped with a mass spectrometer detector. Routine compounds can be found in Table 1.

1.1.2 Unlike convention full scan 8270; this method utilizes the instrument's select ion monitoring (SIM) capabilities. By monitoring for a few specific ions the sensitivity can be increased 10 to 20 fold.

1.1.3 Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. Reporting limits may vary depending on matrix complications and sample volumes. Reporting limits for this method are in the range of 0.2 to 1.0 ug/l for aqueous samples and 10 to 100 ug/kg for solid samples. Solid matrices are reported on a dry weight basis.

1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the RL. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported RL.

1.1.5 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the RL be reported.

1.1.6 For DOD projects refer to QSM 4.2, Table F4 or QSM 5.0, Table 4 for additional method requirements and data qualifying guidance.

1.2 Summary

1.2.1 This method is adapted from SW846 method 8270D.

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1.2.2 Samples are received, stored and extracted within the appropriate holding times.

1.2.3 Sample preparation is performed in accordance with Accutest SOP OP006, OP007, OP059 and OP060.

1.2.4 The extracts are analyzed on a gas chromatograph equipped with mass spectrometer detector.

1.2.5 The peaks detected are identified by comparison to characteristic ions and retention times specific to the known target list of compounds.

1.2.6 Library searches can not be performed on data acquired in SIM mode because data was only acquired for selected ions.

1.2.7 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Samples shall be collected in amber glass bottles with Teflon lined caps. One-liter bottles are recommended for aqueous samples and 300ml jars are recommended for solid samples.

2.1.2 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until extraction. The extracts must be refrigerated at –10°C to –20°C until analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be extracted within 7 days of collection.

2.2.2 Solid and waste samples must be extracted within 14 days of collection.

2.2.3 Extracts must be analyzed within 40 days of extraction.

3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences.

3.2 Method interferences may be caused by contaminants in solvents, reagents, or glassware. Interferences from phthalate esters can be eliminated by using plastic-free solvent containers and solvent rinsed glassware.

3.3 Other organic compounds, including chlorinated hydrocarbons, petroleum hydrocarbons, and phthalate esters may be coextracted by this method.

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3.4 SIM may provide a lesser degree of confidence in compound identification unless multiple ions are monitored for each compound. In general, Accutest monitors 3 ions per compound.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all MS methods, a CCV must be analyzed at the beginning of each analytical run. For DoD QSM 5 Projects and additional CCV must be analyzed at the end of the run.

4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.5 Internal Standards: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Internal standards for Mass Spec methods are often deuterated forms of target analytes. Internal standards are used to compensate for retention time and response shifts during an analytical run.

4.6 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.

4.7 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.8 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.9 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

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4.10 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.11 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.12 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.13 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

5.1 Methylene Chloride – pesticide grade or equivalent

5.2 Semivolatile stock standards – Various mixes, traceable to Certificate of Analysis

5.3 Decafluorotriphenylphosphine mix (DFTPP) – Also contains pentachlorophenol, benzidine and DDT.

5.4 Base/neutral surrogate standards – dependent on the analytes being analyzed

Nitrobenzene-d5
2-Fluorobiphenyl
P-Terphenyl-d14

5.5 Acid surrogate standards – dependent on the analytes being analyzed

Phenol-d6
2-Fluorophenol
2,4,6-Tribromophenol

5.6 Internal standards – dependent on the analytes being analyzed

1,4-Dichlorobenzene-d4	Naphthalene-d8
Acenaphthene-d10	Phenanthrene-d10
Chrysene-d12	Perylene-d12

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6.0 APPARATUS

6.1 Gas Chromatograph – Agilent Technologies 6890 with 7683 Autosampler

6.1.1 Gas Chromatograph

The analytical system that is complete with a temperature programmable gas chromatograph and all required accessories, analytical columns, and gases.

6.1.2 The injection port is designed for split-splitless or on-column injection with capillary columns.

6.1.3 Autosampler allows for unattended sample and standard injection throughout the analytical run.

6.2 Mass Spectrometer – Agilent Technologies 5973 and 5975

The mass spectrometer must be capable of scanning from 35-500 amu every second or less utilizing a 70-volt (nominal) electron energy in the electron impact ionization mode. It must also be capable of producing a mass spectrum that meets all the criteria in section 7.4.1.1 when injecting 50 ng of Decafluorotriphenylphosphine (DFTPP).

For this method it also must be capable of operating in Select Ion Mode (SIM). The selected ions are nominal ions but may have small mass defect, usually less than 0.2 amu, in their spectra. The acquisition table should be set to include these mass defects. The dwell time may be automatically calculated by the laboratory's GC/MS software. The total scan time should be less than 1,000 msec and produce at least 5 to 10 scans per chromatographic peak.

The mass spectrometer must be capable of analyzing multiple groups for up to 30 specific ions. Use the primary ion for quantitation and the secondary ions for confirmation. The start and end of each group should be time programmable and can be determined from the full scan analysis. Each group of specific ions is referred to as a descriptor.

6.3 Data System – Agilent Technologies MS Chemstation rev. DA 02.0x, DA 03.0x or EA 02.0x.

6.3.1 A computer system interfaced to the mass spectrometer that allows for the continuous acquisition and storage of all mass spectral data obtained throughout the duration of the chromatographic program.

6.3.2 The computer utilizes software that allows searching any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus

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time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP).

6.3.3 The software should allow for integrating the abundances in any EICP between specific time or scan number limits. See Table 3.

6.3.4 Data is archived to magnetic tape for long term storage.

6.4 Column – TG-5MS or equivalent: 30m X 0.25mm X 0.25um
– ZB-Semivoaltiles or equivalent: 30m X 0.25mm X 0.25um

6.5 Gas-tight syringes and class "A" volumetric glassware for dilutions of standards and extracts.

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified reference standards. All standards must be logged in the Semivolatile Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at temperatures between –10 °C and –20 °C, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, preparation information, and vendor part numbers can be found in the MS STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from several commercial vendors. All vendors must supply a "Certificate of Analysis" with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor's expiration date. Once opened, the hold time is reduced to one year or the vendor's expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with methylene chloride. The hold time for intermediate standards is six months or the vendor's expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicates analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for the semivolatile organics are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. The low standard is at a concentration at or below

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the RL and the remaining standards define the working range of the detector.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 Gas Chromatograph Conditions and Mass Spectrometer Descriptors

1 or 2ul autosampler injection Pulsed splitless or splitless

Carrier gas – UHP Helium (7.7psi to 36psi @1.5 psi/min ramp pressure)
Injection port temperature – 280 °C Transfer line temperature – 280 °C

Oven program – 40 °C for 1.0 minutes
27.5 °C/min to 265 °C for 0 minutes
5 °C/min to 295 °C for 0 minutes
20 °C/min to 320 °C for 0 minutes

OR

Oven program – 40 °C for 1.5 minutes
30 °C/min to 190 °C for 0 minutes
10 °C/min to 260 °C for 0 minutes
25 °C/min to 320 °C for 2.0 minutes

Source temperature – 230 °C Quad temperature – 150 °C

GC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

MS Descriptors – Monitor 3 characteristic ions for each target analyte, and 2 characteristic ions for each surrogate and internal standard. Each descriptor may have up to 30 ions; however, the more ions in a descriptor, the less the sensitivity. Therefore, it is beneficial to use multiple descriptors for longer analytes lists.

GC conditions and mass spectrometer descriptors are dependent on the analytes being analyzed. Refer to the specific instrument methods for actual conditions and descriptors.

7.3 Sample Preparation

7.3.1 Water Samples

A 1000ml aliquot of sample is pH adjusted and extracted with methylene chloride utilizing separatory funnel extraction. The extract is concentrated to 1.0ml.

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7.3.2 Solid Samples

A 15 or 30-gram aliquot of sample is extracted with methylene chloride and acetone utilizing pulse sonication or microwave extraction. The extract is concentrated to 1.0ml.

7.4 Gas Chromatographic Analysis

Instrument calibration consists of two major sections:

Initial Calibration Procedures
Continuing Calibration Verification

7.4.1 Initial Calibration Procedures

Before samples can be run, the GC/MS system must be tuned, the injection port inertness must be verified, and the instrument must be calibrated.

7.4.1.1 Tune Verification (DFTPP)

The instrument should be hardware tuned per manufacturer's instructions. Verify the instrument tune by injecting 50ng of DFTPP solution onto the instrument. The resulting DFTPP spectra should meet the criteria in the following table.

DFTPP KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
51	30-60 of mass 198
68	<2 % of mass 69
70	<2 % of mass 69
127	40-60 % of mass 198
197	<1 % of mass 198
198	Base peak, 100 % relative abundance
199	5-9 % of mass 198
275	10-30 % of mass 198
365	>1 % of mass 198
441	Present but less than mass 443
442	>40 % of mass 198
443	17-23 % of mass 442

Evaluate the tune spectrum using three mass scans from the chromatographic peak and a subtraction of instrument background. This procedure is performed automatically by the MS Chemstation software by running "autofind" on the DFTPP peak.

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Select the scans at the peak apex and one to each side of the apex. Calculate an average of the mass abundances from the three scans.

Background subtraction is required. Select a single scan in the chromatogram that is absent of any interfering compound peak and no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the tuning compound peak.

If the criteria are not achieved, the analyst must retune the mass spectrometer and repeat the test until all criteria are met.

Analysis must not begin until the tuning criteria are met. The injection time of the acceptable tune analysis is considered the start of the 12-hour clock. The same mass spec settings must be used for the calibration standards and samples that were used for the tune evaluation standard. The exception being that the tune evaluation standard must be acquired in full scan mode and all others in SIM mode.

7.4.1.2 Injection Port Inertness Verification

This requirement is optional if samples are being analyzed for PAHs only. It must be evaluated if any other analytes are being reported.

DDT, pentachlorophenol, and benzidine must also be evaluated in the tune standard. These compounds are used to assess injection port inertness and column performance.

Pentachlorophenol and benzidine should be present at their normal responses and, no peak tailing should be visible. The tailing factor for Benzidine must be less than 2 and the tailing factor for pentachlorophenol must be less than 2.

DDT breakdown should not exceed 20%. Breakdown is calculated as follows:

$$\%DDT_{BREAKDOWN} = \frac{(\text{DDE Area} + \text{DDD Area}) \times 100}{(\text{DDE Area} + \text{DDD Area} + \text{DDT Area})}$$

If degradation is excessive or peak tailing is noticed, injection port maintenance is required.

This performance test must be passed before any samples or standards are analyzed.

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7.4.1.3 Internal Standard Calibration

A minimum 5-point calibration curve is created for the semivolatile organic compounds and surrogates using an internal standard technique. Accutest Laboratories routinely performs a 6-point calibration to maximize the calibration range.

The low point may be omitted from the calibration table for any compound with an RL set at the level two standard. Additionally the high point may be omitted for any compound that exhibits poor linearity at the upper end of the calibration range.

An entire level may be omitted provided that a minimum of 5 points remain. There must be technical justification to omit an entire level. This should be documented in the run log.

Response factors (RF) for each analyte are determined as follows:

$$RF = (A_{analyte} \mathbf{X} C_{istd})/(A_{istd} \mathbf{X} C_{analyte})$$

$A_{analyte}$ = area of the analyte
A_{istd} = area of the internal standard
$C_{analyte}$ = concentration of the analyte
C_{istd} = concentration of the internal standard.

The mean RF and standard deviation of the RF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

%RSD = (Standard Deviation of RF X 100) / Mean RF

If the %RSD $\leq$ 20%, linearity through the origin can be assumed and the mean RF can be used to quantitate target analytes in the samples. **The %RSD should be $\leq$ 15% for any DoD QSM projects.**

Alternatively if the %RSD > 20% a calibration curve of response vs. amount can be plotted. If the correlation coefficient (r) is $\geq$0.995 ($r^2 \geq$0.990) then the curve can be used to quantitate target analytes in the samples.

NOTE: If a linear regression is used for an analyte, then the low standard must be recalculated against the current initial calibration. The recovery of any analyte using a linear

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regression must be 70% -130% of the expected value. This requirement does not apply to quadratic regressions.

The method also employs minimum response factor (RF) criteria for select target analytes. See Table 2 for the analytes and associated minimum response factors. Unlike previous revisions that only set a minimum for the average RF, 8270D requires that the minimum RF be met for each level of the calibration curve.

7.4.1.4 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV should be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be ≤ 30%. If the %D > 30%, the analysis of samples may still proceed if the analyte failed high and the analyte is not expected to be present in the samples. However, if a reportable analyte is detected in a sample and the %D for that analyte was greater than 30% in the ICV, the sample will need to be reanalyzed on a system with a passing ICV for that analyte.

For any DoD QSM project, the %D for all target compounds should be ≤ 20%. If samples must be analyzed with an analyte of interest having a %D > 20%, then the data must be qualified accordingly.

If the ICV does not meet this criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

7.4.2 Continuing Calibration Verification (CCV)

7.4.2.1 Inject 1ul of the tune evaluation mix at the beginning of each 12-hour shift. Evaluate the resultant peaks against the criteria in sections 7.4.1.1 and 7.4.1.2. The injection time of this standard starts the 12-hour window.

7.4.2.2. Analyze a continuing calibration check standard. The CCV should be at or below the mid-point of the calibration curve.

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7.4.2.3. The response factor for any target analyte listed in Table 2 must meet the listed minimum value.

7.4.2.4. The %D for all other analytes of interest should be ≤ 20%. If the %D > 20%, the analysis of samples may still proceed if the analyte failed high and the analyte is not expected to be present in the samples. However, if a reportable analyte is detected in a sample and the %D for that analyte was greater than 20% in the CCV, the sample will need to be reanalyzed on a system with a passing CCV for that analyte, or the data must be qualified.

For any DoD QSM project, the %D for all target compounds should be ≤ 20%. If samples must be reported with an analyte of interest having a %D > 20%, then the data must be qualified accordingly, regardless of whether the analyte was detected or not.

7.4.2.5. The criteria in 7.4.2.3 and 7.4.2.4 must be met for the continuing calibration to be considered valid. Only analytes that are being reported for a given sample must meet the criteria in 7.4.2.3 and 7.4.2.4. If the first continuing calibration verification does not meet criteria, a second standard may be injected.

Rationale for second standard such as instrument maintenance, clipped column, remade standard, etc should be documented in the run log or maintenance log. Reanalysis of second standard without valid rationale may require the analysis of a third standard (in which case both the second and third standard would have to pass).

If the second standard (or third) does not meet criteria, the system must be recalibrated.

7.4.2.6. For DoD QSM 5.0 compliance an additional CCV must be analyzed at the end of each run. The %D for all target compounds in this CCV should be ≤ 50%. If the %D > %50 for any target compound, then the samples should be reanalyzed at least once at the appropriate dilution. If the %D > %50 for the analytes in the reanalysis, the department supervisor shall review the data and determine what further action is necessary. This may include reanalyzing the samples at a higher dilution or qualifying the data.

NOTE: If samples are ND and an analyte in the CCV fails high, then the sample does not need to be reanalyzed.

If samples must be reported with an analyte of interest having a %D > 50%, then the data must be qualified accordingly, regardless of whether the analyte was detected or not.

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7.4.2.7. If any of the internal standard response changes by more than a factor of two (-50% to +100%) or retention time changes by more than 30 seconds (10 seconds for DOD QSM 5.0 compliance) from the midpoint standard of the last initial calibration, the mass spectrometer must be inspected for malfunctions and corrections made, as appropriate. Corrective action may include re-calibration (initial Calibration) of the instrument.

7.4.3 Sample Extract Analysis

7.4.3.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Tune Evaluation Mix
Initial Calibration Standards (or CCV)
QC Extracts
Sample Extracts

7.4.3.2 Two microliters of internal standard solution is added to every 100ul of extract in the autosampler vial. Generally, 400ul of extract are transferred to the autosampler vial with a gas tight syringe.

7.4.3.3 One or two microliters (same amount as standards) of extract is injected into the GC by the autosampler. The data system then records the resultant peak responses and retention times.

7.4.3.4 Qualitative identification

The target compounds shall be identified by analysts with competent knowledge in the interpretation of mass spectra by comparison of the sample mass spectrum to the mass spectrum of a standard of the suspected compound. The criteria required for a positive identification is:

The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

The sample component must elute at the same relative retention time (RRT) as the daily standard. The RRT of sample component must be within ± 0.06 RRT units of the standard.

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All ions monitored in the standard mass spectra should be present in the sample spectrum.

The relative intensities of these ions must agree within ± 30% between the daily standard and sample spectra. (Example: For an ion with an abundance of 50% in the standard spectra, the corresponding sample abundance must be between 20 and 80%.

Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 50% of sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

If peak identification is prevented by the presence of interferences, further cleanup may be required or the extract must be diluted so that the interference does not mask any analytes.

7.4.3.5 Quantitative analysis

When a target compound has been identified, concentration will be based on the integrated area of the quantitation ion, which is normally the base peak.

The sample matrix may produce an interference with the primary ion. This may be characterized by an excessive background signal of the same ion, which distorts the peak shape beyond a definitive integration. The interference could also, severely inhibit the response of the internal standard ion.

If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

7.5 Maintenance and Trouble Shooting

7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.5.2 All instrument maintenance must be documented in the appropriate “Instrument Repair and Maintenance” log. The log will include such items as problem, action taken, correction verification, date, and analyst.

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7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.5.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD).

9.1 Internal Standards

9.1.1 1,4-Dichlorobenzene-d4, Naphthalene-d8, Acenaphthene-d10, Phenanthrene-d10, Chrysene-d12 and Perylene-d12 can be used as internal standards for this method. The internal standards used are dependent on the compounds being analyzed. The response of the internal standard in all subsequent runs should be within a factor of two (-50% to +100%) of the internal standard response in the opening CCV for each sequence. On days that an initial calibration is performed, the internal standard responses should be compared to the internal standard responses for the mid-point standard.

9.1.2 If the internal standard responses are not within limits, the following are required.

9.1.2.1 Check to be sure that there are no errors in calculations, integrations, or internal standards solutions. If errors are found, recalculate the data accordingly.

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9.1.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.1.2.3 If no problem is found, prepare a second aliquot of extract and reanalyze the sample.

9.1.2.4 If upon reanalysis, the responses are still not within limits, the problem is considered matrix interference. The extract may need to be diluted or the results qualified.

9.2 Surrogates

9.2.1 Nitrobenzene-d5, 2-Fluorobiphenyl, and p-Terphenyl-d14 are used as the base neutral surrogate standards and Phenol-d5, 2-Fluorophenol, and 2,4,6-Tribromophenol are used as the acid surrogate standards to monitor the efficiency of the extraction. The surrogates used are dependent on the compounds being analyzed.

A known amount of surrogate standard is added to each sample including the QC set prior to extraction. The percent recovery for each surrogate is calculated as follows:

% Recovery = (Sample Amount / Amount Spiked) X 100

The percent recovery must fall within the established control limits for all surrogates for the results to be acceptable.

9.2.2 If any surrogate recovery is not within the established control limits, the following are required. Note: If the samples are being analyzed for only base neutral compounds or only acid compounds, then only the relative surrogates need to be monitored.

9.2.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, surrogate solutions or internal standard solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.2.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.2.2.3 If no problem is found, re-extract and reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-

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detect, then re-extraction may not be necessary. For any DoD QSM projects the resulting data must be qualified accordingly. If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.

9.2.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates from both sets of analysis should be reported on the final report.

9.3 Method Blank

9.3.1 The method blank is either de-ionized water or sodium sulfate (depending upon sample matrix) to which the surrogate standard has been added. The method blank is then extracted and taken through all cleanup procedures along with the other samples to determine any contamination from reagents, glassware, or high level samples. The method blank must be free of any analytes of interest or interferences at ½ the required reporting level to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

9.3.2 If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.

9.3.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.

9.3.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination should be investigated and documented. The samples should be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Blank Spike

9.4.1 The blank spike is either de-ionized water or sodium sulfate (depending upon sample matrix) to which the surrogate standard and spike standard have been added. The blank spike is then extracted and taken through all cleanup procedures along with the other samples to monitor the efficiency

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of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable. The large number of analytes in this method presents a substantial probability that a few of the analytes will fall outside of the established control limits. This may not indicate that the system is out of control; therefore, corrective action may not be necessary.

Upper and lower marginal exceedance (ME) limits can be established to determine when corrective action is necessary. A marginal exceedance in the Blank Spike is defined as a recovery being outside of 3 standard deviations but within 4 standard deviations of the mean.

The number of allowable marginal exceedances is based on the number of analytes in the Blank Spike. Marginal Exceedances must be random. If the same analyte exceeds the BS control limits repeatedly, it is an indication of a systematic problem and corrective action must be taken.

Marginal exceedances are not permitted for analytes that are deemed to be “Compounds of Concern” for a specific project. “Compounds of Concern” are different from “Target Compounds”. “Target Compounds” are all analytes that are being reported for a site where “Compounds of Concern” are those analytes expected to be present at the site.

The number of allowable marginal exceedances is as follows:

1) 31-50 analytes in BS, 2 analytes allowed in ME range;

2) 11-30 analytes in BS, 1 analyte allowed in ME range;

3) < 11 analytes in BS, no analytes allowed in ME range

9.4.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions or internal standard solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

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9.4.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary and the sample results can be reported without qualification.

9.4.2.4 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. For any DoD QSM projects the resulting data must be qualified accordingly.

9.4.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.4.2.6 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4.2.7 Because of their problematic nature, benzidine, benzaldehyde, and benzoic acid are generally not evaluated in the blank spike unless they are of specific concern for a given project.

9.5 Matrix Spike and Matrix Spike Duplicate

9.5.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then extracted and taken through all cleanup procedures along with the other samples to monitor the precision and accuracy of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.5.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions or internal standard solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

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9.5.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.5.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extraction but are an indication of the sample matrix effects.

9.5.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

$$RPD = [| MS\ Result - MSD\ Result |\ /\ Average\ Result] \times 100$$

The RPD for each analyte should fall within the established control limits. If more than 33% of the RPDs fall outside of the established control limits, the MS and MSD should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The concentration of each analyte in the original sample is calculated as follows:

$$Water\ (ug/l) = (CONC_{inst}) \times (V_F / V_I) \times DF$$

$$Soil\ (ug/kg) = [(CONC_{inst}) \times (V_F / W_I) \times DF] / \%solids$$

$CONC_{inst}$	=	Instrument concentration calculated from the initial calibration using mean RF, linear curve, or quadratic curve
DF	=	Dilution Factor
V_F	=	Volume of final extract (ul)
V_I	=	Volume of sample extracted (ml)
W_I	=	Weight of sample extracted (g)
%solids	=	Dry weight determination in decimal form

All soils are reported on a dry weight basis.

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11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the Accutest Health and Safety Plan and Personal Protection Policy, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment should be used by all analysts.

11.2 Pollution Prevention

Waste solvents from the sample analysis and standards preparation are collected in waste storage bottles and are eventually transferred to the chlorinated waste drum.

Sample Extracts are archived and stored for 60 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000D Revision 4, July 2014

SW846 Method 8270D Revision 4, February 2007

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TABLE 1

Routine Target Analytes

Naphthalene	Pentachlorophenol
2-Methylnaphthalene	2,4-Dinitrotoluene
1-Methylnaphthalene	2,6-Dinitrotoluene
Acenaphthylene	Hexachlorobenzene
Acenaphthene	Hexachlorobutadiene
Fluorene	bis(2-Chloroethyl)ether
Phenanthrene	2,4-Dichlorophenol
Anthracene	1,4-Dioxane
Fluoranthene	1,1'-Biphenyl
Pyrene	Diphenyl Ether
Benzo[a]anthracene	4-Nitrophenol
Chrysene	2,4-Dinitrophenol
Benzo[b]fluoranthene	N-Nitroso-di-n-propylamine
Benzo[k]fluoranthene	N-nitrosodimethylamine
Benzo[a]pyrene	Nitrobenzene
Indeno[1,2,3-cd]pyrene	Dibenzofuran
Dibenz[a,h]anthracene	bis(2-Ethylhexyl)phthalate
Benzo[g,h,i]perylene	Hexachlorocyclopentadiene
Carbazole	

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TABLE 2

Minimum Response Factors

Analyte	Min. RF	Analyte	Min. RF
Naphthalene	0.700	N-nitroso-di-n-propylamine	0.500
2-Methylnaphthalene	0.400	Hexachlorocyclopentadiene	0.050
1-Methylnaphthalene	0.400	2,4-Dinitrophenol	0.010
Acenaphthylene	0.900	4-Nitrophenol	0.010
Acenaphthene	0.900	Pentachlorophenol	0.050
Fluorene	0.900	bis(2-chloroethyl)ether	0.700
Phenanthrene	0.700	2,4-Dinitrotoluene	0.200
Anthracene	0.700	2,6-Dinitrotoluene	0.200
Fluoranthene	0.600	Hexachlorobenzene	0.100
Pyrene	0.600	1,4-Dioxane	n/a
Benzo[a]anthracene	0.800	1,1' Biphenyl	0.010
Chrysene	0.700	Diphenyl Ether	n/a
Benzo[b]fluoranthene	0.700	Carbazole	0.010
Benzo[k]fluoranthene	0.700	Dibenzofuran	0.800
Benzo[a]pyrene	0.700	bis(2-Ethylhexyl)phthalate	0.010
Indeno[1,2,3-cd]pyrene	0.500		
Dibenz[a,h]anthracene	0.400		
Benzo[g,h,i]perylene	0.500		

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TABLE 3

Characteristic Ions

Analyte	Quant. Ion	Q1	Q2
Naphthalene-d8 IS	136	68	
Nitrobenzene-d5 SS	82	128	54
Naphthalene	128	129	127
2-Methylnaphthalene	142	141	115
1-Methylnaphthalene	142	141	115
Acenaphthene-d10 IS	164	162	160
2-Fluorobiphenyl SS	172	171	
Acenaphthylene	152	151	153
Acenaphthene	153	152	154
Fluorene	166	165	167
Phenanthrene-d10 IS	188	94	80
Phenanthrene	178	179	176
Anthracene	178	179	176
Fluoranthene	202	101	203
Chrysene-d12 IS	240	120	236
Pyrene	202	101	203
Terphenyl-d14 SS	244	122	212
Benzo[a]anthracene	228	226	229
Chrysene	228	226	229
Perylene-d12 IS	264	260	265
Benzo[b]fluoranthene	252	253	125
Benzo[k]fluoranthene	252	253	125
Benzo[a]pyrene	252	253	125
Indeno[1,2,3-cd]pyrene	276	138	277
Dibenz[a,h]anthracene	278	139	279
Benzo[g,h,i]perylene	276	138	277

Analyte	Quant. Ion	Q1	Q2
N-nitroso-di-n-propylamine	42	70	
Hexachlorocyclopentadiene	237	235	
2,4-Dinitrophenol	184	154	
4-Nitrophenol	139	65	
2,4,6-Tribromophenol	330	332	141
Pentachlorophenol	266	264	268
bis(2-chloroethyl)ether	93	63	95
2,4-Dinitrotoluene	165	63	182
2,6-Dinitrotoluene	165	89	121
Hexachlorobenzene	284	142	249
1,4 Dioxane	88	58	43
1,1' Biphenyl	154	153	152
Diphenyl Ether	170	141	77
Carbazole	167	166	139
Dibenzofuran	168	139	169
bis(2-Ethylhexyl)phthalate	149	167	279

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STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF BASE-NEUTRAL AND ACID (BNAs) EXTRACTABLES FROM SOLID SAMPLES

Prepared by: Norm Farmer Date: 09/02/15

Approved by: Mark Erstling Date: 09/04/15

Annual Review

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TEST NAME: **STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF BASE-NEUTRAL AND ACID (BNAs) EXTRACTABLES FROM SOLID SAMPLES**

Method: SW846 3550C/8270D

Dept: OP

Revised Sections: 2.0, 5.7, 5.8, 6.4, 7.0, 8.2, 8.6-8.8, 8.15 and 11.0

1.0 Summary, Scope and Application

1.1 Summary

Solid samples are serially extracted by pulse sonication, concentrated by Kuderna-Danish apparatus, and stored in glass vials with Teflon lined screw caps.

1.2 Scope and Application

This procedure is applicable to solid samples, including soils and sediments, submitted for BNA analysis by GC/MS method SW-846 8270D.

2.0 Discussion and Comments

This procedure is adapted from SW-846 methods 3500C and 3550C. The method outlined in this SOP is designed for low concentration samples (concentration of the individual organic components is expected to be less than 20mg/kg).

Although the mass spectrometer identifies compounds by specific ions, it will respond to most organic compounds. It is important to minimize extraneous contaminants by scrupulously cleaning all glassware and by using only high purity reagents. Additionally, all extraction items that come in contact with the sample must be made from glass, stainless steel, or Teflon. Plastic items must be avoided because they can lead to phthalate contamination.

3.0 Preservation and Holding Times

3.1 Preservation

3.1.1 Samples shall be collected in glass jars with Teflon lined caps. 250ml jars are recommended for solid samples.

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3.1.2 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until extraction. The extracts must be refrigerated at –10°C to –20°C until analysis.

3.2 Holding Time

3.2.1 Solid samples must be extracted within 14 days of collection. The Date/Time that the extraction is started and completed must be recorded on the prep sheet.

3.2.2 Extracts must be analyzed within 40 days of extraction.

4.0 Definitions

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 12 hours which ever comes first.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.4 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.5 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.6 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.7 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

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4.8 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.9 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 Reagents

5.1 Acetone – pesticide grade or equivalent

5.2 Methylene chloride – pesticide grade or equivalent

5.3 Anhydrous sodium sulfate – precleaned to remove phthalates

5.4 BNA Surrogate Solution – prepared in acetone or methanol at a concentration specified by the GC/MS analyst. All surrogate solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

5.5 BNA Spike Solution #1– prepared in acetone or methanol at a concentration specified by the GC/MS analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use. This solution contains the majority of the spiked analytes.

5.6 BNA Spike Solution #2– prepared in acetone or methanol at a concentration specified by the GC/MS analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use. This solution contains analytes that are not stable when mixed with those in Spike #1.

5.7 OPP Spike Solutions– prepared in acetone or methanol at a concentration specified by the GC/MS analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use. This solution contains Appendix II and IX OP Pesticide analytes.

5.8 AP9 Spike Solutions– prepared in acetone or methanol at a concentration specified by the GC/MS analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use. This solution contains additional Appendix II or IX analytes.

6.0 Glassware and Apparatus

6.1 400ml thick walled beaker

6.2 Glass funnels (large enough to support the filters)

6.3 500ml Erlenmeyer flask

6.4 Spatula – Stainless Steel, Teflon, or Wood. Wood should not be used for oily samples

6.5 0.5ml or 1.0ml syringes

6.6 1.0ml volumetric flask

6.7 500ml Kuderna-Danish (K-D) flask

6.8 10ml graduated concentrator tube

6.9 3-ball macro Snyder column

6.10 Disposable transfer pipettes

6.11 Teflon boiling chips

6.12 Glass wool – precleaned

6.13 Fisher P8 filters – or equivalent

6.14 2.0ml glass screw cap vials – caps must have Teflon lined septa

6.15 Water bath – adjustable temperature control

6.16 Nitrogen evaporator

6.17 Ultrasonic disrupter – minimum power of 300 watts with pulse capability

6.18 Disrupter horns – ¾" solid titanium tip

6.19 Top loading balance – capable of weighing samples to +/- 0.1 grams

7.0 Sonic Disrupter

The Misonix S3000 and Qsonica Q700 dual horn sonic disrupters do not require tuning. The sonic disrupters should be set in the pulse mode with a 50% duty cycle (energy on 50% of the time and off 50% of the time). The Misonix S3000 and Qsonica Q700 dual horn sonic disrupters will adjust the amplitude automatically to deliver 300 watts to the disrupter horns. Higher power settings may be used.

Read and follow the manufacturer's instructions for operating the sonic disrupters. Manufacturer's instructions may be found in the Active SOP directory. Any instrument maintenance or repairs in should be documented in the "Instrument Repair and Maintenance" logbook.

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8.0 Procedure

8.1 The extraction of all samples must be documented on a "prep sheet". The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the GC/MS analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

8.2 Decant any free liquid from the solid sample. Remove any foreign objects such as twigs or rocks. Thoroughly mix the sample with a spatula. Samples that are tightly packed or contain obvious layers may need to be transferred to a larger container for proper mixing. Refer to SOP QA034 for more information on sample homogenization.

8.3 Transfer approximately 30 grams of each sample to the appropriately labeled beakers. Use a clean spatula for each sample. Record the weight to the nearest 0.1gram on the prep sheet.

8.4 Add approximately 30 grams of sodium sulfate to each sample and mix until each sample has a free flowing sandy texture. Wetter soils will require more sodium sulfate.

8.5 Transfer approximately 30 grams of each of the QC samples to the appropriately labeled beakers. This includes the method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD). Use 30 grams of sodium sulfate and/or clean sand for the MB and BS. Use additional 30 gram aliquots of a sample for the MS and MSD. If there is insufficient sample amount, a lesser amount may be used. Record the sample ID, bottle number and weight on the prep sheet.

8.6 Using the dedicated spike syringe add 0.5ml of spike solution #1 and #2 to the BS, MS, and MSD. Record the spike lot number on the prep sheet.

8.7 If samples are being analyzed for Appendix II or IX add 0.5ml of OPP spike to the above BS, MS, and MSD in section 8.6. Then prepare a BS2, MS2, and MSD2 as described in section 8.5 and add 0.5ml of AP9 spike to each of these QC samples.

8.8 Using the dedicated surrogate syringe add 0.5ml of surrogate solution to each of the samples including the QC samples. Record the surrogate lot number on the prep sheet

8.9 Immediately add 100ml of 80:20 methylene chloride and acetone to each of the beakers. This will minimize the loss of the more volatile analytes.

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NOTE: Crushed concrete samples should be extracted with 100ml aliquots of methylene chloride. Concrete reacts with the acetone to form excessive Aldol Condensation by-products that interfere with the early eluting acid target compounds and surrogates.

CAUTION: ALL SOLVENT ADDITIONS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

8.10 Label the Erlenmeyer flasks and place a glass filter funnel containing a Fisher P8 filter on the top of each flask.

8.11 Place a glass filter funnel containing a Fisher P8 filter on the top of each Erlenmeyer flask. **NOTE:** Samples may also be filtered directly into the K-D's.

8.12 Place the disrupter horn in the beaker such that the tip of the horn is approximately ½ inch into to solvent but not touching the beaker or the sample.

8.13 Sonicate the sample for 3 minutes.

8.14 Remove the beaker and decant the solvent through the filter funnel into the Erlenmeyer flask.

8.15 Repeat steps 8.12 to 8.14 two more times with additional 100ml solvent aliquots. All three solvent aliquots will be combined in the K-D flask.

8.16 After the final extraction, transfer the entire sample to the funnel, rinse thoroughly, and allow the solvent to drain through the sample.

NOTE: It is important to clean the disrupter horn between samples. This is done by rinsing the horn with the extraction solvent and wiping it dry with a Kim-wipe or paper towel.

8.17 If the entire extraction procedure can not be completed on the same day, the Erlenmeyer flasks may be covered with aluminum foil and refrigerated.

8.18 Assemble and label the K-D flasks and concentrator tubes. Using forceps, place a Teflon boiling chip in each concentrator tube and set each K-D flask in a support stand.

8.19 Transfer each extract to the appropriately labeled K-D. Rinse each Erlenmeyer flask with methylene chloride and transfer it to the appropriate K-D. Attach a Snyder column to each K-D flask.

CAUTION: ALL EXTRACT TRANSFERS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

8.20 Pre-wet the Snyder column with a few drops of methylene chloride and place the K-D assembly in a hot (75 - 85 ^{o}C) water bath. **NOTE:** If the bath is too hot, the

more volatile compounds may be lost during this step. Concentrate the extract to approximately 5ml.

8.21 Remove the K-D assembly from the bath and allow it to cool. Remove the Snyder columns and rinse them with methylene chloride and then with acetone before placing them back in their storage rack.

8.22 Wipe the water from the joint area between the K-D flask and the concentrator tube. Be sure that the sample ID is still on the concentrator tube. Remove the concentrator tube from the K-D flask, **rinse the joint with solvent**, and place the concentrator tube in the rack for the nitrogen evaporator.

8.23 Use a steady stream of nitrogen to concentrate the extract to 0.5ml.

8.24 If the extract is cloudy or contains water droplets, run the extract through a micro column of glass wool and sodium sulfate.

8.25 Transfer the extract to a 1.0ml volumetric flask. Rinse the concentrator tube with a few drops of methylene chloride and transfer it to the volumetric flask. Adjust the final volume to 1.0ml. **NOTE:** If the extract will not concentrate to 1.0ml, choose the next appropriate final volume. Be sure to record the final volume on the prep sheet.

8.26 Transfer the extract to an appropriately labeled 2.0ml screw cap vial. Store the extracts in the “extract freezer” until they are needed for analysis.

9.0 Quality Assurance and Quality Control

9.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. A batch may be held open for up to 12 hours; however, samples should not be added after the QC set has been completed. **NOTE:** Some project plans may require different batch definitions.

9.2 A method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD) must be extracted with each new batch of samples.

10.0 Safety and Waste Disposal

10.1 Safety

10.1.1 Safety glasses, gloves and lab coats should be worn when handling samples, standards or solvents.

10.1.2 **Hearing protection** must be worn while operating the sonic disrupters. The high frequency could cause permanent hearing loss.

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10.1.3 Avoid touching the disrupter horns while they are active. Contact may cause burns or tissue damage.

10.1.4 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.

10.1.5 Methylene chloride is an inhalation hazard and a suspected carcinogen. Fume hoods must be used to minimize exposure to vapors.

10.2 Waste Disposal

10.2.1 Waste methylene chloride is placed in the “chlorinated waste” container.

10.2.2 Waste acetone is placed in the “non-chlorinated waste” container.

10.2.3 Extracted soil samples are placed in a waste container after the solvent has drained.

10.2.4 Waste soil from the homogenizing process should be placed in the “soil waste” container. **NOTE:** Waste soil from foreign soils must follow “foreign soil” disposal requirements.

10.2.5 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining soil samples are transferred to the appropriate drums for disposal.

11.0 References

SW-846 Method 3500C, Rev. 3, 02/07

SW-846 Method 3550C, Rev. 3, 02/07

SW-846 Method 8270D, Rev. 4, 07/14

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STANDARD OPERATING PROCEDURE FOR THE TOXICITY CHARACTERISTIC LEACHING OF SEMIVOLATILE ORGANICS AND METALS (TCLP)

Prepared by: Norm Farmer Date: 08/08/14

Approved by: Mark Erstling Date: 08/15/14

Annual Review

Reviewed by: Norm Farmer Date: 09/09/15

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TEST NAME: STANDARD OPERATING PROCEDURE FOR THE TOXICITY CHARACTERISTIC LEACHING OF SEMIVOLATILE ORGANICS AND METALS (TCLP)

Method: SW846 1311

Dept: OP

Revised Sections: 5.7, 7.2.8, 7.4.1, 7.4.2 and 7.5.4

1.0 Summary, Scope and Application

1.1 Summary

For liquid and aqueous samples containing less than 0.5% solids, the sample is filtered through TCLP filter paper and the filtrate is defined as the TCLP leachate. The leachate can then be analyzed for semivolatile organics and metals.

For solid samples, the solid portion of the sample is extracted by adding extraction fluid equal to 20 times the weight of the sample and rotating the sample for 18 hours at 30 rpm. The extraction fluid used is based on the alkalinity of the solid portion of the sample. After leaching, the sample is filtered through TCLP filter paper. The leachate can then be analyzed for semivolatile organics and metals.

1.2 Scope and Application

This procedure is applicable to samples submitted for TCLP semivolatile analysis and/or TCLP metals analysis.

1.2.1 Metals by 6010

1.2.2 Mercury by 7470

1.2.3 Semivolatiles by 8270

1.2.4 Pesticides by 8081

1.2.5 Herbicides by 8151

1.2.6 Extractable TPH by 8015

2.0 Discussion and Comments

This procedure is adapted from SW-846 method 1311. The method utilizes an extraction bottle and rotary agitation device to evaluate the presence and mobility of semivolatile analytes and metals. It is not applicable for evaluating the mobility of volatile analytes.

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3.0 Preservation and Holding Times

3.1 Preservation

3.1.1 Samples shall be collected in amber glass bottles with Teflon lined caps. One-liter bottles are recommended for aqueous samples and 300ml jars are recommended for solid samples. Liquid samples for the analysis of metals only may be collected in HDPE bottles.

3.1.2 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until leaching.

3.1.3 Samples for TCLP analysis should not be chemically preserved prior to leaching. After filtration, the TCLP leachate for metals should be preserved to a pH <2 with nitric acid unless the leachates will be digested immediately.

3.1.4 TCLP Leachates for semivolatile organics must be protected from light and stored at ≤ 6°C from the time of filtration until extraction.

3.2 Holding Time

3.2.1 Samples submitted for the analysis of semivolatile organics including pesticides and herbicides must be leached within 14 days of collection.

3.2.2 Samples submitted for the analysis of mercury must be leached within 28 days of collection.

3.2.3 Samples submitted for the analysis of metals (except mercury) must be leached within 180 days of collection.

3.2.4 Leachates for semivolatile organics must be extracted by the appropriate procedure within 7 days of filtration.

4.0 Definitions

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

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4.4 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.5 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.6 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.7 Leachate Blank Spike (LBS): An aliquot of TCLP fluid spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Leachate blank spike recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.8 Leachate Blank (LB): An aliquot of TCLP fluid to which all reagents are added in the same volumes or proportions as used in sample processing. The leachate blank is processed simultaneously with the samples through all the steps of the analytical procedure. The Leachate blank is used to document contamination resulting from the analytical process.

4.9 Leachate Spike (LS): A sample leachate aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The leachate spike recoveries are used to document the bias of a method in a given sample matrix.

4.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.12 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

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5.0 Reagents

5.1 Reagent water – distilled or deionized - free of interferences

5.2 Hydrochloric Acid, 1.0N Fisher brand or equivalent

5.3 Sodium Hydroxide, 10.0N Fisher brand or equivalent

5.4 Glacial Acetic Acid, Reagent Grade

5.5 Extraction Fluid #1: Add 57 ml of glacial acetic acid and 64.3 ml of 10.0N sodium hydroxide to a 1000ml graduated cylinder and dilute to 1 liter with reagent water. Transfer to a PTFE lined carboy. Using a 1000ml graduated cylinder, transfer an additional 9 liters of reagent water to the carboy. Mix thoroughly. This will prepare 10 liters of Fluid #1. The preparation of all TCLP fluids must be logged in the Organics Reagent Logbook and the pH must be verified prior to use. The pH of this solution should be 4.93 $\pm$ 0.05.

NOTE: If the pH of the fluid is out of range, remake the fluid.

5.6 Extraction Fluid #2: Add 57 ml of glacial acetic acid to a 1000ml graduated cylinder and dilute to 1 liter with reagent water. Transfer to a PTFE lined carboy. Using a 1000ml graduated cylinder, transfer an additional 9 liters of reagent water to the carboy. Mix thoroughly. This will prepare 10 liters of Fluid #2. The preparation of all TCLP fluids must be logged in the Organics Reagent Logbook and the pH must be verified prior to use. The pH of this solution should be 2.88 $\pm$ 0.05.

NOTE: If the pH of the fluid is out of range, remake the fluid.

5.7 Buffer solution at pH 2, pH 4, pH 7 and pH 10. Commercially available solutions that have been validated by comparison to NIST standards are recommended for routine use. All buffers must be labeled on receipt and after opening. Buffer solutions should be refreshed weekly. **When analyzing samples from West Virginia the buffers must be refreshed on the day of use.**

6.0 Glassware and Apparatus

6.1 Agitation apparatus – Environmental Express, Millipore Corp., or equivalent. Must be capable of rotating the extraction vessels in an end-over-end fashion at 30 $\pm$ 2 rpm.

6.2 Extraction Vessels – 2 liter PTFE coated HDPE bottles

6.3 Filtration device - Millipore Corp.142 mm, or equivalent, capable of exerting pressures of up to 50 psi

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6.4 Filters – Environmental Express or equivalent, 0.7um glass fiber, 142 mm diameter. Filters are acid washed by the manufacturer.

6.5 pH meter - capable of reading ± 0.05 pH units

6.6 Balance - capable of weighing ± 0.01 g

6.7 Graduated cylinders – 100ml and 1000ml

6.8 Beakers – 250 ml glass or plastic

6.9 Watchglass - appropriate to cover beaker

6.10 Magnetic Stirrer and stir bars

6.11 PTFE lined 20 liter carboy

6.12 Thermometer, calibrated against an NIST traceable thermometer

6.13 Water bath – adjustable temperature control

7.0 Procedure

7.1 The preparation of all samples must be documented. See Section 8.1 for the various logbooks and prep sheets that are required for this method. The prep sheet will include such items as: sample ID, bottle number, initial volume, final volume, pHs, lot numbers, batch numbers, and leachate dates and times.

The extraction technician is responsible for filling out all the required information. A copy of the prep sheet will be submitted to the analyst with the leachates. The leaching start date and time are entered into LIMS.

7.2 Determination of Percent Solids

7.2.1 If the sample will obviously yield no liquid when subjected to pressure filtration, proceed to Section 7.5.

7.2.2 If the sample is liquid or mixed-phase (solid and liquid), proceed as follows. **NOTE:** If the sample appears to contain an organic liquid phase, notify the Department Supervisor. It is recommended that samples containing organic phases be analyzed as “totals” instead of TCLP.

7.2.3 Pre-weigh the filter and container that will receive the filtrate. Document all weights in the TCLP_SPLP Description Log.

7.2.4 Assemble the filtering apparatus as per the manufacturer's instructions.

7.2.5 Transfer a 100 gram aliquot of the sample to a beaker and record the weight. If a 100 gram aliquot is not available, inform the Department Supervisor.

7.2.6 Quantitatively transfer the sample aliquot to the filter apparatus. Slurries may be allowed to settle and the liquid portion filtered prior to transferring the solid portion of the sample. **NOTE**: If sample material has adhered to the sample container, obtain the weight of this residue and subtract from the total weight of the sample.

7.2.7 Complete the assembly of the filtration device, and gradually apply pressure until fluid is expelled or 10 psi is obtained. If no fluid is expelled, gradually increase the pressure in 10 psi increments to a maximum of 50 psi. If no fluid is expelled in any 2 minute period, stop the filtration. Shut off the pressurizing gas and vent the filtration system using the top vent.

CAUTION: DO NOT REMOVE FLANGE CLAMPS WHILE SYSTEM IS PRESSURIZED! SERIOUS INJURY MAY RESULT.

NOTE: Instantaneous application of high pressure can cause the filter to clog prematurely.

7.2.8 The material in the filtration apparatus is defined as the solid phase.

NOTE: Some high viscosity liquids (oils, paints) will not filter under these circumstances. The material remaining within the filtration device is defined as the solid phase.

NOTE: If the sample appears to contain an organic liquid phase, notify the Department Supervisor. It is recommended that samples containing organic phases be analyzed as “totals” instead of TCLP.

7.2.9 Remove the solid phase of the sample and the filter from the filtration apparatus. If there is a noticeable amount of filtrate entrained in the filter, then dry at 100 °C ± 20 until two successive readings yield the same value within ±1%. Record the final weight.

7.2.10 Determine the percent solids as follows:

$$\% \text{ solids} = \frac{(W - F) \times 100}{T}$$

W = Weight of sample remaining on filter
F = Weight of filter
T = Initial weight of sample used

7.2.11 If the sample contains <0.5% solids, the filtrate is defined as the sample leachate. **NOTE:** Additional aliquots may need to be filtered to generate sufficient volume for all of the analysis. Proceed to Section 7.5.10.

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7.3 Determination of Particle Size

7.3.1 Evaluate the solid portion of the sample for particle size. If the solid portion of sample has a surface area equal to or greater than 3.1 cm^2/gram, then the sample does not require particle size reduction. This would apply to samples such as paper, filter material or rags.

7.3.2 Alternatively, if the solid portion of the sample is smaller than 1 cm in its narrowest dimension (i.e. is capable of passing through a 9.5 mm sieve), then the sample does not require particle size reduction.

7.3.3 If the sample does not meet the particle size criteria listed above, then prepare the solid portion of the sample for extraction by crushing, cutting, or grinding the sample. Care should be taken to minimize any potential metals contamination.

7.3.4 Document the sample description and any particle size reduction in the TCLP_SPLP Description Log.

7.4 Determination of Extraction Fluid

7.4.1 pH Meter Calibration

Make sure that the pH electrode is clean. If the electrode is coated with oil or grease, then it must be washed with a 50% water-methanol solution and then rinse it well with DI water. Do not soak the electrode in the acetone solution. Soak the electrode in a beaker containing pH 7 buffer for approximately 2 hours before using.

Connect the pH electrode to the pH meter. Calibrate the meter using three of the following buffers: pH 2, pH 4, pH 7 or pH 10. Buffers chosen must bracket the pH range. Read back the remaining buffer. For details on specific calibration procedure, see the instruction manual for the meter being used.

After the calibration is complete, analyze the 3 buffer solutions to ensure that an accurate calibration was obtained. Record the results in the TCLP Fluid Determination Log. Readings must be within 0.05 pH units of the buffer solution's true value.

7.4.2 Transfer a 5.0 gram aliquot of the solid phase of the sample to a 250 ml beaker. Record the actual weight in the fluid determination log.

NOTE: The particle size of the solid phase should be < 1mm for this step. This may require some particle size reduction.

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7.4.3 Add 96.5 ml of DI water to the beaker. Place a magnetic stir bar in the beaker and cover with a watch glass. Stir vigorously for 5 minutes. Measure and record the pH in the TCLP Fluid Determination Log. If the pH is <5.0, use extraction fluid #1, and proceed to step 7.5.

7.4.4 If the pH is >5.0, add 3.5 ml of 1.0N HCl and swirl gently. Cover the beaker with a watch glass and heat to 50℃ for 10 minutes.

7.4.5 Allow the solution to cool. Stir vigorously for 5 minutes. Measure and record the pH. If the pH is <5.0, use extraction fluid #1. If the pH is >5.0, use extraction fluid #2.

NOTE: All pH measurements must be recorded to two places after the decimal point.

7.5 Extraction of Semivolatile Organics and Metals

7.5.1 If the sample contains 100% solids, and the sample does not need particle size reduction transfer a minimum of 100g aliquot of the sample to the extraction vessel. Record the weight to ± 0.1 gram on the TCLP_SPLP Sample Prep Sheet. Add 20 times the sample weight of the appropriate extraction fluid to the leaching vessel. Swirl gently and watch for the evolution of carbon dioxide. If no gasses are evolved, cap the container and mount on the rotary agitator. Proceed to section 7.5.4.

7.5.2 If the sample contains <0.5% solids, the filtrate obtained in step 7.2 is defined as the sample leachate. Proceed to section 7.5.10.

7.5.3 If the sample is mixed phase and/or contains >0.5% solids, transfer a 100g aliquot of the sample or more, based on % solids to the filtration device. Assemble the filtration apparatus, and gradually apply pressure to remove any free liquids. Expelled liquid is stored in a glass container, and is to be recombined with sample leachate. Transfer the solid portion of the sample to the appropriate extraction vessel. Add a volume of the appropriate TCLP fluid, calculated as follows:

$$\frac{20 \times \text{sample wt (g)} \times \text{\% solids}}{100} = \text{ml extraction fluid}$$

Swirl gently and watch for evolution of carbon dioxide. Cap the extraction bottle and attach to rotary agitator. Allow the extraction to proceed 18 ± 2 hrs.

NOTE: If the sample contains <25% solids, more sample can be filtered to obtain sufficient solids for leaching such that all analyses may be performed. Consult the Department Supervisor.

7.5.4 Rotate at 30 ±2 rpm. Make sure to measure and record the rotation rate and tumbler ID on the TCLP_SPLP Sample Prep Sheet. Allow the extraction to proceed for 18 ± 2 hrs.

The vessels should be vented periodically during the first hour to prevent pressure build up.

NOTE: The temperature of the extraction room must be 23 ± 2 °C during the extraction period. Record the temperature on TCLP_SPLP Sample Prep Sheet. Use a Hi/Lo thermometer to monitor the room temperature through out the extraction period.

7.5.5 After the leaching period has elapsed, remove the extraction vessels from the rotary agitator and allow them to settle.

7.5.6 Assemble the filtration device. Filter each sample into an appropriately labeled container. Multiple filters may be used. Be sure to thoroughly clean the filtration apparatus between samples.

7.5.7 If a compatible liquid was obtained in Section 7.5.3, combine the liquids at this time.

7.5.8 If the liquids are not compatible, record the total volume of the expelled liquid in the sample description logbook and submit both fractions for analysis. Notify the Department Supervisor.

NOTE: Department Supervisor will notify the Project Manager to determine if the phases are to be mathematically combined as in Section 7.5.13, or to be report separately.

7.5.9 Measure and record the pH of each leachate in the TCLP Fluid Determination Log. See Section 7.4.1 for pH meter calibration.

NOTE: All pH measurements must be recorded to two places after the decimal point.

7.5.10 Aliquot the leachate for the necessary analyses. Listed below are the minimum quantities required for analysis. Additional aliquots will be needed for QC samples.

7.5.10.1	Metals (including Mercury)	100ml
7.5.10.2	Semivolatiles by 8270	100ml
7.5.10.3	Pesticides by 8081	100ml
7.5.10.4	Herbicides by 8151	10ml
7.5.10.5	TPH by 8015	100ml

7.5.11 Leachates for metals analysis are stored in labeled plastic bottles and transferred to the metals department.

7.5.12 All other aliquots (semi-volatile organics) are transferred to amber glass bottles and stored at ≤ 6°C until the subsequent extractions can be performed.

7.5.13 If individual phase are analyzed separately (see 7.5.8) conduct the appropriate analysis and combine the results mathematically by using the following formula:

Final Analyte Conc. = [(V1*C1)+(V2*C2)] / (V1+V2)

V1 = The volume of the first phase (l)
C1 = The conc. of the analyte of concern in the first phase (mg/l)
V2 = The volume of the second phase (l)
C2 = The conc. of the analyte of concern in the second phase (mg/l)

8.0 Documentation

8.1 Documentation for this analysis is quite extensive. At minimum the following logbooks or prep sheets must be filled out completely.

8.1.1 TCLP_SPLP Description Log

8.1.2 TCLP Fluid Determination Log

8.1.3 TCLP_SPLP Sample Prep Sheet

8.1.4 Extraction Bottle Tracking Log

8.1.5 Organics Reagent Log

8.2 For every 20 extractions performed in an extraction vessel, a leachate blank must be performed using that vessel. Document this in the Extraction Bottle Tracking Log.

8.3 For each original matrix type extracted, (soil, water, sludge, etc.) a leachate spike must be performed. Various unique matrices may require their own leachate spikes.

9.0 Quality Assurance, Quality Control and Method Performance

9.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. A batch may be held open for up to 6 hours; however, samples should not be added after the QC set has been completed. **NOTE:** All samples and QC samples must leached for the required amount of time.

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9.2 A leachate blank (LB) and sample duplicate (DUP) must be leached with each batch of samples. A leachate blank must be prepared for each fluid type used in a given batch.

9.3 All spiking for the matrix spike (MS) and matrix spike duplicate (MSD), leachate spike (LS), and leachate blank spike (LBS) occurs after filtration.

9.4 Method performance is monitored through the routine analysis of negative and positive control samples. Leachate blank spikes and matrix spikes are not applicable to the leaching portion of this test; however, they will be used later to assess the extraction and digestion efficiency of the specific methods performed on the leachate.

9.5 A sample duplicate is used to assess method precision. Sample duplicate %RPD is compared to method defined control limits. Control limits are stored in the LIMS.

10.0 Safety and Waste Disposal

10.1 Safety

10.1.1 Safety glasses, gloves and lab coats should be worn when handling acids, samples, standards or solvents.

10.1.2 Perform all filtration in a fume hood.

10.1.3 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.

10.2 Waste Disposal

10.2.1 The TCLP filter and remaining sample is placed in a waste container.

10.2.2 Extra leachate is rinsed down the drain with large amounts of water.

10.2.3 Waste soil from the homogenizing process should be place in the “soil waste” container. **NOTE:** Waste soil from foreign soils must follow “foreign soil” disposal requirements.

11.0 References

SW-846 Method 1311, Rev. 0, 07/92

SW-846 Method 1312, Rev. 0, 09/94

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APPENDIX C
Project Schedule

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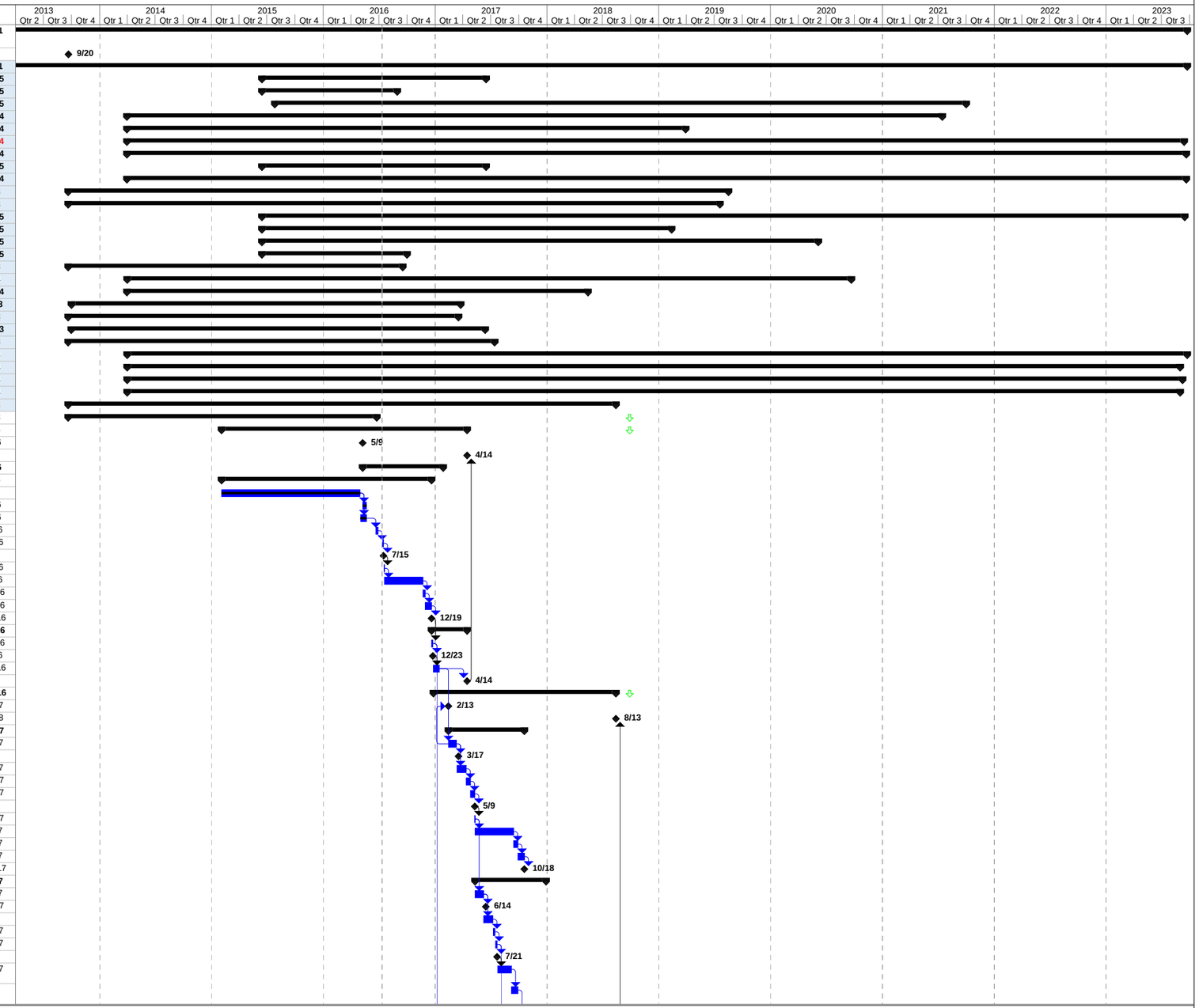
New Mexico-Arizona Group
Holloman AFB, New Mexico
Performance Based Remediation
Integrated Master Schedule

FPM Remediations, Inc.

ID	Name	Date of Exercise	Projected Date of Exercise	POP Deadline	Duration	Start
1	**Environmental Remediation in accordance with the PBR Statement of Objectives (SOO) - Contract Award**	**NA**	NA	**Wed 9/26/18**	**5837 days**	**Thu 5/10/01**
2	Award	NA	NA	**NA**	0 days	Fri 9/20/13
3	**Holloman AFB**	**NA**	**NA**	**NA**	**5837 days**	**Thu 5/10/01**
4	**SS013 - Sodium Arsenite Spill Area**	**NA**	**NA**	**Thu 6/15/17**	**524 days**	**Mon 6/15/15**
33	**OT014 - Former Entomology Shop Area**	**NA**	**NA**	**Thu 6/15/17**	**316 days**	**Mon 6/15/15**
59	**SS017 - BX Gas Station Fuel Spill**	**NA**	**NA**	**Thu 9/30/21**	**1614 days**	**Mon 7/27/15**
251	**SS018 - Chromic Acid Spill Site**	**NA**	**NA**	**Mon 8/30/21**	**1903 days**	**Mon 3/31/14**
489	**SD027 - PAD 9 Washrack Area - Rad Waste**	**NA**	**NA**	**Sat 3/30/19**	**1305 days**	**Mon 3/31/14**
550	**LF029 - Old Army Landfill**	**NA**	**NA**	**Fri 9/22/23**	**2467 days**	**Mon 3/31/14**
815	**DP030 - Grease Trap Disposal Pits**	**NA**	**NA**	**Fri 9/22/23**	**2472 days**	**Mon 3/31/14**
1019	**OT032 - Former Primate Research Area**	**NA**	**NA**	**Thu 6/15/17**	**524 days**	**Mon 6/15/15**
1048	**SD033 - Cooking Grease Disposal Trench**	**NA**	**NA**	**Fri 9/22/23**	**2472 days**	**Mon 3/31/14**
1251	**OT037 - Early Missile Testing Site**	**NA**	**NA**	**Sat 9/22/18**	**1541 days**	**Fri 9/20/13**
1332	**OT038 - Test Sled Maintenance Area**	**NA**	**NA**	**Wed 9/26/18**	**1521 days**	**Fri 9/20/13**
1412	**SS039 - Missile Fuel Spill Area**	**NA**	**NA**	**Fri 9/22/23**	**2154 days**	**Mon 6/15/15**
1745	**RW042 - Radioactive Waste Disposal Area**	**NA**	**NA**	**Fri 6/30/17**	**956 days**	**Mon 6/15/15**
1850	**SS065 - Test Cell Surface Spill**	**NA**	**NA**	**Tue 6/30/20**	**1299 days**	**Mon 6/15/15**
1904	**SS067 - Spill and Sand Blasting Residuals Area**	**NA**	**NA**	**Fri 6/30/17**	**340 days**	**Mon 6/15/15**
1929	**SS069 - Flightline Fuel Spill Area**	**NA**	**NA**	**Sat 9/22/18**	**781 days**	**Fri 9/20/13**
1984	**TU904 - Building 1194**	**NA**	**NA**	**Wed 9/30/20**	**1689 days**	**Tue 4/1/14**
2142	**TU515 - Building 889**	**NA**	**NA**	**Sat 9/30/17**	**1076 days**	**Mon 3/31/14**
2269	**TU503 - Building 221**	**NA**	**NA**	**Wed 3/29/17**	**909 days**	**Tue 10/1/13**
2397	**TU506 - Building 901**	**NA**	**NA**	**Wed 3/22/17**	**911 days**	**Fri 9/20/13**
2524	**TU508 - Building 298**	**NA**	**NA**	**Wed 3/22/17**	**966 days**	**Mon 9/30/13**
2647	**TU518 - UST 7003**	**NA**	**NA**	**Wed 3/22/17**	**995 days**	**Fri 9/20/13**
2774	**OD20K - 20,000 Pound Open Detonation Unit**	**NA**	**NA**	**Fri 9/22/23**	**2474 days**	**Tue 4/1/14**
2989	**OW967 - SWMU 20 (Within T-38 Site)**	**NA**	**NA**	**Fri 9/22/23**	**2457 days**	**Tue 4/1/14**
3190	**OW968 - SWMU 19 (Within T-38 Site)**	**NA**	**NA**	**Fri 9/22/23**	**2463 days**	**Tue 4/1/14**
3391	**SS059, SS524 - T-38 Test Cell (SWMU 229)**	**NA**	**NA**	**Fri 9/22/23**	**2457 days**	**Tue 4/1/14**
3605	**TS851 - Former Skeet Range**	**NA**	**NA**	**Sat 9/22/18**	**1277 days**	**Fri 9/20/13**
3606	**Achieve Final Action Memorandum**	**Fri 9/20/13**	**Fri 9/20/13**	**Sat 9/22/18**	**720 days**	**Fri 9/20/13**
3635	**Achieve Final Non-Time Critical Removal Action (NTCRA) Work Plan**	**Fri 9/20/13**	**Mon 9/29/14**	**Sat 9/22/18**	**574 days**	**Tue 2/3/15**
3636	NTP (TS851/0063AB)	NA	NA	NA	0 days	Mon 5/9/16
3637	POP Completion Date	NA	NA	NA	0 days	Fri 4/14/17
3638	**Explosive Safety Submission (ESS)**	**NA**	NA	NA	**189 days**	**Mon 5/9/16**
3649	**Non-Time Critical Removal Action (NTCRA) Work Plan**	**NA**	NA	NA	**490 days**	**Tue 2/3/15**
3650	Prepare and Submit Draft NTCRA Work Plan	NA	NA	NA	324 days	Tue 2/3/15
3651	Air Force Approval Draft NTCRA Work Plan Milestone	NA	NA	NA	10 days	Mon 5/9/16
3652	Air Force Review of Draft/Provide Comments	NA	NA	NA	15 days	Mon 5/2/16
3653	Respond to Air Force Comments	NA	NA	NA	5 days	Tue 6/21/16
3654	Prepare and Submit Draft Final NTCRA Work Plan	NA	NA	NA	5 days	Mon 7/11/16
3655	Air Force Approval of Draft Final NTCRA Work Plan Milestone	NA	NA	NA	0 days	Fri 7/15/16
3656	Submit Draft Final for EPA Review	NA	NA	NA	1 day	Mon 7/18/16
3657	EPA Review of Draft Final/Provide Comments	NA	NA	NA	90 days	Tue 7/19/16
3658	Respond to EPA Comments on Draft Final and Prepare NTCRA Work Plan	NA	NA	NA	5 days	Tue 11/22/16
3659	Air Force and EPA Review of Final NTCRA Work Plan/Revise as needed	NA	NA	NA	15 days	Tue 11/29/16
3660	EPA and Air Force Approval of Final NTCRA Work Plan Milestone	NA	NA	NA	0 days	Mon 12/19/16
3661	**NTCRA Field Activities**	**NA**	NA	NA	**84 days**	**Tue 12/20/16**
3662	UIC Permit/Utility Locates/Dig Permits/Mobilization	NA	NA	NA	4 days	Tue 12/20/16
3663	Construction Bond	NA	NA	NA	0 days	Fri 12/23/16
3664	Soil Removal, Confirmatory Soil Sampling and Site Restoration	NA	NA	NA	15 days	Mon 12/26/16
3665	ERPIMS Submission	NA	NA	NA	0 days	Fri 4/14/17
3666	**Achieve Site Closeout (SC) in accordance with Table 1 of the SOO**	**NA**	**Thu 8/13/15**	**Sat 9/22/18**	**426 days**	**Mon 12/26/16**
3667	NTP (TS851/0063AC)	NA	NA	NA	0 days	Mon 2/13/17
3668	POP Completion Date	NA	NA	NA	0 days	Mon 8/13/18
3669	**NTCRA Completion Report**	**NA**	NA	NA	**178 days**	**Mon 2/13/17**
3670	Prepare and Submit Draft NTCRA Completion Report	NA	NA	NA	20 days	Mon 2/13/17
3671	Air Force Approval Draft NTCRA Completion Report Milestone	NA	NA	NA	0 days	Fri 3/17/17
3672	Air Force Review of Draft/Provide Comments	NA	NA	NA	22 days	Mon 3/13/17
3673	Respond to Air Force Comments	NA	NA	NA	10 days	Wed 4/12/17
3674	Prepare and Submit Draft Final NTCRA Completion Report	NA	NA	NA	10 days	Wed 4/26/17
3675	Air Force Approval of Draft Final NTCRA Completion Report Milestone	NA	NA	NA	0 days	Tue 5/9/17
3676	Submit Draft Final for EPA Review	NA	NA	NA	1 day	Wed 5/10/17
3677	EPA Review of Draft Final/Provide Comments	NA	NA	NA	90 days	Thu 5/11/17
3678	Respond to EPA Comments on Draft Final and Prepare NTCRA Completion Report	NA	NA	NA	10 days	Thu 9/14/17
3679	Air Force and EPA Review of Final NTCRA Completion Report/Revise as needed	NA	NA	NA	15 days	Thu 9/28/17
3680	EPA and Air Force Approval of Final NTCRA Completion Report Milestone	NA	NA	NA	0 days	Wed 10/18/17
3681	**NFA ESS**	**NA**	NA	NA	**166 days**	**Thu 5/11/17**
3682	Prepare and Submit Draft NFA ESS	NA	NA	NA	20 days	Thu 5/11/17
3683	Air Force Approval Draft NFA ESS Milestone	NA	NA	NA	0 days	Wed 6/14/17
3684	Air Force Review of Draft/Provide Comments	NA	NA	NA	22 days	Thu 6/8/17
3685	Respond to Air Force Comments/Prepare and Submit Draft Final NFA ESS	NA	NA	NA	5 days	Mon 7/10/17
3686	Air Force Review of Draft Final NFA ESS/Revise as needed	NA	NA	NA	5 days	Mon 7/17/17
3687	Air Force Approval Draft Final NFA ESS Milestone	NA	NA	NA	0 days	Fri 7/21/17
3688	AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Review of Draft Final/Provide Comments	NA	NA	**NA**	33 days	Mon 7/24/17
3689	Respond to AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Comments on Draft Final and Prepare Final NFA ESS	NA	NA	**NA**	15 days	Thu 9/7/17



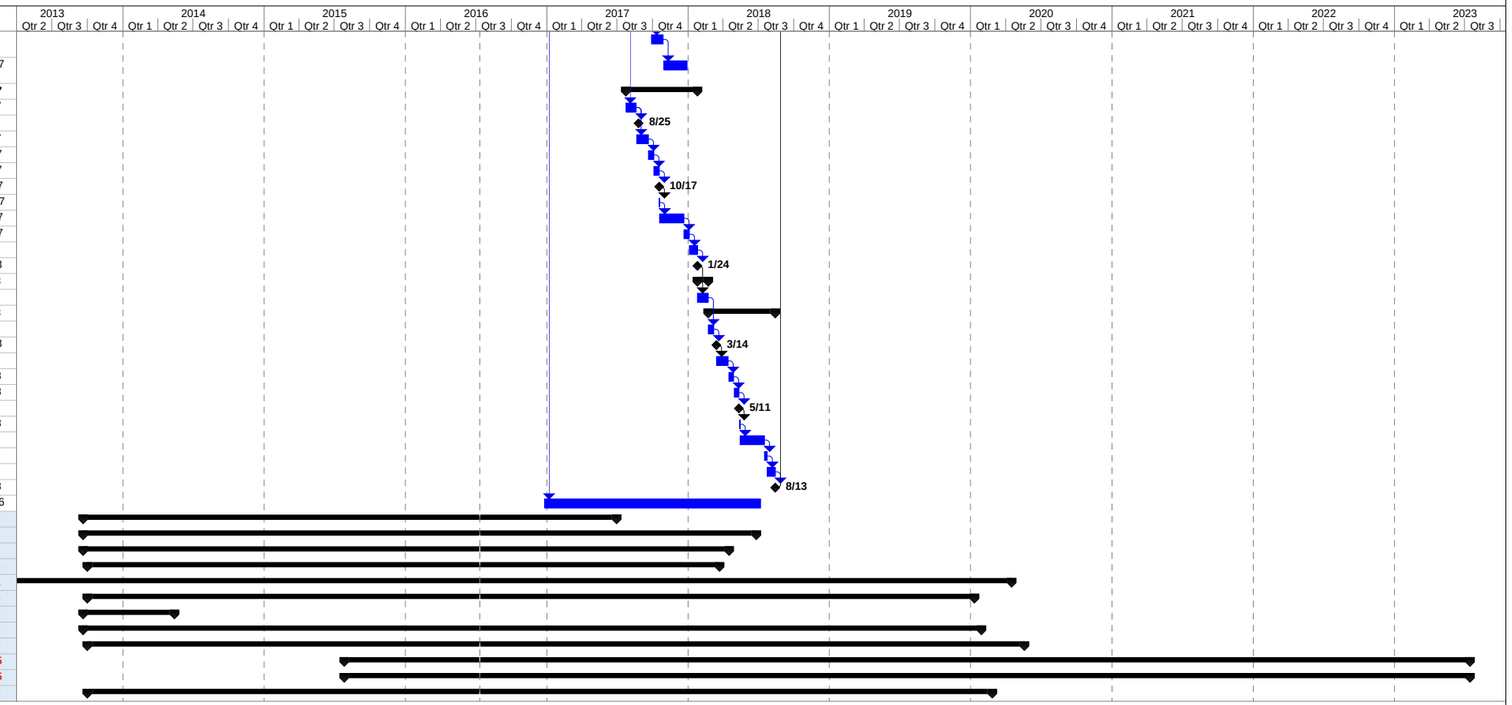
Project: Integrated Master Schedule
Date: Tue 7/12/16
File: AZ-NM Holloman IMS July 2016 U

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Critical | Critical Split | Progress | Deadline

New Mexico-Arizona Group
Holloman AFB, New Mexico
Performance Based Remediation
Integrated Master Schedule

FPM Remediations, Inc.

ID	Name	Date of Exercise	Projected Date of Exercise	POP Deadline	Duration	Start
3690	AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Review of Final NFA ESS/Revise as needed	NA	NA	**NA**	22 days	Thu 9/28/17
3691	AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Approval of Final NFA ESS Milestone	NA	NA	**NA**	44 days	Mon 10/30/17
3692	**Proposed Plan**	**NA**	NA	NA	**133 days**	**Mon 7/24/17**
3693	Prepare and Submit Draft Proposed Plan	NA	NA	NA	20 days	Mon 7/24/17
3694	Air Force Approval Draft Proposed Plan Milestone	NA	NA	NA	0 days	Fri 8/25/17
3695	Air Force Review of Draft/Provide Comments	NA	NA	NA	22 days	Mon 8/21/17
3696	Respond to Air Force Comments	NA	NA	NA	10 days	Wed 9/20/17
3697	Prepare and Submit Draft Final Proposed Plan	NA	NA	NA	10 days	Wed 10/4/17
3698	Air Force Approval of Draft Final Proposed Plan Milestone	NA	NA	NA	0 days	Tue 10/17/17
3699	Submit Draft Final for EPA Review	NA	NA	NA	1 day	Wed 10/18/17
3700	EPA Review of Draft Final/Provide Comments	NA	NA	NA	45 days	Thu 10/19/17
3701	Respond to EPA Comments on Draft Final and Prepare Proposed Plan	NA	NA	NA	10 days	Thu 12/21/17
3702	Air Force and EPA Review of Final Proposed Plan/Revise as needed	NA	NA	NA	15 days	Thu 1/4/18
3703	EPA and Air Force Approval of Final Proposed Plan Milestone	NA	NA	NA	0 days	Wed 1/24/18
3704	**Public Comment Period**	**NA**	NA	NA	**20 days**	**Thu 1/25/18**
3705	Comment Period	NA	NA	NA	20 days	Thu 1/25/18
3706	**No Further Action Record of Decision (NFA ROD)**	**NA**	NA	NA	**123 days**	**Thu 2/22/18**
3707	Prepare and Submit Draft NFA ROD	NA	NA	NA	10 days	Thu 2/22/18
3708	Air Force Approval Draft NFA ROD Milestone	NA	NA	NA	0 days	Wed 3/14/18
3709	Air Force Review of Draft/Provide Comments	NA	NA	NA	22 days	Thu 3/15/18
3710	Respond to Air Force Comments	NA	NA	NA	10 days	Mon 4/16/18
3711	Prepare and Submit Draft Final NFA ROD	NA	NA	NA	10 days	Mon 4/30/18
3712	Air Force Approval of Draft Final NFA ROD Milestone	NA	NA	NA	0 days	Fri 5/11/18
3713	Submit Draft Final for EPA Review	NA	NA	NA	1 day	Mon 5/14/18
3714	EPA Review of Draft Final/Provide Comments	NA	NA	NA	45 days	Tue 5/15/18
3715	Respond to EPA Comments on Draft Final and Prepare NFA ROD	NA	NA	NA	5 days	Tue 7/17/18
3716	Air Force and EPA Review of Final NFA ROD/Revise as needed	NA	NA	NA	15 days	Tue 7/24/18
3717	EPA and Air Force Approval of Final NFA ROD Milestone	NA	NA	NA	0 days	Mon 8/13/18
3718	PBR Contractor Plan B (Trigger Evaluation/Implementation)	NA	NA	NA	400 days	Mon 12/26/16
3719	**XU853 - Missile Test Stands Area**	**NA**	**NA**	**Sat 9/22/18**	**985 days**	**Fri 9/20/13**
3794	**XU854 - Able 51 Area**	**NA**	**NA**	**Sat 9/29/18**	**1242 days**	**Fri 9/20/13**
3951	**FI857 - Former Bunker**	**NA**	**NA**	**Sat 9/22/18**	**1192 days**	**Fri 9/20/13**
4059	**SR858 - Former Small Arms Range**	**NA**	**NA**	**Sat 9/22/18**	**1168 days**	**Tue 10/1/13**
4205	**SR859 Former Skeet Range**	**NA**	**NA**	**Fri 5/29/20**	**4940 days**	**Thu 5/10/01**
4349	**TS862 - Jeep Target Area Skeet Range**	**NA**	**NA**	**Fri 5/29/20**	**1639 days**	**Tue 10/1/13**
4493	**SR863 - 1000 Inch Range**	**NA**	**NA**	**Sat 9/22/18**	**168 days**	**Fri 9/20/13**
4535	**SR864 - Poorman Range**	**NA**	**NA**	**Fri 5/22/20**	**1658 days**	**Fri 9/20/13**
4612	**ML865 - Ballistics Rain Field**	**NA**	**NA**	**Fri 5/29/20**	**1730 days**	**Tue 10/1/13**
4752	**ML866 - Former Bombing Range**	**NA**	**NA**	**Fri 9/22/23**	**2080 days**	**Mon 7/27/15**
4894	**SR867 - Possible Firing Range**	**NA**	**NA**	**Fri 9/22/23**	**2080 days**	**Mon 7/27/15**
5036	**RR869 - Debris Field**	**NA**	**NA**	**Wed 1/29/20**	**1671 days**	**Tue 10/1/13**



Project: Integrated Master Schedule
Date: Tue 7/12/16
File: AZ-NM Holloman IMS July 2016 U

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Critical | Critical Split | Progress | Deadline

APPENDIX D
Health and Safety Activity Hazard Analysis

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Site Description:

This is a Site-Specific Health and Safety Activity Hazard Analysis for the Non-Time Critical Removal Action (NTCRA) at the TS851a – Former Skeet Range MRS at Holloman AFB. The objective of the NTCRA is to remove identified threats to human health and the environment due historical releases at the site.

Summary of Contaminants

MRS	Identified Releases	Primary Release Mechanism	Potential MC
TS851a – Former Skeet Range	Small Arms Training, Clay Target Debris	Small Arms Training	PAHs

Site-Specific Health and Safety Concerns:

- Slip/Trip/Fall potential due to uneven ground while walking sites
- Muscular injury due to lifting supplies/equipment
- Heavy Equipment
- Ticks (e.g., tick borne diseases); mosquitoes (West Nile virus); deer flies, horse flies, bees, wasps.
- Spiders and Scorpions
- Chemical hazards (e.g., PAHs in soil, gasoline, diesel fuel)

Refer to the Activity Hazard Analysis for additional information regarding site-specific hazards and procedures to control or mitigate the hazard.

Health and Safety Personnel and Contact Information:

Emergency Contact Information		Phone Number
Ambulance:		911
Fire:		911
Sheriff:		911
Hospital:	2669 N Scenic Dr, Alamogordo, NM 88310	911 / (575) 439-6100
National Spill Response Center		911 / (800) 424-8802
Poison Control Center:	New Mexico Poison Center	911 / (800) 22-1222
Federal OSHA Hot Line		(800) 321-6742
FPM Project Manager	Peter Corigliano	Office: (315) 336-7721 Cell: (315) 527-3415
FPM Program Manager	Gaby Atik, P.E., PMP	Office: (315) 336-7721 x. 202 Cell: (315) 725-4497
FPM Occupational Health Specialist	Luisa Proctor (Director) Sherri Vigiano, NP	(315) 451-3906
FPM Safety and Health Manager	Tim O'Rourke, CIH	Office: (607) 687-7434 Cell: (607) 427-4714
FPM Health, Safety, and Environment Representative	David Forse	Office: (315) 336-7721 x. 203 Cell (315) 336-7580
FPM Corporate Safety and Health Supervisor	Stephanie O. Davis, P.G., R.G., CPG	Office: (631) 737-6200 x. 228

Route to Hospital

21 min (13.2 miles)

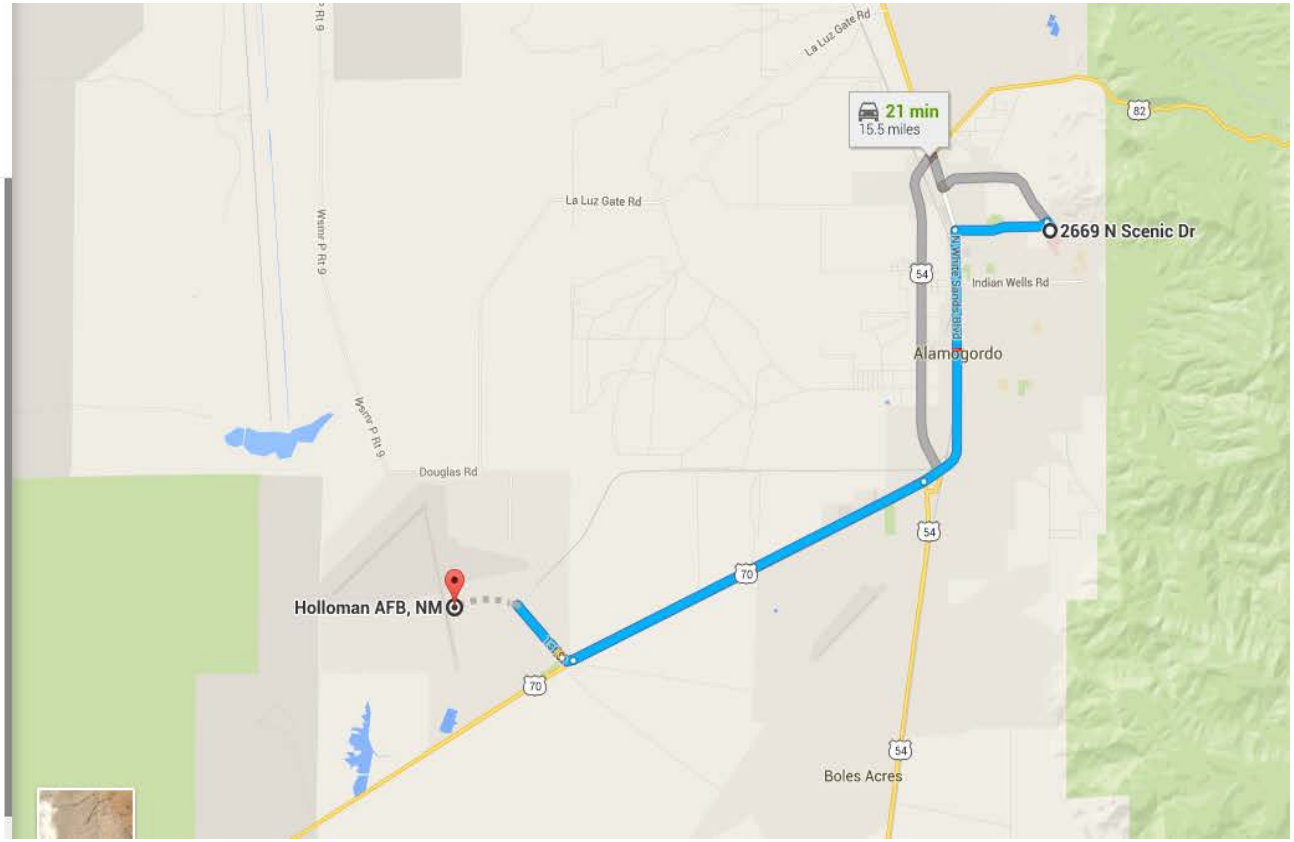
via N White Sands Blvd and US-70 W

19 min without traffic

This route has restricted usage or private roads.

2669 N Scenic Dr
Alamogordo, NM 88310

- Head northwest on N Scenic Dr toward Pueblo Trail
  0.1 mi
- Turn left onto Fairgrounds Rd/Hobby Dr
  Continue to follow Fairgrounds Rd
  1.5 mi
- Turn left onto N White Sands Blvd
  4.1 mi
- Continue onto US-70 W
  6.2 mi
- Use the right 2 lanes to turn right toward 1st St
  0.2 mi
- Continue onto 1st St
  Partial restricted usage road
  1.1 mi



ACTIVITY HAZARD ANALYSIS

Activity: Excavation and Surface Soil Sampling		
Principle Steps	**Potential Safety / Health Hazard**	**Recommended Controls**
All Steps	1. **Weather, Temperature** 2. **Sun and Wind**	1. Weather, Temperature Be sure that all workers are properly clothed and wear appropriate PPE. Heat and cold stress conditions should be monitored by the SSHO and addressed during the morning tailgate meeting. Workers should utilize the buddy system to check your co-worker for signs of heat and cold stress. Drink at least 0.5 liters of water per hour during work breaks. 2. Sun and Wind Exposed skin should be checked regularly for sunburn and/or frostbite. Workers should wear hats with wide brims to avoid direct sun. Sunscreen will be provided onsite.
Mobilization	1. **Slip, trip, fall, lifting Hazard** 2. **Biological Hazards** 3. **Mechanical Hazards** 4. **Chemical Hazards**	1. Slip, Trip, Fall, Lifting Hazard Wear the appropriate PPE. Look where you are going, and always use firm footing. Do not use equipment to poke into animal burrows or nests. Utilize proper lifting technique, size up load before lifting, and ask for help when lifting items over 50 lbs. Maintain firm footing while walking on uneven surfaces. Avoid open trenches/excavations. Wear work boots that are in good condition. Watch where you walk. Maintain awareness of site conditions and walk only in areas that have been cleared. 2. Biological Hazards Snakes: If anyone is bitten by any snake, go immediately to the hospital. If the snake is dead, bring it with you to hospital for verification. Snake gaiters will be made available to site workers, if requested. Ticks, mosquitoes, bees, wasps, and flies: Wear long sleeves and long pants; tuck pant legs into socks and tape around socks. Spray repellent on clothing and exposed skin. Ticks: Avoid walking through brush or rubbing against bushes and trees. Check for ticks following field activities. Be aware of tick borne disease symptoms. Mosquitoes: Be aware of West Nile virus symptoms. Deer flies: If repellants are not sufficient, use fly patches for control.

		Spiders: Be aware of the possible presence of venomous spiders, including; the Black Widow, Brown Spiders, and Scorpions. If bitten, attempt to capture spider and bring with you to hospital for identification. Plants: Avoid contact with poisonous plants like Foxglove, Jimson Weed, and Oleander. 3. Mechanical Hazards Pinch points for mechanical equipment including off-road vehicles, Safe driving practices in site vehicles will be utilized during the project. 4. Chemical Hazards Liquinox® may be onsite for use in decontamination. PAH contamination will be present onsite. No smoking, eating or drinking while working onsite. Soap and water, or other hand cleaning method will be provided onsite prior to eating at a designated area. Always use the buddy system.
Excavation with Heavy Equipment	1. **Slip, trip, fall, lifting, pinch points Hazard** 2. **Biological Hazards** 3. **Mechanical Hazards** 4. **Chemical Hazards**	1. Slip, Trip, Fall, Lifting, Pinch Points Hazard Wear the appropriate PPE including high visibility clothing and hardhats while working around equipment. Look where you are going, and always use firm footing. Never put yourself between you and heavy equipment where the operator cannot see you. Do not use equipment to poke into animal burrows or nests. Utilize proper lifting technique, size up load before lifting, and ask for help when lifting items over 50 lbs. Maintain firm footing while walking on uneven surfaces. Avoid open trenches/excavations. Wear work boots that are in good condition. Watch where you walk. Maintain awareness of site conditions and walk only in areas that have been cleared. 2. Biological Hazards Snakes: If anyone is bitten by a venomous snake (Rattlesnake and Coral Snake), go immediately to the hospital. If the snake is dead, bring with you to hospital for verification. Snake gaiters will be made available to site workers, if requested. Ticks, mosquitoes, and flies: Wear long sleeves and long pants; tuck pant legs into socks and tape around socks. Spray repellent on clothing and exposed skin. Ticks: Avoid walking through brush or rubbing against bushes and trees. Check for ticks following field activities. Be aware of tick borne disease symptoms. Mosquitoes: Be aware of West Nile virus symptoms. Deer flies: If repellants are not sufficient, use fly patches

		for control. Spiders: Be aware of the possible presence of venomous spiders, including; the Black Widow, Brown Spiders, and Scorpions. If bitten, attempt to capture spider and bring with you to hospital for identification. Plants: Avoid contact with poisonous plants like Foxglove, Jimson Weed, and Oleander. 3. Mechanical Hazards Pinch points for mechanical equipment including off-road vehicles, Safe driving practices in site vehicles will be utilized during the project. Crushing and striking hazard exists for heavy equipment use. 4. Chemical Hazards Liquinox® will be onsite for use in decontamination. PAH contamination will be present onsite. No smoking, eating or drinking while working onsite. Soap and water, or other hand cleaning method will be provided onsite prior to eating at a designated area. Always use the buddy system. Gasoline and Diesel fuel may be onsite for re-fueling.
Soil Sampling	1. **Slip, Trip, Fall, lifting Hazard** 2. **Biological Hazards** 3. **Mechanical Hazards** 4. **Chemical Hazards**	1. Slip, Trip, Fall, Lifting Hazard Wear the appropriate PPE. Look where you are going, and always use firm footing. Do not use equipment to poke into animal burrows or nests. Utilize proper lifting technique, size up load before lifting, and ask for help when lifting items over 50 lbs. Maintain firm footing while walking on uneven surfaces. Avoid open trenches/excavations. Wear work boots that are in good condition. Watch where you walk. Maintain awareness of site conditions and walk only in areas that have been cleared. 2. Biological Hazards Snakes: If anyone is bitten by a venomous snake (Rattlesnake and Coral Snake), go immediately to the hospital. If the snake is dead, bring with you to hospital for verification. Snake gaiters will be made available to site workers, if requested. Ticks, mosquitoes, and flies: Wear long sleeves and long pants; tuck pant legs into socks and tape around socks. Spray repellent on clothing and exposed skin. Ticks: Avoid walking through brush or rubbing against bushes and trees. Check for ticks following

		field activities. Be aware of tick borne disease symptoms. Mosquitoes: Be aware of West Nile virus symptoms. Deer flies: If repellants are not sufficient, use fly patches for control. Spiders: Be aware of the possible presence of venomous spiders, including; the Black Widow, Brown Spiders, and Scorpions. If bitten, attempt to capture spider and bring with you to hospital for identification. Plants: Avoid contact with poisonous plants like Foxglove, Jimson Weed, and Oleander. 3. Mechanical Hazards Pinch points for mechanical equipment including off-road vehicles, Safe driving practices in site vehicles will be utilized during the project. 5. Chemical Hazards Liquinox® will be onsite for use in decontamination. PAH contamination will be present onsite. No smoking, eating or drinking while working onsite. Soap and water, or other hand cleaning method will be provided onsite prior to eating at a designated area. Always use the buddy system.
Demobilization	1. **Slip, Trip, Fall, lifting Hazard** 2. **Biological Hazards** 3. **Mechanical Hazards** 4. **Chemical Hazards**	1. Slip, Trip, Fall, Lifting Hazard Wear the appropriate PPE. Look where you are going, and always use firm footing. Do not use equipment to poke into animal burrows or nests. Utilize proper lifting technique, size up load before lifting, and ask for help when lifting items over 50 lbs. Maintain firm footing while walking on uneven surfaces. Avoid open trenches/excavations. Wear work boots that are in good condition. Watch where you walk. Maintain awareness of site conditions and walk only in areas that have been cleared. 2. Biological Hazards Snakes: If anyone is bitten by a venomous snake (Rattlesnake and Coral Snake), go immediately to the hospital. If the snake is dead, bring with you to hospital for verification. Snake gaiters will be made available to site workers, if requested. Ticks, mosquitoes, and flies: Wear long sleeves and long pants; tuck pant legs into socks and tape around socks. Spray repellent on clothing and exposed skin. Ticks: Avoid walking through brush or rubbing against bushes and trees. Check for ticks following

		field activities. Be aware of tick borne disease symptoms. Mosquitoes: Be aware of West Nile virus symptoms. Deer flies: If repellants are not sufficient, use fly patches for control. Spiders: Be aware of the possible presence of venomous spiders, including; the Black Widow, Brown Spiders, and Scorpions. If bitten, attempt to capture spider and bring with you to hospital for identification. Plants: Avoid contact with poisonous plants like Foxglove, Jimson Weed, and Oleander. 3. Mechanical Hazards Pinch points for mechanical equipment including off-road vehicles, Safe driving practices in site vehicles will be utilized during the project. 4. Chemical Hazards Liquinox® will be onsite for use in decontamination. PAH contamination will be present onsite. No smoking, eating or drinking while working onsite. Soap and water, or other hand cleaning method will be provided onsite prior to eating at a designated area. Always use the buddy system.
7. Contractor's Representative (Signature and Date)		

The following lists equipment to be used onsite and describes associated training.

Equipment to be used

Equipment to be used	Inspection Requirements	Training Requirements
Disposable Poly Scoop	Sealed, single use disposable	Onsite instruction
Trimble GPS Unit	Calibration, proper setup	Training received through manufacturer's instructions prior to magnetometer assisted visual reconnaissance.
Automobile And Excavation Equipment.	Make sure to have enough gas, proper tire inflation, working lights, check trailer/load if towing.	Licensed to drive, Vehicular safety will be stressed in morning meetings.