CDFB 96

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS 27th FIGHTER WING (ACC)
CANNON AIR FORCE BASE, NEW MEXICO

ENTERED

2 1 MAR 1996

W. P. Ard, Colonel, USAF
Commander, 27th Support Group
100 S DL Ingram Blvd Suite 200
Cannon AFB NM 88103-5217

RECEIVED APR 1996

Ms. Barbara Hoditschek
New Mexico Environment Department
Hazardous and Radioactive Materials Bureau
2044 Galisteo St.
P.O. Box 26110
Santa Fe NM 87502

Dear Ms. Hoditschek

Attached for your review and comments is the Draft Work Plan for the Preliminary Assessment/site Investigation for Area of Concern (AOC) D on Cannon AFB. AOC D is located on the golf course in the vicinity of the 7th hole tee box and fairway.

If you have any questions, please contact Mr. Sanford Hutsell at (505) 784-4348 or Mr. John Constantine at (505) 784-6378.

W. P. ARD, Colonel, USAF
Commander, 27th Support Group

Attachment:
Work Plan (two volumes)

cc:
EPA Region VI (D. Neleigh)
NMED (R. Kern)
HQ ACC CES/ESVW w/o Atch (M. Calvert)

LIBRARY COPY

DRAFT WORK PLAN

SITE INSPECTION (SI) FOR AREA OF CONCERN - D CANNON AIR FORCE BASE NEW MEXICO

VOLUME II OF II
APPENDICES B - F

CONTRACT NO. DACW45-94-D-0049
DELIVERY ORDER NO. 0004

FEBRUARY, 1996

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

ATTN: MR. LARRY WAGNER

PREPARED BY:

IMS, P.C.
ENVIRONMENTAL & ENGINEERING
115 METRO PARK
ROCHESTER, NY 14623
TEL: (716) 427-0690

VOLUME II OF II

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APPENDIX C	QUALITY ASSURANCE PLAN, O'BRIEN & GERE
APPENDIX D	MATERIAL SAFETY DATA SHEETS - ASBESTOS
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LIST OF ACRONYMS AND ABBREVIATIONS

ACC	Air Combat Command
ACM	Asbestos Containing Material
ACGIH	American Conference of Governmental Industrial Hygienists
AFB	Air Force Base
AIHA	American Industrial Hygiene Association
AOC	Area of Concern
APR	Air Purifying Respirator
ASTM	American Society of Testing and Materials
BEC	Base Environmental Coordinator
°C	Degree Celsius
CAI	Certified Asbestos Inspector
CDLT	Contract Data Loading Tool
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act, 1980
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CLP	Contract Laboratory Protocol
COC	Chain-of-Custody
CPR	Cardiovascular Pulmonary Resuscitation
DQO	Data Quality Objective
DQCR	Data Quality Control Report
EKG	Electrocardiogram

°F	Degree Fahrenheit
FSP	Field Sampling Plan
GC/MS	Gas Chromatograph/Mass Spectrometer
gpm	Gallons per minute
HEPA	High Efficiency Particulate Air
HSA	Hollow Stem Auger
HQ	Headquarters
HTW	Hazardous and Toxic Waste
ID	Inside diameter
IDL	Instrument Detection Limit
IDLH	Immediately Dangerous to Life or Health
IDW	Investigation Derived Waste
IDWMP	Investigation Derived Waste Management Plan
IMS	IMS, P.C. Environmental & Engineering
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
MCE	Mixed Cellulose Ester
MDL	Method Detection Limit
MRD	Missouri River Division

MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSDS	Material Safety Data Sheet
MSHA	Mining Safety and Health Administration
MSL	Mean Sea Level
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NRR	Noise Reduction Rating
OB&G	O'Brien & Gere
OEW	Ordnance and Explosive Waste
OSHA	Occupational Safety and Health Administration
OVA	Organic Vapor Analyzer
PARCC	Precision, Accuracy, Representativeness, Completeness, Comparability
PCM	Phase Contrast Microscopy
PEL	Permissible Exposure Limit
PID	Photoionization Detector
PPE	Personal Protective Equipment
PAH	Polynuclear Aromatic Hydrocarbon
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAP	Quality Assurance Plan

QAPP	Quality Assurance Project Plan
QC	Quality Control
QCSR	Quality Control Summary Report
REL	Recommended Exposure Limit
RPD	Relative Percent Difference
RRF	Relative Response Factor
SB	Soil Boring
SDG	Sample Delivery Group
SI	Site Inspection
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
STEL	Short Term Exposure Limit
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TFW	Tactical Fighter Wing
TLV	Threshold Limit Value
TM	Technical Manager
TRPH	Total Recoverable Petroleum Hydrocarbons
TWA	Time Weighted Average
USACE	U.S. Army Corps of Engineers

USEPA	U.S. Environmental Protection Agency
UXO	Unexploded Ordnance
W-C	Woodward-Clyde
VOC	Volatile Organic Compounds

Kevin M. Bull
Quality Assurance Manager

Quanterra Incorporated
5910 Breckenridge Parkway, Suite H
Tampa, Florida 33610

813 621-0784 Telephone
813 623-6021 Fax

Quanterra
Environmental Services

January 10, 1996

IMS Environmental & Engineering
115 Metro Park
Rochester, NY 14623

Attention: Praveen Srivastava, Ph.D.

Dear Dr. Srivastava:

This correspondence is in regard to our telephone conversation of January 10, 1996, pertaining to the current validation status of Quanterra Tampa by the U.S. Army Corps of Engineers (ACOE). Enclosed is a copy of the letter of validation from the ACOE.

As you may note, the current validation by the ACOE expires on January 10, 1996. We have been in contact with the Prime Contractors for our current projects under the ACOE regarding this issue. According to the ACOE, we may receive an extension of our current validation for a period of up to six months, but also the process of revalidating Quanterra Tampa has begun. I will append this letter once we receive notification from the ACOE as to this extension.

If Quanterra Tampa can be of further assistance on this matter, please call Steve Tafuni or me at (813) 621-0784.

Sincerely,

Kevin M. Bull
Quality Assurance Manager

Enclosure

cc: Randy Grubbs, Laboratory Manager
George Gatlin, Regional Director of Quality Assurance
Steve Tafuni, Project Manager

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS — MRD
HTRW MANDATORY CENTER OF EXPERTISE
12565 WEST CENTER ROAD
OMAHA, NEBRASKA 68144-3869

COPY

REPLY TO
ATTENTION OF

June 28, 1995

Hazardous, Toxic and Radioactive Waste
Center of Expertise

Quanterra, Inc.
5910 Breckenridge Parkway
Suite H
Tampa, Florida 33610

Gentlemen:

This correspondence addresses the ongoing validation status of Quanterra, Inc. of Tampa, FL by the U.S. Army Corps of Engineers (USACE) Hazardous, Toxic and Radioactive Waste Center of Expertise (HTRW MCX) for HTRW analysis.

With the inclusion of the recent successful analysis for Cyanide (by EPA 9010A/9012), Herbicides (by EPA 8150A), Polychlorinated Biphenyls (by EPA 8080 in water and soil), Pesticides (by EPA 8080) and TRPH (by EPA 9071/418.1 in soil), your laboratory has successfully analyzed performance evaluation samples as listed below:

METHOD	PARAMETERS	MATRIX
8240	Volatile Organics	Water
8270	Semivolatile Organics	Water
8270	Semivolatile Organics	Soil
8080	Organochlorine Pesticides	Water
8080	Polychlorinated Biphenyls	Water
8080	Polychlorinated Biphenyls	Soil
8150A	Herbicides	Water
SW-846	TAL Metals(1)	Water
SW-846	TAL Metals(1)	Soil
418.1	TRPH	Water
9071/418.1	TRPH	Soil
9010A/9012	Cyanide	Water
various	Anions(2)	Water

Mod 8015	Total Petroleum Hydrocarbons	Water
Mod 8015	Total Petroleum Hydrocarbons	Soil

Remarks: 1) TAL Metals: Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc.

2) Anions: chloride, fluoride, sulfate, nitrate, and *ortho*-phosphate.

Based on the successful analysis of the performance evaluation samples indicated in the table in paragraph two above, your laboratory will be validated for multimedia sample analysis by the methods listed above. The period of validation for all parameters has been previously established and expires on January 10, 1996.

USACE reserves the right to conduct additional laboratory auditing or to suspend validation status for any or all of the listed parameters if deemed necessary. It should be noted that your laboratory may not subcontract USACE analytical work to any other laboratory location without the approval of this office. This laboratory validation does not guarantee the delivery of any analytical samples from a USACE Contracting Officer Representative.

If you have any questions or comments please contact Ms. Elena Webster at (402) 697-2574.

Sincerely,

Marcia C Davies

MARCIA C. DAVIES, PH.D.
Director, USACE Hazardous,
Toxic and Radioactive Waste
Center of Expertise

Comprehensive Quality Assurance Plan

QA Number 870270G

for

Quanterra Incorporated

5910 Breckenridge Parkway, Suite H
Tampa, FL 33610
(813) 621-0784

prepared by

Quanterra Incorporated
5910 Breckenridge Parkway, Suite H
Tampa, FL 33610
(813) 621-0784

RECEIVED
OCT 16 1995
Dept. of Environmental
Quality Assurance

Randall C. Grubbs
Laboratory Director

10/12/95
Date

Kevin M. Bull
Laboratory QA Manager

10/12/95
Date

Sylvia S. Labie
DER-QA Officer

12-4-95
Date

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C.	Method Validation for Total Fluoride in Soil/Sediment - 340.1/340.2 Modified (FLDEP Approved 8-26-92)	4	12/04/91
D.	Method Validation for Alternate Analysis of Sulfur, Tin and Titanium by Inductively Coupled Plasma Atomic Emission Spectroscopy	NA	Repealed
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3.0 Statement of Policy

3.1 Introduction

Quanterra Incorporated (Quanterra) was formed in June 1994 as a joint venture of MetPath, Inc. (a subsidiary of Corning Incorporated) and IT Corporation (a subsidiary of International Technology Corporation). Quanterra's predecessors operated as Enseco and International Technology Analytical Services. Quanterra Incorporated has its headquarters in Englewood, Colorado.

Quanterra Tampa began operation in 1985 as one of the Wadsworth/ALERT Laboratories. Wadsworth/Alert was an independent testing laboratory organized to deliver comprehensive and reliable analytical services to its clients in a responsive and complete manner. Wadsworth/ALERT Laboratories, Inc. was headquartered in North Canton, Ohio, which had been a leading independent laboratory for over 50 years. The Wadsworth network was purchased by Corning and added to the Enseco network in 1991.

Quanterra Tampa offers conventional and mobile laboratory services with a particular emphasis on providing full-service analytical capabilities. The laboratory maintains a number of analytical programs designed to fulfill the needs of its clients in the technical aspects of environmental control and regulatory compliance. These analytical programs include:

CERCLA-ENVIRONMENTAL ASSESSMENTS

Contamination Profiles and Assessments
- Groundwater Monitoring/Surface Water Evaluations and Soil/Sediment, Subsurface Investigations
  - Complete Analytical Characterizations
  - Priority Pollutants
  - Hazardous Substance List Parameters
  - Appendix VII, IX Constituents
  - Herbicides, Pesticides, PCBs
  - Trihalomethanes (THMs)
  - Metals

Surface Surveys and Investigations
- Wipes, Swabs, etc.

Restoration Project Monitoring and Evaluations
- Clean-up Monitoring and Evaluation
- Treatment System Evaluation and Monitoring

Compliance Monitoring and Evaluations
- Quality Control Verification
- Long-Term Compliance Verification

TSCA SURVEYS

PCB Surveys
- Environmental Surveys
  - Air, Water, Soil
- Waste Product Surveys
  - Oils, Fluids, Waxes, Sludges

Factory Contamination Surveys

RCRA-INDUSTRIAL WASTE MANAGEMENT

Characteristic Waste Parameters
- Ignitability
- Reactivity
- Corrosivity
- EP Toxicity, TCLP

Hazardous Waste Analysis
- Descriptive Properties
- Physical Properties
- Disposal Parameters
- Chemical Composition
  - Organic, Inorganic, Metallic Composition

Groundwater Monitoring
- Quarterly Monitoring Parameters
  - Suitability, Quality, and Contamination Parameters
  - Radioactivity

Complete Analytical Characterizations
- Appendix VII, IX Analysis

Delisting Petitions
- Lagoon, Pile, Sludge Pond, Waste Stream Characterizations

NPDES-INDUSTRIAL PRETREATMENT

Permitting, Compliance Monitoring and Evaluation
- Water, Wastewater, and Industrial Effluent Analysis
  - EPA Form 2C Analysis
    - Parts, A, B, and C
  - Complete Analytical Characterizations

SDWA-DRINKING WATER
Compliance Monitoring and Evaluation
- Regulated Parameters
  - Herbicides, Pesticides
  - Trihalomethanes (THMs)
  - Metals
- Complete Analytical Characterizations

Treatment System Monitoring and Evaluation

3.2 Mission

Quanterra's mission is to be recognized as the premier provider of environmental laboratory services by being world class in quality and technology, and by setting the standard of excellence within the industry. Quanterra's management is committed to providing quality services that meet the requirements of our clients and satisfy regulatory requirements. Management is dedicated to providing an environment that encourages the achievement of excellence, demands integrity in all aspects of its operation, and requires active participation of all associates and vendors in meeting its quality goals.

The Comprehensive Quality Assurance Plan is the internal guidance document in administering the QA/QC program of Quanterra Tampa. As such, it is written so that it meets or exceeds all requirements of the Florida Department of Environmental Regulation as outlined in the Florida Administrative Code 62-160.

4.0 Organization and Responsibility

4.1 Capabilities

Quanterra Tampa maintains personnel and equipment for operations associated with field and laboratory operations.

4.2 Key Personnel

The general responsibilities of key personnel involved in field and laboratory operations with respect to QA/QC are as follows:

4.2.1 Vice-President and General Manager of Laboratory Operations

The Vice-President and General Manager of Laboratory Operations (General Manager) is responsible for evaluating the information supplied by the Laboratory Director (Laboratory Manager). The General Manager determines the effectiveness of Quanterra's Quality Management System, and is responsible for implementing the Quality Management Plan (QMP) and the Quality Assurance Management Plan (QAMP). This responsibility includes the commitment to provide the leadership and financial resources necessary to ensure that the laboratory and staff are able to offer the highest quality, scientifically sound and legally defensible data and services to our clients. The General Manager reports directly to the President and CEO of Quanterra.

4.2.2 Laboratory Director

The Laboratory Director oversees daily operations of the analytical laboratory, and thus, he/she is responsible for implementation of the QMP and QAMP within the laboratory. Responsibilities include interacting with group coordinators and project managers to coordinate projects and workload. In addition, the Laboratory Director assumes responsibility for maintaining method compliance in the laboratory. He/she interacts with the QA Manager in the laboratory and ensures the incorporation of such requirements into daily operations. The Laboratory Director aids the QA Manager in addressing corrective actions and preparing the laboratory to meet certification and approval program requirements. The Laboratory Director reports to the General Manager.

4.2.3 Operations Manager

The Operations Manager supervises the daily activities of the Operational Groups. This person supervises QC activities performed as part of the routine analytical operations. The Operations Manager reports to the Laboratory Director.

4.2.4 Laboratory Quality Assurance Manager

The QA Manager supervises QA functions pertaining to laboratory analytical operations. These responsibilities include managing certification and approval programs, maintaining QC objective data, conducting internal QA audits and overseeing external audits initiating and managing corrective action based on internal QC data, and preparing and submitting any quality assurance plans. Other functions include: establishing standard operating procedures based on current industry standards, and preparing quality assurance reports for management, clients, and regulatory agencies. The QA Manager is responsible for ensuring that all final data meets the criteria of the Quality Control program and reports directly to the Regional QA Director and indirectly to the Laboratory Director.

4.2.5 Sampling Team Leader (Supervisor)

The Sampling Team Leader implements and supervises all laboratory and field activities pertaining to the sampling group. This individual is responsible for ensuring that all sampling activities are conducted in accordance with documented sampling procedures. This person also ensures that proper quality control procedures are incorporated into the daily operation of the group, including proper documentation of all sampling activities and subsequent timely submittal of samples to the laboratory. The Sampling Team Leader reports to the Laboratory Director.

4.2.6 Analytical Team Leader (Supervisor)

The Analytical Team Leader implements and supervises all analytical activities pertaining to the respective analytical group. This individual is responsible for reviewing raw data and analytical results. He/she also ensures that the proper quality control requirements are incorporated into the daily operation of the group. The Analytical Team Leader reports to the Laboratory Director.

4.3 Laboratory Personnel

ADMINISTRATION

Name	Responsibilities
Jim Kaiser	President/ CEO, Quanterra Incorporated
Peggy S. Sleevi	Corporate Director of QA, Quanterra Incorporated
Robert E. George	General Manager, Quanterra Eastern Region
George Gatlin	Regional Director of QA, Quanterra Eastern Region
Randall C. Grubbs	Operations Manager/Laboratory Director
Kevin M. Bull	Laboratory Quality Assurance Manager

LABORATORY OPERATIONS

Name	Responsibilities
Jeff Graham	Customer Service Manager
Rob Corden	Shipping Supervisor
Carol McNulty	Receiving Supervisor
Richard Detar	Metals Supervisor
Julie Woods	Wet Chemistry Supervisor
Sue Barton	GC/MS Semi-Volatile Organic Supervisor
Steve Bell	GC/MS Volatile Organic Supervisor
Jesslyn Frater	GC Volatile Organic Supervisor
Allen Mitchell	GC & HPLC Semi-Volatile Organic Supervisor
Mark Hopkins	Organic Extractions Supervisor
David Gann	Sampling Group Supervisor

FIGURE 4.1

CORPORATE ORGANIZATIONAL CHART

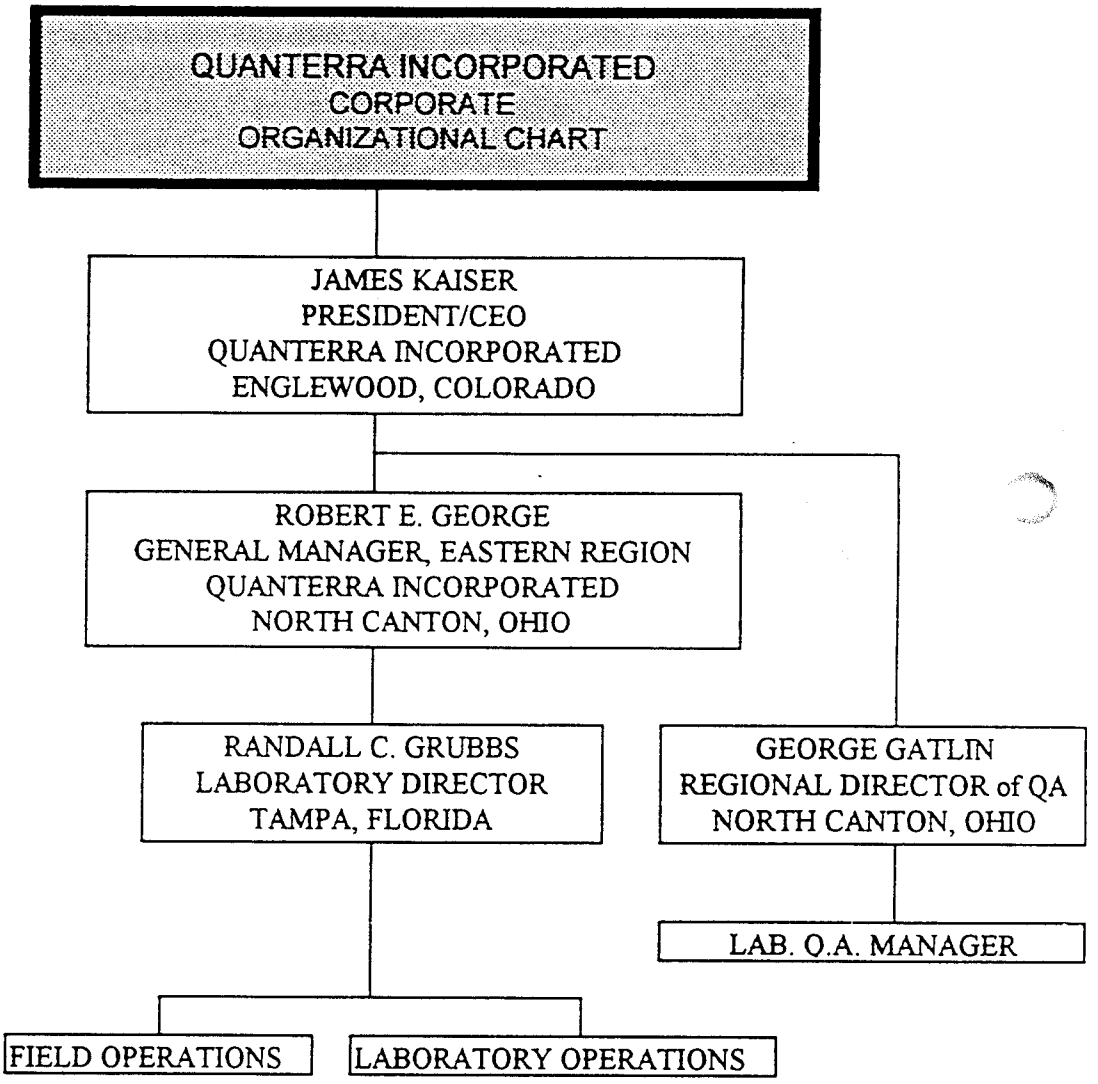


FIGURE 4.2

LABORATORY SUPERVISOR ORGANIZATIONAL CHART

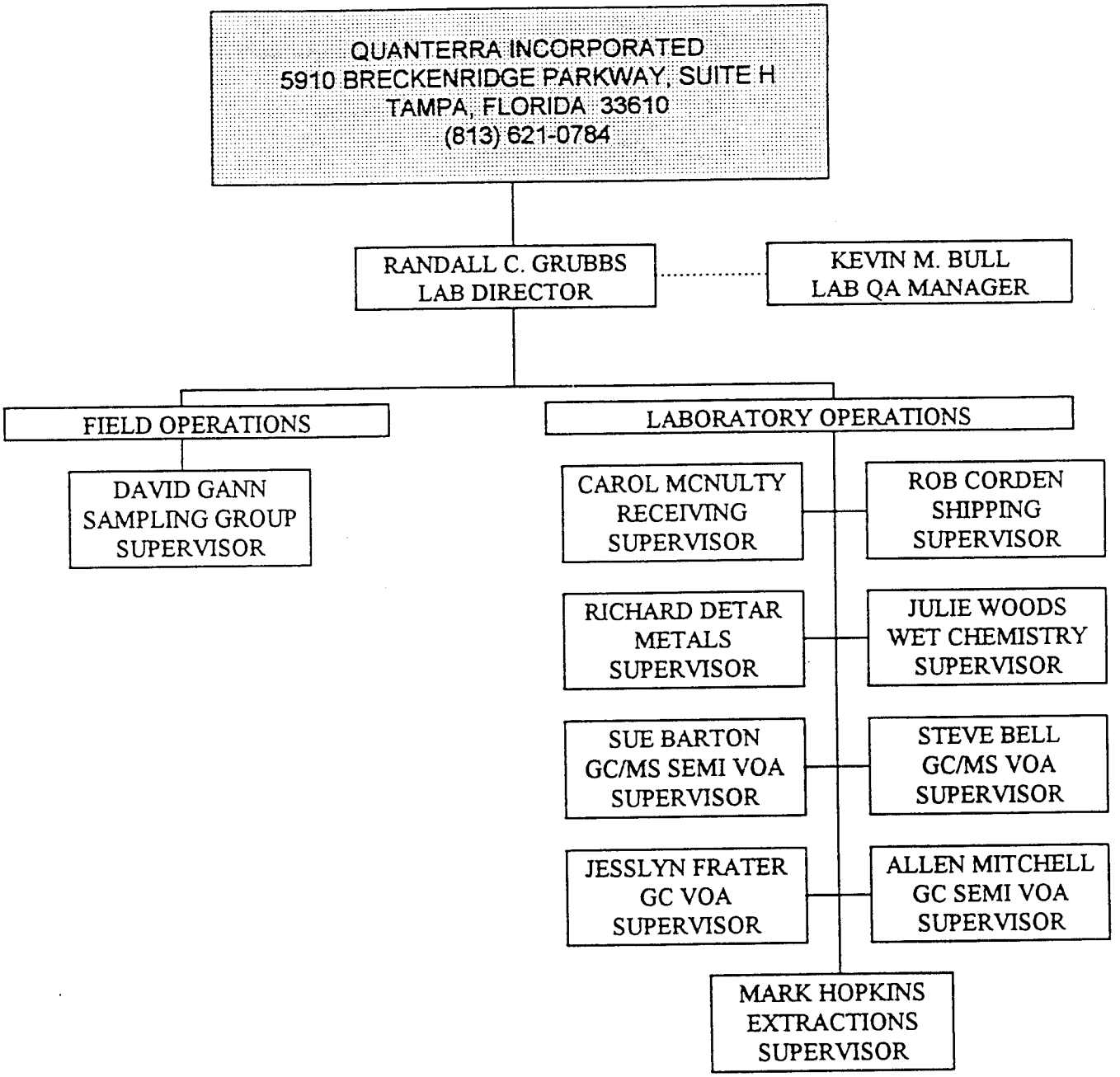
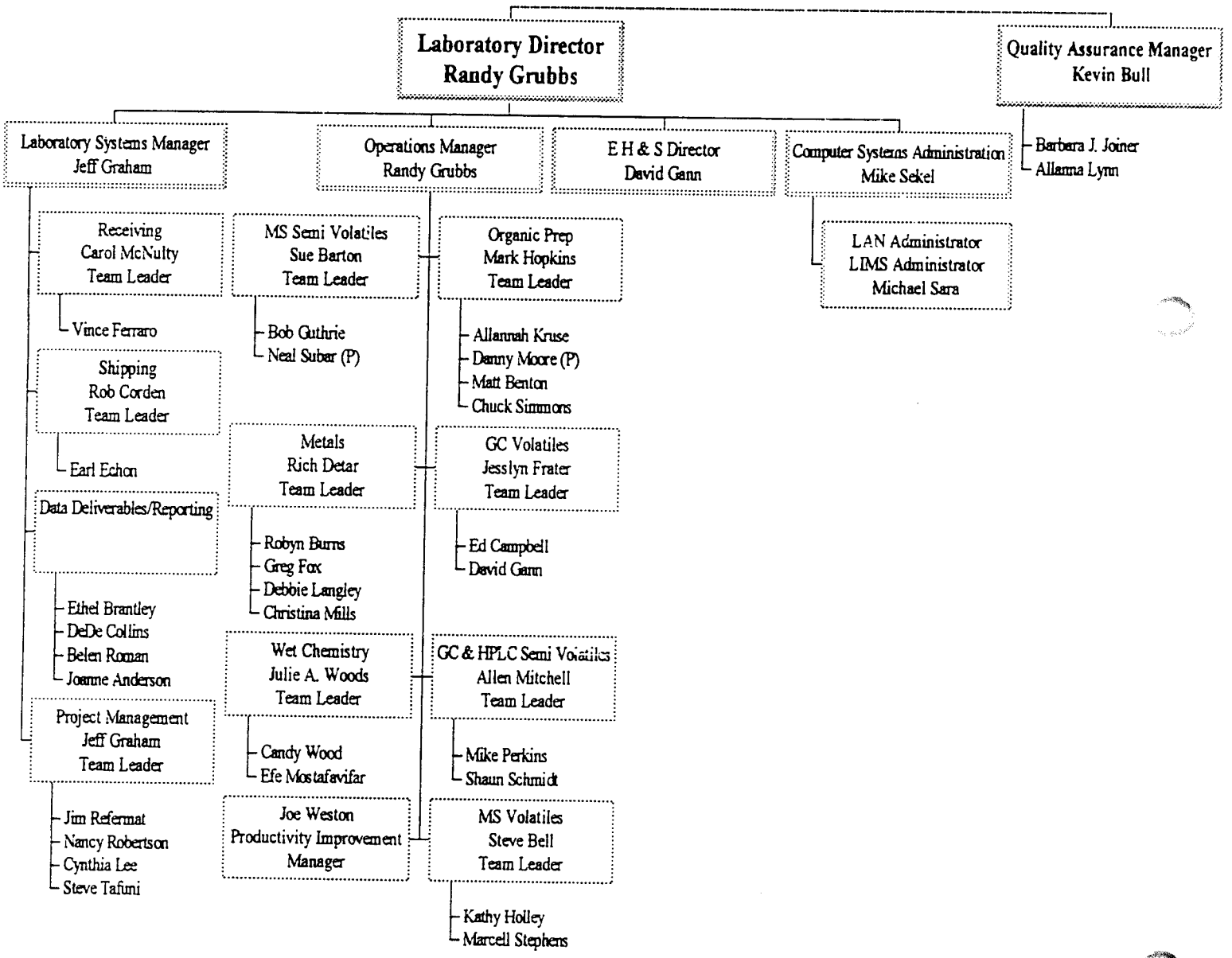


FIGURE 4.3

LABORATORY PERSONNEL ORGANIZATIONAL CHART



5.0 QA Targets for Precision, Accuracy and Method Detection Limits

The Accuracy, Precision and Method Detection Limit values presented in the following sections are based upon local laboratory historical data and method validation studies using spikes, replicates and standards where available. EPA method control data, advisory limits or limits generated from corporate historical data, are used where historical data is not available. These limits are replaced with local laboratory historical data within one year from the addition of those analytes to the CompQAP.

5.1 Field Analytical Parameters

Field analytical parameters are listed in Table 5-1.

TABLE 5-1
DATA QUALITY OBJECTIVES

FIELD ANALYTICAL PARAMETERS
WATER MATRIX

Parameter	Method
pH	EPA 150.1
Specific Conductance	SM 2510B
Temperature	SM 2550B
Dissolved Oxygen	EPA 360.1
Residual Chlorine	SM 4500Cl G

5.2 Laboratory Data Quality Objectives

The laboratory data quality objectives are presented in Tables 5-2 through 5-8 as outlined below. The tables are organized into analytical groups. For the current revision of this plan, data quality objectives are listed for just two matrices; water and soil/sediment. "Water" (W) encompasses groundwater, surface water and leachates from toxicity characterizations. "Soil/Sediment" (S) covers all solids and soils as well as chemical waste. Future revisions may further divide objectives more specifically as data becomes available. The following summary notes the page numbers on which these groups/tables begin.

Page #	Analytical Group	Tables Included
5	Wet Chemistry	5-2
10	Metals	5-3
16	GC Volatile Organics	5-4
25	GC/MS Volatile Organics	5-5
44	GC Semi-Volatile Organics	5-6
52	HPLC	5-7
54	GC/MS Semi-Volatile Organics	5-8
67	Data Quality Objectives Notations and Explanations for Tables 5-2 through 5-8	

5.3 Preparation Methods Summary

Sample preparation methods are presented in Table 5-9 (pages 62 through 63). Where preparations are not indicated for a method, these procedures are contained in the analytical methods themselves

TABLE 5-2
DATA QUALITY OBJECTIVES

WET CHEMISTRY

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL mg/L	MDL mg/kg
ACOE/EPA365.2	S	Phosphorous - Orthophosphate	33	L	50 - 141	L	NA	1
	S	Phosphorous - Total	33	L	50 - 141	L	NA	1
ACOE/EPA351.3	S	Nitrogen - Kjeldahl	20	L	79 - 114	L	NA	2.9
ACOE/EPA 353.3	S	Nitrogen - Nitrate	14	L	67 - 118	L	NA	2.9
ACOE/EPA 354.1	S	Nitrogen - Nitrite	13	L	77 - 119	L	NA	1
ACOE/EPA 353.3	S	Nitrogen - Nitrate/Nitrite	14	L	67 - 118	L	NA	2.9
DEP-SOP	W	Nitrogen - Ammonia (Unionized)	NA	L	NA	L	NA	NA
EPA 1010	S	Flashpoint-Closed Cup	10	L	90-110	L	NA	NA
EPA 1010	W	Flashpoint - Closed Cup	10	L	90 - 110	L	NA	NA
EPA 110.2	W	Color	5 CU	L	5 CU	L	NA	NA
EPA 130.2	W	Hardness	22	L	78 - 122	L	0.9	NA
EPA 150.1	W	pH	1	L	90 - 110	L	0.05 SU	NA
EPA 160.1	W	Residue - Filterable (TDS)	16	L	55 - 151	L	2.7	NA
EPA 160.2	W	Residue - Nonfilterable (TSS)	20	L	80 - 120	L	2.3	NA
EPA 160.3	W	Residue - Total	20	L	80 - 120	L	2.3	NA
EPA 160.3	S	Residue - Total	5	L	NA	L	NA	1%
EPA 160.4	W	Residue - Volatile and Fixed	20	L	70 - 130	L	2.3	NA
EPA 160.5	W	Residue - Settleable	20	L	80 - 120	L	NA	NA
EPA 180.1	W	Turbidity	20	L	71 - 130	L	0.2	NA
	W	Bromide	30	L	50-150	L	0.0094	NA
EPA 300.0	W	Chloride	30	L	75 - 125	L	0.13	NA
	W	Nitrogen - Nitrate	30	L	75 - 125	L	0.026	NA
	W	Nitrogen-Nitrite	30	L	50-150	L	0.0075	NA
	W	Phosphorous - Orthophosphate	20	L	75 - 125	L	0.027	NA
	W	Sulfate	20	L	75 - 125	L	0.056	NA
	W	Fluoride	20	L	75- 125	L	0.14	NA
EPA 310.1	W	Alkalinity	17	L	85 - 110	L	0.8	NA

TABLE 5-2
DATA QUALITY OBJECTIVES

WET CHEMISTRY
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL mg/L	MDL mg/kg
EPA 325.2	W	Chloride	16[6]	L	48-133[6]	L	0.20	NA
EPA 325.3	W	Chloride	12	L	90 - 114	L	1	NA
EPA 335.1	W	Cyanide - Amenable	25	L	63 - 114	L	0.001	NA
EPA 335.2	W	Cyanide - Total	25	L	63 - 114	L	0.001	NA
EPA 335.3	W	Cyanide - Total	22[6]	L	48-238[6]	L	0.003	NA
EPA 340.2	W	Fluoride	20	L	77 - 131	L	0.01	NA
EPA 340.2 MOD	S	Fluoride (DI Leachate or Distilled)	51	L	43 - 118	L	NA	140
EPA 350.2	W	Nitrogen - Ammonia	20	L	77 - 127	L	0.1	NA
EPA 350.3	W	Nitrogen - Ammonia	20	L	77 - 127	L	0.01	NA
EPA 351.3	W	Nitrogen - Kjeldahl	20	L	79 - 114	L	0.1	NA
EPA 351.3 - 350.3	W	Nitrogen - Total Organic	20	L	79 - 114	L	0.1	NA
EPA 353.2	W	Nitrogen - Nitrite	13[6]	L	63-149[6]	L	0.004	NA
	W	Nitrogen - Nitrate/Nitrite	5[6]	L	110-149[6]	L	0.004	NA
EPA 353.3	W	Nitrogen - Nitrate	14	L	67 - 118	L	0.01	NA
EPA 353.3	W	Nitrogen - Nitrate/Nitrite	14	L	67 - 118	L	0.01	NA
	W	Nitrogen - Nitrite	13	L	77 - 114	L	0.01	NA
EPA 354.1	W	Nitrogen - Nitrite	13	L	77 - 119	L	0.01	NA
EPA 360.1	W	Oxygen - Dissolved	20	L	80 - 120	L	NA	NA
EPA 365.1	W	Phosphorous - Orthophosphate	44[6]	L	10-130[6]	L	0.06	NA
	W	Phosphorous - Total	44[6]	L	10-130[6]	L	0.12	NA
EPA 365.2	W	Phosphorous - Orthophosphate	33	L	50 - 141	L	0.02	NA
	W	Phosphorous - Total	33	L	50 -141	L	0.04	NA
EPA 370.1	W	Silica	30	L	50-150	L	0.027	NA
EPA 375.4	W	Sulfate	10	L	87 - 104	L	0.8	NA
EPA 376.1	W	Sulfide - Total	14	L	46 - 117	L	0.6	NA
EPA 405.1	W	Oxygen - Biochemical Demand	20	L	80 - 120	L	0.16	NA

TABLE 5-2
DATA QUALITY OBJECTIVES

WET CHEMISTRY
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL mg/L	MDL mg/kg
EPA 410.1	W	Oxygen - Chemical Demand	20	L	80 - 120	L	18	NA
EPA 413.1	W	Oil and Grease	20	L	80 - 120	L	1	NA
EPA 415.1	W	Carbon - Total Organic	31	L	81 - 126	L	0.2	NA
EPA 418.1	W	Petroleum Hydrocarbons	24	L	75 - 124	L	0.33	NA
EPA 420.1	W	Phenols - Total	15	L	73 - 101	L	0.03	NA
EPA 7196	W	Chromium - Hexavalent	12[6]	L	74 - 117	L	0.02	NA
SW846 9010	W	Cyanide - Total	25	L	63 - 114	L	0.001	NA
	S	Cyanide - Total	25	L	63 - 114	L	NA	0.15[6]
	W	Cyanide - Amenable	25	L	63 - 114	L	0.001	NA
	W	Cyanide - Reactive	25	L	63 - 114	L	10	NA
	S	Cyanide - Reactive	25	L	63 - 114	L	NA	10
SW846 9030	W	Sulfide - Total	14	L	46 - 117	L	0.6	NA
	S	Sulfide - Total	14	L	46 - 117	L	NA	20
	W	Sulfide - Reactive	14	L	46 - 117	L	50	NA
	S	Sulfide - Reactive	14	L	46 - 117	L	NA	50
SW846 9045	S	pH	1	L	90 - 110	L	NA	0.05 SU
SW846 9056	W	Chloride	20	L	75 - 125	L	0.13	NA
	W	Nitrogen - Nitrate	20	L	75 - 125	L	0.026	NA
	W	Phosphorous - Orthophosphate	20	L	75 - 125	L	0.027	NA
	W	Sulfate	20	L	75 - 125	L	0.056	NA
	W	Fluoride	20	L	75- 125	L	0.14	NA
SW846 9060	W	Carbon - Total Organic	31	L	81 - 126	L	0.2	NA
SW846 9071	S	Oil and Grease	20	L	80 - 120	L	NA	1
SW846 9073 Draft	S	Petroleum Hydrocarbons	30	L	50 - 140	L	NA	2.7
SW846 9252	S	Chloride	15	L	88 - 125	L	NA	200
ASTM D240/E711	W	BTU per mass unit	20[6]	L	50-150[6]	L	1[6]	NA
ASTM D2015-94	S	BTU per mass unit	20[6]	L	50-150[6]	L	NA	1[6]
ASTM D1385	W	Hydrazine	30	L	50-150	L	0.003	NA
	S	Hydrazine	30	L	50-150	L	NA	

TABLE 5-2
DATA QUALITY OBJECTIVES

WET CHEMISTRY
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL mg/L	MDL mg/kg
SM 2120B	W	Color		L		L		NA
SM 2320B	W	Alkalinity	17	L	85 - 110	L	0.8	NA
SM 2320B	W	Bicarbonate Alkalinity	NA	L	NA	L	NA	NA
SM 2320B	W	Carbonate Alkalinity	NA	L	85 - 110	L	NA	NA
SM 2320B	W	Hydroxide Alkalinity	NA	L	85 - 110	L	NA	NA
SM 2320B	W	Phenolphthalein Alkalinity	17	L	85 - 110	L	0.8	NA
SM 2330B	W	Corrosivity - Langelier Index	0.5 SU	L	0.5 SU	L	NA	NA
SM 2340B	W	Hardness, Calcium	30	L	50-150	L		NA
	W	Hardness, Total	30	L	50-150	L		NA
SM 2510B	W	Specific Conductance	10	L	90 - 112	L	0.05	NA
SM 2520B	W	Salinity	20	L	80 - 120	L	1 g/L	NA
SM 2540B	W	Residue - Total	20	L	80 - 120	L	2.3	NA
SM 2540C	W	Residue - Filterable (TDS)	16	L	55 - 151	L	2.7	NA
SM 2540D	W	Residue - Nonfilterable (TSS)	20	L	80 - 120	L	2.8	NA
SM 2540E	W	Residue - Volatile and Fixed	20	L	70 - 130	L	2.3	NA
SM 2540F	W	Residue - Settleable	20	L	80 - 120	L	NA	NA
SM 2540G	S	Residue - Total and Fixed	20	L	70 - 130	L	NA	2.3
SM 4500-Cl G	W	Chlorine - Residual	20	L	80 - 120	L	0.03	NA
SM 4500-Cl D	W	Chloride	30	L	50 - 150	L		NA
SM 4500-F C	W	Fluoride	30	L	50 - 150	L		NA
SM 4500NO3	W	Nitrogen/Nitrate	30	L	50 - 150	L		NA
	W	Nitrogen/Nitrite	30	L	50 - 150	L		NA
	W	Total Nitrogen	30	L	50 - 150	L		NA
SM 5210 B	W	Oxygen - Biochemical Demand	20	L	80 - 120	L	0.16	NA
SM 5210 B	W	Oxygen - Carbonaceous BOD	20	L	80 - 120	L	0.4	NA
SM 5220 C	W	Oxygen - Chemical Demand	20	L	80 - 120	L	18	NA
SM 5310 B	W	Carbon - Total Organic	31	L	81 - 126	L	0.2	NA
SM 5540C	W	Foaming Agents (MBAS)	24	L	75 - 125	L	0.02	NA

TABLE 5-2
DATA QUALITY OBJECTIVES

WET CHEMISTRY
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL mg/L	MDL mg/kg
DEP 62-709.530 (1)	S	Foreign Matter	NA	NA	NA	NA	NA	NA
SM 2150 B	W	Odor	5 TON	L	5 TON	L	NA	NA
$TKN+NO_3+NO_2$	W	Nitrogen - Total	NA	L	NA	L	NA	NA

TABLE 5-3
DATA QUALITY OBJECTIVES

METALS
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 202.2	W	Aluminum		L		L		NA
EPA 204.2	W	Antimony	14	L	74-102	L	1.8	NA
SM 3113 B	W	Antiminoy	14	L	74-102	L	1.8	NA
EPA 206.2	W	Arsenic	19	L	80-119	L	1.8	NA
SM 3113 B	W	Arsenic	19	L	80-119	L	1.8	NA
EPA 208.2	W	Barium	30	L	50-150	L		NA
EPA 210.2	W	Beryllium	30	L	50-150	L		NA
EPA 213.2	W	Cadmium	14	L	90-118	L	0.7	NA
SM 3113B	W	Cadmium	14	L	90-118	L	0.7	NA
EPA 218.2	W	Chromium	12	L	90-119	L	0.5	NA
SM 3113 B	W	Chromium	12	L	90-119	L	0.5	NA
EPA 219.2	W	Cobalt	30	L	50-150	L		NA
EPA 220.2	W	Copper	30	L	50-150	L		NA
EPA 236.2	W	Iron	30	L	50-150	L		NA
EPA 239.2	W	Lead	24	L	76-124	L	1	NA
SM 3113 B	W	Lead	24	L	76-124	L	1	NA
EPA 243.2	W	Manganese	30		50-150			
EPA 270.2	W	Selenium	20	L	76-116	L	0.6	NA
SM 3113 B	W	Selenium	20	L	76-116	L	0.6	NA
EPA 272.2	W	Silver	30	L	50-150	L		NA
SM 3111 B	W	Silver	30	L	50-150	L		NA
EPA 279.2	W	Thallium	15	L	66-127	L	1.7	NA
EPA 200.9	W	Thallium	15	L	66-127	L	1.7	NA
EPA 282.2	W	Tin	30	L	50-150	L		NA
EPA 286.2	W	Vanadium	30	L	50-150	L		NA
EPA 289..2	W	Zinc	30	L	50-150	L		NA
SW846 7041	W	Antimony	14	L	74-102	L	1.8	NA
	S		27	L	60-112	L	NA	8.4

TABLE 5-3
DATA QUALITY OBJECTIVES

METALS
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 7060	W	Arsenic	19	L	80-119	L	2	NA
	S		15	L	77-107	L	NA	0.1
SW846 7131	W	Cadmium	14	L	90-118	L	4	NA
	S		20	L	71-110	L	NA	0.25
SW846 7191	W	Chromium	12	L	90-119	L	0.5	NA
	S		24	L	67-115	L	NA	1.2
SW846 7421	W	Lead	24	L	76-124	L	1	NA
	S		22	L	77-122	L	NA	0.05
SW846 7740	W	Selenium	20	L	76-116	L	2	NA
	S		26	L	67-119	L	NA	0.1
SW846 7841	W	Thallium	13	L	50-102	L	2	NA
	S		13	L	50-102	L	NA	0.1
SW846 6010	S	Aluminum	10	L	87-108	L	NA	2.1
	W		10	L	87-108	L	62	NA
	S	Antimony	17	L	78-113	L	NA	0.67
	W		23	L	73-120	L	17	NA
	S	Arsenic	12	L	90-113	L	NA	0.86
	W		10	L	89-108	L	21	NA
	S	Barium	12	L	83-109	L	NA	0.078
	W		15	L	81-110	L	1	NA
	S	Beryllium	8	L	89-102	L	NA	0.05
	W		19	L	79-118	L	1	NA
	S	Boron	15	L	85-127	L	NA	0.35
	W		15	L	85-127	L	34	NA
	S	Cadmium	17	L	73-107	L	NA	0.17
	W		15	L	76-110	L	3	NA
	S	Calcium	17	L	90-137	L	NA	6.3
	W		31	L	64-127	L	140	NA

TABLE 5-3
DATA QUALITY OBJECTIVES

METALS
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 6010 (Continued)	S	Chromium	14	L	80-108	L	NA	0.12
	W		21	L	74-117	L	2	NA
	S	Cobalt	15	L	85-113	L	NA	0.11
	W		16	L	83-115	L	3	NA
	S	Copper	13	L	88-115	L	NA	0.14
	W		23	L	79-125	L	5	NA
	S	Iron	11	L	90-110	L	NA	1.0
	W		19	L	82-121	L	45	NA
	S	Lead	34	L	65-135	L	NA	1.0
	W		21	L	68-125	L	17	NA
	S	Lithium	30	L	50-150	L	NA	0.12
	W		30	L	50-150	L	0.0004	NA
	S	Magnesium	15	L	90-129	L	NA	3.1
	W		21	L	83-126	L	16	NA
	S	Manganese	8	L	90-110	L	NA	0.052
	W		18	L	83-119	L	3	NA
	S	Molybdenum	9	L	90-107	L	NA	0.29
	W		11	L	82-104	L	5	NA
	S	Nickel	13	L	84-110	L	NA	0.46
	W		21	L	72-114	L	10	NA
	S	Phosphorus	9	L	32-110	L	NA	2.6
	W		9	L	82-105	L	47	NA
	S	Potassium	13	L	83-114	L	NA	15
	W		15	L	83-114	L	180	NA
	S	Selenium	14	L	85-121	L	NA	2.6
	W		18	L	91-127	L	60	NA
	S	Silver	17	L	71-106	L	NA	0.14
	W		16	L	70-101	L	9	NA

TABLE 5-3
DATA QUALITY OBJECTIVES

METALS
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 6010 (Continued)	S	Sodium	20	L	85-125	L	NA	10
	W		20	L	85-125	L	180	NA
	S	Strontium	12	L	88-112	L	NA	0.12
	W		12	L	88-112	L	3	NA
	S	Thallium	20	L	60-137	L	NA	2.0
	W		20	L	60-137	L	0.04	NA
	S	Tin	10	L	90-110	L	NA	0.77
	W		10	L	90-110	L	16	NA
	S	Vanadium	15	L	89-111	L	NA	0.17
	W		23	L	70-125	L	3	NA
	S	Zinc	23	L	84-110	L	NA	0.43
	W		16	L	69-125	L	19	NA
	S	Zirconium	30	L	50-150	L	NA	0.19
	W		30	L	50-150	L	3	NA
SW846 6010A (Trace)								
	S	Antimony	30	L	50-150	L	3	NA
	W		30	L	50-150	L	NA	0.12
	S	Arsenic	30	L	50-150	L	3	NA
	W		30	L	50-150	L	NA	0.12
	S	Cadmium	30	L	50-150	L	1	NA
	W		30	L	50-150	L	NA	0.05
	S	Chromium	30	L	50-150	L	2	NA
	W		30	L	50-150	L	NA	0.08
	S	Lead	30	L	50-150	L	3	NA
	W		30	L	50-150	L	NA	0.095
	S	Lithium	30	L	50-150	L	4	NA
	W		30	L	50-150	L	NA	0.12

TABLE 5-3
DATA QUALITY OBJECTIVES

METALS
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 6010 (Trace) (continued)	S	Selenium	30	L	50-150	L	4	NA
	W		30	L	50-150	L	NA	0.20
	S	Silver	30	L	50-150	L	1	NA
	W		30	L	50-150	L	NA	0.05
	S	Thallium	30	L	50-150	L	4	NA
	W		30	L	50-150	L	NA	0.33
	S	Tin	30	L	50-150	L	3	NA
	W		30	L	50-150	L	NA	0.11
EPA 200.7	W	Aluminum	10	L	87-108	L	62	NA
		Antimony	23	L	73-120	L	17	NA
		Arsenic	10	L	89-108	L	21	NA
		Barium	15	L	81-110	L	1	NA
		Beryllium	19	L	79-118	L	1	NA
		Boron	15	L	85-127	L	34	NA
		Cadmium	15	L	76-110	L	3	NA
		Calcium	31	L	64-127	L	141	NA
		Chromium	21	L	74-117	L	2	NA
		Cobalt	16	L	83-115	L	3	NA
		Copper	23	L	79-125	L	5	NA
		Iron	19	L	82-121	L	45	NA
		Lead	21	L	68-125	L	17	NA
		Lithium	30	L	50-150	L	4	NA
		Magnesium	21	L	83-126	L	16	NA
		Manganese	18	L	83-119	L	3	NA

TABLE 5-3
DATA QUALITY OBJECTIVES

METALS
(continued)

Method	Matrix	Analyte/Component	% RSD Precision[1]	Range Conc.	% R Accuracy[2]	Range Conc.	ug/L MDL	mg/kg
EPA 200.7 (Continued)	W	Molybdenum	11	L	82-104	L	2	NA
		Nickel	21	L	72-114	L	1	NA
		Phosphorus	9	L	82-105	L	26	NA
		Potassium	15	L	83-114	L	34	NA
		Selenium	18	L	91-127	L	3	NA
		Silicon	20	L	22-103	L	450	NA
		Silver	16	L	70-101	L	0.4	NA
		Sodium	20	L	85-125	L	85	NA
		Strontium	12	L	88-112	L	1	NA
		Thallium	20	L	60-137	L	0.5	NA
		Tin	10	L	90-110	L	33	NA
		Titanium	30	L	50-150	L	3	NA
		Vanadium	23	L	70-125	L	2	NA
		Zinc	16	L	69-125	L	11	NA
		Zirconium	30	L	50-150	L	3	NA
EPA 200.7 (Trace)	W							
		Antimony	30	L	50-150	L	3	NA
		Arsenic	30	L	50-150	L	3	NA
		Cadmium	30	L	50-150	L	1	NA
		Chromium	30	L	50-150	L	2	NA
		Lead	30	L	50-150	L	3	NA
		Selenium	30	L	50-150	L	4	NA
		Silver	30	L	50-150	L	1	NA
		Thallium	30	L	50-150	L	4	NA
SW846 7471	S	Mercury	27	L	83-138	L	NA	0.0045
SW846 7470 EPA 245.1	W	Mercury	22	L	80-130	L	0.023	NA

TABLE 5-4
DATA QUALITY OBJECTIVES

GC VOLATILE ORGANICS

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 502.2	W	Benzene	16	L	70-117	L	0.5	NA
		Bromobenzene	17	L	78-114	L	0.7	NA
		Bromochloromethane	10	L	87-108	L	0.1	NA
		Bromodichloromethane	24	L	72-123	L	1.0	NA
		Bromoform	15	L	75-125	L	0.7	NA
		Bromomethane	18	L	37-145	L	1.0	NA
		n-Butylbenzene	13	L	86-112	L	0.6	NA
		sec-Butylbenzene	11	L	84-108	L	0.4	NA
		tert-Butylbenzene	12	L	88-111	L	0.6	NA
		Carbon tetrachloride	16	L	81-129	L	0.8	NA
		Chlorobenzene	12	L	79-108	L	0.4	NA
		Chloroethane	23	L	82-121	L	1.0	NA
		Chloroform	12	L	85-109	L	0.6	NA
		Chloromethane	21	L	75-131	L	1.0	NA
		2-Chlorotoluene	24	L	75-124	L	0.5	NA
		4-Chlorotoluene	24	L	75-124	L	0.5	NA
		Dibromochloromethane	21	L	87-130	L	1.0	NA
		1,2-Dibromo-3-chloropropane	27	L	78-134	L	0.3	NA
		1,2-Dibromoethane	27	L	66-120	L	1.0	NA
		Dibromomethane	17	L	68-118	L	1.0	NA
		1,2-Dichlorobenzene	17	L	85-119	L	0.7	NA
		1,3-Dichlorobenzene	17	L	81-115	L	0.8	NA
		1,4-Dichlorobenzene	15	L	84-115	L	0.8	NA

TABLE 5-4
DATA QUALITY OBJECTIVES

GC VOLATILE ORGANICS
(Continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 502.2 (Continued)	W	Dichlorodifluoromethane	15	L	83-128	L	0.4	NA
		1,1-Dichloroethane	17	L	83-117	L	0.8	NA
		1,2-Dichloroethane	16	L	75-139	L	1.0	NA
		1,1-Dichloroethene	27	L	48-130	L	0.6	NA
		cis-1,2-Dichloroethene	21	L	67-111	L	0.4	NA
		trans-1,2-Dichloroethene	17	L	81-115	L	0.8	NA
		1,2-Dichloropropane	15	L	75-123	L	0.7	NA
		1,3-Dichloropropane	12	L	90-117	L	0.6	NA
		2,2-Dichloropropane	15	L	79-107	L	0.7	NA
		1,1-Dichloropropene	10	L	91-106	L	0.4	NA
		1,3-Dichloropropene	30	L	50-150	L		NA
		Ethylbenzene	10	L	84-106	L	0.5	NA
		Hexachlorobutadiene	10	L	95-108	L	0.3	NA
		Isopropylbenzene	10	L	86-103	L	0.4	NA
		p-Isopropyltoluene	11	L	91-114	L	0.6	NA
		Methylene chloride	19	L	82-122	L	1.0	NA
		Methyl-tert-butyl-ether	30	L	50-150	L		NA
		Naphthalene	12	L	92-115	L	0.6	NA
		n-Propylbenzene	12	L	88-112	L	0.6	NA
		Styrene	21[6]	L	84-128[6]	L	0.1	NA
		1,1,1,2-Tetrachloroethane	21	L	72-116	L	0.7	NA
		1,1,2,2-Tetrachloroethane	19	L	70-126	L	0.1	NA
		Tetrachloroethene	13	L	75-127	L	0.6	NA
		Toluene	16	L	70-117	L	0.4	NA
		1,2,3-Trichlorobenzene	10	L	86-104	L	0.4	NA
		1,2,4-Trichlorobenzene	10	L	86-104	L	0.5	NA
		1,1,1-Trichloroethane	14	L	81-125	L	0.5	NA
		1,1,2-Trichloroethane	17	L	81-133	L	0.5	NA

TABLE 5-4
DATA QUALITY OBJECTIVES

GC VOLATILE ORGANICS
(Continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 502.2 (Continued)		Trichloroethene	13	L	75-123	L	0.4	NA
		Trichlorofluoromethane	14	L	87-131	L	1.0	NA
	W	1,2,3-Trichloropropane	17	L	72-122	L	0.4	NA
		1,2,4-Trimethylbenzene	10	L	90-109	L	0.5	NA
		1,3,5-Trimethylbenzene	11	L	89-112	L	0.6	NA
		Vinyl chloride	22	L	44-176	L	0.2	NA
		o-Xylene	21	L	84-128	L	0.5	NA
		m-Xylene	21	L	84-128	L	0.3	NA
		p-Xylene	21	L	84-128	L	0.6	NA
EPA 601, SW846 8010	W	Benzyl chloride	10	L	86-106	L	0.48	NA
		Bromobenzene	17	L	78-114	L	0.51	NA
		Bromochloromethane	30	L	50-150	L		NA
		Bromodichloromethane	22	L	61-133	L	0.20	NA
		Bromoform	14	L	75-125	L	0.23	NA
		Bromomethane	18	L	37-145	L	0.44	NA
		Carbon tetrachloride	16	L	81-129	L	0.17	NA
		Chlorobenzene	24	L	58-133	L	0.13	NA
		Chloroethane	23	L	82-121	L	0.41	NA
		2-Chloroethyl vinyl ether	21	L	50-156	L	0.43	NA
		Chloroform	12	L	85-109	L	0.33	NA
		1-Chlorohexane	12	L	58-133	L	0.62	NA
		Chloromethane	21	L	75-131	L	0.35	NA
		2-Chlorotoluene [11]	24	L	75-124	L	0.62	NA
		Dibromochloromethane	21	L	87-130	L	0.17	NA
		Dibromomethane	17	L	68-118	L	0.46	NA
		1,2-Dichlorobenzene	17	L	85-119	L	0.26	NA
		1,3-Dichlorobenzene	17	L	81-115	L	0.32	NA
		1,4-Dichlorobenzene	15	L	84-115	L	0.28	NA

TABLE 5-4
DATA QUALITY OBJECTIVES

GC VOLATILE ORGANICS
(Continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 601, SW846 8010 (Continued)	W	Dichlorodifluoromethane	15	L	83-128	L	0.26	NA
		1,1-Dichloroethane	17	L	83-117	L	0.26	NA
		1,2-Dichloroethane	16	L	75-139	L	0.60	NA
		1,1-Dichloroethene	28	L	43-131	L	0.28	NA
		cis-1,2-Dichloroethene [11]	24	L	69-121	L	0.20	NA
		trans-1,2-Dichloroethene	17	L	81-115	L	0.21	NA
		1,2-Dichloropropane	15	L	75-123	L	0.25	NA
		cis-1,3-Dichloropropene	14	L	78-122	L	0.20	NA
		trans-1,3-Dichloropropene	21	L	65-128	L	0.24	NA
		Methylene chloride	19	L	82-122	L	0.21	NA
		1,1,1,2-Tetrachloroethane	21	L	72-116	L	0.57	NA
		1,1,2,2-Tetrachloroethane	19	L	70-126	L	0.25	NA
		Tetrachloroethene	13	L	75-127	L	0.19	NA
		1,1,1-Trichloroethane	14	L	81-125	L	0.26	NA
		1,1,2-Trichloroethane	17	L	81-133	L	0.25	NA
		Trichloroethene	13	L	75-123	L	0.23	NA
		Trichlorofluoromethane	14	L	87-131	L	0.36	NA
		1,2,3-Trichloropropane	17	L	72-122	L	0.51	NA
		Vinyl chloride	22	L	44-176	L	0.39	NA

TABLE 5-4
DATA QUALITY OBJECTIVES

GC VOLATILE ORGANICS
(Continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL ug/kg
EPA 602, SW846 8020	W	Benzene	15	L	70-117	L	0.5	NA
		Chlorobenzene	24	L	58-133	L	0.2	NA
		1,2-Dichlorobenzene	17	L	85-119	L	0.7	NA
		1,3-Dichlorobenzene	17	L	81-115	L	0.8	NA
		1,4-Dichlorobenzene	15	L	84-115	L	0.8	NA
		Ethylbenzene	10	L	84-106	L	0.2	NA
		Toluene	16	L	70-117	L	0.2	NA
		Methyl-t-butyl ether	16	L	75-108	L	0.2	NA
		Xylenes	21	L	84-128	L	0.2	NA
EPA 601 MOD, SW846 8010 Mod.	W	Ethylene dibromide	25	L	81-135	L	0.01	NA
		1,2-Dibromo-3-chloropropane	20	L	80-120	L	0.1	NA
SW846 8010	S	Benzyl chloride	27	L	58-112	L	NA	0.956
		Bromobenzene	11	L	82-106	L	NA	0.27
		Bromodichloromethane	31	L	65-127	L	NA	0.25
		Bromoform	28	L	77-125	L	NA	0.62
		Bromomethane	36	L	37-148	L	NA	0.48
		Carbon tetrachloride	24	L	62-111	L	NA	0.30
		Chlorobenzene	19	L	74-114	L	NA	0.34
		Chloroethane	25	L	67-117	L	NA	0.44
		2-Chloroethyl vinyl ether	36	L	54-127	L	NA	0.81
		Chloroform	17	L	66-125	L	NA	0.26
		1-Chlorohexane	15	L	75-119	L	NA	0.30
		Chloromethane	33	L	67-134	L	NA	0.27
		2-Chlorotoluene [11]	13	L	84-113	L	NA	0.23

TABLE 5-4
DATA QUALITY OBJECTIVES

GC VOLATILE ORGANICS
(Continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL ug/kg
SW846 8010 (Continued)	S	Dibromochloromethane	31	L	69-133	L	NA	0.26
		Dibromomethane	28	L	86-143	L	NA	0.44
		1,2-Dichlorobenzene	16	L	83-117	L	NA	0.32
		1,3-Dichlorobenzene	16	L	83-117	L	NA	0.34
		1,4-Dichlorobenzene	16	L	83-117	L	NA	0.33
		Dichlorodifluoromethane	22	L	83-128	L	NA	0.87
		1,1-Dichloroethane	15	L	63-125	L	NA	0.25
		1,2-Dichloroethane	16	L	70-125	L	NA	0.32
		1,1-Dichloroethene	30	L	45-137	L	NA	0.27
		cis-1,2-Dichloroethene[11]	24	L	69-121	L	NA	0.23
		trans-1,2-Dichloroethene	15	L	77-108	L	NA	0.28
		1,2-Dichloropropane	25	L	60-111	L	NA	0.24
		cis-1,3-Dichloropropene	20	L	22-178	L	NA	0.19
		trans-1,3-Dichloropropene	26	L	58-125	L	NA	0.22
		Methylene chloride	25	L	83-125	L	NA	0.24
		1,1,1,2-Tetrachloroethane	28	L	72-116	L	NA	0.25
		1,1,2,2-Tetrachloroethane	24	L	56-125	L	NA	0.99
		Tetrachloroethene	22	L	65-112	L	NA	0.34
		1,1,1-Trichloroethane	17	L	83-119	L	NA	0.33
		1,1,2-Trichloroethane	25	L	68-119	L	NA	0.44
		Trichloroethene	28	L	64-121	L	NA	0.37
		Trichlorofluoromethane	16	L	65-125	L	NA	0.28
		1,2,3-Trichloropropane	18	L	84-119	L	NA	0.90
		Vinyl chloride	22	L	44-176	L	NA	0.33

TABLE 5-4
DATA QUALITY OBJECTIVES

GC VOLATILE ORGANICS
(Continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8020	S	Benzene	21	L	71-114	L	NA	0.7
		Chlorobenzene	19	L	74-114	L	NA	0.2
		1,2-Dichlorobenzene	16	L	83-117	L	NA	0.3
		1,3-Dichlorobenzene	16	L	83-117	L	NA	0.2
		1,4-Dichlorobenzene	16	L	83-117	L	NA	1.2
		Ethylbenzene	10	L	86-108	L	NA	0.2
		Toluene	12	L	84-128	L	NA	0.2
		Methyl-t-butyl ether	20	L	72-112	L	NA	0.2
		Xylenes	11	L	82-125	L	NA	0.2
SW846 8010 Mod.	S	Ethylene dibromide	25	L	81-135	L	NA	0.01
		1,2-Dibromo-3-chloropropane	20	L	80-120	L	NA	0.1
SW846 8010	S	Benzyl chloride	27	H	58-112	H	NA	0.061
		Bromobenzene	11	H	82-106	H	NA	0.064
		Bromodichloromethane	31	H	65-127	H	NA	0.026
		Bromoform	28	H	77-125	H	NA	0.028
		Bromomethane	36	H	37-148	H	NA	0.055
		Carbon tetrachloride	24	H	62-111	H	NA	0.021
		Chlorobenzene	19	H	74-114	H	NA	0.017
		Chloroethane	25	H	67-117	H	NA	0.052
		2-Chloroethyl vinyl ether	36	H	54-127	H	NA	0.054
		Chloroform	17	H	66-125	H	NA	0.041
		1-Chlorohexane	15	H	75-119	H	NA	0.078
		Chloromethane	33	H	67-134	H	NA	0.044
		2-Chlorotoluene [11]	13	H	84-113	H	NA	0.078

TABLE 5-4
DATA QUALITY OBJECTIVES

GC VOLATILE ORGANICS
(Continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8010 (Continued)	S	Dibromochloromethane	31	H	69-133	H	NA	0.022
		Dibromomethane	28	H	86-143	H	NA	0.058
		1,2-Dichlorobenzene	16	H	83-117	H	NA	0.032
		1,3-Dichlorobenzene	16	H	83-117	H	NA	0.040
		1,4-Dichlorobenzene	16	H	83-117	H	NA	0.035
		Dichlorodifluoromethane	22	H	83-128	H	NA	0.032
		1,1-Dichloroethane	15	H	63-125	H	NA	0.032
		1,2-Dichloroethane	16	H	70-125	H	NA	0.076
		1,1-Dichloroethene	30	H	45-137	H	NA	0.034
		cis-1,2-Dichloroethene [11]	24	H	69-121	H	NA	0.025
		trans-1,2-Dichloroethene	15	H	77-108	H	NA	0.026
		1,2-Dichloropropane	25	H	60-111	H	NA	0.031
		cis-1,3-Dichloropropene	20	H	22-178	H	NA	0.024
		trans-1,3-Dichloropropene	26	H	58-125	H	NA	0.030
		Methylene chloride	25	H	83-125	H	NA	0.027
		1,1,1,2-Tetrachloroethane	28	H	72-116	H	NA	0.072
		1,1,2,2-Tetrachloroethane	24	H	56-125	H	NA	0.032
		Tetrachloroethene	22	H	65-112	H	NA	0.024
		1,1,1-Trichloroethane	17	H	83-119	H	NA	0.032
		1,1,2-Trichloroethane	25	H	68-119	H	NA	0.031
		Trichloroethene	28	H	64-121	H	NA	0.028
		Trichlorofluoromethane	16	H	65-125	H	NA	0.045
		1,2,3-Trichloropropane	18	H	84-119	H	NA	0.064
		Vinyl chloride	22	H	44-176	H	NA	0.048

TABLE 5-4
DATA QUALITY OBJECTIVES

GC VOLATILE ORGANICS
(Continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8020	S	Benzene	21	H	71-114	H	NA	0.01
		Chlorobenzene	19	H	74-114	H	NA	0.02
		1,2-Dichlorobenzene	16	H	83-117	H	NA	0.04
		1,3-Dichlorobenzene	16	H	83-117	H	NA	0.01
		1,4-Dichlorobenzene	16	H	83-117	H	NA	0.01
		Ethylbenzene	10	H	86-108	H	NA	0.01
		Toluene	12	H	84-128	H	NA	0.02
		Methyl-t-butyl ether	20	H	72-112	H	NA	0.01
		Xylenes	11	H	82-125	H	NA	0.02
SW846 8010 Mod.	S	Ethylene dibromide	25	H	81-135	H	NA	0.001
		1,2-Dibromo-3-chloropropane	20	H	80-120	H	NA	0.01

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 524.2	W	Benzene	30	L	50-150	L		NA
		Bromobenzene	30	L	50-150	L		NA
		Bromochloromethane	30	L	50-150	L		NA
		Bromodichloromethane	30	L	50-150	L		NA
		Bromoform	30	L	50-150	L		NA
		Bromomethane	30	L	50-150	L		NA
		n-Butylbenzene	30	L	50-150	L		NA
		sec-Butylbenzene	30	L	50-150	L		NA
		tert-Butylbenzene	30	L	50-150	L		NA
		Carbon tetrachloride	30	L	50-150	L		NA
		Chlorobenzene	30	L	50-150	L		NA
		Chloroethane	30	L	50-150	L		NA
		Chloroform	30	L	50-150	L		NA
		Chloromethane	30	L	50-150	L		NA
		2-Chlorotoluene	30	L	50-150	L		NA
		4-Chlorotoluene	30	L	50-150	L		NA
		Dibromochloromethane	30	L	50-150	L		NA
		1,2-Dibromo-3-chloropropane	30	L	50-150	L		NA
		1,2-Dibromoethane	30	L	50-150	L		NA
		Dibromomethane	30	L	50-150	L		NA
		1,2-Dichlorobenzene	30	L	50-150	L		NA
		1,3-Dichlorobenzene	30	L	50-150	L		NA
		1,4-Dichlorobenzene	30	L	50-150	L		NA
		Dichlorodifluoromethane	30	L	50-150	L		NA
		1,1-Dichloroethane	30	L	50-150	L		NA
		1,2-Dichloroethane	30	L	50-150	L		NA
		1,1-Dichloroethene	30	L	50-150	L		NA

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 524.2 (continued)		cis-1,2-Dichloroethene	30	L	50-150	L		NA
		trans-1,2-Dichloroethene	30	L	50-150	L		NA
		1,2-Dichloropropane	30	L	50-150	L		NA
		1,3-Dichloropropane	30	L	50-150	L		NA
		2,2-Dichloropropane	30	L	50-150	L		NA
		1,1-Dichloropropene	30	L	50-150	L		NA
		1,3-Dichloropropene	30	L	50-150	L		NA
		Ethylbenzene	30	L	50-150	L		NA
		Hexachlorobutadiene	30	L	50-150	L		NA
		Isopropylbenzene	30	L	50-150	L		NA
		p-Isopropyltoluene	30	L	50-150	L		NA
		Methylene chloride	30	L	50-150	L		NA
		Methyl-tert-butyl-ether	30	L	50-150	L		NA
		Naphthalene	30	L	50-150	L		NA
		n-Propylbenzene	30	L	50-150	L		NA
		Styrene	30	L	50-150	L		NA
		1,1,1,2-Tetrachloroethane	30	L	50-150	L		NA
		1,1,2,2-Tetrachloroethane	30	L	50-150	L		NA
		Tetrachloroethene	30	L	50-150	L		NA
		Toluene	30	L	50-150	L		NA
		1,2,3-Trichlorobenzene	30	L	50-150	L		NA
		1,2,4-Trichlorobenzene	30	L	50-150	L		NA
		1,1,1-Trichloroethane	30	L	50-150	L		NA
		1,1,2-Trichloroethane	30	L	50-150	L		NA
		Trichloroethene	30	L	50-150	L		NA
		Trichlorofluoromethane	30	L	50-150	L		NA
		1,2,3-Trichloropropane	30	L	50-150	L		NA
		1,2,4-Trimethylbenzene	30	L	50-150	L		NA
		1,3,5-Trimethylbenzene	30	L	50-150	L		NA

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] % RSD	Conc. Range	Accuracy[2] % R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 524.2 (continued)		Vinyl chloride	30	L	50-150	L		NA
		o-Xylene	30	L	50-150	L		NA
		m-Xylene	30	L	50-150	L		NA
		p-Xylene	30	L	50-150	L		NA
EPA 624	W	Acetone[8]	15	L	87-115	L	1.63	NA
SW846 8240		Acrolein[8]	15	L	87-119	L	4.70	NA
		Acrylonitrile[8]	17	L	21-128	L	7.89	NA
		Benzene	16	L	76-126	L	0.62	NA
		Benzyl Chloride[8]	15	L	27-110	L	0.78	NA
		Bromobenzene[11]	15	L	75-127	L	0.64	NA
		Bromodichloromethane	15	L	67-114	L	0.46	NA
		Bromoform	8	L	66-125	L	0.63	NA
		Bromomethane	15	L	87-117	L	0.68	NA
		2-Butanone (MEK)[8]	36	L	14-126	L	1.98	NA
		Carbon disulfide[8]	9	L	81-125	L	0.66	NA
		Carbon tetrachloride	12	L	77-125	L	0.58	NA
		Chlorobenzene	13	L	74-113	L	1.88	NA
		Chloroethane	18	L	80-121	L	0.62	NA
		2-Chloroethyl vinyl ether	20	L	61-125	L	0.54	NA
		Chloroform	15	L	87-111	L	0.52	NA
		1-Chlorohexane[11]	15	L	52-111	L	0.73	NA
		Chloromethane	20	L	41-160	L	0.64	NA
		2-Chlorotoluene[11]	15	L	85-140	L	1.20	NA
		4-Chlorotoluene[11]	15	L	66-119	L	0.66	NA
		Dibromochloromethane	8	L	79-125	L	0.56	NA
		Dibromomethane[8]	15	L	87-141	L	1.40	NA
		1.2-Dichlorobenzene[7]	15	L	73-125	L	0.58	NA
		1,3-Dichlorobenzene[7]	15	L	77-119	L	0.70	NA
		1,4-Dichlorobenzene[7]	15	L	74-122	L	0.78	NA

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 624								
SW846 8240		Dichlorodifluoromethane	12	L	79-105	L	0.89	NA
(Continued)		1,1-Dichloroethane	12	L	82-109	L	0.63	NA
		1,2-Dichloroethane	17	L	76-128	L	0.60	NA
	W	1,1-Dichloroethene	19	L	63-123	L	0.58	NA
		cis-1,2-Dichloroethene[11]	26	L	63-142	L	0.69	NA
		trans-1,2-Dichloroethene	12	L	79-109	L	0.74	NA
		1,2-Dichloropropane	15	L	88-118	L	0.70	NA
		cis-1,3-Dichloropropene	12	L	84-109	L	0.40	NA
		trans-1,3-Dichloropropene	12	L	84-109	L	0.47	NA
		Ethylbenzene	14	L	85-115	L	0.64	NA
		2-Hexanone[8]	18	L	85-123	L	2.20	NA
		Methylene chloride	19	L	77-135	L	0.62	NA
		4-Methyl-2-pentanone (MIBK)[8]	23	L	63-133	L	3.19	NA
		Styrene[8]	22	L	52-120	L	0.74	NA
		1,1,2,2-Tetrachloroethane	17	L	77-111	L	0.68	NA
		Tetrachloroethene	14	L	81-110	L	0.82	NA
		Toluene	23	L	75-122	L	1.05	NA
		1,1,1-Trichloroethane	13	L	81-110	L	0.72	NA
		1,1,2-Trichloroethane	14	L	84-114	L	0.53	NA
		Trichloroethene	10	L	75-115	L	0.74	NA
		Trichlorofluoromethane	15	L	82-113	L	0.79	NA
		Vinyl acetate[8]	21	L	83-125	L	0.65	NA
		Vinyl chloride	24	L	56-152	L	0.68	NA
		Xylenes (total)[8]	17	L	83-118	L	0.54	NA
		Ethylene Dibromide [10,8,6]	25	L	81-135	L	1.40	NA

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
EPA 624 SW846 8240	W	APPENDIX IX ADDENDUM						
		Acetonitrile	38	L	26-102	L	17	NA
		Bis(2-chloroethoxy)methane[11]	20	L	40-160	L	0.80	NA
		2-Chloro-1,3-Butadiene (Chloroprene)	68	L	34-170	L	4	NA
		3-Chloropropene (Allyl Chloride)	29	L	51-111	L	0.5	NA
		Chloromethylmethyl ether[11]	20	L	40-160	L	1.2	NA
		Cyclohexane[11]	20	L	40-160	L	1.6	NA
		1,2-Dibromo-3-chloropropane	16	L	99-132	L	0.9	NA
		trans-1,4-Dichloro-2-butene	38	L	31-108	L	2	NA
		1,4-Dioxane	20	L	84-124	L	44	NA
		Ethyl methacrylate	10	L	67-88	L	0.6	NA
		Iodomethane	13	L	83-110	L	0.7	NA
		Isobutyl Alcohol	29	L	77-136	L	132	NA
		Isopropanol[11]	20	L	40-160	L	16	NA
		Isoprene[11]	20	L	40-160	L	1.2	NA
		Methacrylonitrile	52	L	30-133	L	6	NA
		Methyl methacrylate	9	L	79-97	L	0.5	NA
		Propionitrile (Ethyl Cyanide)[6,8]	20	L	70-130	L	6.9	NA
		1,1,1,2-Tetrachloroethane	7	L	68-82	L	0.4	NA
		1,2,3-Trichloropropane	12	L	78-104	L	0.7	NA
		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon)[11]	15	L	56-138	L	1	NA

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8240	S	Acetone	18	L	80-120	L	NA	1.63
		Acrolein	11	L	87-119	L	NA	4.70
		Acrylonitrile	18	L	21-128	L	NA	7.89
		Benzene	13	L	87-114	L	NA	0.62
		Bromodichloromethane	21	L	67-111	L	NA	0.64
		Bromoform	22	L	58-125	L	NA	0.63
		Bromomethane	11	L	87-110	L	NA	0.68
		2-Butanone (MEK)	17	L	85-119	L	NA	1.98
		Carbon disulfide	9	L	81-125	L	NA	0.66
		Carbon tetrachloride	18	L	66-125	L	NA	0.58
		Chlorobenzene	21	L	72-115	L	NA	1.88
		Chloroethane	11	L	82-114	L	NA	0.62
		2-Chloroethyl vinyl ether	15	L	80-111	L	NA	0.54
		Chloroform	15	L	87-111	L	NA	0.52
		Chloromethane	18	L	79-115	L	NA	0.64
		Dibromomethane	15	L	87-141	L	NA	0.56
		Dibromochloromethane	16	L	71-125	L	NA	1.40
		1.2-Dichlorobenzene[7]	15	L	73-125	L	NA	0.58
		1,3-Dichlorobenzene[7]	15	L	77-119	L	NA	0.70
		1,4-Dichlorobenzene[7]	15	L	74-122	L	NA	0.78
		Dichlorodifluoromethane	12	L	79-105	L	NA	0.89
		1,1-Dichloroethane	12	L	87-112	L	NA	0.63
		1,2-Dichloroethane	16	L	78-110	L	NA	0.60
		1,1-Dichloroethene	28	L	60-145	L	NA	0.58
		trans-1,2-Dichloroethene	10	L	81-107	L	NA	0.74
		1,2-Dichloropropane	13	L	88-109	L	NA	0.70
		cis-1,3-Dichloropropene	14	L	74-125	L	NA	0.40

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8240 (Continued)	S	trans-1,3-Dichloropropene	14	L	74-125	L	NA	0.47
		Ethylbenzene	14	L	74-125	L	NA	0.64
		2-Hexanone	17	L	87-129	L	NA	2.20
		Methylene chloride	22	L	86-130	L	NA	0.62
		4-Methyl-2-pentanone (MIBK)	12	L	90-125	L	NA	3.19
		Styrene	21	L	57-122	L	NA	0.74
		1,1,2,2-Tetrachloroethane	24	L	71-117	L	NA	0.68
		Tetrachloroethene	10	L	80-107	L	NA	0.82
		Toluene	12	L	85-109	L	NA	1.05
		1,1,1-Trichloroethane	12	L	83-108	L	NA	0.72
		1,1,2-Trichloroethane	19	L	75-113	L	NA	0.53
		Trichloroethene	19	L	64-103	L	NA	0.74
		Trichlorofluoromethane	18	L	82-118	L	NA	0.79
		Vinyl acetate	10	L	90-117	L	NA	0.65
		Vinyl chloride	24	L	71-119	L	NA	0.68
		Xylenes (total)	10	L	80-106	L	NA	0.54
		Ethylene Dibromide[10,6]	25	L	81-135	L	NA	1.40

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8240	S	APPENDIX IX ADDENDUM						
		Acetonitrile	38	L	26-102	L	NA	17
		2-Chloro-1,3-Butadiene (Chloroprene)	68	L	34-170	L	NA	4
		3-Chloropropene (Allyl Chloride)	29	L	51-111	L	NA	0.5
		1,2-Dibromo-3-chloropropane	16	L	99-132	L	NA	0.9
		trans-1,4-Dichloro-2-butene	38	L	31-108	L	NA	2
		1,4-Dioxane	20	L	84-124	L	NA	44
		Ethyl methacrylate	10	L	67-88	L	NA	0.6
		Iodomethane	13	L	83-110	L	NA	0.7
		Isobutyl Alcohol	29	L	77-136	L	NA	132
		Methacrylonitrile	52	L	30-133	L	NA	6
		Methyl methacrylate	9	L	79-97	L	NA	0.5
		1,1,1,2-Tetrachloroethane	7	L	68-82	L	NA	0.4
		1,2,3-Trichloropropane	12	L	78-104	L	NA	0.7

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8240	S	Acetone	15	H	87-115	H	NA	5.8
		Acrolein	15	H	87-119	H	NA	5.9
		Acrylonitrile	36	H	21-128	H	NA	8.4
		Benzene	18	H	83-119	H	NA	0.7
		Bromodichloromethane	22	H	67-111	H	NA	0.7
		Bromoform	10	H	58-125	H	NA	0.3
		Bromomethane	20	H	63-125	H	NA	0.8
		2-Butanone (MEK)	23	H	76-123	H	NA	9.5
		Carbon disulfide	24	H	75-145	H	NA	1.0
		Carbon tetrachloride	21	H	75-135	H	NA	0.9
		Chlorobenzene	21	H	72-115	H	NA	0.4
		Chloroethane	25	H	67-117	H	NA	0.7
		2-Chloroethyl vinyl ether	15	H	80-111	H	NA	1.0
		Chloroform	15	H	87-111	H	NA	0.4
		Chloromethane	20	H	71-112	H	NA	0.8
		Dibromomethane	15	H	87-141	H	NA	0.14
		Dibromochloromethane	14	H	69-125	H	NA	0.3
		1.2-Dichlorobenzene[7]	15	H	73-125	H	NA	0.06
		1,3-Dichlorobenzene[7]	15	H	77-119	H	NA	0.07
		1,4-Dichlorobenzene[7]	15	H	74-122	H	NA	0.08
		Dichlorodifluoromethane	12	H	79-105	H	NA	0.8
		1,1-Dichloroethane	18	H	85-123	H	NA	0.3
		1,2-Dichloroethane	22	H	78-110	H	NA	0.9
		1,1-Dichloroethene	25	H	66-120	H	NA	0.6
		trans-1,2-Dichloroethene	18	H	81-107	H	NA	0.8
		1,2-Dichloropropane	13	H	88-109	H	NA	0.1

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8240 (Continued)	S	cis-1,3-Dichloropropene	23	H	62-110	H	NA	1.0
		trans-1,3-Dichloropropene	21	H	62-110	H	NA	0.9
		Ethylbenzene	27	H	77-133	H	NA	0.3
		2-Hexanone	16	H	84-116	H	NA	5.0
		Methylene chloride	21	H	75-118	H	NA	0.9
		4-Methyl-2-pentanone (MIBK)	23	H	63-133	H	NA	7.9
		Styrene	20	H	64-135	H	NA	0.3
		1,1,2,2-Tetrachloroethane	22	H	71-117	H	NA	0.6
		Tetrachloroethene	10	H	80-107	H	NA	0.2
		Toluene	17	H	82-116	H	NA	0.6
		1,1,1-Trichloroethane	20	H	83-124	H	NA	0.8
		1,1,2-Trichloroethane	13	H	84-111	H	NA	0.3
		Trichloroethene	25	H	75-122	H	NA	0.8
		Trichlorofluoromethane	18	H	82-118	H	NA	0.4
		Vinyl acetate	22	H	75-117	H	NA	9.2
		Vinyl chloride	23	H	70-117	H	NA	0.7
		Xylenes (total)	18	H	80-106	H	NA	0.5

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8240	S	APPENDIX IX ADDENDUM						
		Acetonitrile	38	H	26-102	H	NA	11
		2-Chloro-1,3-Butadiene (Chloroprene)	68	H	34-170	H	NA	3
		3-Chloropropene (Allyl Chloride)	29	H	51-111	H	NA	1
		1,2-Dibromo-3-chloropropane	16	H	99-132	H	NA	1
		trans-1,4-Dichloro-2-butene	38	H	31-108	H	NA	1
		1,4-Dioxane	20	H	84-124	H	NA	28
		Ethyl methacrylate	10	H	67-88	H	NA	1
		Iodomethane	13	H	83-110	H	NA	100
		Isobutyl Alcohol	29	H	77-136	H	NA	82
		Methacrylonitrile	52	H	30-133	H	NA	4
		Methyl methacrylate	9	H	79-97	H	NA	1
		1,1,1,2-Tetrachloroethane	7	H	68-82	H	NA	1
		1,2,3-Trichloropropane	12	H	78-104	H	NA	1

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8260	W	Acetone	22	L	40-160	L	9.5	NA
		Acrolein	20	L	40-160	L	5.0	NA
		Acrylonitrile	16	L	40-160	L	0.5	NA
		Benzene	11	L	71-110	L	0.36	NA
		Bromobenzene	16	L	65-110	L	0.5	NA
		Bromochloromethane	18	L	57-110	L	0.6	NA
		Bromodichloromethane	11	L	49-110	L	0.15	NA
		Bromoform	11	L	28-110	L	0.51	NA
		Bromomethane	28	L	55-121	L	0.88	NA
		2-Butanone (MEK)	28	L	25-110	L	3.2	NA
		n-Butylbenzene	11	L	58-110	L	0.3	NA
		sec-Butlybenzene	10	L	68-110	L	0.3	NA
		tert-Butylbenzene	15	L	66-110	L	0.4	NA
		Carbon disulfide	15	L	66-110	L	0.20	NA
		Carbon tetrachloride	20	L	38-110	L	0.21	NA
		Chlorobenzene	14	L	71-110	L	0.20	NA
		Chloroethane	21	L	60-110	L	0.50	NA
		2-Chloroethyl vinyl ether	20	L	40-160	L	2.7	NA
		Chloroform	18	L	64-110	L	0.36	NA
		Chloromethane	20	L	40-160	L	0.89	NA
		2-Chlorotoluene	25	L	51-110	L	0.7	NA
		4-Chlorotoluene	21	L	65-116	L	0.6	NA
		1,2-Dibromoethane (Ethylene Dibromide)	20	L	54-110	L	0.6	NA
		Dibromochloromethane	15	L	34-110	L	0.26	NA
		Dibromomethane	12	L	65-110	L	0.26	NA

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8260 (continued)	W	1,2-Dibromo-3-chloropropane	10	L	10-110	L	0.2	NA
		1,2-Dichlorobenzene	14	L	66-100	L	0.4	NA
		1,3-Dichlorobenzene	28	L	48-115	L	0.8	NA
		1,4-Dichlorobenzene	15	L	70-110	L	0.4	NA
		Dichlorodifluoromethane	23	L	58-114	L	0.87	NA
		1,1-Dichloroethane	29	L	43-112	L	0.30	NA
		1,2-Dichloroethane	11	L	74-110	L	0.12	NA
		1,1-Dichloroethene	11	L	63-110	L	0.26	NA
		cis-1,2-Dichloroethene	24	L	50-110	L	0.7	NA
		trans-1,2-Dichloroethene	14	L	59-110	L	0.29	NA
		1,2-Dichloroethene-Total	30	L	50-150	L	0.53	NA
		1,2-Dichloropropane	21	L	55-110	L	0.16	NA
		1,3-Dichloropropane	20	L	59-110	L	0.6	NA
		2,2-Dichloropropane	23	L	41-110	L	0.7	NA
		1,1-Dichloropropene	14	L	64-110	L	0.4	NA
		cis-1,3-Dichloropropene	17	L	46-110	L	0.14	NA
		trans-1,3-Dichloropropene	14	L	48-110	L	0.18	NA
		Ethylbenzene	18	L	63-110	L	0.18	NA
		2-Hexanone	30	L	16-110	L	2.9	NA
		Hexachlorobutadiene	21	L	43-110	L	0.6	NA
		Iodomethane	10	L	60-110	L	0.3	NA
		Isopropyl Benzene	11	L	72-110	L	0.3	NA
		Methylene chloride	17	L	69-109	L	0.39	NA
		4-Methyl-2-pentanone (MIBK)	37	L	10-110	L	2.3	NA
		Naphthalene	53	L	14-142	L	1.6	NA
		n-Propylbenzene	14	L	60-110	L	0.4	NA
		Styrene	18	L	60-110	L	0.25	NA

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8260 (Continued)	W	1,1,1,2-Tetrachloroethane	25	L	36-110	L	0.54	NA
		1,1,2,2-Tetrachloroethane	13	L	56-110	L	0.71	NA
		Tetrachloroethene	15	L	67-110	L	0.27	NA
		p-Isopropyl Toluene	10	L	68-110	L	0.3	NA
		Toluene	12	L	70-110	L	0.13	NA
		1,2,4-Trichlorobenzene	30	L	50-150	L	0.95	NA
		1,1,1-Trichloroethane	13	L	61-110	L	0.34	NA
		1,1,2-Trichloroethane	22	L	56-110	L	0.35	NA
		1,2,3-Trichlorobenzene	14	L	56-110	L	0.4	NA
		1,2,4-Trimethylbenzene	10	L	68-110	L	0.3	NA
		1,3,5-Trimethylbenzene	12	L	70-110	L	0.4	NA
		Trichloroethene	22	L	75-110	L	0.4	NA
		Trichlorofluoromethane	18	L	58-110	L	0.37	NA
		1,2,3-Trichloropropane	46	L	46-156	L	0.83	NA
		Vinyl acetate	30	L	19-110	L	0.48	NA
		Vinyl chloride	18	L	71-115	L	0.39	NA
		Xylenes (total)	36	L	74-110	L	1.1	NA

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL ug/L	MDL mg/kg
SW846 8260	S	Acetone	22	L	40-160	L	NA	0.009
		Acrolein	20	L	40-160	L	NA	5.0
		Acrylonitrile	16	L	40-160	L	NA	0.5
		Benzene	11	L	71-110	L	NA	0.002
		Bromobenzene	16	L	65-110	L	NA	0.5
		Bromochloromethane	18	L	57-110	L	NA	0.0009
		Bromodichloromethane	11	L	49-110	L	NA	0.3
		Bromoform	11	L	28-110	L	NA	0.001
		Bromomethane	28	L	55-121	L	NA	0.001
		2-Butanone (MEK)	28	L	25-110	L	NA	0.11
		n-Butylbenzene	11	L	58-110	L	NA	0.3
		sec-Butlybenzene	10	L	68-110	L	NA	0.3
		tert-Butylbenzene	15	L	66-110	L	NA	0.4
		Carbon Disulfide	30	L	50-150	L	NA	0.001
		Carbon tetrachloride	20	L	38-110	L	NA	0.001
		Chlorobenzene	14	L	71-110	L	NA	0.0009
		Chloroethane	21	L	60-110	L	NA	0.002
		2-Chloroethyl vinyl ether	20	L	40-160	L	NA	2.7
		Chloroform	18	L	64-110	L	NA	0.001
		Chloromethane	20	L	40-160	L	NA	0.001
		2-Chlorotoluene	25	L	51-110	L	NA	0.7
		4-Chlorotoluene	21	L	65-116	L	NA	0.6
		1,2-Dibromoethane	20	L	54-110	L	NA	0.6
		Dibromochloromethane	15	L	34-110	L	NA	0.0008
		Dibromomethane	12	L	65-110	L	NA	0.001
		1,2-Dibromo-3-chloropropane	10	L	10-110	L	NA	0.2
		1,2-Dichlorobenzene	14	L	66-100	L	NA	0.4

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8260 (Continued)	S	1,3-Dichlorobenzene	28	L	48-115	L	0.8
		1,4-Dichlorobenzene	15	L	70-110	L	0.4
		Dichlorodifluoromethane	23	L	58-114	L	0.0008
		1,1-Dichloroethane	29	L	43-112	L	0.001
		1,2-Dichloroethane	11	L	74-110	L	0.001
		1,1-Dichloroethene	11	L	63-110	L	0.0010
		cis-1,2-Dichloroethene	24	L	50-110	L	0.001
		trans-1,2-Dichloroethene	14	L	59-110	L	0.001
		1,2-Dichloropropane	21	L	55-110	L	0.002
		1,3-Dichloropropane	20	L	59-110	L	0.6
		2,2-Dichloropropane	23	L	41-110	L	0.7
		1,1-Dichloropropene	14	L	64-110	L	0.4
		cis-1,3-Dichloropropene	17	L	46-110	L	0.0007
		trans-1,3-Dichloropropene	14	L	48-110	L	0.001
		Ethylbenzene	18	L	63-110	L	0.001
		2-Hexanone	30	L	16-110	L	0.008
		Hexachlorobutadiene	21	L	43-110	L	0.6
		Iodomethane	10	L	60-110	L	0.3
		Isopropyl Benzene	11	L	72-110	L	0.3
		Methylene chloride	17	L	69-109	L	0.003
		4-Methyl-2-pentanone (MIBK)	37	L	10-110	L	0.006
		Naphthalene	53	L	14-142	L	1.6
		n-Propylbenzene	14	L	60-110	L	0.4
		Styrene	18	L	60-110	L	0.002
		1,1,1,2-Tetrachloroethane	25	L	36-110	L	0.001
		1,1,2,2-Tetrachloroethane	13	L	56-110	L	0.002
		Tetrachloroethene	15	L	67-110	L	0.001

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8260 (Continued)	S	p-Isopropyl Toluene	10	L	68-110	L	0.3
		Toluene	12	L	70-110	L	0.002
		1,1,1-Trichloroethane	13	L	61-110	L	0.001
		1,1,2-Trichloroethane	22	L	56-110	L	0.001
		1,2,3-Trichlorobenzene	14	L	56-110	L	0.4
		1,2,4-Trimethylbenzene	10	L	68-110	L	0.3
		1,3,5-Trimethylbenzene	12	L	70-110	L	0.4
		Trichloroethene	22	L	75-110	L	0.001
		Trichlorofluoromethane	18	L	58-110	L	0.001
		1,2,3-Trichloropropane	46	L	46-156	L	0.002
		Vinyl acetate	30	L	19-110	L	0.002
		Vinyl chloride	18	L	71-115	L	0.002
		Xylenes (total)	36	L	74-110	L	0.004
SW846 8260	S	Acetone	22	H	40-160	H	0.009
		Acrolein	20	H	40-160	H	0.5
		Acrylonitrile	16	H	40-160	H	0.05
		Benzene	11	H	71-110	H	0.02
		Bromobenzene	16	H	65-110	H	0.05
		Bromochloromethane	18	H	57-110	H	0.009
		Bromodichloromethane	11	H	49-110	H	0.03
		Bromoform	11	H	28-110	H	0.01
		Bromomethane	28	H	55-121	H	0.01
		2-Butanone (MEK)	28	H	25-110	H	0.11
		n-Butylbenzene	11	H	58-110	H	0.03
		sec-Butlybenzene	10	H	68-110	H	0.03
		Carbon disulfide	30	H	50-150	H	0.01
		tert-Butylbenzene	15	H	66-110	H	0.01

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8260 (Continued)	S						
		Carbon tetrachloride	20	H	38-110	H	0.06
		Chlorobenzene	14	H	71-110	H	0.009
		Chloroethane	21	H	60-110	H	0.02
		2-Chloroethyl vinyl ether	20	H	40-160	H	0.27
		Chloroform	18	H	64-110	H	0.01
		Chloromethane	20	H	40-160	H	0.01
		2-Chlorotoluene	25	H	51-110	H	0.07
		4-Chlorotoluene	21	H	65-116	H	0.06
		1,2-Dibromoethane	20	H	54-110	H	0.06
		Dibromochloromethane	15	H	34-110	H	0.008
		Dibromomethane	12	H	65-110	H	0.01
		1,2-Dibromo-3-chloropropane	10	H	10-110	H	0.02
		1,2-Dichlorobenzene	14	H	66-100	H	0.04
		1,3-Dichlorobenzene	28	H	48-115	H	0.08
		1,4-Dichlorobenzene	15	H	70-110	H	0.04
		Dichlorodifluoromethane	23	H	58-114	H	0.008
		1,1-Dichloroethane	29	H	43-112	H	0.01
		1,2-Dichloroethane	11	H	74-110	H	0.01
		1,1-Dichloroethene	11	H	63-110	H	0.01
		cis-1,2-Dichloroethene	24	H	50-110	H	0.01
		trans-1,2-Dichloroethene	14	H	59-110	H	0.01
		1,2-Dichloropropane	21	H	55-110	H	0.02
		1,3-Dichloropropane	20	H	59-110	H	0.06
		2,2-Dichloropropane	23	H	41-110	H	0.07
		1,1-Dichloropropene	14	H	64-110	H	0.04
		cis-1,3-Dichloropropene	17	H	46-110	H	0.007
		trans-1,3-Dichloropropene	14	H	48-110	H	0.01

TABLE 5-5
DATA QUALITY OBJECTIVES
GC /MS VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8260 (Continued)	S	Ethylbenzene	18	H	63-110	H	0.01
		2-Hexanone	30	H	16-110	H	0.08
		Hexachlorobutadiene	21	H	43-110	H	0.06
		Iodomethane	10	H	60-110	H	0.03
		Isopropyl Benzene	11	H	72-110	H	0.03
		Methylene chloride	17	H	69-109	H	0.03
		4-Methyl-2-pentanone (MIBK)	37	H	10-110	H	0.06
		Naphthalene	53	H	14-142	H	0.16
		n-Propylbenzene	14	H	60-110	H	0.04
		Styrene	18	H	60-110	H	0.02
		1,1,1,2-Tetrachloroethane	25	H	36-110	H	0.01
		1,1,2,2-Tetrachloroethane	13	H	56-110	H	0.02
		Tetrachloroethene	15	H	67-110	H	0.01
		p-Isopropyl Toluene	10	H	68-110	H	0.03
		Toluene	12	H	70-110	H	0.02
		1,1,1-Trichloroethane	13	H	61-110	H	0.01
		1,1,2-Trichloroethane	22	H	56-110	H	0.01
		1,2,3-Trichlorobenzene	14	H	56-110	H	0.04
		1,2,4-Trimethylbenzene	10	H	68-110	H	0.03
		1,3,5-Trimethylbenzene	12	H	70-110	H	0.04
		Trichloroethene	22	H	75-110	H	0.01
		Trichlorofluoromethane	18	H	58-110	H	0.01
		1,2,3-Trichloropropane	46	H	46-156	H	0.02
		Vinyl acetate	30	H	19-110	H	0.02
		Vinyl chloride	18	H	71-115	H	0.02
		Xylenes (total)	36	H	74-110	H	0.04

TABLE 5-6
DATA QUALITY OBJECTIVES
GC SEMI-VOLATILE ORGANICS

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
EPA 504.1	W	1,2-Dibromo-3-chloropropane	30	L	50-150	L	
		Ethylene Dibromide	30	L	50-150	L	
EPA 505	W	Endrin	32	L	60-125	L	0.20
		Lindane (G-BHC)	24	L	48-105	L	0.07
		Methoxychlor	29	L	69-129	L	0.2
		Toxaphene	36	L	32-116	L	1.4
EPA 508	W	Aldrin	30	L	50-150	L	
		Chlordane	30	L	50-150	L	
		Dieldrin	30	L	50-150	L	
		Endrin	30	L	50-150	L	
		Heptachlor	30	L	50-150	L	
		Heptachlor Epoxide	30	L	50-150	L	
		Lindane	30	L	50-150	L	
		Methoxychlor	30	L	50-150	L	
		Toxaphene	30	L	50-150	L	
		Hexachlorobenzene	30	L	50-150	L	
		Hexachlorocyclopentadiene	30	L	50-150	L	
		PCB-1016	30	L	50-150	L	
		PCB-1221	30	L	50-150	L	
		PCB-1232	30	L	50-150	L	
		PCB-1242	30	L	50-150	L	
		PCB-1248	30	L	50-150	L	
		PCB-1254	30	L	50-150	L	
		PCB-1260	30	L	50-150	L	

TABLE 5-6
DATA QUALITY OBJECTIVES
GC SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
EPA 515.1	W	2,4-D	35	L	22-105	L	1.7
		2,4,5-T	29	L	40-150	L	0.8
		2,4,5-TP (Silvex)	35	L	28-125	L	0.7
		Dalapon	30	L	50-150	L	
		Dicamba	30	L	50-150	L	
		Dinoseb	30	L	50-150	L	
		Pentachlorophenol	30	L	50-150	L	
		Picloram	30	L	50-150	L	
EPA 608 SW846 8080	W	Aldrin	22	L	65-110	L	0.0027
		a-BHC	13	L	66-110	L	0.0044
		b-BHC	14	L	84-124	L	0.0105
		g-BHC (Lindane)	24	L	48-105	L	0.0053
		d-BHC	18	L	70-106	L	0.0015
		Chlordane	30	L	61-121	L	0.4356
		4,4'-DDD	31	L	53-115	L	0.0301
		4,4'-DDE	31	L	53-115	L	0.011
		4,4'-DDT	31	L	53-115	L	0.0367
		Dieldrin	22	L	67-113	L	0.0107
		Endosulfan I	20	L	57-105	L	0.0091
		Endosulfan II	31	L	48-110	L	0.0203
		Endosulfan sulfate	28	L	54-110	L	0.0278
		Endrin	32	L	60-125	L	0.0213
		Endrin aldehyde	29	L	53-113	L	0.039
		Endrin ketone	20[6]	L	50-150[6]	L	0.0264
		Heptachlor	31	L	67-129	L	0.0069
		Heptachlor epoxide	22	L	50-96	L	0.0056

TABLE 5-6
DATA QUALITY OBJECTIVES
GC SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
EPA 608		Hexachlorobenzene	9[13]	L	103[13]	L	0.0068
SW846 8080		Methoxychlor[8]	29	L	69-129	L	0.7812
(Continued)		Toxaphene	36	L	32-116	L	1.40
	W	PCB-1016	29	L	64-122	L	0.5241
		PCB-1221	39	L	25-102	L	0.4295
		PCB-1232	27	L	53-107	L	0.5419
		PCB-1242	26	L	54-108	L	0.1852
		PCB-1248	46	L	28-122	L	0.0996
		PCB-1254	34	L	55-125	L	0.1362
		PCB-1260	27	L	54-110	L	0.3651
SW846 8080	S	Aldrin	23	L	22-158	L	0.04
		a-BHC	23	L	60-107	L	0.05
		b-BHC	10	L	33-53	L	0.07
		g-BHC (Lindane)	35	L	57-127	L	0.04
		d-BHC	23	L	58-105	L	0.04
		Chlordane	30	L	61-121	L	0.40
		4,4'-DDD	25	L	33-134	L	0.06
		4,4'-DDE	25	L	33-115	L	0.07
		4,4'-DDT	25	L	33-115	L	0.05
		Dieldrin	32	L	50-114	L	0.06
		Endosulfan I	20	L	57-105	L	0.05
		Endosulfan II	35	L	40-110	L	0.05
		Endosulfan sulfate	35	L	28-110	L	0.05
		Endrin	29	L	41-157	L	0.06
		Endrin aldehyde	30	L	38-100	L	0.05
		Endrin ketone	20[6]	L	50-150[6]	L	0.04[6]
		Heptachlor	28	L	41-153	L	0.06

TABLE 5-6
DATA QUALITY OBJECTIVES
GC SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8080 (Continued)	S	Heptachlor epoxide	21	L	52-94	L	0.05
		Methoxychlor	34	L	36-105	L	0.08
		Toxaphene	31	L	42-104	L	0.50
		PCB-1016	40	L	59-140	L	0.6
		PCB-1221	21	L	70-113	L	0.4
		PCB-1232	37	L	37-112	L	0.5
		PCB-1242	20	L	63-143	L	1.0
		PCB-1248	20	L	61-121	L	0.5
		PCB-1254	22	L	74-133	L	0.6
		PCB-1260	16	L	69-101	L	0.5
SW846 8140 SW846 8141	W	Dichlorvos	20	L	16-120	L	0.081
		Mevinphos	20	L	43-130	L	0.063
		Ethoprop	20	L	38-114	L	0.029
		Naled	20	L	10-120	L	0.166
		Phorate	20	L	31-120	L	0.048
		Demeton, Total	20	L	12-120	L	0.088
		Diazinon	20	L	64-192	L	0.033
		Disulfoton	20	L	34-110	L	0.045
		Ronnel	20	L	41-124	L	0.052
		Methyl Parathion	20	L	25-110	L	0.050
		Trichlornate (Trichloroate)	20	L	10-110	L	0.046
		Chloropyrifos	20	L	41-123	L	0.097
		Fenthion	20	L	16-110	L	0.017
		Tokuthion	20	L	16-120	L	0.035
		Malathion	20[5]	L	80-120[5]	L	0.40
		Stirophos	20	L	16-120	L	0.061
		Merphos	20	L	40-120	L	0.239
		Bolstar	20	L	63-189	L	0.406

TABLE 5-6
DATA QUALITY OBJECTIVES
GC SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8140	W	Fensulfonthion	20	L	33-120	L	0.327
SW846 8141		Azinphos-methyl	20	L	64-193	L	0.094
(continued)		Coumaphos	20	L	39-118	L	0.052
		Atrazine	30[5]	L	131-223[5]	L	0.05[5]
		Simazine	48[5]	L	79-225[5]	L	0.06[5]
SW846 8140	S	Dichlorvos	20	L	16-120	L	0.009
SW846 8141		Mevinphos	20	L	43-130	L	0.007
		Ethoprop	20	L	38-114	L	0.005
		Naled	20	L	10-120	L	0.008
		Phorate	20	L	31-120	L	0.005
		Demeton, Total	20	L	12-120	L	0.007
		Diazinon	20	L	64-192	L	0.005
		Disulfoton	20	L	34-110	L	0.005
		Ronnel	20	L	41-124	L	0.006
		Methyl Parathion	20	L	25-110	L	0.006
		Trichlornate (Trichloroate)	20	L	10-110	L	0.004
		Chloropyrifos	20	L	41-123	L	0.012
		Fenthion	20	L	16-110	L	0.005
		Tokuthion	20	L	16-120	L	0.004
		Stirophos	20	L	16-120	L	0.011
		Malathion	20[5]	L	80-120[5]	L	0.0055[5]
		Merphos	20	L	40-120	L	0.006
		Bolstar	20	L	63-189	L	0.009
		Fensulfonthion	20	L	33-120	L	0.014
		Azinphos-methyl	20	L	64-193	L	0.021
		Coumaphos	20	L	39-118	L	0.012
		Atrazine	20[6]	L	50-150[6]	L	0.01[6]
		Simazine	20[6]	L	50-150[6]	L	0.01[6]

TABLE 5-6
DATA QUALITY OBJECTIVES
GC SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8150	W	2,4-D	33	L	22-105	L	0.71
		Dalapon	20	L	40-160	L	1.25
		2,4,DB	20	L	40-160	L	0.89
		Dicamba	20	L	40-160	L	0.05
		Dichloroprop	20	L	40-160	L	0.88
		Dinoseb	20	L	40-160	L	0.35
		MCPA	20	L	40-160	L	56.32
		MCPP	20	L	40-160	L	55.10
		2,4,5-TP (Silvex)	35	L	28-125	L	0.06
		2,4,5-T	29	L	40-150	L	0.03
SW846 8150	S	2,4-D	35	L	35-150	L	0.44
		Dalapon	20	L	40-160	L	0.71
		2,4,DB	20	L	40-160	L	0.35
		Dicamba	20	L	40-160	L	0.04
		Dichloroprop	20	L	40-160	L	0.42
		Dinoseb	20	L	40-160	L	0.16
		MCPA	20	L	40-160	L	21.7
		MCPP	20	L	40-160	L	21.5
		2,4,5-TP (Silvex)	27	L	40-125	L	0.03
		2,4,5-T	29	L	40-150	L	0.05

TABLE 5-6
DATA QUALITY OBJECTIVES
GC SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8151	W	Acifluorfen	31[5]	L	74-168[5]	L	0.096[5]
		Bentazon	34[5]	L	70-170[5]	L	0.10
		Chloramben	29[5]	L	68-154[5]	L	0.093[5]
		2,4-D	20	L	37-126	L	0.85
		Dalapon	20	L	32-101	L	3.1
		2,4-DB	20	L	38-111	L	0.70
		DCPA diacid	19[5]	L	45-103[5]	L	0.02[5]
		Dicamba	20	L	37-113	L	0.044
		3,5-Dichlorobenzoic acid	33[5]	L	53-151[5]	L	0.061[5]
		Dichloroprop	20	L	43-113	L	1.0
		Dinoseb	20	L	14-70	L	0.63
		5-Hydroxydicamba	33[5]	L	54-152[5]	L	0.04[5]
		MCPA	20	L	33-96	L	77
		MCPP	20	L	42-146	L	76
		4-Nitrophenol	47[5]	L	60-202[5]	L	0.13[5]
		Pentachlorophenol	20	L	42-148	L	0.012
		Picloram	20	L	44-138	L	0.14[5]
		2,4,5-TP (Silvex)	20	L	39-125	L	0.09
		2,4,5-T	20	L	33-119	L	0.11
SW846 8151	S	Acifluorfen	20[6]	L	50-150[6]	L	0.001[6]
		Bentazon	20[6]	L	50-150[6]	L	0.095
		Chloramben	20[6]	L	50-150[6]	L	0.001[6]
		2,4-D	30[6]	L	40-160[6]	L	0.19
		Dalapon	30[6]	L	40-160[6]	L	0.26
		2,4-DB	30[6]	L	40-160[6]	L	0.34
		DCPA diacid	20[6]	L	50-150[6]	L	0.001[6]
		Dicamba	30[6]	L	40-160[6]	L	0.018
		3,5-Dichlorobenzoic acid	20[6]	L	50-150[6]	L	0.38[5]

TABLE 5-6
DATA QUALITY OBJECTIVES
GC SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8151 (Continued)	S	Dichloroprop	30[6]	L	40-160[6]	L	0.18
		Dinoseb	30[6]	L	40-160[6]	L	0.16[12]
		5-Hydroxydicamba	20[6]	L	50-150[6]	L	0.001[6]
		MCPA	30[6]	L	40-160[6]	L	13
		MCPP	30[6]	L	40-160[6]	L	15
		4-Nitrophenol	20[6]	L	50-150[6]	L	.00034[5]
		Pentachlorophenol	30[6]	L	60-140[6]	L	.015
		Picloram	30[6]	L	50-150[6]	L	0.001[6]
		2,4,5-TP (Silvex)	30[6]	L	40-160[6]	L	0.016
		2,4,5-T	30[6]	L	40-160[6]	L	0.018

TABLE 5-7
DATA QUALITY OBJECTIVES

HPLC ORGANICS

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
EPA 610 SW846 8310	W	Acenapthene	50	L	10-124	L	1.0172
		Acenaphthylene	50	L	10-139	L	1.2599
		Anthracene	50	L	10-126	L	0.8306
		Benzo(a)anthracene	50	L	12-135	L	0.0464
		Benzo(b)fluoranthene	50	L	10-150	L	0.0741
		Benzo(k)fluoranthene	50	L	10-159	L	0.071
		Benzo(g,h,i)perylene	50	L	10-116	L	0.1509
		Benzo(a)pyrene	50	L	10-128	L	0.0681
		Chrysene	50	L	10-199	L	0.0836
		Dibenzo(a,h)anthracene	50	L	10-110	L	0.1053
		Fluoranthene	50	L	14-123	L	0.1444
		Fluorene	50	L	10-142	L	1.9504
		Indeno(1,2,3-cd)pyrene	50	L	10-116	L	0.0466
		1-Methylnaphthalene	50	L	30-130	L	1.3208
		2-Methylnaphthalene	50	L	30-130	L	1.3014
		Naphthalene	50	L	10-122	L	1.7432
		Phenanthrene	50	L	10-155	L	0.8381
		Pyrene	50	L	10-140	L	0.1179
SW846 8310	S	Acenapthene	50	L	10-124	L	31.04
		Acenaphthylene	50	L	10-139	L	51.80
		Anthracene	50	L	10-126	L	22.98
		Benzo(a)anthracene	50	L	12-135	L	0.91
		Benzo(b)fluoranthene	50	L	10-150	L	0.77
		Benzo(k)fluoranthene	50	L	10-159	L	1.48
		Benzo(g,h,i)perylene	50	L	10-116	L	0.45
		Benzo(a)pyrene	50	L	10-128	L	1.08
		Chrysene	50	L	10-199	L	0.69

TABLE 5-7
DATA QUALITY OBJECTIVES

HPLC ORGANICS

(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8310 (continued)	S	Dibenzo(a,h)anthracene	50	L	10-110	L	0.99
		Fluoranthene	50	L	14-123	L	1.93
		Fluorene	50	L	10-142	L	28.32
		Indeno(1,2,3-cd)pyrene	50	L	10-116	L	2.23
		1-Methylnaphthalene	50	L	50-150	L	27.95
		2-Methylnaphthalene	50	L	50-150	L	29.76
		Naphthalene	50	L	10-122	L	26.69
		Phenanthrene	50	L	10-155	L	18.61
		Pyrene	50	L	10-140	L	0.92

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
EPA 625	W	Acenaphthene	24	L	57-104	L	2.5
SW846 8270		Acenaphthylene	19	L	57-104	L	2.4
(PAHs)		Anthracene	28	L	39-124	L	3.1
		Benzo(a)anthracene	31	L	36-128	L	2.0
		Benzo(b)fluoranthene	22	L	43-108	L	3.5
		Benzo(k)fluoranthene	33	L	28-126	L	4.0
		Benzo(g,h,i)perylene	51	L	29-232	L	2.5
		Benzo(a)pyrene	27	L	35-117	L	1.9
		Chrysene	36	L	48-118	L	2.3
		Dibenzo(a,h)anthracene	37	L	32-180	L	2.6
		Fluoranthene	30	L	60-120	L	9.1
		Fluorene	28	L	34-118	L	5.1
		Indeno(1,2,3-cd)pyrene	41	L	33-194	L	2.2
		1-Methylnaphthalene	24	L	48-101	L	5.1
		2-Methylnaphthalene	15	L	43-82	L	5.4
		Naphthalene	23	L	25-97	L	3.2
		Phenanthrene	27	L	36-118	L	2.7
		Pyrene	30	L	58-148	L	3

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8270 (PAHs)	S	Acenaphthene	22	L	34-122	L	0.13
		Acenaphthylene	21	L	29-122	L	0.15
		Anthracene	35	L	22-130	L	0.17
		Benzo(a)anthracene	39	L	23-102	L	0.13
		Benzo(b)fluoranthene	25	L	23-124	L	0.18
		Benzo(k)fluoranthene	35	L	20-127	L	0.13
		Benzo(ghi)perylene	65	L	10-150	L	0.13
		Benzo(a)pyrene	35	L	22-126	L	0.16
		Chrysene	30	L	16-107	L	0.12
		Dibenzo(a,h)anthracene	30	L	50-150	L	0.14
		Fluoranthene	27	L	20-148	L	0.31
		Fluorene	30	L	20-138	L	0.13
		Indeno(1,2,3-cd)pyrene	50	L	22-200	L	0.16
		1-Methylnaphthalene	31	L	15-111	L	0.13
		2-Methylnaphthalene	31	L	15-111	L	0.10
		Naphthalene	21	L	29-112	L	0.14
		Phenanthrene	35	L	22-127	L	0.16
		Pyrene	26	L	38-141	L	0.15

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8270 (BNAs)	W	Acenaphthene	24	L	57-104	L	2.5
		Acenaphthylene	19	L	57-104	L	2.4
		Anthracene	28	L	39-124	L	3.1
		Benzidine	15	L	1-22	L	2.0
		Benzo(a)anthracene	31	L	56-128	L	2.0
		Benzo(b)fluoranthene	22	L	43-108	L	3.5
		Benzo(k)fluoranthene	33	L	28-126	L	4.0
		Benzo(g,h,i)perylene	51	L	29-232	L	2.5
		Benzo(a)pyrene	27	L	35-117	L	1.9
		Benzyl alcohol[8]	36	L	28-142	L	8.5
		bis(2-Chloroethoxy)methane	25	L	40-98	L	4.1
		bis(2-Chloroethyl)ether	30	L	22-94	L	5.1
		bis(2-Chloroisopropyl)ether 2,2-Oxybis(1-chloropropane)	26	L	34-114	L	9.1
		bis(2-Ethylhexyl)phthalate	35	L	11-100	L	2.3
		4-Bromophenyl phenyl ether	33	L	50-116	L	5.8
		Butyl benzyl phthalate	38	L	7-122	L	2.5
		2-Chloronaphthalene	21	L	22-77	L	4.6

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
EPA 625	W						
SW846 8270		4-Chlorophenyl phenyl ether	37	L	41-109	L	4.4
(BNAs)		Chrysene	36	L	48-118	L	2.3
(Continued)		Dibenzo(a,h)anthracene	37	L	32-180	L	2.6
		Di-n-butyl phthalate	25	L	28-103	L	5.5
		1,2-Dichlorobenzene	20	L	17-56	L	7.2
		1,3-Dichlorobenzene	20	L	16-55	L	7.4
		1,4-Dichlorobnezene	20	L	16-56	L	7.0
		3,3'-Dichlorobenzidine	40	L	46-127	L	5.3
		Diethylphthalate	26	L	28-106	L	8.3
		Dimethylphthalate	28	L	19-105	L	7.5
		2,4-Dinitrotoluene	22	L	22-81	L	7.4
		2,6-Dinitrotoluene	24	L	19-86	L	5.1
		Di-n-octylphthalate	31	L	14-93	L	3.1
		Fluoranthene	30	L	60-120	L	9.1
		Fluorene	28	L	34-118	L	5.1
		Hexachlorobenzene	36	L	14-98	L	3.9
		Hexachlorobutadiene	21	L	16-88	L	6.1
		Hexachlorocyclopentadiene	31	L	2-55	L	2.5
		Hexachloroethane	12	L	13-70	L	8.9
		Indeno(1,2,3-cd)pyrene	41	L	33-194	L	2.2
		Isophorone	15	L	26-65	L	3.4
		1-Methylnaphthalene	24	L	48-101	L	5.1
		2-Methylnaphthalene	15	L	43-82	L	5.4
		Naphthalene	23	L	25-97	L	3.2
		2-Nitroaniline[8]	39	L	52-170	L	9.1
		3-Nitroaniline[8]	39	L	55-172	L	7.1
		4-Nitroaniline[8]	48	L	74-195	L	7.5

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
EPA 625	W	Nitrobenzene	15	L	23-62	L	3.6
SW846 8270		n-Nitroso-dimethylamine	21	L	13-65	L	8
(BNAs)		n-Nitroso-diphenylamine	32	L	37-134	L	7.4
(Continued)		n-Nitroso-di-n-propylamine	29	L	40-127	L	6.6
		Phenanthrene	27	L	36-118	L	2.7
		Pyrene	30	L	58-148	L	4.0
		1,2,4-Trichlorobenzene	15	L	27-65	L	5.0
		Benzoic acid[8]	34	L	16-72	L	34
		4-Chloro-3-methylphenol	36	L	8-101	L	8.3
		2-Chlorophenol	21	L	17-89	L	4.0
		2,4-Dichlorophenol	36	L	26-103	L	2.2
		2,4-Dimethylphenol	24	L	24-77	L	4.7
		2,4-Dinitrophenol	34	L	9-96	L	8.8
		2-Methyl-4,6-dinitrophenol	35	L	29-99	L	7.4
		2-Methylphenol[8]	26	L	20-95	L	5.2
		4-Methylphenol[8]	32	L	10-85	L	2.5
		2-Nitrophenol	20	L	31-100	L	3.1
		4-Nitrophenol	34	L	13-99	L	5.9
		Pentachlorophenol	42	L	13-96	L	7.5
		Phenol	23	L	15-97	L	6.5
		2,4,5-Trichlorophenol[8]	33	L	20-159	L	3.6
		2,4,6-Trichlorophenol	36	L	20-112	L	4.6
		1,2-Diphenylhydrazine	5	L	66 - 91	L	2.6

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8270 (BNAs)	W	APPENDIX IX ADDENDUM					
		Acetophenone	23	L	50-96	L	3
		2-Acetylaminofluorene	24	L	45-114	L	14
		4-Aminobiphenyl	36	L	32-106	L	7
		Aniline	17	L	43-91	L	1.8
		Aramite 1	50	L	33-103	L	3
		Aramite 2	46	L	10-65	L	2
		2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	40	L	63-145	L	4
		Chlorobenzilate	23	L	20-66	L	6
		4-Chloroaniline	17	L	43-91	L	1.9
		Diallate 1	17	L	48-83	L	1
		Diallate 2	20	L	52-92	L	3
		Dibenzofuran	11	L	85-117	L	3.1
		2,6-Dichlorophenol	14	L	73-101	L	8
		Dimethoate	44	L	10-65	L	14
		p-(Dimethylamino)azobenzene	19	L	18-57	L	4
		7,12-Dimethylbenz[a]anthracene	23	L	24-71	L	5
		3,3-Dimethyl benzidine	55	L	10-91	L	11
		a,a-Dimethylphenethylamine	31	L	22-85	L	23
		m-Dinitrobenzene	18	L	12-24	L	7
		Diphenylamine	13	L	39-66	L	5
		Ethyl methanesulfonate	13	L	40-67	L	11
		Hexachlorophene	50	L	10-110	L	2354
		Hexachloropropene	11	L	44-67	L	3

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8270 (BNAs) (Continued)	W	Isosafrole 1	16	L	26-59	L	5
		Isosafrole 2	21	L	19-63	L	4
		Methapyrilene	21	L	26-69	L	11
		3-Methylcholanthrene	10	L	16-33	L	9
		3-Methylphenol	23	L	50-97	L	
		Methyl methanesulfonate	13	L	37-64	L	11
		1,4-Naphthoquinone	25	L	13-37	L	6
		1-Naphthylamine	19	L	40-78	L	8
		2-Naphthylamine	16	L	39-72	L	4
		4-Nitroquinoline-1-oxide	10	L	34-88	L	6
		n-Nitrosodi-n-butylamine	30	L	64-124	L	8
		n-Nitrosodiethylamine	15	L	40-170	L	18
		n-Nitrosomethylethylamine	22	L	43-90	L	4
		n-Nitrosomorpholine	25	L	42-94	L	4
		n-Nitrosopiperidine	16	L	45-78	L	3
		n-Nitrosopyrrolidine	26	L	46-98	L	3
		n-Nitro-o-toluidine	12	L	60-140	L	5
		Pentachlorobenzene	15	L	55-87	L	1
		Pentachloronitrobenzene	23	L	50-96	L	2
		Phenacetin	15	L	75-150	L	6
		p-Phenylenediamine	21	L	47-89	L	13
		2-Picoline	20	L	51-91	L	20
		Pronamide	26	L	60-114	L	5
		Pyridine	22	L	63-105	L	6
		Safrole	14	L	31-60	L	4
		1,2,4,5-Tetrachlorobenzene	9	L	48-86	L	4
		2,3,4,6-Tetrachlorophenol	44	L	39-128	L	6

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8270 (BNAs) (Continued)	W	APPENDIX IX ADDENDUM					
		o-Toluidine	25	L	48-99	L	1
		O,O,O-Triethyl-Phosphorothioate	15	L	54-85	L	2
		1,3,5-Trinitrobenzene	20	L	5-85	L	1
		Isodrin	12	L	86-114	L	9
		Kepone	35	L	67-141	L	140
		Thionazin	16	L	85-123	L	15
		Methyl Parathion	21	L	80-132	L	20
		Disulfoton	14	L	46-75	L	1
		Parathion	11	L	87-114	L	11
		Famphur	51	L	27-131	L	19
		Phorate	20	L	27-62	L	2
		Pentachloroethane	22	L	12-58	L	7
		Sulfotepp	17	1	29-64	L	13
EPA 625 (Selective Ion Monitoring)	W	Dioxin Screen	Non-Quant	-	-	-	-
SW846 8270 (BNAs)	S	Acenaphthene	22	L	34-122	L	0.13
		Acenaphthylene	21	L	29-122	L	0.15
		Anthracene	35	L	22-130	L	0.17
		Benzidine	15	L	1-22	L	0.30
		Benzo(a)anthracene	39	L	23-102	L	0.13
		Benzo(b)fluoranthene	25	L	23-124	L	0.18
		Benzo(k)fluoranthene	35	L	20-127	L	0.13

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8270 (BNAs) (Continued)	S	Benzo(g,h,i)perylene	65	L	10-150	L	0.13
		Benzo(a)pyrene	35	L	22-126	L	0.16
		Benzyl alcohol	35	L	21-163	L	0.21
		bis(2-Chloroisopropyl)ether (2,2'-Oxybis (1-Chloropropane)	26	L	34-114	L	0.14
		bis(2-Ethylhexyl)phthalate	35	L	11-100	L	0.18
		4-Bromophenyl phenyl ether	35	L	51-122	L	0.12
		Butyl benzyl phthalate	38	L	7-122	L	0.16
		2-Chloronaphthalene	23	L	50-125	L	0.16
		4-Chlorophenyl phenyl ether	43	L	37-124	L	0.13
		Chrysene	30	L	16-107	L	0.12
		Dibenzo(a,h)anthracene	48	L	22-216	L	0.14
		Di-n-butyl phthalate	25	L	28-103	L	0.14
		1,2-Dichlorobenzene	43	L	20-132	L	0.15
		1,3-Dichlorobenzene	43	L	20-132	L	0.14
		1,4-Dichlorobnezene	43	L	20-132	L	0.16
		3,3'-Dichlorobenzidine	45	L	10-146	L	0.14
		Diethylphthalate	43	L	12-143	L	0.18
		Dimethylphthalate	44	L	26-115	L	0.12
		2,4-Dinitrotoluene	41	L	10-119	L	0.17
		2,6-Dinitrotoluene	41	L	10-119	L	0.13
		Di-n-octylphthalate	31	L	14-93	L	0.20
		Fluoranthene	27	L	20-148	L	0.31
		Fluorene	30	L	20-138	L	0.13
		Hexachlorobenzene	37	L	22-108	L	0.11
		Hexachlorobutadiene	33	L	24-116	L	0.16
		Hexachlorocyclopentadiene	31	L	2-55	L	0.16
		Hexachloroethane	25	L	8-80	L	0.17

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8270	S	Indeno(1,2,3-cd)pyrene	50	L	22-200	L	0.16
(BNAs)		Isophorone	50	L	22-200	L	0.11
(Continued)		1-Methylnaphthalene	31	L	15-111	L	0.13
		2-Methylnaphthalene	31	L	15-111	L	0.10
		Naphthalene	21	L	29-112	L	0.14
		2-Nitroaniline	42	L	32-165	L	0.16
		3-Nitroaniline	48	L	31-177	L	0.17
		4-Nitroaniline	47	L	38-229	L	0.22
		Nitrobenzene	31	L	10-101	L	0.14
		n-Nitroso-dimethylamine	21	L	13-65	L	0.30
		n-Nitroso-diphenylamine	31	L	28-121	L	0.30
		n-Nitroso-di-n-propylamine	44	L	25-114	L	0.21
		Phenanthrene	35	L	22-127	L	0.16
		Pyrene	26	L	38-141	L	0.15
		1,2,4-Trichlorobenzene	24	L	38-136	L	0.16
		Benzoic acid	34	L	16-72	L	0.50
		4-Chloro-3-methylphenol	35	L	29-101	L	0.19
		2-Chlorophenol	29	L	19-100	L	0.10
		2,4-Dichlorophenol	32	L	16-114	L	0.30
		2,4-Dimethylphenol	30	L	26-100	L	0.30
		2,4-Dinitrophenol	34	L	9-96	L	0.20
		2-Methyl-4,6-dinitrophenol	32	L	15-100	L	0.30
		2-Methylphenol	32	L	10-103	L	0.30
		4-Methylphenol	32	L	10-103	L	0.30
		2-Nitrophenol	29	L	16-103	L	0.20
		4-Nitrophenol	58	L	10-147	L	0.70
		Pentachlorophenol	39	L	10-112	L	0.20
		Phenol	24	L	15-112	L	0.30

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8270 BNAs (Continued)	W	2,4,5-Trichlorophenol	41	L	13-136	L	0.40
		2,4,6-Trichlorophenol	30	L	21-112	L	0.11
		bis(2-Chloroethoxy)methane	46	L	19-113	L	0.12
		bis(2-Chloroethyl)ether	54	L	10-138	L	0.30
		1,2-Diphenylhydrazine	5	L	67 - 91	L	0.06
SW846 8270	S	APPENDIX IX ADDENDUM					
		Acetophenone	23	L	50-96	L	0.1
		2-Acetylaminofluorene	24	L	65-114	L	0.4
		4-Aminobiphenyl	36	L	32-106	L	0.2
		Aniline	17	L	43-91	L	0.28
		Aramite 1	50	L	33-103	L	0.1
		Aramite 2	46	L	10-65	L	0.1
		2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	40	L	63-145	L	0.1
		4-Chloroaniline	17	L	43-91	L	0.2
		Chlorobenzilate	23	L	20-66	L	0.2
		Diallate 1	17	L	48-83	L	0.1
		Diallate 2	20	L	52-92	L	0.1
		Dibenzofuran	11	L	85-117	L	0.1
		2,6-Dichlorophenol	14	L	73-101	L	0.2
		Dimethoate	44	L	10-65	L	0.4
		p-(Dimethylamino)azobenzene	19	L	18-57	L	0.1
		7,12-Dimethylbenz[a]anthracene	23	L	24-71	L	0.1
		3,3-Dimethyl benzidine	55	L	10-91	L	0.3
		a,a-Dimethylphenethylamine	31	L	22-85	L	0.7
		m-Dinitrobenzene	18	L	12-24	L	0.2

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8270 (Continued)	S	APPENDIX IX ADDENDUM					
		Diphenylamine	13	L	39-66	L	0.1
		Ethyl methanesulfonate	13	L	40-67	L	0.3
		Hexachlorophene	50	L	10-110	L	762
		Hexachloropropene	11	L	44-67	L	0.1
		Isosafrole 1	16	L	26-59	L	0.1
		Isosafrole 2	21	L	19-63	L	0.1
		Methapyrilene	21	L	26-69	L	0.3
		3-Methylcholanthrene	8	L	16-33	L	0.3
		3-Methylphenol	23	L	50-97	L	0.1
		Methyl methanesulfonate	13	L	37-64	L	0.3
		1,4-Naphthoquinone	25	L	13-37	L	0.2
		1-Naphthylamine	19	L	40-78	L	0.2
		2-Naphthylamine	16	L	39-72	L	0.1
		4-Nitroquinoline-1-oxide	10	L	34-88	L	0.2
		n-Nitrosodi-n-butylamine	30	L	64-124	L	0.2
		n-Nitrosodiethylamine	15	L	40-170	L	0.5
		n-Nitrosomethylethylamine	22	L	43-90	L	0.1
		n-Nitrosomorpholine	25	L	42-94	L	0.1
		n-Nitrosopiperidine	16	L	45-78	L	0.1
		n-Nitrosopyrrolidine	26	L	46-98	L	0.1
		n-Nitro-o-toluidine	12	L	60-140	L	0.1
		Pentachlorobenzene	15	L	55-87	L	0.1
		Pentachloronitrobenzene	23	L	50-96	L	0.6
		Phenacetin	15	L	75-150	L	0.2

TABLE 5-8
DATA QUALITY OBJECTIVES

GC/MS SEMI-VOLATILE ORGANICS
(continued)

Method	Matrix	Analyte/Component	Precision[1] %RSD	Conc. Range	Accuracy[2] %R	Conc. Range	MDL (ug/L/mg/kg)
SW846 8270 (Continued)	S	APPENDIX IX ADDENDUM					
		p-Phenylenediamine	21	L	47-89	L	0.4
		2-Picoline	20	L	51-91	L	0.6
		Pronamide	26	L	60-114	L	0.1
		Pyridine	22	L	63-105	L	0.2
		Safrole	14	L	31-60	L	0.1
		1.2.4.5-Tetrachlorobenzene	19	L	48-86	L	0.1
		2.3.4.6-Tetrachlorophenol	44	L	39-128	L	0.2
		o-Toluidine	25	L	48-99	L	0.1
		O,O,O-Triethyl-Phosphorothioate	15	L	54-85	L	0.1
		1,3,5-Trinitrobenzene	20	L	5-85	L	0.1
		Isodrin	12	L	86-114	L	0.3
		Kepone	35	L	67-141	L	4.0
		Thionazin	16	L	85-123	L	0.4
		Methyl Parathion	21	L	80-132	L	0.6
		Disulfoton	14	L	46-75	L	0.1
		Parathion	11	L	87-114	L	0.3
		Famphur	51	L	27-131	L	0.5
		Phorate	20	L	27-62	L	0.1
		Pentachloroethane	22	1	12-58	1	0.15
		Sulfotepp	17	L	29-64	L	0.43
EPA 625 Selected Ion Monitoring	S	Dioxin Screen	Non-Quant	-	-	-	-

Data Quality Objective Table Notations and Explanations

The following notations are used throughout the data quality objectives tables to convey the following explanations as listed below.

Notation	Explanation
1	Relative Percent Difference (RPD) unless otherwise noted.
2	Percent recovery unless otherwise noted.
3	Method detection limits are not applicable to this analysis.
4	In-house generated limits from the North Canton/Corporate facility. These limits will be updated with limits from the Florida facility database as they are acquired with a maximum time frame of one year from date of Comprehensive QAP approval.
5	Method limits or targets.
6	Advisory limits or targets.
7	Parameter is only listed under EPA 600 series of analytical methods.
8	Parameter is only listed under EPA SW 846 series of analytical methods.
9	These additional parameters are analyzed by this method for the full Appendix IX analytical list.
10	This parameter is only analyzed by this method upon special request.
11	This parameter is supported by a method validation study found in Appendix E or Appendix H.
12	Laboratory established control limits from CompQAP 8150 list.
13	Limits calculated based on water MDL's.

Data Quality Objective Table References

The following sources have been used to obtain the analytical methods identified in the data quality objective tables.

40 CFR Part 136, Appendix A, Test Procedures for Analysis of Organic Pollutants, July 1989

DER-SOP for Unionized Ammonia, Rev. 1, 10/3/83

Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020. Revised March 1983.

Methods for the Determination of Organic Compounds in Drinking Water. EPA 600/4-88/039, December 1988.

Procedures for Handling and Chemical Analysis of Sediments and Water Samples. EPA/Corps of Engineers CE-81-1. March 1981.

Standard Methods for the Examination of Water and Wastewater. 18th Edition. 1992.

Test Methods for Evaluation Solid Waste - Physical/Chemical Methods. EPA/SW 846. 3rd Edition, 1986 and its Revision II Dated January 1995.

TABLE 5-9

SAMPLE PREPARATION METHODS SUMMARY

Parameter	Matrix	Prep Method	Notes
Semi-Volatiles (Organics) EPA 8080, 8140, 8141, 8270, 8310	Water/Leachate	EPA 3510, 3520	
	Solid	EPA 3540, 3550	
	Waste	EPA 3580	1
Purgeables (Volatile Organics) SW846 8010,8020, 8240,8260	Water/Leachate	EPA 5030	
	Solid/Waste	EPA 5030	
Ethylene Dibromide SW846 8010 (Mod.), 8240,8260	Water/Leachate	EPA 5030	
	Solid/Waste	EPA 5030	
Metals (ICP) SW846 6010	Water/Leachate	EPA 3010	
	Solid/Waste	EPA 3050	
	Water/Leachate/Solid/ Waste	EPA 3005	
Metals (GFAA) EPA 204.2(Sb), 213.2(Cd), 218.2(Cr), 239.2(Pb), 279.2(Tl)	Water	EPA 600/4-79-020, Paragraph 4.1	

TABLE 5-9

SAMPLE PREPARATION METHODS SUMMARY
(continued)

Parameter	Matrix	Prep Method	Notes
Metals (GFAA) SW846 7041(Sb), 7060(As) 7131(Cd),7191(Cr), 7421(Pb), 7740(Se), 7841(Tl)	 Water/Leachate Solid/Waste Water/Leachate/ Solid/Waste	 EPA 3020 EPA 3050 EPA 3005	 3
Halogens SW846 9252	Solid/Waste	EPA 5050 (Draft)	
Hydrocarbons (TRPH) SW846 9073 (Draft)	Solid/Waste	EPA 9071	
Nitrate-Nitrite Nitrate, Nitrite EPA 353.3	Solid/Waste	EPA/CE pg 3-183	
Total Kjeldahl Nitrogen EPA 351.3	Solid/Waste	EPA/CE pg 3-201	
Phosphorous EPA 365.2	Solid/Waste	EPA/CE pg 3-223 (ortho) EPA/CE pg 3-227 (Total) EPA/CE pg 3-232	
Reactive Cyanide SW846 9010	Waste	EPA SW846 7.3.3.2	
Reactive Sulfide SW846 9030	Waste	EPA SW846 7.3.4.2	
SPLP Extraction	Water/Solid/Waste	EPA SW846 1312	4
TCLP Extraction	Water/Solid/Waste	EPA SW846 1311	4
EPTOX Extraction	Water/Solid/Waste	EPA SW846 1310	4

NOTES

1. For matrices which are classified as waste but are solid or aqueous in nature, the preparation method appropriate to the nature of the sample may be used.

2. Method 3040 (solvent dissolution) may be used for certain projects. According to the nature of the project requirements and nature of the samples.

3. EPA 7060 and EPA 7740 are prepared according to the methods and not EPA 3020

4. The leachate extracts can be analyzed by any method appropriate for the analysis of waters.

6.0 Sampling Procedures

6.1 Sample Collection Guidelines

Quanterra Tampa offers full field sampling capabilities, as well as advises clients as to the proper handling of samples submitted to the laboratory. Upon request, the laboratory also provides sample containers for use by client sampling teams.

Quanterra Tampa references USEPA-approved and FDEP-recognized sample collection methods and equipment for guidance in field activities as outlined in the following technical publications:

a) EPA Region IV Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual (February, 1991)

b) FDEP-QAS Guidance Documents

c) FDEP Manual for Preparing Quality Assurance Plans (September 30, 1992)

The guidelines provided in this CompQAP as well as these references will be available to all field personnel both in-house and in the field.

6.2 Sampling Capabilities

Table 6-1 summarizes Quanterra Tampa's current sample collection capabilities by parameter group. Table 6-2 lists general sampling equipment used for most field sample collection events. Table 6-3 gives a summary of the sampling equipment utilized by Quanterra Tampa along with the intended matrix parameters and restrictions associated with each piece of equipment.

TABLE 6-1

SAMPLING CAPABILITIES

Major Analytical Group	Matrix Group
Volatile Organics	Drinking water, surface water, groundwater, wastewater, sediments, soils, liquid and solid hazardous wastes
Extractable Organics	Drinking water, surface, water, groundwater, wastewater, sediments, soils, liquid and solid hazardous wastes
Metals	Drinking water, surface water, groundwater, wastewater, sediments, soils, liquid and solid hazardous wastes
Inorganic Anions	Drinking water, groundwater, surface water, wastewater, sediments, soils, liquid and solid hazardous waste
Organics	Drinking water, groundwater, surface water, wastewater, sediments, soils, liquid and solid hazardous waste
Physical Properties	Drinking water, groundwater, surface water, wastewater, sediments, soils, liquid and solid hazardous waste
Microbiology	Drinking water, groundwater, surface water, wastewater
Cyanide	Drinking water, groundwater, surface water, wastewater, sediments, soils, liquid and solid hazardous waste

TABLE 6-2

GENERAL USE SAMPLING EQUIPMENT

Equipment Type	Matrix	Use
Orion SA210 Portable pH Meter	Water	pH Determination
Markson 200 Portable Conductivity Meter	Water	Conductivity Determination
YSI 51B Portable Oxygen Meter	Water	Field Dissolved Oxygen Determinations
Narrow Range pH Paper Techniques	Water	Verification of Presentation
Tape Measure	Water	Well Depth Determination
Flow Meter	Water	Flow Rate Determination
Braided Nylon Cord	Water	Well Purging and Bailing
Hand Pump Pressure Sprayers	All	Equipment Decontamination
Stainless Steel Buckets Equipment Decontamination	All	Intermediate Container and
Disposable Latex Gloves	All	Personnel Protection
Ice Chests	All	Sample Transportation
5 Gallon Plastic Bucket (calibrated at 1 gallon intervals)	Water	Well Purging
Century OVA 128 Portable Organic Vapor Analyzer	All	Total Organic Vapor Determination
Roctest Model Model CPR6 Water Level Indicator	Water	Well Water Level Determinations
Dayton Model 3W178G Generator	Water	Electrical Supply for Grundfos Pump
Nalgene Carboy	All	Analyte-free Water Container

TABLE 6-3

SAMPLING EQUIPMENT

Equipment Type	Construction		Use	Parameter Groups	Restrictions and Precautions
	Housing	Tubing			
WATER SAMPLING Ground, Surface, Drinking, Waste Water Sampling					
1. Pumps ISCO Models 2700,2710,3710 (Peristaltic, Autosampling)	SS, Teflon	SS, Teflon	Purging	All Parameters	See Note 1 and 2
			Sampling	Metals, Inorganics	See Note 3
Groundwater Sampling					
2. Bailers a. Teflon (3' and 1' length) (1 7/8" and 3/4" diameter)	Teflon		Purging, Sampling	All Parameter Groups	See Note 4
b. Stainless Steel (3')	SS		Purging, Sampling	All Parameter Groups	See Note 4

TABLE 6-3
SAMPLING EQUIPMENT
(Continued)

Equipment Type	Construction		Use	Parameter Groups	Restrictions and Precautions
	Housing	Tubing			
3. Pumps					
a. Grundfos Redi Flo 2 Submersible Pump	SS, Teflon	SS, Teflon	Purging	Purging Only	See Note 1 and 2
b. Masterflex Peristaltic Pump	SS, Teflon	SS, Teflon	Purging,	All Parameter Groups	See Note 3
			Sampling	All Parameter Groups (excluding VOCs)	See Note 8
Surface Water Sampling					
4. Teflon Nansen Bottle	Teflon	Teflon	Grab Samples at Specified Depth	All Parameter Groups	None
5. VanDorn Sampler		Teflon	Grab Samples at Specified Depth	Metals, Inorganics	See Note 5

TABLE 6-3
SAMPLING EQUIPMENT
(Continued)

Equipment Type	Construction		Use	Parameter Groups	Restrictions and Precautions
	Housing	Tubing			
6. Pre-Rinsed Sample Containers	Glass		Grab Samples	All Parameter Groups	None
7. Stainless Steel Grab Arm With Teflon Cup	Teflon		Grab Samples	All Parameter Groups	None
Waste Water Sampling					
8. Pre-Rinsed Sample Containers	Glass		Grab Samples	All Parameter Groups	None
9. Stainless Steel Grab Arm With Teflon Cup	Teflon		Grab Samples	All Parameter Groups	None
SOIL/WASTE SAMPLING					
Soil/Sediment/Waste Sampling					
1. Stainless Steel Trowel, Scoop, Spoon or Spatula	SS		Sampling, Compositing	Inorganics, Extractable, Organics, Trace Metals Volatile Organics	See Note 7

TABLE 6-3
SAMPLING EQUIPMENT
(Continued)

Equipment Type	Construction		Use	Parameter Groups	Restrictions and Precautions
	Housing	Tubing			
2. Stainless Steel Mixing Tray	SS		Compositing & Homogenizing	Inorganics, Extractable, Organics, Trace Metals	None
3. Stainless Steel Corer	SS		Sampling	All Parameter Groups	See Note 6
4. Stainless Steel Shovel	SS		Clearing & Sampling	All Parameter Groups	None
5. Stainless Steel Hand Auger	SS		Sampling	All Parameter Groups	None
6. Stainless Steel Shelby	SS		Sampling	All Parameter Groups	See Note 6
7. Stainless Steel Split Spoon	SS		Sampling	All Parameter Groups	None
8. Pre-Rinsed Sample Containers	Glass		Grab Samples	All Parameter Groups	None

TABLE 6-3
SAMPLING EQUIPMENT
(Continued)

Equipment Type	Construction		Use	Parameter Groups	Restrictions and Precautions
	Housing	Tubing			
Liquid/Solid Waste Sampling					
9. Disposable Profile Tube	Teflon		Sampling Phase Determination	Waste Characterization	None
10. Spark Proof Barrel Wrench	Brass		Opening Drums	All Parameter Groups	None

NOTES & RESTRICTIONS

1. When purging for organics or metals, the entire length of tubing (or pipe) or the portion which comes in contact with the formation water should be constructed of teflon or stainless steel. If other materials (i.e., rigid PVC, polyethylene or polypropylene) are used, the following protocols must be followed: 1) contact with formation waters will be minimized by slowly withdrawing the pump from the water column during the last phase of purging, thus removing from the well any water which has contacted the exterior of the pump and/or tubing; 2) a single well volume must be removed with the sampling device before sampling begins. Tygon^{tm} must never be used for purging when organics are of interest.

2. Equipped with foot valve to prevent backflow of purged water into the well.

3. The flexible tubing used for the peristaltic pump should be medical grade silicone tubing. Delivery tubing must be constructed of suitable non-metallic materials.

4. Purging a well by bailer is not the preferred or recommended technique.

5. If sampling for metals analysis, equipment will be made of stainless steel or a suitable non-metallic parameter.

6. Liner should be either stainless steel or teflon. If samples are transported in liner to the laboratory, then VOC sample should be taken from the interior of the core.

7. Samples for Volatile Organic analysis should not be taken from a composited sample.

8. For extractible organics, Masterflex Peristaltic Pump, used for purposes of sampling extractible organics, must be configured as specified in Figure 4.10 of DEP-QA-001/90.

6.3 Decontamination and Cleaning Procedures

The decontamination and cleaning procedures outlined in this section are to be used by all sampling personnel to clean sampling and other field equipment prior to use. Sufficient clean equipment should be transported to the field so that an entire event can be conducted without the need for cleaning equipment in the field. Equipment which is not cleaned in the field is immediately rinsed with tap water and tagged with sampling location for transport back to the lab for cleaning using in-house protocol. Field cleaning procedures are included to cover times when the amount of precleaned equipment available is insufficient to complete the sampling event. Specific cleaning and quality control procedures are presented in the following sections.

6.3.1 Cleaning Materials

a) Laboratory Detergent -standard brands of phosphate-free and ammonia-free laboratory detergent such as Liquinox.

b) Hydrochloric Acid -prepared from reagent grade hydrochloric acid and deionized water.

c) Nitric Acid -prepared from reagent grade nitric acid and deionized water.

d) Isopropanol -pesticide grade to be used as standard cleaning solvent. Other solvents may be substituted for a particular investigation if their use is deemed necessary.

e) Tap Water -obtained from any municipal water treatment system.

f) Analyte-free Water -water that has been treated in such a way as to be characterized as having no analytes of interest at or above the detection limit for those analytes. Analyte-free water may be deionized, distilled and/or "polished" with additional carbon beds.

g) Cleaning Brushes -brushes shall not be of the wire wrapped type and should be constructed of appropriate material which allows for sufficient scrubbing action in the presence of cleaning fluids while not compromising the integrity of the brush.

6.3.2 Decontamination and Cleaning Procedures for General Use Equipment

For those types of equipment which are not directly used for sampling, such as tape measures, probes, meters, etc., the basic cleaning protocol will be to scrub with soapy water, rinse thoroughly with tap water, then an analyte-free water. Any equipment used in direct sampling procedures, such as buckets, trays, auto samplers, tubing, etc., should be cleaned as outlined in Section 6.3.3. Equipment which is not reused, such as bailer lanyards and disposable gloves, should be containerized and disposed of properly.

Analyte-free water containers will be either virgin sampling containers (see 6.3.4) or of the Naglene Carboy type. Reusable containers will be kept covered at all times and the exterior washed with laboratory detergent and analyte-free water as needed. Between uses, the interior shall be solvent rinsed twice with Isopropanol and then thoroug rinsed with analyte-free water.

All ice chests and reusable shipping/transport containers will be washed with laboratory detergent (interior and exterior) and rinsed with tap water and air-dried prior to storage. In the event of severe contamination, the container will be subjected to the cleaning procedures used for field sampling equipment. If the container is still visibly contaminated after cleaning, it will be removed from service and disposed of properly.

6.3.3 Decontamination and Cleaning Procedures for Field Sampling and Purging Equipment

Controlled Procedures

1. Clean with hot soapy water using Liquinox detergent and scrubbing with a brush as necessary to dislodge particulates and films.

2. Rinse thoroughly with hot tap water.

3. Rinse with 15% reagent grade hydrochloric acid. This step would be omitted for any metallic sampling equipment.

4. Rinse thoroughly with analyte-free water.

5. Rinse thoroughly with isopropanol.

6. Rinse thoroughly with analyte-free water.

7. An in-house equipment blank will be taken for each batch of equipment cleaned, with a maximum of 20 pieces of equipment per batch.

8. Allow all equipment to air dry before storage.

9. Carefully wrap equipment in aluminum foil for storage and transport to site.

Note: When sampling equipment has been exposed to samples containing oil, grease or other hard-to-remove materials, it may be necessary to rinse the equipment before step 1 above with pesticide-grade acetone, followed by pesticide-grade hexane then pesticide-grade acetone again.

On-Site Procedures

1. Clean with soapy water using Liquinox detergent and scrubbing with a brush as necessary to dislodge particulates and films.

2. Rinse thoroughly with analyte-free water.

3. Rinse with 15% reagent grade hydrochloric acid. This step would be omitted for any metallic sampling equipment.

4. Rinse thoroughly with analyte-free water.

5. Rinse thoroughly with isopropanol.

6. Rinse thoroughly with analyte-free water. If analyte-free water is not available, do not rinse with deionized or distilled water, but just allow to air dry as long as possible.

7. Allow all equipment to air dry as long as possible, then wrap with aluminum foil.

Note: When sampling equipment has been exposed to samples containing oil, grease or other hard-to-remove materials, it may be necessary to rinse the equipment before step 1 above with pesticide-grade acetone, followed by pesticide-grade hexane then pesticide-grade acetone again. If field equipment is heavily contaminated and cannot be cleaned by these procedures, then it should be discarded or stored until more rigorous methods may be employed at the base of operations.

Teflon Tubing Protocol

1. Soak all tubing completely in a non-contaminating container filled with hot soapy water. Brush or wipe away any visible contaminations from the outside of the tubing as well as inside the ends.

2. Rinse tubing exterior and ends thoroughly with hot tap water, 15% reagent grade nitric acid, analyte-free water, isopropanol and analyte-free water.

3. Using a field type pump, pump large quantities of hot soapy water and hot tap water through the connected tubing.

4. Again using the field type pump, pump the rinse reagents as described in (2) above through the tubing. Allow the acid and solvent to remain in tubing for 15 minutes each before water rinses.

5. Rinse the exterior with analyte-free water once again and allow to air dry before storage.

6. Carefully wrap the tubing lengths in aluminum foil with connectors still attached for storage and transport to site.

Note: If the tubing cannot be adequately cleaned by these or other procedures (three solvent rinses described above), then it will be removed from service and disposed of.

6.3.4 Procedures for Obtaining Sample Containers

All sample containers are currently obtained in virgin condition. These containers meet the EPA anayte specific concentration requirements for quality controlled sample containers. The "cleanliness" of all containers is further verified through the analysis of trip blanks, equipment rinsate blanks (outlined in Section 6.3.5) and an in-house verification program. The effectiveness of the sample container cleanliness and storage program will be spot checked by collecting analyte-free water in standard sample containers and submitting them to the laboratory for a series of routine trace organic and inorganic analyses. Non-trace level techniques (organic and inorganic) will only be performed if sample container contamination is indicated by other routine blanks. These container blanks will be collected at a minimum of one set per manufactured lot and/or shipping lot of sample containers. All containers that have left the lab facility must be used by the sampler for that event or destroyed if returned unused. Records of vendor certification, receiving dates of container lots as well as results from equipment rinsate blanks and container blanks are maintained on-site.

6.3.5 Quality Control Procedures for Cleaning Operations

This section establishes guidelines for specific quality control procedures to monitor the effectiveness of the sampling equipment cleaning procedures and sample container cleanliness. These procedures shall be carried out by sampling personnel and the results documented and monitored by the QA Manager.

a) Rinsate Blank -the effectiveness of the cleaning procedures shall be monitored by rinsing cleaned equipment with analyte-free water and submitting the collected rinse water to the laboratory for analysis of routine trace metal, inorganic anions, and extractable and purgeable organic parameters. One piece of equipment per equipment type shall be selected for this procedure each time equipment is cleaned.

The laboratory analysis of all rinsate blanks must demonstrate that all analytes of interest are below the routine detection limit. Any necessary corrective action will be initiated by the QA Manager.

6.3.6 Handling and Storage of Cleaned Sampling Equipment and Containers

All equipment and sample containers that are cleaned utilizing these procedures shall be labelled with the cleaning date. Cleaned items will be stored in a contaminant-free environment and segregated from contaminated equipment. Sampling items returned unused from the field will be subjected to cleaning procedures prior to any subsequent use or storage.

6.4 Sample Preservation, Holding Times, Container Types, Required Sample Volumes

Pre-preserved containers are provided to clients and utilized by field sampling crews. Bottles are labelled with the type of test(s) to be performed and with the type of preservative used, if any. Appropriate preservatives are also used for each test during the collection of field equipment and procedural quality control samples in order to monitor any contaminants that may be introduced by the preservative. The client/sampling crew receives instructions for filling each type of container provided, as well as additional preservative from the same source as that from which the containers were preserved. In the case of multiple preservatives, bottles and preservatives are supplied separately to facilitate the proper preservation procedure. Appropriate sample preservation, maximum

recommended holding times and container types, and required sample volumes are outlined by parameter group and matrix in Table 6-4 (Aqueous Matrices) and Table 6-5 (Non-Aqueous Matrices).

6.5 Sample Transportation

Sample coolers containing the appropriate bottles are provided to the client or acquired by the sampling team. Chain-of-custody documentation begins at this point by the release of the cooler/bottles to the sampling team. After sample collection, the containers are packed in wet ice and returned to the laboratory via personal delivery or professional courier. Samples are delivered to the laboratory for analysis as soon as practical after sample collection. (In general, less than twenty-four (24) hours will elapse before sample delivery.) The samples are properly preserved, packaged for transport, and accompanied by chain-of-custody documentation prior to shipment or transport to the laboratory. The samples are submitted to the designated sample custodian for proper acceptance into the laboratory. The laboratory routinely uses professional courier services such as UPS or FedEx to ship bottles and samples. When using professional courier services, the bottles and/or coolers must be sealed with sample seals (see Section 7.1.2.b and Figure 7-2). All shipping documents and receipts are maintained with the project and/or client file. The laboratory also offers personal courier service to clients and accepts sample deliveries from client-chosen courier services.

6.5.1 Non-Hazardous Samples

Environmental samples are transported in commercially obtained high-density, polypropylene coolers. Proper packaging of samples using foam and/or bubble-pack and wet ice is done to prevent breakage. Watertight plastic bags are used to prevent sampling instructions, chain-of-custody records and other paperwork from being damaged.

6.5.2 Hazardous Samples

Hazardous samples as defined in the D.O.T. Hazardous Material Table (CFR 172.101) are transported as specified in the regulations. Other potentially hazardous samples are packaged and shipped as follows:

Samples are placed in 32 oz. glass jars with TFE-lined lids or polyethylene bottles, as appropriate. All filled containers have sufficient air-space to allow for sample expansion. Samples to be analyzed for low-level volatile organics are placed in 40 mL vials with no headspace and with appropriate septum lids. The sample containers are then sealed in a polyethylene zip-lock bag. Bagged containers are placed inside a 1 gallon paint can surrounded by inert packing material (eg. vermiculite). The can is sealed and placed in a DOT-12B fiberboard box or equivalent and properly labelled in accordance with DOT specifications (49 CFR 172.101).

6.6 Sample Collection Quality Control Procedures

The following sample collection quality control standards and procedures must be followed during all sampling events.

6.6.1 Experience Requirements

All Quanterra Tampa field personnel must have completed four weeks of field training under supervision of a qualified trainer on appropriate types of field studies before conducting similar sampling programs without supervision. During this period, the employee receives instruction in sample site selection, preparation of equipment and materials, sample collection techniques for various matrices, preservation and documentation procedures, packing and shipping of samples, and associated quality control procedures. All sampling personnel will be required to review and be familiar with all applicable protocols contained in this document and its associated references.

6.6.2 Documentation and Traceability Requirements

All sample collection activities are traceable through field records to the person collecting the sample and to the specific piece of sampling equipment used to collect the sample (where appropriate). In a similar fashion, all maintenance and calibration records for sampling equipment are kept so that they, too, are traceable. SPecific types of field documentation maintained include sample custody forms (eg., sample labels, sample seals, and chains-of custody), and the field sample notebook. A more thorough discussion of documentation as well as sample forms is found in Section 7.

6.6.3 Field Quality Control Samples

The following field quality control samples will be collected during field sampling events at a frequency which is outlined in Section 11.1.

Trip Blanks

To ensure the integrity of containers for volatile compounds a representative container is filled with analyte-free water, taken into the field with the empty sample containers, and returned for analysis without being opened. This sample is known as a trip blank. When feasible all sample aliquots for volatile compound analysis will be placed in a separate shipping container such that only one trip blank per container will be needed. In these cases each site will be segregated by ziplock bags.

Equipment Blanks

If sampling equipment must be cleaned on-site and reused, equipment blanks are required to determine the effectiveness of the cleaning procedures used. Equipment blanks are collected by preserving the final rinse water in an appropriate container and submitting it to the laboratory for analysis in the same cooler as the remaining samples.

Field Duplicates

Duplicate sampling procedures are used during sample collection procedures to measure the precision of the sampling process. Duplicate samples are collected for each procedure and matrix when a client requests this procedure, when duplicates are specified by protocol, and/or at a frequency outlined in Section 11.1.1. Field duplicates are collected by sampling from successively collected volumes or portions, e.g. from the next bailer of sample water. The duplicate samples will be preserved and submitted for the same analyses as the required

samples. Duplicate sample data will be generated and reported with the required samples and reviewed by the QA Manager as a part of normal laboratory quality control procedures. The Operations Manager and Sampling Group Supervisor will be apprised of any anomalies involving field duplicate data and will initiate corrective action as necessary.

Field Split Samples

The use of a split sample is predominantly at the discretion of the consulting or sampling firm. Its purpose is to measure variability between laboratories. A split sample is where two samples are taken from a single, larger homogeneous sample. Consequently, well mixed wastes or liquids would be the only sample types for which a true split may be taken. If there is not sufficient liquid sample in the sampling device to fill all containers in a single sample "pull" then a method of mixing in a larger container is required. Alternatively, containers may be filled by successive "pulls" provided the portion of the device used is alternated between containers. Split sample acquisition and reporting is initiated by the client and as such the client is responsible for initiating any corrective action or investigative procedures.

6.7 Sampling Protocols

Parameters to be measured are usually dictated by the purpose of an investigation and should be based on required monitoring conditions or on the field investigator's knowledge of the investigation. From this knowledge, all samples should be collected from the least to the most contaminated areas. In addition, any wells containing free product will not be sampled for trace analysis. Generally, for water sampling, all pieces of equipment and/or non-preserved containers should be pre-rinsed with sample water before the actual sample is taken. This does not apply to pre-preserved containers or to those samples taken for volatile organics analysis, total recoverable petroleum hydrocarbons, oil & grease or bacteriological samples.

Representative sampling sites and the type and construction of sampling equipment selected is dictated by the type of investigation undertaken. The material that sampling equipment is constructed of can affect sample results. Materials used for construction and/or preparation of the sampling equipment must not contaminate the sample being collected and must be readily cleaned so that samples are not cross-contaminated.

Personnel handling samples should always wear a new pair of disposable latex gloves for personal safety as well as preventing the possibility of cross-contamination between samples.

During all sampling events, the field notebook is used to document sampling activities, including descriptions of sample locations and any other data deemed necessary to allow future traceability of the event by reviewing the sampling documentation.

The following represents the preferred order of sample collection from a given location.

1. VOC
2. TOX
3. TOC
4. Extractable Organics (as well as TRPH and O&G)
5. Total Metals
6. Dissolved Metals
7. Microbiological
8. Inorganics
9. Radionuclides

6.7.1 Wastewater Sampling

The wide variety of conditions existing at different sampling locations require that some judgement be made regarding the methodology and procedure for collection of a representative sample of wastewater.

6.7.1.1 Wastewater Sampling Site Considerations

Influent wastewaters are preferably sampled at points of highly turbulent flow in order to ensure proper mixing while avoiding taking samples from either the surface or bottom of the stream. In all cases, samples should be collected upstream from recirculated plant supernatant and sludges, and the samples should be completely untreated.

Where applicable, effluent wastewater samples should be collected at the location specified in the NPDES permit or at the most representative site downstream from all entering wastewater streams prior to discharge into the receiving waters.

6.7.1.2 Wastewater Sampling

Equipment

Specific equipment which may be used for wastewater sampling includes the following with restrictions and exceptions as noted in Table 6-3 and Section 6.8.

Automatic Sampler - ISCO Models 2700, 2710, 3710
Stainless Grab Arm With Teflon Cup
Pre-rinsed Sample Containers

Composite Sampling

Automatic samplers may be used to collect composite samples over various time periods. Aliquot size will normally be 100 mL per hour or thirty minute interval. If refrigeration is recommended or desired during compositing, the sample container can be packed with ice. Composite samples must be taken from the receiving waters unless homogenous mixing is demonstrated and noted. In lieu of automatic equipment or if personal, continuous observation of the stream is required, manual equipment may be used over extended periods of time to collect the composite sample.

Grab Sampling

Grab samples will normally be obtained using a grab arm with a teflon cup or a sample container itself. The best method includes inverting the container, lowering to the desired depth and tipping the collection container so that the mouth of the container faces upstream. With the exception of oil and grease sampling, microbiological sampling, and pre-preserved containers, all containers shall be rinsed twice prior to filling.

6.7.1.3 Wastewater Sampling Protocol

a) Determine flow variability using flow meter and record in field notebook.

b) If flow is highly variable, conduct sampling on a flow-proportional basis noting the proportional volumes to be taken in the field notebook.

c) If flow is not significantly variable, conduct sampling on a time-proportional basis noting the beginning and ending times in the field notebook.

d) Rinse and fill a clean sampling cup or sample container with the sample water by tipping the container in the stream so that the mouth of the container faces upstream and measure pH, specific conductivity, and temperature. Record results and time in the field notebook.

e) Fill three (3) VOA containers as specified in Section 6.8.1 (Special Considerations for Sampling Volatile Organics). Label and seal vials and record ID numbers and time in the field notebook. Put vials in zip-lock plastic bag and place on ice in sample cooler.

f) Rinse non-preserved sample bottles with sample and fill to within 1/2 inch of top. Label and seal bottles, record ID numbers and time in the field notebook. Place samples on ice in sample cooler.

g) Fill preserved sample bottles slowly. Do not pre-rinse containers which contain preservative. Cap and invert bottle to mix preservative.

h) Verify pH of acid-preserved or base-preserved samples by pouring a small amount of sample into a clean container or sampling cup and measuring pH using test strips.

i) If pH is correct for the type of preservative, label and seal bottle, record pH, sample ID and time in field notebook and place vial on ice in zip-lock bag.

j) If pH is not correct, add additional acid or base until the correct pH is achieved. Record additional acid or base volume in notebook.

k) Complete chain-of-custody documentation.

l) Pack samples and associated paperwork for safe transport to the laboratory.

6.7.2 Surface Water Sampling

A surface water sampling program is based upon a variety of factors, mainly study objectives and water use. It is important to assess the characteristics of the water body being sampled in order to obtain a representative sample of surface water which meets the objective of the study. Various bodies of water, including lakes, ponds, impoundments, streams, rivers, and estuary waters present unique sampling challenges. In addition to physical access, anomalies such as stratification, mixing, sediment deposition, and salinity must be considered when developing a sampling program for surface water.

6.7.2.1 Surface Water Sampling Site Considerations

Sample site selection for surface water should be made with consideration to accessibility, water flow, presence of sediment and study objectives. Typically, sampling site selection will be pre-determined by the site specific sampling plan or client request. Special care should be exercised when collecting samples relative to the sampler's vessel and body. Whenever possible, samples should be taken from the bow of the boat or upstream from the sampler or boat. Care must also be taken not to disturb any sediments in the immediate area of sample collection. The field notebook should describe environmental conditions and relative positions of sampling equipment such as motors or generators which could affect the samples.

6.7.2.2 Surface Water Sampling Considerations

Specific equipment which may be used for surface water sampling includes the following items with restrictions and/or exceptions as noted in Table 6-3 and Section 6.8.

VanDorn Sampler
Teflon Nansen Bottle
Stainless Steel Grab Arm With Teflon Cup
Pre-rinsed Sample Containers
Automatic Samplers - ISCO Models 2700,2710,3710

Types of Samples

Special consideration must be given to the type of sample being collected. The overall protocol as outlined in Section 6.7.2.3 is applicable to all types of sampling techniques given the specific considerations presented below.

Point Sampling

This would essentially be a grab sample where a pre-rinsed container or grab arm is inverted into the water then tipped so that its mouth faces the flow (if any).

Depth Specific Sampling

Samples may be obtained at specified depths by utilizing a VanDorn Sampler. The cylinder is lowered to the desired depth while water is flowing freely through it. At the appropriate depth, a messenger is sent down the rope causing the two stoppers to close tightly. The cylinder is then brought to the surface and samples are collected from a valve on the sampler. Depth of sampling is recorded in the field notebook.

In the case of a teflon Nansen bottle, samples are obtained at specified depths by lowering the inverted bottle to the desired depth. A messenger is sent down the rope causing the bottle to turn to an upright position. Once the bottle has been allowed to fill completely it may be retrieved and samples taken by gently pouring from the bottle.

Pump Sampling

A peristaltic pump may be used for certain surface water applications which could include compositing from several sites or depth specific sampling.

6.7.2.3 Surface Water Sampling Protocol

a) Select sampling site and provide access to the site by extending, wading, boat or other suitable means.

b) Measure total depth of water and flow rate (if applicable) at the sampling site and record in field notebook.

c) Rinse and fill a clean sampling cup or sample container with the sample water by tipping the container in the water so that the mouth of the container faces upstream (if applicable) and measure pH, specific conductivity, dissolved oxygen and temperature. Record results and time in field notebook.

d) For depth specific samples lower the appropriate sampling device with a measured length of rope to the desired depth. Retrieve sample and measure pH, specific conductivity, dissolved oxygen and temperature of the water. Record results, time and depth in field notebook.

e) Fill three (3) VOA containers as specified in Section 6.8.1 (Special Considerations for Sampling Volatile Organics). Label and seal vials and record ID numbers and time in the field notebook. Put vials in zip-lock plastic bag and place on ice in sample cooler.

f) Rinse non-preserved sample bottles with sample and fill to within 1/2 inch of top. Label and seal bottles, rec ID numbers and time in the field notebook. Place samples on ice in sample cooler.

g) Fill preserved sample bottles slowly. Do not pre-rinse containers which contain preservative. Cap and invert bottle to mix preservative.

h) Verify pH of acid-preserved or base-preserved samples by pouring a small amount of sample into a clean container or sampling cup and measuring pH using test strips.

i) If pH is correct for the type of preservative, label and seal bottles, record pH, sample ID numbers and time in field notebook and place vials on ice in zip-lock bag(s).

j) If pH is not correct, add additional acid or base until the correct pH is achieved. Record additional acid or base volume in notebook.

k) Complete chain-of-custody documentation.

l) Pack samples and associated paperwork for safe transport to the laboratory.

6.7.3 Groundwater Monitor Wells Sampling

Groundwater is usually sampled through an in-place well, either temporarily or permanently installed. Groundwater wells with in-place permanent plumbing will be sampled as in Section 6.7.4.

6.7.3.1 Groundwater Sampling Site Considerations

Installation of groundwater monitoring wells is limited to experienced and knowledgeable persons such as hydrogeologists. For the purpose of this manual it will be assumed that only pre-existing, adequately developed groundwater wells or other pre-existing, accessible groundwater sources will be sampled by Quanterra Tampa personnel. Whenever it is necessary to use the gas powered generator, care will be taken to assure that it is down wind from the sampling site.

6.7.3.2 Groundwater Sampling Considerations

Equipment

Specific equipment which may be used for groundwater purging and/or sampling includes the following items with restrictions and/or exceptions as noted in Table 6-3 and Section 6.8.

Grundfos Redi-Flo 2 submersible pump
Automatic Sampler-peristaltic pump-ISCO Models 2700,2710,3710
Teflon and Stainless steel bailers
Masterflex Peristaltic pump

When organics and/or metals are being sampled, then all equipment coming in contact with the well water will be teflon or stainless steel. The only exception would be as noted in note 1 from Table 6-3.

Well Purging

In order to clear the well of stagnant water which may not be representative of the groundwater conditions present, wells will be purged until three to five times the volume of standing water in the well has been removed. Specific conductance, temperature and pH will be measured after each purge and will be recorded in the field notebook along with a record of the volume purged. The amount purged is considered adequate when either the parameters measured do not deviate more than 5% after a minimum of three well volumes or when five well volumes have been purged. If a well is pumped dry, this constitutes an adequate purge and the well can be sampled following recovery.

The determination of the volume of standing water in a well is made by measuring the depth of the water in the well and the depth of the well itself. Both measurements should be in feet utilizing a tape measure with an accuracy of 0.1 feet. These measurements should always be made from the top of the well casing unless otherwise noted in notebook. The difference of these values provides the actual height of the water column (h) in feet. The diameter of the well (d) in inches can then be used in the following formula, along with the height (h) and a conversion factor, to provide the sampler with the volume (v) in gallons of the standing water.

$$V = (0.041)\,(d^2)\,(h)$$

After determining the volume of water in the well itself, purging will be accomplished using a teflon or stainless steel bailer or appropriate pump. To the extent that it is feasible, purging should be conducted from the top of the water column working down as level decreases. If purging is performed by a pump without the proper inert tubing, then the last well volume will be purged by using an appropriate bailer.

Upon completion of purging, separate bailers will be used to conduct sampling. Sampling must occur within six (6) hours (ten (10) hours for slow wells) after purging is complete. Braided nylon cord used to haul bailers, will not be allowed to touch the ground or casing, and will be discarded after one use. Care must be taken when purging (and sampling) wells so that water in the well is not contaminated by disturbing the well casement causing particles to fall into the water.

6.7.3.3 Groundwater Monitor Well Sampling Protocol

a) Record the diameter of the well casing and the casing composition (if known) in the field notebook.

b) Place aluminium foil or heavy duty plastic sheeting on ground around well casing to protect equipment from contamination.

c) Record the water level depth and well depth using the Roctest CPR-6 water level indicator or a decontaminated measuring tape, in the field notebook.

d) Calculate volume of water present in the well and record in notebook. Use the following calculation:
   $V = (0.041)(d^2)(h)$
   V = volume of water in gallons
   d = diameter of well in inches
   h = height of water in well in feet

e) Begin purging procedure using a teflon bailer or suitable pump. Measure and record purged volumes using a calibrated bucket.

f) Measure pH, specific conductance and temperature after three (3) well volumes have been purged and record data, noting date and time in notebook.

g) Continue purging at one gallon intervals until (a) five (5) well volumes have been purged or (b) until pH, specific conductance, and temperature readings are within ± 5% for consecutive samples or (c) the well is purged dry. Record data along with date and time in field notebook.

h) Replace purging bailer or pump with sampling bailer and rinse by removing an additional bailer full of well water.

h) Fill three (3) VOA containers as specified in Section 6.8.1 (Special Considerations for Sampling Volatile Organics). Label and seal vials and record ID numbers and time in the field notebook. Put vials in zip-lock plastic bag and place on ice in sample cooler.

i) Rinse non-preserved sample bottles with sample and fill to within 1/2 inch of top. Label and seal bottles, record ID numbers and time in the field notebook. Place samples on ice in sample cooler.

j) Fill preserved sample bottles slowly. Do not pre-rinse containers which contain preservative. Cap and invert bottle to mix preservative.

k) Verify pH of acid-preserved or base-preserved samples by pouring a small amount of sample into a clean container or sampling cup and measuring pH using test strips.

l) If pH is correct for the type of preservative, label and seal bottles, record pH, sample ID and time in field notebook and place vials on ice in zip-lock bag(s).

m) If pH is not correct, add additional acid or base until the correct pH is achieved. Record additional acid or base volume in notebook.

n) Complete chain-of-custody documentation.

o) Pack samples and associated paperwork for safe transport to the laboratory.

p) Re-secure monitor wells (if applicable) before leaving site.

6.7.4 Potable Water Sampling

Potable water sampling is typically conducted through use of a permanently-installed well, production well, or taps which are serviced directly by potable water supplies. This type of sampling is also applicable to groundwater wells which are serviced by permanent or "in-place" plumbing.

6.7.4.1 Potable Water Sampling Site Considerations

Similar care and techniques used in groundwater sampling are applicable to samples of potable water drawn from wells. When sampling potable water from production taps, taps selected should be supplied with water from a service pipe connected directly to a water main in the segment of interest and if possible, should not be separated from the segment of interest by a storage tank. Aerator, strainer, and hose attachments on the tap must be removed before sampling.

6.7.4.2 Potable Water Sampling Considerations

Equipment

There is no specific purging or sampling equipment required for sources with in-place plumbing. The only equipment would be a bucket to measure purge volume and possibly an intermediate container for taking samples.

Well and Line Purging

If there is a known volume of the well, service pipes or storage tank, then that volume should be purged before sampling begins. Otherwise, the cold water tap should be opened (as much as possible without splashing) for fifteen minutes. At this point the site should be considered purged and sampling may begin using a reduced flow rate of about 500 mL/min.

6.7.4.3 Potable Water Sampling Protocol

a) If sampling from wells, follow groundwater sampling protocol found in Section 6.7.3.3 of this manual.

b) If sampling from production wells with taps, remove any attachments and begin purging procedure by opening the cold water tap until a maximum flow is achieved without splashing. Measure the flow rate using calibrated bucket, and record rate in field notebook. Allow line to purge for fifteen (15) minutes or until service line has been completely cleared. Record purge time and time of day in field notebook.

c) Prior to collecting samples the flow rate should be reduced to approximately 500 mL/min (0.1 gal/min).

d) Rinse clean sampling cup or container with sample and collect sufficient volume to measure pH, specific conductance, and temperature in field notebook.

e) Fill three (3) VOA containers as specified in Section 6.8.1 (Special Considerations for Sampling Volatile Organics). Label and seal vials and record ID numbers and time in the field notebook. Put vials in zip-lock plastic bag and place on ice in sample cooler.

d) Rinse non-preserved sample bottles with sample and fill to within 1/2 inch of top. Label and seal bottles, record ID numbers and time in the field notebook. Place samples on ice in sample cooler.

e) Fill preserved sample bottles slowly. Do not pre-rinse containers which contain preservative. Cap and invert bottle to mix preservative.

f) Verify pH of acid-preserved or base-preserved samples by pouring a small amount of sample into a clean container or sampling cup and measuring pH using test strips.

g) If pH is correct for the type of preservative, label and seal bottle, record pH, sample ID numbers and time in field notebook and place vials on ice in zip-lock bag(s).

h) If pH is not correct, add additional acid or base until the correct pH is achieved. Record additional acid or base volume in notebook.

i) Complete chain-of-custody documentation.

j) Pack samples and associated paperwork for safe transport to the laboratory.

6.7.5 Soil/Sediment Sampling

Soil sampling is performed to obtain information on an area or tract of land. Strategic sampling may provide valuable data as to the nature of the site with a minimum number of samples and effort. Sediment sampling is a procedure to obtain solid type samples from where a "runoff" has occurred (a land based surface sample) or from the bottom of some water body.

6.7.5.1 Soil/Sediment Sampling Site Considerations

Areas selected for soil sampling will be situated in order to collect a representative fraction with the minimum number of samples. Selection of sampling sites will be determined by client direction, site specific sampling plan and/or determination of the most appropriate sampling points by the sample collector after evaluation of topographical features such as surface runoff direction. Initial site investigation generally involves the selection of sampling sites which provide pertinent data from which a more specific sampling plan may be established, if necessary. At no time will samples for analysis be taken from the auger flights or cuttings from hollow flights. Also any samples used to make geological/lithological or vapor determinations will not be used for trace analyses.

6.7.5.2 Soil/Sediment Sampling Considerations

Equipment

Specific equipment which may be used for soil and sediment sampling includes the following items with the restrictions and/or exceptions as noted in Table 6-3 and Section 6.8. All samples are mixed thoroughly before being placed in containers, with the exception of VOC samples and those samples which remain in a tube or core.

Stainless Steel Trowel, Scoop, Spoon, Spatula
Stainless Steel Hand Auger and Corer
Stainless Steel Shovel, Shelby and Split Spoon
Stainless Steel or Glass Mixing Tray

Sediment Sampling

Surface sediments will be sampled like soil samples. When sediment from below a body of water is desired, then some special considerations must be made. In calm water the sediment may be sampled using an open scoop, spoon, trowel, etc. For moving bodies of water a closed container should be used to "grab" the sediment and bring it to the surface without losing the fine particles. The procedures outlined in Section 6.7.5.3 are applicable to sediment sampling with the understanding of the above noted considerations.

Shallow Subsurface Sampling Techniques

Shallow subsurface soil samples may be collected by digging a hole with a stainless steel shovel and collecting a sample at the desired depth using a stainless steel spoon or a shelby tube. Care should be taken to remove all loose soil and backfill from the hole before sampling. The Shelby tube is pushed into the soil to be sampled and removed. The sample is then transferred to a sample container or sealed in the tube for shipment to the laboratory.

Deeper Subsurface Soil Sampling

For deeper sampling using hand equipment, a stainless steel auger is used to bore a hole until the desired depth is achieved. A clean auger bucket, Shelby tube or split-spoon is used to collect the sample.

The stainless steel hand auger consists of a bucket, a boring extension, and handle. At the bottom of the bucket are two cutting edges. Boring is achieved by turning the handle and applying downward pressure.

The split-spoon sampler is used to collect a sample at a pre-determined depth by inserting it into a pre-drilled hole and forcing it into the undisturbed soil at the bottom of the hole. The split-spoon is retrieved from the hole and opened to collect the undisturbed portion of the sample.

The core sampler provides the ability to simultaneously drill a hole while preserving the column of soil/sediment. This column is then either composited or sampled at specified "depths".

6.7.5.3 Soil/Sediment Sampling Protocol

a) Locate and record sampling site in field notebook using site description and/or topographical map.

b) Prepare the sampling site by removing any surface matter such as vegetative growth or debris. Record any comments regarding characteristics of sampling site (e.g. color, odor, debris, etc) in field notebook.

c) If subsurface samples are desired, prepare a hole or trench to the desired depth using a stainless steel shovel or auger.

d) Remove any loose backfill material which remains in the hole.

e) Collect sample at desired depth using stainless steel spoon, hand auger with clean bucket, split-spoon or shelby tube. Record depth of sampling in field notebook.

f) Transfer undisturbed portion of sample to a clean glass or stainless steel pan and fill VOA vials with undisturbed portion.

g) Leaving no headspace in the container, cap and label vials, record sample ID, depth of sample, and time of day in notebook, and place in zip-lock bag on ice.

h) After thorough mixing, fill remaining sample containers to within 1/2 inch of top. Cap and label bottles, place on ice and record sample ID and time in field notebook.

i) Complete chain-of-custody documentation.

j) Pack samples and associated paperwork for transport to the laboratory.

k) Where applicable, backfill sampling holes which were excavated before leaving the site.

6.7.6 Waste/Drum Sampling

6.7.6.1 General Considerations

Sampling closed containers shall be considered a high-hazard operation. Sampling and safety procedures outlined in Quanterra Tampa Health and Safety Manual will be strictly observed during hazardous sampling operations. In addition, all personnel involved in hazardous sampling operations must have successfully completed OSHA's forty (40) hour safety training course and any subsequent update requirements. Additional safety guidance will be referenced in the draft EPA Safety Manual for Hazardous Waste Site Investigation. Hazardous conditions must always be assumed present when sampling a container, and appropriate caution exercised. When possible, historical information (including any labels) relating to the container should be obtained and reviewed prior to sampling. Should radioactive, shock-sensitive or other extremely hazardous materials of this type be suspected present, appropriate experts will be called upon to screen a site before any sampling may take place.

6.7.6.2 Waste/Drum Sampling Considerations

Equipment

Specific equipment which may be used for waste sampling includes the following items with the restrictions and/or exceptions as noted in Table 6-3 and Section 6.8.

Disposable profile tube for sampling drums containing homogeneous or stratified liquids.
Sparkproof barrel wrench for opening waste drums.
Various stainless steel equipment (described for soil/sediment) for sampling solid or semi-solid wastes.
Sample containers.

Open Container Sampling

Open containers generally present less hazard than closed containers and should be sampled first when both types of containers are present in order to familiarize the sampling team with the types of materials that may be present in closed containers.

For liquid waste samples, a disposable glass profile tube will be used to collect a representative sample in case of multiple layers. If a representative sample is not possible through use of a profile tube (i.e. larger tanks), other measures may be necessary such as collecting the sample through a valve or spigot. In cases where representation of the sample is questionable, notes to that effect will be made in the field notebook and the Project Manager notified. If layers are sampled separately then the layer sampled must be clearly identified.

For solid waste samples, stainless steel spoons (with extension devices, if needed) and/or push-tubes may be used to collect representative samples. Compositing of the waste is necessary if the solid waste pile or container is considered to be non-homogeneous. A stainless steel pan and spoon may be used to homogenize the sample fractions collected.

Where possible, all waste samples should be composited with depth to provide a representative sample. Exceptions encountered should be noted in the field notebook.

Closed Container Sampling

Closed containers must be considered extremely hazardous from the standpoint of unknown factors relating to toxicity, explosion, or fire. Spark-proof barrel wrenches are used to open closed containers. Full compliance with applicable Health and Safety protocols are required when opening closed containers. Two or more persons must be present in the sampling area and a third present in a designated safe area before closed containers are opened. Once opened, container sampling may proceed following open container sampling protocol.

6.7.6.3 Waste Sampling Protocol

a) Locate sampling site on map or suitable reference for future reference. Record this information in the field notebook as well as what type of container is being sampled.

b) Determine whether the waste to be sampled presents a high-hazard condition. Take necessary steps to ensure compliance with applicable safety standards.

c) If waste is in a closed container, provide access to the container by removing the lid (bung) using a spark pro barrel wrench.

d) If liquid waste is contained in a large tank, locate a valve or port appropriate for collecting the sample. Using either a profile tube or spigot, fill an appropriate sample container with liquid to within 1/2 inch of the top. Cap and label the sample, record sample ID and time of day in the field notebook, and store the sample for transport per applicable preservation requirements and hazardous sample handling protocols.

e) When using profile tubes to sample liquid waste, sample by placing thumb over hole and dipping tube into waste. Remove tube and note layer profiles and drain sample into container. Record physical description of sample, including depths of stratifications, if any, in the field notebook along with other pertinent sample data.

f) If waste is solid, collect a representative sub-sample at appropriate depths using push tubes, or stainless steel spoon with extension device.

g) Composite solid waste sample in stainless steel pan with stainless steel spoon and transfer composite sample to appropriate container. Cap and label bottle, record sample ID, physical description and time of day in the field notebook.

h) Pack samples according to hazardous waste sample transportation and preservation protocols. Include completed chain-of-custody papers and associated paperwork for transport.

6.8 Special Sampling Considerations

Situations which require additional or special steps during the sampling procedure to ensure sample integrity are outlined below.

6.8.1 Volatile Organic Samples

Samples to be analyzed for the presence of volatile organic compounds are collected and stored in 40 mL septum vials with screw caps with a Teflon-lined silicon disk in the cap (teflon side toward sample).

Multiple samples from the same site are always collected when sampling for volatile organics and special attention will be given to minimizing headspace in the sample container, regardless of sample matrix. No samples being collected for volatile organic compounds will be composited or mixed.

The sampler will determine, either historically or by on-site testing if water to be sampled contains chlorine. If the water contains no chlorine, sample vials containing four drops of concentrated HCl should be filled with the sample and labelled HCl-preserved. Care should always be taken when collecting volatile samples so that aeration due to splashing is minimized. This may be accomplished by gently pouring the water sample down the side of the vial. The vial is then slightly overfilled (convex meniscus) so that when the screw cap is tightened, head space is eliminated. Sample vials containing water to be analyzed for volatile organics should be checked upon completion of filling by inverting the vial, tapping the vial gently against your hand and looking for the presence of air bubbles. If any bubbles are present, the procedure should be repeated. Soil samples should be placed in the vials minimizing mixing and headspace.

If the water sample contains chlorine, then it should be collected into a vial containing four drops of concentrated HCl, but not filled to the top. Four drops of 10% sodium thiosulfate should then be added, the vial "topped off" with sample, capped tightly and mixed thoroughly. All containers should be clearly marked with preservative contents to avoid confusion in the field.

6.8.2 Composite Samples

6.8.2.1 Water Samples

When necessary, field compositing of water samples may be performed using the following guidelines.

a) Use equivalent aliquots (minimum 100 mL) when mixing a composite.

b) Composite samples may be collected in a precleaned, sample-rinsed plastic or stainless steel bucket, depending on desired analyses.

c) After adding equivalent aliquots of each sub-sample to be composited, gently swirl the water to allow compete mixing without aeration.

d) Transfer the resulting composite to sample bottles using standard sampling protocols as outlined previously in this manual.

e) Compositing volatile organic samples in the field is not recommended unless specified by FDEP.

6.8.2.2 Solid Samples

When necessary, field compositing of solid samples may be performed using the following guidelines. All individual solid sub-samples should be mixed thoroughly in a stainless steel pan using a stainless steel spoon.

a) Transfer equivalent aliquots of soil sub-samples to a clean stainless steel or glass mixing pan. Equivalent aliquots may be determined by weight (if a balance is available) or estimated by volume. The field sampler's notebook should specify the method and all weights or volumes of sub-samples.

b) Mix thoroughly using a stainless steel spoon.

c) Fill sampling containers from the pan following standard sampling protocols outlined previously in this manual.

d) Compositing volatile organics samples is not recommended unless specified by FDEP.

6.8.3 Dissolved Constituent Samples

When sampling for dissolved constitutents, the peristaltic pump equipped on the positive pressure side with a on piece, in-line, non-contaminating disposable 0.45um or 1.0um filter (see further) will be usd. All samples for trace metal analysis must use a 1.0um filter, whereas samples for analysis of dissolved constituents (orthophosphorous, silica, dissolved metals, etc.) must use the 0.45um filter. The sample will be filtered directly from the well into a sample container for immediate preservation. If the well is greater than 25 feet deep then the submersible pump will be used to bring the water to the surface and filtered or will proceed at that point as described above. Upon Client/FDEP request an additional non-filtered sample must be taken. Additionally, any time filtered samples are taken, at least one filtered equipment blank of analyte-free water should be taken and analyzed.

6.8.4 Oil and Grease Samples

When sampling for oil and grease analysis, samples should never be composted nor should intermediate containers be used unless absolutely necessary. In addition, sample containers and bailers should not be rinsed with sample before collection.

6.8.5 Bacteriological Samples

When sampling activities include collection for microbiological types of analysis, the maintenance of sterile containers is very important. This would encompass such things as avoiding any contact with tops or edges of containers and keeping containers sealed until needed. Other considerations require no compositing be performed and that samples reach the laboratory within the 6 hour holding time. The holding time constraint may require the use of personal and/or professional couriers to shuttle samples to the laboratory as soon as they are collected.

TABLE 6-4

PRESERVATION SUMMARY FOR AQUEOUS MATRICES

Parameter	Container[1]	Preservative[2]	Recommended Holding Time[3]	Amount Required
Bacteriological:				
Coliform, Fecal and Total .	P,G	Cool, 4°C 008% $Na_2S_2O_3$[4]	6 hours	250 mL
Radiological:				
Alpha, Beta, and Radium	P,G	HNO_3 to pH<2	6 months	2 L
Metals:				
Chromium VI	P,G	Cool, 4°C	24 hours	250 mL
Mercury	P,G	HNO_3 to pH<2	28 days	250 mL
Metals, except above	P,G	HNO_3 to pH<2	6 months	1 L
Physical Properties:				
Acidity	P,G	Cool, 4°C	14 days	250 mL
Alkalinity	P,G	Cool, 4°C	14 days	250 mL
Biochemical Oxygen Demand	P,G	Cool,4°C	48 hours	500 mL
Bromide	P,G	None Required	28 days	250 mL
Carbon, Total Organic	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days	4 x 40 mL
Chemical Oxygen Demand	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days	250 mL
Chloride	P,G	None Required	28 days	250 mL

TABLE 6-4

PRESERVATION SUMMARY FOR AQUEOUS MATRICES
(continued)

Parameter	Container[1]	Preservative[2]	Recommended Holding Time[3]	Amount Required
Chlorine, Total and Residual	P,G	None Required	Analyze immediately	250 mL
Color	P,G	Cool, 4°C	48 hours	500 mL
Conductivity	P,G	Cool, 4°C	28 days	250 mL
Cyanide, Total and Amenable to Chlorination	P,G	Cool, 4°C NaOH to pH>12[6] 0.6g ascorbic acid[4]	14 days[6]	100 mL
Fluoride	P	None Required	28 days	250 mL
Hardness	P,G	HNO_3 to pH<2	6 mos.	100 mL
Halogens, Total Organic	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days	2 x 250 mL
Hydrocarbons, Total Recoverable Petrol. (IR)	G	Cool, 4°C HCl to pH<2	28 days	2 L
Nitrogen, Ammonia	P,G	Cool, 4°C $H2SO_4$ to pH<2	28 days	250 mL
Nitrogen, Unionized Ammonia	P,G	Cool, 4°C H_2SO_4 to pH<2 Na_2S2O_3[4]	28 days	7 L 500 mL
Nitrogen, Kjeldahl	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days	1 L
Nitrogen, Nitrate	P,G	Cool, 4°C	48 hours	250 mL
Nitrogen, Nitrate - Nitrite	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days	250 mL

TABLE 6-4

PRESERVATION SUMMARY FOR AQUEOUS MATRICES
(continued)

Parameter	Container[1]	Preservative[2]	Recommended Holding Time[3]	Amount Required
Nitrogen, Nitrite	P,G	Cool, 4°C	48 hours	250 mL
Nitrogen, Organic	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days	250 mL
Odor	G	Cool, 4°C	6 hours	500 mL
Oil and Grease	G	Cool, 4°C H_2SO_4 to pH<2	28 days	1 L
Oxygen, Dissolved Probe	G, Bottle and Top	None Required	Analyze immediately	300 mL
Oxygen, Dissolved Winkler	G, Bottle and Top	Fix on-site, store in dark	8 hours	300 mL
Hydrogen Ion (pH)	P,G	None Required	Analyze immediately	25 mL
Phenolics	G	Cool, 4°C H_2SO_4 to pH<2	28 days	1 L
Phosphorus, Orthophosphate	P,G	Filter Immediately Cool, 4°C	48 hours	1 L
Phosphorus, Elemental	G	Cool, 4°C	48 hours	250 mL
Phosphorus, Total	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days	250 mL
Residue, Total Solids (TS)	P,G	Cool, 4°C	7 days	250 mL
Residue, Filterable Solids (TDS)	P,G	Cool, 4°C	7 days	250 mL

TABLE 6-4

PRESERVATION SUMMARY FOR AQUEOUS MATRICES
(continued)

Parameter	Container[1]	Preservative[2]	Recommended Holding Time[3]	Amount Required
Residue, Non-Filterable Solids (TSS)	P,G	Cool, 4°C	7 days	1 L
Residue, Settleable	P,G	Cool, 4°C	48 hours	250 mL
Residue, Volatile	P,G	Cool, 4°C	7 days	250 mL
Silica	P, G	Cool, 4°C	28 days	500 mL
Sulfate	P,G	Cool, 4°C	28 days	500 mL
Sulfide	P,G	Cool,4°C Add Zinc Acetate and NaOH to pH>9	7 days	1 L
Sulfite	P,G	None Required	Analyze immediately	250 mL
Surfactants (MBAS)	P,G	Cool, 4°C	48 hours	1 L
Temperature	P,G	None Required	Analyze immediately	250 mL
Turbidity	P,G	Cool, 4°C	48 hours	500 mL
Organics:				
Base/Neutral Acid Extractables (GC/MS)	G, TFE Lined Cap	Cool, 4°C .008% $Na_2S_2O_3$[4]	7 days until extraction, 40 days after	1 L
Polynuclear Aromatic Hydrocarbons	G, TFE Lined Cap	Cool, 4°C .008% $Na_2S_2O_3$[4] Store in Dark	7 days until extraction, 40 days after	1 L
Pesticides/PCB's, Herbicides	G, TFE Lined Cap	Cool, 4°C Store in Dark	7 days until extraction, 40 days after	1 L

TABLE 6-4

PRESERVATION SUMMARY FOR AQUEOUS MATRICES
(continued)

Parameter	Container[1]	Preservative[2]	Recommended Holding Time[3]	Amount Required
Purgeable Halocarbons (EPA 601,501.1)	G, TFE Lined Cap	Cool, 4°C .008% $Na_2S_2O_3$[4]	14 days	3 x 40 mL
Purgeable Aromatics (EPA 602,624,502.2)	G, TFE Lined Cap	Cool, 4°C .008% $Na_2S_2O_3$[4] HCl to pH<2	14 days[5]	3 x 40 mL
Volatile Organics (EPA 8010, 8020,8240):				
No Residual Chlorine	G, TFE Lined Cap	Cool, 4°C 4 Drops HCl	14 days	3 x 40 mL
Residual Chlorine	G, TFE Lined Cap	Collect Sample in a 40 mL VOA Container Preserved with 4 drops of concentrated HCl. Add 4 drops of 10% $Na_2S_2O_3$. Cap tightly and mix Cool, 4°C	14 days	3 x 40 mL

NOTES

1. P = polyethylene, G = glass.

2. Preservative should be contained in the containers as sample is added or added to the sample immediately. Each aliquot of composite samples should be preserved at collection if possible. Automatic compositing samplers should be maintained at 4°C until preservation can be performed.

3. Holding times listed are maximum recommended times for each particular preparation or analysis; therefore, every effort will be made to analyze/prepare the samples as soon as possible after sampling.

4. Preservative required only if residual chlorine is known to be present.

5. If pH is not adjusted, samples must be analyzed within seven days of sampling.

6. If the sampler determines sulfide to be present (using lead acetate paper), then the sample may be shipped preserved with NaOH and analyzed within 24 hours or it can be treated in the field using cadmium nitrate before preservation.

7. Temperature, pH and salinity (if applicable) must be measured on site at the time of sample collection. Laboratory analysis of the ammonium ion concentration should be conducted within eight hours of sample collection. If prompt analysis of ammonia is impossible, preserve samples with H_2SO_4 to pH between 1.5 and 2. Acid-preserved samples, stored at 4°C, may be held up to 28 days for ammonia determination.

TABLE 6-5

PRESERVATION SUMMARY FOR SOLID MATRICES

Parameter	Container[1]	Preservative[2]	Recommended Holding Time[3]	Amount Required
Radiological:				
Alpha, Beta, Radiums	P,G	Cool, 4°C	6 months	200 g
Metals:				
Chromium VI	P,G	Cool, 4°C	24 hours	50 g
Mercury	G P	Cool, 4°C Cool, 4°C	13 days 28 days	50 g 50 g
Metals, except above	P,G	Cool, 4°C	6 months	50 g
Physical Properties:				
Acidity	P,G	Cool, 4°C	14 days	50 g
Alkalinity	P,G	Cool, 4°C	14 days	50 g
Bromide	P,G	None Required	28 days	50 g
Chloride	P,G	None Required	28 days	50 g
Cyanide, Total and Amenable to Chlorination	P,G	Cool, 4°C	14 days	50 g
Fluoride	P	None Required	28 days	50 g
Halogens, Total Organic	P,G	Cool, 4°C	28 days	50g
Hydrocarbons, Total Recoverable Petrololeum	G	Cool, 4°C	28 days	100 g
Nitrogen, Ammonia	P,G	Cool, 4°C	28 days	50 g
Nitrogen, Kjeldahl	P,G	Cool, 4°C	28 days	50 g

TABLE 6-5

PRESERVATION SUMMARY FOR SOLID MATRICES
(continued)

Parameter	Container[1]	Preservative[2]	Recommended Holding Time[3]	Amount Required
Nitrogen, Nitrate	P,G	Cool, 4°C	48 hours	50 g
Nitrogen, Nitrate - Nitrite	P,G	Cool, 4°C	28 days	50 g
Nitrogen, Nitrite	P,G	Cool, 4°C	48 hours	50 g
Nitrogen, Organic	P,G	Cool, 4°C	48 hours	50 g
Oil and Grease	G	Cool, 4°C	28 days	50 g
Hydrogen Ion (pH)	P,G	None Required	Analyze immediately	50 g
Phenolics	G	Cool, 4°C	28 days	50 g
Phosphorus, Orthophosphate	P,G	Cool, 4°C	48 hours	50 g
Phosphorus, Elemental	G	Cool, 4°C	48 hours	50 g
Phosphorus, Total	P,G	Cool, 4°C	28 days	50 g
Silica	P	Cool, 4°C	28 days	50 g
Sulfate	P,G	Cool, 4°C	28 days	50 g
Sulfide	P,G	Cool, 4°C	28 days	50 g
Sulfite	P,G	Cool, 4°C	Analyze immediately	50 g
Organics:				
Base/Neutral/Acid Extractables	G, TFE Lined Cap	Cool, 4°C	14 days until extraction, 40 days after	150 g

TABLE 6-5

PRESERVATION SUMMARY FOR SOLID MATRICES
(continued)

Parameter	Container[1]	Preservative[2]	Recommended Holding Time[3]	Amount Required
Polynuclear Aromatic Hydrocarbons	G, TFE Lined Cap	Cool, 4°C	14 days until extraction, 40 days after	150 g
Pesticides/PCB's, Herbicides	G, TFE Lined Cap	Cool, 4°C	14 days until extraction, 40 days after	150 g
Volatile Organics	G, TFE Lined Cap	Cool, 4°C	14 days	150 g

NOTES

1. P = polyethylene, G = glass.

2. Preservative should be contained in the containers as sample is added or added to the sample immediately. Each aliquot of composite samples should be preserved at collection, if possible. Automatic compositing samplers should be maintained at 4°C until preservation can be performed.

3. Holding times listed are maximum recommended times for each particular preparation or analysis; therefore, every effort will be made to analyze/prepare the samples as soon as possible after sampling.

6.9 Reagent and Standard Storage

Reagents and standards maintained for field use will be stored in the laboratory in appropriate cabinets, refrigerators, or designated areas along with routine laboratory reagents and standards. Reagents and standards maintained for field use will be clearly labelled as such. Table 6-6 summarizes the storage method for each reagent and standard maintained by the laboratory for field use.

Sample containers containing preservative are not stored at the laboratory. Preservative is added to sample containers immediately prior to field activities. When shipping containers, the preservatives are included in separate containers in concentrations consistent with federal regulations.

TABLE 6-6

STANDARD AND REAGENT STORAGE

Chemical	Method of Storage
Nitric, Hydrochloric and Sulfuric Acids	Original Containers, Acid Safety Cabinet, Segregated by Acid Type
Isopropanol	Original Containers, Solvent Safety Cabinet in Volatiles Lab
Analyte-Free Water	Acquired from Laboratory System Prior to Use
pH Standards	Laboratory Reagent Cabinet in Wet Lab
Conductivity Standards	Laboratory Reagent Cabinet in Wet Lab
Chlorine Test Reagents	Refrigerator in Wet Lab
Assorted Dry Chemicals and Aqueous Solutions	Laboratory Reagent Cabinet in Wet Lab

6.10 Waste Disposal

Quanterra Tampa maintains a waste disposal program that is followed both in the field and at the laboratory. The field disposal program is designed to safely and legally dispose of contaminated sample material and any introduced solvents, cleaning solutions or reagents associated with the sampling procedures. The program requires that all wastes be segregated in terms of water solubility, evaporative solvents, and sample waste.

6.10.1 Solvent Waste Disposal

Solvents used in the decontamination process (isopropanol and acetone) are collected in an open bucket. All wastes are drummed and disposed of consistent with the waste characterization. Any remaining solvent is to be carried back to the lab and containerized with the flammable waste solvents for disposal by a commercial disposal company.

All other solvents used at a sampling site are segregated and containerized according to flammability and chlorination. These containers are transported to the lab where they are emptied into the appropriate waste solvent drums. These drums are then available for disposal by a commercial disposal company as described in Section 8.5.1.

6.10.2 Aqueous Waste Disposal

Aqueous based waste generated in the field is containerized and transported back to the laboratory for proper disposal as outlined in Section 8.5.2.

6.10.3 Other Waste Disposal

All other items considered contaminated, such as gloves, disposable equipment, toweling, etc., should be segregated, containerized and tagged with sampling site and date. These wastes will be transported to the laboratory for further segregation (if necessary) and proper disposal as described in Section 8.5.3.

7.0 Sample Custody

7.1 Sample Custody Objectives

A sample is physical evidence collected from a site or from the environment. As such, a sample must be documented in a manner which provides all information necessary for proper analysis and legal defense of sample results. Legal sample custody is defined as maintaining the sample in one of the following situations: 1) In the actual possession of the sampler or transferee. 2) In the view of the person having possession. 3) Secured by the sampler or transferee in such a way that the sample cannot be tampered with. Documentation (chain-of-custody) begins when sample containers are prepared and submitted to the client and continues through sample analysis, reporting and disposal. Legal chain-of-custody procedures which are used by Quanterra Tampa for all sampling events are described in the following sections.

7.1.1 Legal Chain-of-Custody Procedures

Legal chain-of-custody documentation is necessary to track the possession of each sample from collection through analysis. To be legally defensible, this documentation should always be done using waterproof ink. Any corrections required on all laboratory and field records will be made by drawing a single line through the error and initialing and dating the correction.

The chain-of-custody procedure begins when pre-cleaned, appropriately preserved bottles are prepared by the laboratory for transport to sampling sites. The bottle record/sampling instructions form and chain-of-custody form are completed by the Sample Custodian and indicate that the laboratory has relinquished clean sample containers to the sampler.

Field personnel are responsible for maintaining a continuous legal chain-of-custody throughout the sampling process. This includes keeping containers secured and sealed at all times and documenting all activities on the chain-of-custody form and in the field notebook. Samples must be submitted to the laboratory under the supervision of the field sampler or by a courier with seals maintaining the integrity of the sample set.

Samples submitted to the Laboratory are accompanied by the chain-of-custody form. This form is completed and sealed within the sample transport container to be opened and examined by the laboratory Sample Custodian. All entries on the chain-of-custody form must coincide with the corresponding sample labels. Additionally, a sample receipt form is completed for each sample shipment. If discrepancies are noted by the Sample Custodian, the client or sampler must be contacted to resolve any conflicting information.

All pertinent sample custody forms are reviewed by the Project Manager and maintained until completion of the project, at which time a copy of each is included in the final analytical report. The Sample Custodian logs-in the samples using a sample receiving logbook as well as an electronic data system (described in Section 12) which generates laboratory bench sheets. Each sample which is logged into the laboratory is given a unique identification number and placed in labelled storage areas. Samples removed from these storage areas are tracked by way of a sample custody logbook. Other methods of internal chain-of-custody include bench worksheets and preparation and instrument logbooks. Periodically, expired samples are purged and disposed of using waste disposal procedures described in Section 8.5. This purging is also documented in the sample receiving logbook.

7.1.2 Sample Custody Forms

Quanterra Tampa and client sampling teams are provided with the following forms which are used in the sample documentation process and to ensure sample integrity. An example of each of the following forms is presented in Figures 7-1 to 7-8 at the end of this section.

a) Sample Labels (Figure 7-1):
Laboratory sample labels are used to ensure proper identification and management of collected samples. These gummed labels are completed and affixed to each sample container at the time of collection. Entries on the sample label include field sample identification designation, sampling location, date and time of collection, sampler name, and additional pertinent field information. These labels may be commercially (by container vendors) or privately printed.

b) Sample Seals (Figure 7-2):
Laboratory sample seals are used to detect unauthorized tampering of samples prior to laboratory acceptance. Sample Seals are affixed to the sample transport containers and/or sample containers in a manner that requires seal breakage in order to access the contents of the containers. Unauthorized seal breakage indicates possible tampering and renders a sample or the transport container of samples suspect.

c) Sampling Instructions Form (Figure 7-3):
This form is used to provide a record of all containers sent for a specific site. The itemized list provides information regarding type and size of container, expected matrix of samples, containers needed per sample, the method, holding time and preservative needed for each sample. There is also space provided for the transport containers being used to be identified. On the reverse of this form are general sampling instructions and notifications.

d) Chain-of-Custody Form (Figure 7-4):
This multi-copy form, pre-printed with Quanterra Tampa's name, address and phone number, provides space for signatures and titles of all persons involved in the chain-of-custody (beginning with container receipt) to be entered with the corresponding date and time of possession. Other pertinent information includes client identification, project identification or sampling location, field sample identification and description, date and time of sample collection, sample container amounts, required analyses, sample preservation information and any relevant comments. A copy of this completed form is included in all analytical results summary packages.

e) Sample Receipt Form (Figure 7-5):
This checklist is used to record the type of shipping container and the completeness of paperwork associated with the samples. This checklist also records condition and preservation of samples, completeness of labels, adequacy of remaining holding time and the appropriateness of preservation techniques used. The action taken to resolve any discrepancies is noted on this form as well. A copy of this completed form is included in all analytical result summary packages.

f) Sample Receiving Logbook (Figure 7-6a):
This logbook provides a legally bound consecutive reference of all sample lots received by the laboratory. Information contained in the logbook consists of identification numbers, analyses requested, sample matrix, client name and site and number of bottles received. This logbook is also used to document the disposal of samples, by stamping the original logsheet with "Samples Disposed Of" (Figure 7-6b)

g) Sample Custody Logbook (Figure 7-7):
The sample custody logbook is used by those lab personnel who prepare samples for analyses. When a sample is removed from its storage area, the analyst/technician enters the sample I.D., time and initials. When a sample is returned, consumed or disposed of the proper notation with time, date and initials is documented as well.

h) Laboratory Analytical Request Form (Figure 7-8):
The laboratory analytical request form is used in addition to the chain-of-custody form when sending either samples or extracts to another facility for preparation or analysis. This form provides spaces to record sampling time and date; field identification number; laboratory identification number; any sample preparation procedures which have been performed and the date and time performed; and the specific matrix and analyses which are being requested. Distinct forms are used for transfers that are internal to Quanterra (Figure 7-8a) or external to the Quanterra network (Figure 7-8b).

7.2 Field Custody

Data relating to field sampling operations is recorded on the appropriate sample custody forms, including sample labels, sample seals, and chain-of-custodies as well as being kept in the field sample notebook. The field personnel are responsible for receiving the sampling containers from the sample custodian and documenting possession of them throughout the sampling process.

The specific methods for the various forms of documentation are outlined above in section 7.1.2. The protocol which designates how these forms and documents create a continuous, traceable flow of information is as follows. Sample containers are received from the lab with labels specifying the project name, analysis, and any preservative already in the container. The sampler is responsible for assigning a unique identification number to each site sampled and placing that number on all sample container labels from that site. The number may be referenced from a project map and should be clearly identified in the field sampling notebook. This number or designation will be used on the chain-of-custody and sample seals (if applicable). The laboratory identification number (see Section 7.3.1) will reference the field sample identification number on all bench worksheets and reports. By utilizing the field sample notebook and corresponding chain-of-custody for a sampling event, a continuous flow of secure custody and relevant information can be maintained.

7.2.1 Field Sample Notebook

Data from all samples taken by field personnel is entered in a hard-cover, permanently-bound field sample notebook consisting of consecutively-numbered 8 1/2" x 11" pages. The field sample notebook contains entries which document pertinent field data for each sample collected, including:

Client
Name and address of field client
Project or sampling Location
Exact location of each sample collection point
Sampling methodology and equipment, including purging/preparatory equipment and ID#s
Order of sample collection
Analytical parameters for each sample
Process generating sample (as applicable)
Date and time of sample collection
Description of field conditions (such as weather, etc.)
Field sample identification or designation
Field observations and/or measurements
Quality control samples collected
References such as maps, sketches, photographs
Preservation and transport descriptions, including pH (if checked) and any additional preservatives
Name and signature of sample collector
List of visitors or personnel on site during sampling
Information necessary to describe and retrace any unique field sampling procedure
Any field decontamination procedures performed

In addition to the information above, site and sample type specific information will also be entered into the field sampling notebook. This information is outlined in each sampling protocol (see Section 6.7) and includes things like calculations of well volumes, flow rates for in-place plumbing and moving surface waters, type of plumbing, if known, depth of sampling and purging volumes, times and stabilization parameter results.

Field sampling notebooks are maintained chronologically by a designated laboratory records clerk for a minimum period of five years upon completion of a project. By referencing sampling dates, all records associated with a particular sampling event may be compiled and referenced.

7.2.2 Sample Transport

The protocols and documentation associated with transport of sample kits and/or samples have been described in Section 6.5.

7.3 Laboratory Custody

Evidentiary documentation procedures are utilized by the laboratory in a manner which is continuous with field sampling and subsequent sample submittal to the laboratory. These documentation procedures are continued through analysis, reporting, and disposal of all samples as outlined in the following sections.

7.3.1 Sample Receipt Documentation

The laboratory Sample Custodian (Section 4.2.7) receives and documents all samples submitted to the laboratory. This person examines the condition, preservation, and accompanying documentation of all submitted samples prior to approval and formal acceptance by the laboratory. Any sample, preservation, or documentation discrepancies (i.e. broken container, improper or inadequate preservation, inadequate sample volume, inadequate sample documentation, etc.) must be resolved in coordination with the submitting party and laboratory project manager before formal acceptance is executed. All required acceptance data is then recorded and documented in the laboratory sample receiving log and laboratory computerized data management system. In addition, a cooler receipt form is filled out for each container in which samples were received which details pertinent information regarding the condition of the samples upon receipt. A copy of the cooler receipt form is included with the final report submitted to the client. Upon completion of sample documentation, the sample custodian assigns a unique laboratory tracking number and storage location identification to the sample. The laboratory computerized data management system generates laboratory bench worksheets, project summary sheets and pre-gummed sample identification labels. These labels contain the sample identification number, client identification, and storage location among other things and are placed on all sample containers for each unique site. The samples are then placed in the secure sample storage area. The laboratory tracking number is used by the laboratory computerized data management system and laboratory analysts to reference documentation of preparation, analysis and reporting information pertaining to that particular sample in the various laboratory operations logbooks.

A laboratory project manager is assigned to each project, or batch of samples entered into the sample receiving logbook and laboratory data management system. Upon completion of duties by the sample custodian, the laboratory project manager verifies interpretation of custody forms and subsequent data entry by comparing a computer-generated analysis summary form with sample custody papers. At this point, any discrepancies which were documented by the sample custodian are investigated by the project manager and brought to the attention of the submitting party. Upon completion of analysis, sample results and the associated data entry are likewise reviewed and acted upon by the project manager.

7.3.2 Laboratory Bench Worksheets

All paperwork generated by the Sample Custodian via the laboratory data management system contains similar information. The laboratory bench worksheets (examples given in Figures 7-9 through 7-12) contain information such as sampling date, field identification number, number of containers for that site, all storage locations, the client name and the laboratory Project Manager's name. There are places on these worksheets for the analyst/technician to write preparation data (including dates and initials), and analytical results (including dates, initials and instrument run numbers if appropriate). The Sample Custodian places these worksheets in a convenient location to alert analysts of new "in-house" samples. Worksheets for rush turnaround or minimum holding time projects are hand delivered by the Sample Custodian to the appropriate analyst.

7.3.3 Laboratory Operations Logbook

Data generated from the preparation, analysis and reporting of each sample is documented in the appropriate logbook pertaining to each procedure performed in the laboratory. Laboratory logbook entries include the identification of the person performing the procedure, the date it was performed and a detailed description of the procedure itself. Sample results are also included in the laboratory logbook. The laboratory tracking number assigned to each sample is used for documenting all laboratory procedures in the laboratory logbook. Examples of each laboratory logbook used by the laboratory are included in Figures 7-13 through 7-18.

7.3.4 Sample Storage Documentation

Sample storage location is documented by assigning specific locations to each sample. The sample storage location is entered into the laboratory computerized data management system and subsequently appears on all documentation associated with the sample (i.e. laboratory tracking number sample label, laboratory analysis worksheets, project management and tracking documents, etc.). Each sample is required to be returned to the storage location indicated on the sample tracking number label upon completion of lab procedures. The sample custodian is responsible for managing compliance with storage location requirements.

The Sample Custodian places all samples in their designated storage areas. These areas are separate from standards, extracts and reagents and are segregated according to the different types of tests for which they are being submitted. More specifically, the volatile organics analysis samples are stored in a separate VOA refrigerator with access by VOA analysts. Likewise, samples for metals analysis are stored in a central storage room (room temperature) while all other samples are stored in a secure walk-in cooler (4-6^{0}C). A sample custody log is maintained as described in Section 7.1.2.g and Figure 7-7.

The laboratory sample tracking number label applied to each sample is color-coded according to date of sample receipt. This allows samples to be purged from storage location for disposal in a systematic manner. Upon expiration of appropriate holding and storage times, samples are staged for disposal. The staging procedure consists of purging storage locations of samples bearing the appropriate color-coded sample tracking number label indicating expiration of necessary storage time. Once verification of project completion and storage time expiration has been made, samples are properly disposed. Typically, all samples are held for a minimum of 30 days after the final analytical report has been sent to the client. Sample disposal is documented in the laboratory waste disposal logbook.

Extract and digestate disposal is handled by each individual analytical group. These extracts/digestates are maintained for 30 days after final reporting and then disposed of properly. Specifics of the waste disposal program are described in Section 8.4.

7.3.5 Inter-Laboratory Sample Shipment

It is necessary at times to ship samples and/or sample extracts to another laboratory for analysis. Typical situations requiring shipment of samples to a third-party include meeting required turnaround or holding times, parameters not handled in-house, instrument malfunction, etc. Documentation of sample custody for inter-laboratory shipments include chain-of-custody and laboratory sample analysis request form (see Section 7.1.2.h and Figure 7-8).

7.3.6 Reporting of Sample Results

Evidence of sample custody documentation is included with the final analytical reports submitted to the client. All reports include a copy of the chain-of-custody and the cooler receipt form, and a copy of any other pertinent sample documentation such as field logs, shipping papers, sample seals, etc. The original chain-of-custody form and cooler receipt form are maintained with associated laboratory records. Lack of compliance with appropriate documentation requirements is addressed in a quality control narrative appended to the final report. Also, any documented discrepancy associated with sampling, sample transport, laboratory acceptance, sample storage or sample analysis is addressed in a quality control narrative appended to the final report. A sample final report is discussed in Section 12.3 and Figures 12-1 through 12-22.

FIGURE 7-1

SAMPLE CONTAINER LABEL

Client	Date
Site	Time
Sample I.D.	Collected By
Analysis	
Sampling Type _____ Grab _____ Composite _____ Other	
Preservative _____ HNO_3 _____ H_2SO_4 _____ N_aOH _____ HCL _____ OTHER	

FIGURE 7-2

LABORATORY SAMPLE SEAL

Quanterra Environmental Services

№ 036524

Custody Seal

DATE

SIGNATURE

Quanterra Environmental Services

№ 036524

FIGURE 7-3

SAMPLING KIT INSTRUCTION FORM

Sample Kit
Instruction Form

Quote /Sar #: Rev#:1-00

If coolers or bottles are missing or broken , please notify laboratory immediately:

Quanterra Environmental Services
5910 Breckenridge Parkway Suite H
Tampa, Florida 33610 (813)621-0784

PROJECT NAME/#:

Requested by:

Number	Matrix	# of container	Type	Method	Hold time	Preserv.

Temperature blanks have been included in each shipping container. Please do not remove
Custody seals have been provided which may be used to seal the shipping
container during transport between the sampler and the laboratory.
Exercise care when handling caustic or corrosive preservative and pre-preserved bottles.
Do not rinse pre-preserved bottles with sample.

B/LOT#	
40ML PRE.	
40ml	
500ml	
liter P	
liter A	
4oz	
8oz	
16oz	

Preservative Lot#	Dilute	Conc.
HCl		
H2SO4		
HNO3		
NaOH		
Other		

PREPARED BY: Verified by:

Comments:

FIGURE 7-4

CHAIN-OF-CUSTODY FORM

Interlaboratory Chain of Custody

BRECKENRIDGE PKWY., STE. H
TAMPA, FL 33610
PHONE (813) 621-0784 FAX (813) 623 6021

Quanterra Environmental Services

CLIENT CODE _____
QUOTE / SAR NUMBER _____.
Chain-of Custody Record

82766

PROJ. NO.	PROJECT NAME/LOCATION
SAMPLERS: *(Signature)*	

STA. NO.	DATE	TIME	COMP.	GRAB.	STATION LOCATION	NO. OF CONTAINERS	PARAMETER						REMARKS

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	

Distribution Original Accompanies Shipment. Copy returned with Report.

FORM 004

FIGURE 7-5

SAMPLE RECEIPT FORM

Quanterra Environmental Services, Tampa
Sample Shipper Evaluation and Receipt Form

Client _____ Project Name/Number: _____

Samples Received by: _____ Date Received: _____
Signature

Sample Evaluation
Form by: _____
Signature

Type of shipping containers samples received in:

Quanterra cooler: _____ Client cooler: _____

Quanterra shipper _____ Box _____ Other _____

Any "NO" responses or discrepancies should be explained in the "Comments" section.

		Yes	No
1)	Were custody seals on shipping container(s) intact?	_____	_____
2)	Were custody papers properly included with samples?	_____	_____
3)	Were custody papers properly filled out (ink, signed, match labels)?	_____	_____
4)	Did all bottles arrive in good condition (unbroken)?	_____	_____
5)	Were all bottle labels complete (sample no., date, signed, analysis preservatives)?	_____	_____
6)	Were correct bottles used for the tests indicated?	_____	_____
7)	Were proper sample preservativion techniques indicated?	_____	_____
8)	Were samples received within adequate holding times?	_____	_____
9)	Were all VOA bottles checked for the presence of air bubbles? (If air bubbles were found, indicate in comment section)	_____	_____
10)	Were samples in direct contact with wet ice? NOTE TEMPERATURE BELOW	_____	_____
11)	Were samples accepted into the laboratory? (If "No", see comments)	_____	_____

Cooler # _____ Temp ____ C Cooler # _____ Temp. ____

Comments: _____

FIGURE 7-6A

SAMPLE RECEIVING LOGBOOK

```
                                                                                                  Run Date:  9/21/95
                                   QUANTERRA ENVIRONMENTAL LABORATORIES, INC.                     Time:  8:17:08
                                              SAMPLE RECEIVING LOG SHEET
Page  172                                        TAMPA

                                                                INITIALS: MCN  RECEIVING DATE:  9/12/95 DATE REPORTED OUT:_______
B-51120114-
        003   MATRIX: WATER                DUE DATE:  9/19/95   STORAGE LOCATION: vf w
              SAMPLE ID: MW-3
              COMMENTS:
    (0000-00000)
              ANALYSIS: XX-I-15-EV-96(GC8020_L) XX-I-54-DB-96(TRPHIR  )

                                                                INITIALS: FAS  RECEIVING DATE:  9/12/95 DATE REPORTED OUT:_______
B-51120115-
        001   MATRIX: WATER                DUE DATE:  9/19/95   STORAGE LOCATION: vf w
              SAMPLE ID: MW-8
              COMMENTS:
    (0000-00000)
              ANALYSIS: XX-I-15-EV-96(GC8020_L) XX-I-54-DB-96(TRPHIR  )

                                                                INITIALS: MCN  RECEIVING DATE:  9/12/95 DATE REPORTED OUT:_______
B-51120116-
        001   MATRIX: WATER                DUE DATE:  9/26/95   STORAGE LOCATION: w
              SAMPLE ID: 67225  MW2
              COMMENTS:
    (0000-00000)
              ANALYSIS: XX-I-54-DB-14(TRPHIR  )

        002   MATRIX: WATER                DUE DATE:  9/26/95   STORAGE LOCATION: w
              SAMPLE ID: 67225  MW3
              COMMENTS:
    (0000-00000)
              ANALYSIS: XX-I-54-DB-14(TRPHIR  )

        003   MATRIX: WATER                DUE DATE:  9/26/95   STORAGE LOCATION: w
              SAMPLE ID: 67226-01 OIL SEPARATOR
              COMMENTS:
    (0000-00000)
              ANALYSIS: XX-I-54-DB-14(TRPHIR  )

                                                                INITIALS: FER  RECEIVING DATE:  9/12/95 DATE REPORTED OUT:_______
B-51120117-
        001   MATRIX: WATER                DUE DATE:  9/27/95   STORAGE LOCATION: vf e
              SAMPLE ID: 106-MW-02
              COMMENTS: exp. del.,pest/pcb's and herb's must be
    (0000-00000)
              ANALYSIS: XX-I-10-EZ-36(GC8080_L) XX-I-15-AF-36(MS8260_L) XX-I-88-ZZ-01(ARCHIVE )

        002   MATRIX: WATER                DUE DATE:  9/27/95   STORAGE LOCATION: w d
              SAMPLE ID: 106-MW-02
              COMMENTS: exp. del.,pest/pcb's and herb's must be
    (0000-00000)
              ANALYSIS: AG-I-04-DQ-36(M6010_L ) AL-I-04-DQ-36(M6010_L ) AS-I-04-JH-36(MT6010_L) BA-I-04-DQ-36(M6010_L )
                        BE-I-04-DQ-36(M6010_L ) CA-I-04-DQ-36(M6010_L ) CD-I-04-DQ-36(M6010_L ) CO-I-04-DQ-36(M6010_L )
                        CR-I-04-DQ-36(M6010_L ) CU-I-04-DQ-36(M6010_L ) FE-I-04-DQ-36(M6010_L ) HG-I-19-EH-36(M7470_L )
                        KX-I-04-DQ-36(M6010_L ) MG-I-04-DQ-36(M6010_L ) MN-I-04-DQ-36(M6010_L ) NA-I-04-DQ-36(M6010_L )
                        NI-I-04-DQ-36(M6010_L ) PB-I-04-JH-36(MT6010_L) SB-I-04-JH-36(MT6010_L) SE-I-04-JH-36(MT6010_L)
                        TL-I-05-QY-36(M7841_L ) VX-I-04-DQ-36(M6010_L ) XX-I-06-RV-36(CN_LIQ  ) ZN-I-04-DQ-36(M6010_L )
```

FIGURE 7-6B

SAMPLE RECEIVING LOGBOOK
(Showing sample disposal record)

```
RSR080                                   SAMPLE RECEIVING LOG SHEET                                  Ti
Page  301
                                         Tampa

                                                                INITIALS: COR  RECEIVING DATE:  4/25/95 DATE REPORTED OUT:_____
B-50260023-      04677
        007   MATRIX: WATER   SURFACE    DUE DATE:  5/09/95    STORAGE LOCATION: UST
              SAMPLE ID: EQUIP BLANK  4255
              COMMENTS:
    (4816-14712)
               ANALYSIS: XX-I-15-DL-01(GC/DCL )
                                                   SAMPLES
                                                   JUL 11 1995
                                                   DISPOSED OF
                                                                INITIALS: MCN  RECEIVING DATE:  4/25/95 DATE REPORTED OUT:_____
B-50260033-
        001   MATRIX: WATER   SURFACE    DUE DATE:  5/08/95    STORAGE LOCATION: D W
              SAMPLE ID: SI-1
              COMMENTS:
    (4826-14727)
               ANALYSIS: AG-I-05-AS-01(METALS  ) AS-I-05-JI-01(METALS  ) BA-I-05-AS-01(METALS  ) CA-I-05-AS-01(METALS  )
                         CD-I-05-AS-01(METALS  ) CR-I-05-AS-01(METALS  ) CU-I-05-AS-01(METALS  ) FE-I-05-AS-01(METALS  )
                         HG-I-23-BL-01(METALS  ) KX-I-05-AS-01(METALS  ) MG-I-05-AS-01(METALS  ) MN-I-05-AS-01(METALS  )
                         NA-I-05-AS-01(METALS  ) NI-I-05-AS-01(METALS  ) PB-I-05-JI-01(METALS  ) SE-I-05-JI-01(METALS  )
                         XX-I-88-CX-01(IONCHRCL) XX-I-88-CY-01(IONCHRSU) ZN-I-05-JI-01(METALS  )

        001-S MATRIX: WATER   SURFACE    DUE DATE:  5/08/95    STORAGE LOCATION: D W
              SAMPLE ID: SI-1
              COMMENTS:
    (4826-14727)
               ANALYSIS: AG-I-05-AS-01(METALS  ) AS-I-05-JI-01(METALS  ) BA-I-05-AS-01(METALS  ) CA-I-05-AS-01(METALS  )
                         CD-I-05-AS-01(METALS  ) CR-I-05-AS-01(METALS  ) CU-I-05-AS-01(METALS  ) FE-I-05-AS-01(METALS  )
                         KX-I-05-AS-01(METALS  ) MG-I-05-AS-01(METALS  ) MN-I-05-AS-01(METALS  ) NA-I-05-AS-01(METALS  )
                         NI-I-05-AS-01(METALS  ) PB-I-05-JI-01(METALS  ) SE-I-05-JI-01(METALS  ) ZN-I-05-JI-01(METALS  )

        002   MATRIX: WATER   SURFACE    DUE DATE:  5/08/95    STORAGE LOCATION: D W
              SAMPLE ID: SI-2
              COMMENTS:
    (4826-14731)
               ANALYSIS: AG-I-05-AS-01(METALS  ) AS-I-05-JI-01(METALS  ) BA-I-05-AS-01(METALS  ) CA-I-05-AS-01(METALS  )
                         CD-I-05-AS-01(METALS  ) CR-I-05-AS-01(METALS  ) CU-I-05-AS-01(METALS  ) FE-I-05-AS-01(METALS  )
                         HG-I-23-BL-01(METALS  ) KX-I-05-AS-01(METALS  ) MG-I-05-AS-01(METALS  ) MN-I-05-AS-01(METALS  )
                         NA-I-05-AS-01(METALS  ) NI-I-05-AS-01(METALS  ) PB-I-05-JI-01(METALS  ) SE-I-05-JI-01(METALS  )
                         XX-I-88-CX-01(IONCHRCL) XX-I-88-CY-01(IONCHRSU) ZN-I-05-JI-01(METALS  )

        003   MATRIX: WATER   SURFACE    DUE DATE:  5/08/95    STORAGE LOCATION: D W
              SAMPLE ID: SI-3
              COMMENTS:
    (4826-14736)
               ANALYSIS: AG-I-05-AS-01(METALS  ) AS-I-05-JI-01(METALS  ) BA-I-05-AS-01(METALS  ) CA-I-05-AS-01(METALS  )
                         CD-I-05-AS-01(METALS  ) CR-I-05-AS-01(METALS  ) CU-I-05-AS-01(METALS  ) FE-I-05-AS-01(METALS  )
                         HG-I-23-BL-01(METALS  ) KX-I-05-AS-01(METALS  ) MG-I-05-AS-01(METALS  ) MN-I-05-AS-01(METALS  )
                         NA-I-05-AS-01(METALS  ) NI-I-05-AS-01(METALS  ) PB-I-05-JI-01(METALS  ) SE-I-05-JI-01(METALS  )
                         XX-I-88-CX-01(IONCHRCL) XX-I-88-CY-01(IONCHRSU) ZN-I-05-JI-01(METALS  )

                                                                INITIALS: MCN  RECEIVING DATE:  4/25/95 DATE REPORTED OUT:_____
B-50260053-
        001   MATRIX: WATER   SURFACE    DUE DATE:  5/09/95    STORAGE LOCATION: W D
              SAMPLE ID: PNG-1
              COMMENTS:
    (4845-14781)
               ANALYSIS: XX-I-88-CX-01(IONCHRCL) XX-I-88-CY-01(IONCHRSU) XX-I-05-DQ-01(METALS  ) NA-I-05-DQ-01(METALS  )
```

FIGURE 7-7

SAMPLE CUSTODY LOGBOOK

QUANTERRA ENVIRONMENTAL SERVICES, TAMPA
SAMPLE CUSTODY LOG

DATE	TIME	SAMPLE I.D.	AMOUNT TAKEN	BY	RETURNED DATE	RETURNED TIME	AMT.	BY

FIGURE 7-8A

SAMPLE ANALYSIS REQUISITION (INTERNAL)

LABORATORY: 09 QUANTERRA - TAMPA
5307 Industrial Oaks Blvd Suite 160
Austin , TX 78735

NEED ANALYTICAL REPORT BY 10/10/95

ATTN: Jon Bartell

LAB PURCHASE ORDER: SR005916

CLIENT CODE: 111931 PROJECT MANAGER: James E. Refermat

NUMBER OF SAMPLES IN LOT: 0000

SAMPLE I.D.	SAMPLING DATE	ANALYSIS REQUIRED
B5J040160-001 C1AQ0-1-04	10/03/95	Halocarbons, Extractable Organic (450.1 APP D) (TOX) METHOD: 450.1 APP D
B5J040160-002 C1AQ2-1-04	10/03/95	Halocarbons, Extractable Organic (450.1 APP D) (TOX) METHOD: 450.1 APP D
B5J040160-003 C1AQ4-1-04	10/03/95	Halocarbons, Extractable Organic (450.1 APP D) (TOX) METHOD: 450.1 APP D

NEED DETECTION LIMIT AND ANALYSIS DATE INCLUDED IN REPORT.

SHIPPING METHOD: DATE: 10/04/95

SEND REPORT TO:

SAMPLE RECEIVED BY: _____ DATE: _____

PLEASE SEND A SIGNED COPY OF THIS FORM WITH REPORT AT COMPLETION OF ANALYSIS.

THANK YOU.

QUANTERRA - TAMPA

INT: _____ 10/04/95 14:59:25

Quanterra Incorporated
5307 Industrial Oaks Blvd Suite 160
Austin TX 78735

RELINQUISHED BY: Carol McKulty DATE/TIME: 10/4/95 1730

RELINQUISHED BY: _____ DATE/TIME: _____

RECEIVED FOR LAB BY: _____ DATE/TIME: _____

PLEASE RETURN ORIGINAL SAMPLE ANALYSIS REQUISITION

FIGURE 7-8B

SAMPLE ANALYSIS REQUISITION (EXTERNAL)

Quanterra
Environmental Services

Quanterra Incorporated
[illegible] Bee Ridge Parkway, Suite [illegible]
Lakewood Ranch, [illegible]

[illegible] Telephone
[illegible] Fax

TO: _____

FLORIDA TRACKING NUMBER	CLIENT SAMPLE ID	DATE SAMPLED	(FAX) ANALYTICAL DUE DATE	(HARD COPY) REPORT DUE DATE	NUMBER OF CONTAINERS	PARAMETERS

ADDITIONAL COMMENTS:	RELINQUISHED BY/COMPANY	ACCEPTED BY/COMPANY	DATE	TIME

C:\WP51\FORMS\SAMPLERE\FORM1

FIGURE 7-9

LABORATORY BENCH WORKSHEET
GC Volatiles

PSL231 QUANTERRA - DAFA Run Date: 10/11/1995
GC VOLATILE ANALYSIS WORKSHEET Time: 8:22
User ID.: MONOLTVC

REVIEW DATE/BY: _____
WORK ORDER: C1CEL-1-02_____
QUOTE #: 5227
LAB NUMBER: 25J060120-001

CLIENT CODE: 106171
PROJECT MANAGER: Jeff Graham
SITE: Houston -
AMT. REC'D: 3voas 2ltrs
SAMPLE ID: INFLUENT
GC PACKAGE: Routine Report
GC PROGRAM: STANDARD TEST SET
ANALYSIS CODE: XX-I-15-GK-01 GC601_L
WATER, 601, Volatile Organics

STORAGE LOC: vf e

SAMPLING DATE: 10/05/95
RECEIVING DATE: 10/06/95
QC BATCH: 5QGC131

SAMPLE COMMENTS:
as required

ANALYSIS EXP. DATE: 10/19/95

ANALYTICAL DUE DATE: 10/13/95

ANALYSIS COMMENTS:

* * * * * * * * * * * * ANALYSIS/EXTRACTION DATA * * * * * * * * * * * * * * * *

METHOD: 601 LIST: 2301 Q: 40CFR136A Method 601 Standard List
MATRIX: WATER CALIBRATION DATE: _____
EXTRACTION: PURGE AND TRAP - 5 mL purge ID ANALYSIS INSTRUMENT ID: _____
RUN #: _____
UNITS: ug/L As Received DATE: _____
INITIAL: _____ DATE: _____ PH: _____ BY: _____
FINAL: _____ BY: _____ (DL)FACTOR: _____
DRY WEIGHT: _____% COMMENTS: _____

* *

Bromodichloromethane	100	trans-1,3-Dichloropropene. . .	100
Bromoform.	100	Methylene chloride	500
Bromomethane	100	1,1,2,2-Tetrachloroethane. . .	100
Carbon Tetrachloride	100	Tetrachloroethene.	100
Chlorobenzene.	100	1,1,1-Trichloroethane.	100
Chloroethane	100	1,1,2-Trichloroethane.	100
2-Chloroethyl vinyl ether. . .	500	Trichloroethene.	100
Chloroform	100	Trichlorofluoromethane	100
Chloromethane.	100	Vinyl chloride	100
Dibromochloromethane	100	cis-1,2-Dichloroethene	100
1,2-Dichlorobenzene.	100		
1,3-Dichlorobenzene.	100		
1,4-Dichlorobenzene.	100		
Dichlorodifluoromethane. . . .	100		
1,1-Dichloroethane	100		
1,2-Dichloroethane	100		
1,1-Dichloroethene	100		
trans-1,2-Dichloroethene . . .	100		
1,2-Dichloropropane.	100		
cis-1,3-Dichloropropene. . . .	100		

* SURROGATE RECOVERIES *

Bromochloroethane	(073	- 122	) _____
4-Bromofluorobenzene	(070	- 130	) _____

FIGURE 7-10

LABORATORY BENCH WORKSHEET
GC/MS Semi-Volatiles

PSL234 QUANTERRA - TAMPA Run Date: 10/11/1995
GCMS SEMI-VOLATILE ANALYSIS WORKSHEET Time: 8:14
User Id.: MCMULTYC
REVIEW DATE/BY: _____
WORK ORDER: C19H8-1-01
CLIENT CODE: 86753 QUOTE #: 11352
PROJECT MANAGER: James E. Referma LAB NUMBER: PSL0220127-001
SITE: Waste STORAGE LOC: E D W VF
AMT. REC'D: 2xLP/4xLA/3x40ml
SAMPLE ID: Outfall 001
QC PACKAGE: AFCEE DELIVERABLES SAMPLING DATE: 9/26/95
QC PROGRAM: STANDARD TEST SET RECEIVING DATE: 9/28/95
ANALYSIS CODE: XX-I-OT-DP-01 MS625_L WATER, 625, BNA's
SAMPLE COMMENTS:

ANALYTICAL DUE DATE: 10/12/95V

ANALYSIS COMMENTS:
* * * * * * * * * * * * ANALYSIS/EXTRACTION DATA * * * * * * * * * * * * * * * *
METHOD: 625 LIST: 02102 Q: 40CFR136A Method 625 Standard List
MATRIX: WATER EXPIRATION: EXTR ANALYSIS
EXTRACTION: LIQ/LIQ, CONT (B/N/A) - Base-> 10/03/95 11/12/95

TUNE DATE: _____
ANALYSIS: INSTRUMENT ID: _____
INITIAL: _____ CLEANUP: _____ RUN #: _____
FINAL: _____ SPIKE: _____ DATE: _____
SOLVENT: _____ SURROGATE: _____ BY: _____
DATE/BY: ____/____ DRY WT: _____% (DL)FACTOR: _____
COMMENTS: _____ TICS: N
* *
UNITS: ug/L UG/KG % DRY WEIGHT / AS REC'D: As Receive
QC BATCH: S276079

Acenaphthene	10	Chrysene	10
Acenaphthylene	10	Dibenz(a,h)anthracene	10
Anthracene	10	Di-n-butyl phthalate	10
Benzo(a)anthracene	10	1,2-Dichlorobenzene	10
Benzo(a)pyrene	10	1,3-Dichlorobenzene	10
Benzo(b)fluoranthene	10	1,4-Dichlorobenzene	10
Benzo(ghi)perylene	10	3,3'-Dichlorobenzidine	50
Benzo(k)fluoranthene	10	2,4-Dichlorophenol	10
4-Bromophenyl phenyl ether	10	Diethyl phthalate	10
Butyl benzyl phthalate	10	2,4-Dimethylphenol	10
bis(2-Chloroethoxy)methane	10	Dimethyl phthalate	10
bis(2-Chloroethyl) ether	10	2-Methyl-4,6-dinitrophenol	50
bis(2-Chloroisopropyl) ether	10	2,4-Dinitrophenol	50
4-Chloro-3-methylphenol	10	2,4-Dinitrotoluene	10
2-Chloronaphthalene	10	2,6-Dinitrotoluene	10
2-Chlorophenol	10	Di-n-octyl phthalate	10
4-Chlorophenyl phenyl ether	10	bis(2-Ethylhexyl) phthalate	10

* SURROGATE RECOVERIES *

Nitrobenzene-d5	(026	- 131	)	_____
2-Fluorobiphenyl	(027	- 119	)	_____
Terphenyl-d14	(010	- 165	)	_____
2-Fluorophenol	(010	- 116	)	_____
Phenol-d5	(010	- 175	)	_____
2,4,6-Tribromophenol	(010	- 155	)	_____

FIGURE 7-11

LABORATORY BENCH WORKSHEET
Metals

PSLC0300 QUANTERRA INCORPORATED Run Date: 10/11/95
Page 1 CLIENT ANALYSIS SUMMARY Time: 8:19:37
QUANTERRA - TAMPA User Id.: DETARR

CLIENT: 96735 QUOTE/SAR #: 10454
PROJECT MANAGER: Steve Tafuni LAB ID: 3-SL050121-004
PROJECT #: WORK ORDER: C1C12
REPORT TO: RECEIVING DATE: 10/05/95
P.O. NUMBER: SAMPLING DATE: 10/03/95
SITE: SS 5049, 10/95 ANALYTICAL DUE DATE: 10/12/95F
AMOUNT REC'D: 4oz REPORT DUE DATE: 10/16/95
STORAGE LOC: s4 PRIORITY: 07
LOT COMMENTS: 7 DAY TAT WITH PENALITES IF LATE; DATA D SAMPLING TIME:
MATRIX: SOLID RECEIVING TIME: 9:30
SAMPLE ID: B4 (5'-7') SS45049
QC PACKAGE:
SAMPLE COMMENTS:
7day tat w/ penalties if late due by 3pm
Beginning Depth: .00 Ending Depth: .00

***** ANALYSIS *****	WRK LOC	REQUEST DATE	EXTRACTION EXP DATE	ANALYSIS EXP DATE
Inductively Coupled Plasma (6010A)	02	10/05/95	3/31/96	9/27/96
TCLP(1311) -) METALS, TOTAL				
M6010TP PB				
(A-34-00-01) C1C12 Protocol: 3 QC Program: STANDARD TEST SET				
Archive	02	10/05/95	0/00/00	1/10/96
NO SAMPLE PREPARATION PERFORMED / DIRECT INJECTION				
Sampling bailers				
(A-88-ZZ-01) C1C12-1-02 Protocol: D QC Program: STANDARD TEST SET				

FIGURE 7-12

LABORATORY BENCH WORKSHEET
Wet Chemistry

PSL236 QUANTERRA - TAMPA Run Date: 10/11/1995
WET CHEM ANALYSIS Time: 3:21
User Id.: MCNULTYC
REVIEW DATE/BY: _____
_____

* *

WORK ORDER:
CLIENT CODE: 79273 LAB NUMBER: PSI290107-005
PROJECT MANAGER:
SITE:
PROJECT #:
SAMPLE ID: TFG02700
AMOUNT REC"D: 3lt/6voa SAMPLING DATE: 9/25/95
STORAGE LOCATION: vf e w RECEIVING DATE: 9/27/95
ANALYTICAL DUE DATE: 10/11/95W

SAMPLE COMMENTS:
ms/msd required on this lot, diskette required

QC PACKAGE: Routine Report
QC PROGRAM: FL - COMPQAP
MATRIX: WATER

ANALYSIS	WRK. LOC.	REQUEST DATE	ANL/EXTR EXP. DATE	RESULT	UNITS	LDL/ DIL	PREP/ ANALYSIS DATE	INIT/ DCS#
XX-I-54-DB (TRPHIR)	02	9/28/95	0/00/00/ 10/23/95	_____	mg/L	1.0	_____/	_____/
C135E-1-03	As Receive							

FIGURE 7-13

GAS CHROMATOGRAPHY VOLATILE ORGANICS INSTRUMENT LOGBOOK
(Page 1 of 2)

QUANTERRA ENVIRONMENTAL SERVICES, TAMPA
GAS CHROMATOGRAPHY INSTRUMENT LOGBOOK - VOLATILES

Analyst:_____ Batch:_____ Amt.:_____STD:_____ Amt.:_____STD:_____
Instrument:_____ _____ Amt.:_____IS/SS:_____ Amt.:_____IS/SS:_____
Program:_____ _____ Amt.:_____LCS/MS/MSD:_____ Amt.:_____LCS/MS/MSD:_____
Calibration:_____ _____

ALS	Sample ID	Amount Purged	Date	Run # ____/____	List	KRI	Comments

Total Inj_____ STDs_____ Good Inj_____ Instr. RR_____ Dil RR_____ Carry RR_____

FIGURE 7-13

GAS CHROMATOGRAPHY VOLATILE ORGANICS INSTRUMENT LOGBOOK
(Page 2 of 2)

QUANTERRA ENVIRONMENTAL SERVICES, TAMPA
GAS CHROMATOGRAPHY INSTRUMENT LOGBOOK - VOLATILES

Program#_____ Application_____

Column:
Type _____
Length _____ m
I.D. _____ mm
DF _____ um

Flow Rate:
_____ml/min of _____

PID:
Model _____
Temp _____ C
Range/Atenuation _____
Make-up _____ ml/min of _____

HECD:
Model_____
Temp_____ _____ C
Reactor Temp _____ C
Propanol Flow _____ ml/min
_____ml/min of Hydrogen

Autosampler Model_____ Method_____

Purge and Trap:
Trap Type _____
Preheat@_____C_____min
Purge___ __min@ ___C
Dry purge __min@ ___C
Preheat__ _____ ___C
Desorb__ __min@ ___C
Bake____ __min@ ___C

Temp Program:
Inital Temp_____ C Hold____ min
Ramp@_____ C/min to _____ C Hold____ min
Ramp@_____ C/min to _____ C Hold____ min
Ramp@_____ C/min to _____ C Hold____ min
Ramp@_____ C/min to _____ C Hold____ min

Total run time_____min

Program#_____ Application_____

Column:
Type _____
Length _____ m
I.D. _____ mm
DF _____ um

Flow Rate:
_____ml/min of _____

PID:
Model _____
Temp _____ C
Range/Atenuation _____
Make-up _____ ml/min of _____

HECD:
Model_____
Temp_____ _____ C
Reactor Temp _____ C
Propanol Flow _____ ml/min
_____ml/min of Hydrogen

Autosampler Model_____ Method_____

Purge and Trap:
Trap Type _____
Preheat@_____C_____min
Purge___ __min@ ___C
Dry purge __min@ ___C
Preheat__ _____ ___C
Desorb__ __min@ ___C
Bake____ __min@ ___C

Temp Program:
Inital Temp_____ C Hold____ min
Ramp@_____ C/min to _____ C Hold____ min
Ramp@_____ C/min to _____ C Hold____ min
Ramp@_____ C/min to _____ C Hold____ min
Ramp@_____ C/min to _____ C Hold____ min

Total run time_____min

FIGURE 7-14

GC/MS INSTRUMENT LOGBOOK

QUANTERRA ENVIRONMENTAL SERVICES, TAMPA
GC/MS INSTRUMENT LOG

Analyst(s) _____ Date _____

MSA/ MSB/ MSC Tune file (for 70's only) _____

VOA #1 / VOA #2 / VOA #3

Sequence - Batch on Chem Server _____

IS/SS# _____ IS# _____ SS# _____

ALS POS	Lab I.D., Std. #, etc.	Client Code	Data File	Dil	Misc.*	Amt. Inj.	Method (on Chem Server)	Analysis	SOP #	Comments

Additional Information/ Maintenance: _____

*Misc. Codes Reinject = R Reextract = X Screen = S Reinject for Number of Dilutions = D (1,2,3...)

m:\logbooks\msvoa\gcmsinst.xls

FIGURE 7-15

ORGANIC EXTRACTIONS LOGBOOK

QUANTERRA ENVIRONMENTAL SERVICES, TAMPA
BNA/PAH/HPLC EXTRACTIONS LOGBOOK

Prep Date: _____ Matrix : Soil / H2O / TCLP / Waste Concentration date: _____

Initials: _____ Initials: _____

Extraction Method: _____

SAMPLE I.D.	WEIGHT/VOLUME		pH						SURROGATE		SPIKE	
	Initial	Final	Initial	Date	Intermed.	Date	Final	Date	Amount	#	Amount	#

Notes:

Solvent	Lot #	Amount

Batch # _____
Time On: _____
Time Off: _____

FIGURE 7-16

DRY WEIGHT LOGBOOK

QUANTERRA ENVIRONMENTAL SERVICES, TAMPA

Sample ID	Dish weight	Final wt. + dish wt	Final wt. - Dish wt	Initial wt. - Dish wt	Final wt./ Initial wt. (g)	% Dry Weight	BATCH # :
							Date entered :
							Analyst :
							Time entered :
							Oven temp. :
							Date removed :
							Analyst :
							Time removed :
							Oven temp. :
							Comments :

FIGURE 7-17

pH LOGBOOK

QUANTERRA ENVIRONMENTAL SERVICES, TAMPA
pH

4 Buffer: STD# _____ EXP. _____
5 Buffer: STD# _____ EXP. _____
7 Buffer STD# _____ EXP. _____
10 Buffer: STD# _____ EXP. _____

QC Batch# _____
Soil SOP LM-WALT-1410
Water SOP LM-WALT-1470

_____ (2 pt. slope) x _____ (3 pt. eff) = _____ 3 pt slope ÷ 59.16 = _____ %

Calibrate MV
4 _____
7 _____
10 _____

Temp= _____

Date/Analyst	Sample ID	SOILS		pH	Comments
		Soil weight	Water vol.		

FIGURE 7-18

TCLP EXTRACTION LOGBOOK

TCLP EXTRACTION LOGSHEET

ANALYST_____

TUMBLER_____

START DATE____/____/____ STOP DATE____/____/____

START TIME____:____:____ AM PM STOP TIME____:____:____ AM PM

LABORATORY I.D._____ANALYSES:METALS____VOA(ZHE)____ORGANICS____

MATRIX:	AQUEOUS (<.5% SOLIDS)	_____	INITIAL WEIGHT	____G____
	AQUEOUS (>.5% SOLIDS)	_____	FINAL EXTRACT VOLUME	____ML
	SOIL/SEDIMENT	_____	ADDITIONAL AQUEOUS VOLUME	____ML
	ORGANIC LIQUID	_____	FINAL PH	____S.U.
	OTHER (SPECIFY)	_____		

EXTRACTION FLUID TYPE: 1 OR 2 POSITION 1 / ZHE EXTRACTOR ____

LABORATORY I.D._____ANALYSES:METALS____VOA(ZHE)____ORGANICS____

MATRIX:	AQUEOUS (<.5% SOLIDS)	_____	INITIAL WEIGHT	____G____
	AQUEOUS (>.5% SOLIDS)	_____	FINAL EXTRACT VOLUME	____ML
	SOIL/SEDIMENT	_____	ADDITIONAL AQUEOUS VOLUME	____ML
	ORGANIC LIQUID	_____	FINAL PH	____S.U.
	OTHER (SPECIFY)	_____		

EXTRACTION FLUID TYPE: 1 OR 2 POSITION 2 / ZHE EXTRACTOR ____

LABORATORY I.D._____ANALYSES:METALS____VOA(ZHE)____ORGANICS____

MATRIX:	AQUEOUS (<.5% SOLIDS)	_____	INITIAL WEIGHT	____G____
	AQUEOUS (>.5% SOLIDS)	_____	FINAL EXTRACT VOLUME	____ML
	SOIL/SEDIMENT	_____	ADDITIONAL AQUEOUS VOLUME	____ML
	ORGANIC LIQUID	_____	FINAL PH	____S.U.
	OTHER (SPECIFY)	_____		

EXTRACTION FLUID TYPE: 1 OR 2 POSITION 3 / ZHE EXTRACTOR ____

LABORATORY I.D._____ANALYSES:METALS____VOA(ZHE)____ORGANICS____

MATRIX:	AQUEOUS (<.5% SOLIDS)	_____	INITIAL WEIGHT	____G____
	AQUEOUS (>.5% SOLIDS)	_____	FINAL EXTRACT VOLUME	____ML
	SOIL/SEDIMENT	_____	ADDITIONAL AQUEOUS VOLUME	____ML
	ORGANIC LIQUID	_____	FINAL PH	____S.U.
	OTHER (SPECIFY)	_____		

EXTRACTION FLUID TYPE: 1 OR 2 POSITION 4 / ZHE EXTRACTOR

COMMENTS:_____

8.0 Analytical Procedures

The laboratory routinely uses only USEPA approved analytical methods and instrumentation. In the absence of USEPA guidance, methods approved by the Florida DEP are used. Analytical methods used by the laboratory for each project are presented in the associated final analytical report. Field methods are limited to pH, conductivity, temperature and dissolved oxygen for which the analytical procedures are described in Section 6.9 and soil gas screening as described below.

8.1 Field Screening Methods Summary

An organic vapor analyzer will be used for soil contamination. Organic vapor readings shall be obtained using a Century OVA 128 portable organic vapor analyzer having a flame ionization detector in the survey mode. The soil sample shall be brought to a temperature of between 20°C and 30°C in a half-filled, 16 ounce mason jar covered with aluminum foil. The headspace shall be sampled five minutes thereafter. The analyzer shall be calibrated in accordance with the manufacturer's instructions.

8.2 Analytical Methods Summary

Methods currently used by Quanterra Tampa are presented in Section 5.2 and 5.3. Where matrices and/or analytes of interest are not included in the FDEP approved methods list, a method validation data package is provided in the referenced appendix as outlined below.

8.2.1 Total Phenols in Soil/Sediment

This method validation was not approved by the FLDEP (8-26-92) and has been removed from the CompQAP.

Appendix A contained the supporting method validation package for analysis of total phenols in a soil/sediment matrix. Appendix A has been repealed.

8.2.2 Alternate Heating Source for Aqueous Metals Digestion

This method validation was approved by FLDEP (8-26-92) but has been removed from the CompQAP.

The use of the alternate heating source supported by the method validation data in Appendix B has been repealed. This alternate technique is no longer used at the Quanterra Tampa.

8.2.3 Total Fluoride in Soil/Sediment

This method validation has been approved by FLDEP (8-26-92).

Samples of a soil/sediment matrix are prepared and analyzed by modifying and combining EPA Methods 340.1 and 340.2. The modification is based on a distillation preparation and probe analysis procedure developed by EPA Region IV. A summary of the method follows:

> Place 400 ml of deionized water in the all-glass distillation system (as described in Figure 1 of EPA Method 340.1). Slowly add 200 ml of concentrated sulfuric acid and mix carefully. Add 25 to 35 boiling chips to the distillation flask. Pre-distill the acid/water mixture by heating to 180°C, in order to properly adjust the acid/water ratio and to remove any Fluoride contamination that may be present. Discard the distillate from the pre-distillation. Weigh and add a representative 0.5g to 5g portion to the distillation flask containing the acid/water mixture. Add 300 ml deionized water to the flask and repeat the distillation step by heating the acid/water mixture to 180°C until 300 ml of distillate has been collected. Analyze the distillate for Fluoride content using an Ion-Selective Electrode as outlined in EPA Method 340.2.

Appendix C contains the supporting method validation package for the analysis of total fluoride with a soil/sediment matrix.

8.2.4 Alternate Analysis of Tin

This method validation was not approved by FLDEP (8-26-92) and has been removed from the CompQAP.

The quantitative determination of tin by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICPAES) has been shown to be consistent with approved methodologies such as flame atomic absorption spectroscopy.

Appendix D contained a description of the method along with a supporting method validation package. Appendix D has been repealed.

8.2.5 Determination of Organic Compounds in Aqueous Samples by EPA Method 624 or 8240

This method validation was approved by FLDEP (3-14-94).

Appendix E includes method validation data to support the analysis of a series of organic compounds by EPA Method 624 or 8240. The strictest criteria of either method has been met during the generation of this data in order to validate both techniques.

8.2.6 Dioxin Screening Technique

Quanterra Tampa performs the Selected Ion Monitoring (SIM) GC/MS technique to screen for the presence of 2,3,7,8 - TCDDD as described in EPA Method 625. This method is approved and is applicable using water (EPA 625) or Soil/Sediment matrices by applying SIM to SW846 Method 8270.

8.2.7 Modification to EPA Method 3520

This method validation was approved by FLDEP (3/14/94).

Corning Incorporated has developed an alternate, low volume solvent extraction system for continuous liquid/liquid extractions. This technique is performed using the Corning One-Step Extraction vessel. The method validation study included in Appendix G has been approved by the EPA as a replacement for any continuous liquid/liquid techniques performed under NPDES, RCRA and CLP programs.

8.2.7 Determination of Organic Compounds in Samples by EPA Method 625 or 8270

This method validation was approved by FLDEP (2/21/95)

Appendix H includes method validation data to support the analysis of a series of organic compounds by EPA Method 625 or 8270. The strictest criteria of either method has been met during the generation of this data in order to validate both techniques. (Hexachlorophene only for 3510 and 3550).

8.2.8 Determination of Organic Compounds in Samples by EPA Method 601 or 8010

Appendix I includes method validation data to support the analysis of a series of organic compounds by EPA Method 601 or 8010. The strictest criteria of either method has been met during the generation of this data in order to validate both techniques.

8.2.9 Determination of Hexachlorobenzene in Samples by EPA Method 608 or 8080

Appendix J includes method validation data to support the analysis of a Hexachlorobenzene by EPA Method 608 or 8080. The strictest criteria of either method has been met during the generation of this data in order to validate both techniques.

8.3 Laboratory Glassware Cleaning Procedures

Quanterra Tampa maintains specific glassware-cleaning guidelines which ensure that glassware used in the laboratory will not interfere with analytes of interest during the actual testing procedure. As presented in the following section, cleaning procedures are specific for the analyses being performed. Cleaning materials are outlined in Section 6.3.1.

8.3.1 Organic* Glassware Cleaning Procedures

a) After using a piece of glassware, it is rinsed with the last solvent used and carried to the dirty glassware area. If it is visibly dirty, it should be washed immediately.

b) The glassware is immersed in a hot, soapy solution of water and laboratory detergent (pH>10). An appropriate scrub brush is used to scrub the entire interior surface.

c) Rinse the glassware three times vigorously with hot tap water. If the glassware is still visibly dirty, or if spotting or beading occurs, repeat b).

d) After completing the hot tap water rinse, rinse the glassware three times with analyte-free water and place it in the clean drying area. Technical grade methanol and an oven may be used at this point to rinse out water and speed the drying process. Volumetric glassware should not be heated.

e) After drying, the glassware should be spot and stain free. If it is not, then repeat the entire procedure.

f) When possible place the glassware in the muffle-oven and muffle the glassware for a minimum of two hours at 400°C, preferably overnight.

g) Clean glassware is inverted (where applicable) and stored prior to use in a designated clean storage location.

h) Before use, glassware is be pre-rinsed with the solvent inherent to a given procedure.

*Volatile Organic Glassware Deviation

i) Glassware designated for use in volatiles analyses is maintained in a separate area from semi-volatile glassware. Volatiles glassware is rinsed with the following reagents prior to use:

1. Analyte-free water
2. Purge and trap grade methanol
3. Analyte-free water

8.3.2 Metals Glassware Cleaning Procedures

a) After using a piece of glassware, it is rinsed with the last solvent used and carried to the dirty glassware area. If it is visibly dirty, it should be washed immediately.

b) The glassware is immersed in a hot, soapy solution of water and laboratory detergent. An appropriate scrub brush is used to scrub the entire interior surface.

c) Rinse the glassware three times vigorously with hot tap water. If the glassware is still visibly dirty, or if spotting or beading occurs, repeat b).

d) After completing the hot tap water rinse, rinse the glassware three times with analyte-free water and place it in the clean drying area.

e) After air drying, the glassware should be spot and stain free. If it is not, then repeat the entire procedure.

f) Place the glassware in a designated clean storage location free from interferences or contamination.

g) Metals glassware is rinsed with the following reagents prior to use:

1. Analyte-free water
2. 50% nitric acid
3. Analyte-free water

8.3.3 Wet Chemistry Glassware Cleaning Procedures

a) After using a piece of glassware, it is rinsed with the last solvent used and carried to the dirty glassware area. If it is visibly dirty, it should be washed immediately.

b) The glassware is immersed in a hot, soapy solution of water and laboratory detergent. (Omit this step for glassware designated for use in Phosphate determinations.) An appropriate scrub brush is used to scrub the entire interior surface.

c) Rinse the glassware three times vigorously with hot tap water. If the glassware is still visibly dirty, or if spotting or beading occurs, repeat b).

d) After completing the hot tap water rinse, rinse the glassware three times with analyte-free water and place it in the clean drying area.

e) After air drying, the glassware should be spot and stain free. If it is not, then repeat the entire procedure.

F) Place the glassware in a designated clean storage location free from interferences or contamination. Glassware designated for Phosphate determinations is labelled and maintained separately from other glassware.

g) Glassware used in the determination of Phosphate or Nutrients is rinsed with the following reagents prior to use:

1. Analyte-free water
2. 50% hydrochloric acid
3. Analyte-free water

h) Glassware used in TRPH determinations is rinsed with Freon-113 prior to use.

8.4 Laboratory Reagent Storage Procedures

Reagents used for laboratory procedures are purchased from various commercial sources. Records of reagent purchases are maintained by the laboratory. All reagents obtained by the laboratory are labelled with the received and opened date and managed on a rotating stock basis. Laboratory standards are acquired and maintained separately from samples and other chemicals in the same manner as reagents. Storage protocols for laboratory reagents for use in organic, metals, and inorganic methodology are outlined in Table 8-1.

TABLE 8-1

LABORATORY REAGENT STORAGE

Reagent	Method of Storage
Laboratory Detergent	Stored in original containers at each cleaning station.
Nitric Acid	Stored in original containers in vented cabinets designed for acid storage in Metals Preparations Laboratory.
Sulfuric Acid	Stored in original containers in vented cabinets designed for acid storage in Organic Preparations Laboratory.
Hydrochloric Acid	Stored in original containers in vented cabinets designed for acid storage in Metals Preparations Laboratory.
Non-Flammable Organic Solvents	Stored in original containers in vented cabinets designed for solvent storage in Organic Preparations Laboratory.
Flammable Organic Solvents	Stored in original containers in vented cabinets designed for flammable solvent storage in Organic Preparations Laboratory.
Purge and Trap Methanol	Stored in original containers in vented cabinets designed for flammable solvent storage in Volatile Organics Laboratory.
Isopropanol	Stored in original containers in vented cabinets designed for flammable solvent storage in Volatile Organics Laboratory.
Inorganic Reagents	Stored in original containers in cabinets or refrigerator designed for reagent storage in Wet Chemistry Laboratory.
Sodium Sulfate	Stored in glass containers steel pans in a dessicator (after muffling in stainless steel pans) in the Wet Chemistry and Organics Preparation Laboratories.
Organic Reagents	Stored in original containers or preparation glassware in refrigerator in Wet Chemistry and Organics Preparation Laboratories.
Acetic Acid	Stored in original containers in vented cabinets segregated from Inorganic Acids in Metals Preparation Laboratories.

8.5 Laboratory Waste Disposal Procedures

Quanterra Tampa maintains a formal waste disposal program. The disposal program is designed to safely and legally dispose of expired environmental samples and chemical wastes generated by laboratory procedures. Client samples are retained in a controlled access area for 30 days after the analytical report date. If prior arrangements have been made with the client, the samples are returned to the project site by commercial carrier or internal courier. Samples which constitute an excessive volume for disposal or a non-conforming waste stream are returned to the client.

8.5.1 Solvent Waste Disposal

Processes generating waste organic solvents in the laboratory include organic sample preparation and standard/reagent preparation. Flammable, chlorinated and freon approved waste solvent storage containers are maintained in fume hoods in the appropriate laboratories for segregation and collection of waste solvent. When full, the contents of these containers are transferred to the corresponding 55 gallon drums for disposal as described in Section 8.5.4.

Solvent extracts are stored chronologically in a refrigerator approved for flammable solvent storage. Upon expiration of required holding times, sample extracts are disposed of by pouring the extract into the appropriate solvent storage container and placing the empty extract container into the appropriate solid waste container. Similarly, other waste solvents are disposed of by placing them in the appropriate waste collection container for proper disposal by the laboratory. Residual solvents generated from extraction of aqueous samples are allowed to separate from the aqueous matrix for a minimum of 24 hours in a carboy. The water is then decanted into the sink and the remaining solvent is placed in a solvent collection container.

8.5.2 Aqueous Waste Disposal

Aqueous waste, including aqueous samples, digestates, dilute standards and reagents are neutralized to a pH of 5 to 7 before discarding into the sanitary sewer with copious amounts of rinse water. Concentrated standards or reagents are neutralized and containerized in an aqueous waste drum which is then disposed of by a commercial disposal company, as outlined in Section 8.5.4.

8.5.3 Solid Waste Disposal

Solid laboratory wastes can be divided into hazardous and non-hazardous classifications. All solid samples submitted to the laboratory are considered to be hazardous and are disposed of as such. Upon expiration of appropriate holding times, solid samples are transferred to the solid hazardous waste drum. Non-pumpable liquids and semi-solids (such as oils or sludges) are also consolidated into the solids' drum. Any sample containers which may contain sample residue are added to the drum for disposal as well. Section 8.5.4 outlines disposal protocol for solid waste. Waste deemed non-hazardous (i.e. empty sample containers, disposable pipets, etc.) is collected in the laboratory and disposed of separately by conventional means.

8.5.4 Laboratory Chemical Waste Disposal

Laboratory wastes which do not fit into any aforementioned category are disposed of by contracting a third party who is qualified to perform Lab Pack Disposal or by returning the waste to the party from whom it was obtained (if applicable).

8.5.5 Waste Disposal Documentation

Fifty-five gallon drums are maintained by the laboratory in compliance with RCRA regulations for disposal of waste solvents. Sampling and analysis of full drums are done in compliance with requirements imposed by the appropriate disposal company used by the laboratory. The laboratory typically uses Universal Waste and Transit for transport of laboratory wastes.

All records of waste disposal are maintained in the Laboratory Waste Disposal Log. Records include results of analyses performed on the waste, waste disposal manifests, correspondence from disposal firms and any other information necessary to document the disposal of laboratory wastes.

8.6 Mobile Laboratory Analytical Capabilities

All requirements listed in Section 8.0 through Section 8.5 apply to any mobile laboratory facility set-up by Quanterra Tampa.

All analytical methods listed in Sections 5.1, 5.2 and 5.3, and Sections 8.0, 8.1 and 8.2 can be performed for screening analyses and qualitative data in the mobile laboratory. Glassware cleaning procedures outlined in Section 8.3 will be followed in the mobile laboratory. Reagent tracking and storage in the mobile laboratory will be maintained as outlined in Section 8.4. Waste disposal will be performed in the mobile laboratory as outlined in Section 8.5.

9.0 Calibration Procedures and Frequency

9.1 Instrumentation

Quanterra Tampa uses EPA approved instrumentation designed to meet or exceed EPA method performance specifications. A list of Field Analytical Equipment is presented in Table 9-1 and a list of current Laboratory Major Analytical Instrumentation is presented in Table 9-2.

All instrumentation located at Quanterra Tampa can be removed from the facility and set-up in a mobile laboratory. When it is technically not feasible or analytically not prudent to use existing instrumentation, similar instrumentation will be purchased or leased to provide analytical capabilities in a mobile laboratory. This additional equipment will be specifically referenced in a CompQAP revision, addendum, or in a site specific quality assurance plan at the time the mobile laboratory is initiated.

TABLE 9-1

FIELD ANALYTICAL INSTRUMENTATION

Name, Model, Purchase Date	Specifics
YSI 51B Portable/Stationary Oxygen Meter 1990	Field dissolved oxygen measurements
Field grade thermometers Various Dates	Field temperature measurements
Orion SA210 Portable pH Meter 1993	Field pH and conductivity measurements
Century OVA 128 Portable Organic Vapor Analyzer 1993	Field organic vapor determination
Hach DR100 Colorimeter Date Unknown	Field determination of residual chlorine

TABLE 9-2

LABORATORY MAJOR ANALYTICAL INSTRUMENTATION

Name, Model, Purchase Date	Specifics
VOLATILE ORGANICS:	
Perkin Elmer 8500 GC 1989	PID detector and HECD detector in series; Tekmar LSC 4000 concentrator; Tekmar ALS 4200 autosampler; SP4290 dual channel integrator; Nelson Turbochrom III chromatography software.
Perkin Elmer 8500 GC 1990	PID detector and HECD detector in series; Tekmar LSC 2000 concentrator; Tekmar ALS 2050 autosampler; SP4290 dual channel integrator; Nelson Turbochrom III chromatography software.
Hewlett Packard 5890-II GC 1991	Dual, Tandem O.I. PID detectors and O.I. HECD detectors; Dual O.I. 4460A sample concentrators. Dual O.I. MPM-16 autosamplers; Nelson Turbochrom III chromatography software.
Hewlett Packard 5890 GC 1988	Electron Capture Detector; Tekmar LCS concentrator: O.I. 4460A concentrator; O.I. MPM-16 autosampler;HP 3394A integrator.
Hewlett Packard 5890 GC-II 1992	Tandem O.I. PID/FID detectors; Hewlett Packard FID detector; Nelson Turbochrom III chromatography software. Tekmar 7000 Head space unit.
Hewlett Packard 5890 GC 1989	Connected with HP5970 Mass selective detector; Tekmar LSC 2000 concentrator; Tekmar ALS 2016 autosampler.
Hewlett Packard 5970 MSD 1989	Electron impact Mass Selective detector; RTE-6 1000F-series computer; Aquarius software with EPA library; HP 7914 tape drive; HP rugged writer printer.
Hewlett Packard 5890 GC 1992	Connected with HP5970 Mass selective detector; Tekmar LSC 2000 concentrator; Tekmar ALS 2050 autosampler.
Hewlett Packard 5970 MSD 1992	Electron impact Mass Selective detector; RTE-6 1000F-series computer; Aquarius software with EPA library; HP 7914 tape drive; HP rugged writer printer.

TABLE 9-2

LABORATORY MAJOR ANALYTICAL INSTRUMENTATION
(continued)

Name, Model, Purchase Date	Specifics
SEMI-VOLATILE ORGANICS:	
Hewlett Packard 5890 GC 1988	Dual Electron Capture Detectors; HP 7673A auto-injector; HP Turbochrom 4 data station
Hewlett Packard 5890 GC 1993	Dual flame photometric detectors with 7673 A autosampler and HP Turbochrom 4 data station
Hewlett Packard 5890 GC 1993	Dual nitrogen phosphorus detectors and HP Turbochrom 4 data station
Hewlett Packard 5890 GC 1993	Dual electron capture detectors with Leap autosampler and HP Turbochrom 4 data station
Hewlett Packard 5890 GC 1990	Connected with HP5970 Mass selective detector; HP 7673 auto -injector and RTE-A data system
Hewlett Packard 5970 MSD 1990	Electron impact Mass Selective detector; RTE-A 1000-series computer; Aquarius GC/MS software Rev. F with HP 9144 tape drive; HP rugged writer printer. NIS/EPA/NIH 75K/62K mass spectral database.
Hewlett Packard 5890 GC 1993	Connected with HP 5972 Mass selective detector; HP 7673 auto -injector and Chemstation data system.
Hewlett Packard 5972 MSD 1993	EIMS Detector, HP Chem Station B.02.02 with G1034C ver. C.01.05; EnviroQuant Target Compound software; NIS/EPA/NIH 75K MS Database; HP Vectra 486/66 PC; internal Colorado Jumbo 250 archive system; 7686 PrepStation system.
Hewlett Packard 1050/1046A HPLC 1993	HPLC with diode array and Fluorescence detectors; autosampler and Chemstation data system

TABLE 9-2

LABORATORY MAJOR ANALYTICAL INSTRUMENTATION
(continued)

Name, Model, Purchase Date	Specifics
ORGANIC EXTRACTIONS:	
Organomation 120 Evaporators 1989, 1991	Two eight-place steam bath units or Kuderna-Danish concentration; closed system for re-collection of distilled solvents.
Organomation 111 Nitrogen Evaporator 1988	Twelve-place nitrogen blowdown unit for micro-concentration of exacts with heated bath.
Tekmar 500 Sonicator 1987	Macro and Micro horn tips; Sonic disruption extractor; equipped with sound-proof box.
Fisher HN-SII Centrifuge 1991	Four-place centrifuge; 50 mL tube capacity.
Despatch 1000V Muffle-Oven 1991	Capable of 1400°F temperature; 6 cubic feet interior; recirculation fan.
Branson Sonifier 450 Sonicator 1993	Macro Tip with box
Gyrotory Shaker - Model G2 1993	0-500 RPM Rotary Shaker, used for Herb soils (8150) and method 89-45.
Thermolyne-Type 37600 1992	Vortex mixer
ABC GPC System 1993	GPC sample unit (Autoprep 1000) with 23 sample 1993 positions; ABC UVD-1 detector and ABC SCR-1 chart recorder.

TABLE 9-2

LABORATORY MAJOR ANALYTICAL INSTRUMENTATION
(continued)

Name, Model, Purchase Date	Specifics
METALS:	
Leeman Labs PS1000 ICP 1989	Sequential Atomic Emission Detectors; ACER 915 PC with PS-series ICP software; Okidata 320 printer.
Perkin Elmer 5100Z GFAA 1989	Graphite Atomizer with Zeeman Background Correction; IBM PS/2 Model 50 with PE 5100 software; PE AS-60 autosampler; Dual Electrodeless Discharge Lamp power supply; Epson LX-800 printer.
Perkin Elmer 5100Z GFAA 1993	Graphite Atomizer with Zeeman Background Correction; IBM PS/2 Model 70 with PE 5100 software; PE AS-60 autosampler; NEC Pinwriter P2200
Thermo Jarrel Ash ICP 61 1993	Simultaneous Atomic Emission Detectors
Thermo Jarrel Ash ICP 61 Super Trace 1994	Simultaneous ICP with autosampler and axial torch
Leeman Labs PS200 1994	Automated cold vapor and data station
Coleman 5013 Hg Analyzer 1989	Manual, closed-system cold vapor mercury analyzer; Lloyd 450 linear chart recorder.
CEM MDS-81D Microwave 1988	Programmable microwave oven with turntable.

TABLE 9-2

LABORATORY MAJOR ANALYTICAL INSTRUMENTATION
(continued)

Name, Model, Purchase Date	Specifics
WET CHEMISTRY/MISCELLANEOUS:	
Buck HC404 Spectrophotometer 1990	Direct read, Infrared hydrocarbon analyzer; multiple cell path-lengths.
Hach 2100A Nephelometer 1990	Direct reading turbidimeter.
YSI 32 Conductance Meter 1990	Temperature compensation; direct reading.
YSI 51B Oxygen Meter 1990	Direct reading Dissolved Oxygen meter; Probe with stirrer.
Fisher 925 pH/ISE Meter 1990	Multi-point calibration; temperature compensation; Ion-selective electodes for fluoride and ammonium
Hach 456 Digestion Block 1990	Chemical Oxygen Demand reaction heater; 25 sample capability with timer.
CSA 1341 Calorimeter 1984	Parr Bomb/Calorimeter with stirrer; remote ignition; stainless steel bomb.
WAL Rotary Extractor 1989	Two 8-place rotary extractor; satisfies TCLP/EPTOX construction and performance requirements.
Pensky-Marten Flash Tester 1990	Closed cup with stirrer; electric heating mantle.
Fisher Scientific Versa-bath Hot Water Baths 1984, 1991	Two baths with stainless steel tank with removable cover.
Incubator,Labline Instruments, Inc. 1992	Equatherm Ambi-Hi-Lo Chamber

TABLE 9-2

LABORATORY MAJOR ANALYTICAL INSTRUMENTATION
(continued)

Name, Model, Purchase Date	Specifics
WET CHEMISTRY (continued)	
OI Analytical Model 700 TOC analyzer 1993	Autosampler (ASM) Model SHLR; Epson FX85
Thermolyne Type 1400 Muffle Furnace	1200° C Temperature range
Fisher Scientific Isotemp Drying Oven Model 655F	220° C Temperature range
Scientific Products TempCon Gravity Convention Oven	210°C Temperature range
PE UV/UIS Spectrometer Lambda 2 with Super Sipper 1992	Okidata Microline 320 printer
Mitsubishi Kasei Corp. TOX 10 Sigma 1993	5 channel preparator
Dionex 4500 1993	Ion chromatograph with autosampler and AI450 data station
Lachat Quikchem AE 1994	Automated flow injection ion analyzer

TABLE 9-2

LABORATORY MAJOR ANALYTICAL INSTRUMENTATION
(continued)

Name, Model, Purchase Date	Specifics
MISCELLANEOUS	
Millipore ZHE extractors 1990	Two stainless steel extractors with inlet pressure gauge; meets TCLP requirements.
Millipore Filter Apparatus 1990	Positive pressure device; stainless steel with teflon coating; meets TCLP/EPTOX requirements.
Fisher Filter Apparatus 1990	Positive pressure stainless steel device; meets TCLP/EPTOX requirements.
S/P 182 Analytical Balance 1989	
Sartorius 200 Analytical Balance 1990	
Sartorius 3100 Toploading Balances (2) 1990	
Mettler 3600 Toploading Balance 1984	

9.2 Standards

9.2.1 Receipt and Traceability

Receipt of laboratory analytical standards is documented in the appropriate laboratory standard tracking logbook (see Figure 9-1). A separate logbook is maintained for each of the major analytical groups: Metals, Volatile Organics, Wet Chemistry and Semi-Volatile Organics. The logbook contains information listing receipt date, manufacturer's lot number, standard name, concentration, and expiration date, and the assignment of a unique tracking number. The logbook is used as a reference for purging expired standards from their storage locations for disposal. Records including certificates of traceability and manufacturer's assay are maintained by the laboratory in addition to records of standard orders and packing slips, in order to document the acquisition of standards. Upon receipt and subsequent entry into the standard tracking logbook, each standard is labelled with receiving and expiration dates and a unique tracking number, then placed in the appropriate storage location indicated in the logbook.

9.2.2 Standard Sources and Preparation

To ensure the highest purity possible, all primary reference standards and standard solutions used by Quanterra Tampa obtained from the National Institute of Standards and Technology, CRADA or A2LA vendors, or other reliable commercial sources. Procedures for the preparation of working standards from neat and stock standards acquired by the laboratory are documented in the appropriate laboratory standards tracking logbook by analytical group as presented in Table 9-3.

9.2.3 Standardization of Titrating Solutions

Quanterra Tampa purchases manufacturer's standardized and certified titrating solutions. The solutions are verified in the laboratory by analyzing an independently-obtained check standards and solutions. The laboratory acquires titrants from Banco, RICCA and Mallinkrodt.

9.2.4 Mobile Laboratory Standards Requirements

Procedures for standards receipt, traceability and preparation will be followed in the mobile laboratory as outlined in Section 9.2.1, Section 9.2.2 and Section 9.2.3 . Preparation, storage and shelf-life criteria outlined in Table 9-3 will be used in the mobile laboratory

TABLE 9-3

STANDARDS SOURCES AND PREPARATION

Standard Source	Preparation Procedure	Storage	Frequency
Gas Chromatography - Volatiles:			
UltraScientific (A2LA), Supelco; >1000 ppm in Methanol Chemservice; Neat	Dilution into Methanol for Working Standard	VOA Freezer	Monthly, Weekly (Gasses)
Gas Chromatography - Semi-Volatiles			
Ultra Scientific,(A2LA), Supelco, Accustandard Chemservice: Neat Standards and 200 - >2000 ppm Standards in Solution	Intermediates Prepared by Diluting Source Standard into Acetone or Hexane	Semi-Vol Freezer	Semi-Annual (Stocks)
HPLC - Semi-Volatiles			
Ultra Scientific,(A2LA), Supelco, Accustandard Chemservice: Neat Standards and 200 - >2000 ppm Standards in Solution	Intermediates Prepared by Diluting Source Standard into Acryonitrile	Semi-Vol Freezer	Semi-Annual (Stocks)

TABLE 9-3

STANDARDS SOURCES AND PREPARATION
(continued)

Standard Source	Preparation Procedure	Storage	Frequency
Gas Chromatography/Mass Spectrometry - Volatiles:			
Chemserv: Neat Standards UltraScientific (A2LA), Accustandard/ Supelco: >1000 ppm in Methanol	Dilution into Methanol for Working Standard	VOA Freezer	Monthly, (Gasses Weekly)
Gas Chromatography/Mass Spectrometry - Semi-Volatiles:			
Chemserv: Neat Standards UltraScientific (A2LA) >1000 ppm in Dichloromethane	In Dichloromethane: Dilute Neats into Intermediate Stock. Dilute Intermediate Stock into Working Standard.	Semi-Vol Freezer	SemiAnnual (Stocks)

TABLE 9-3

STANDARDS SOURCES AND PREPARATION
(continued)

Standard Source	Preparation Procedure	Storage	Frequency
Metals (Includes ICP, GFAA, and Mercury Analyzer):			
NIST and VHG >500 ppm Solutions	Dilution of Source for Intermediate Standard	Rm. Temp. .15% HNO_3	Semi-Annual (Stocks)
	Dilution of Intermediate for Working Standard	Rm. Temp. .15% HNO_3	Daily (Working Standards)
Ion-Selective Electrode (includes pH, Fluoride, and Ammonia):			
ORION Prepared Solutions	No Preparation Necessary	Wet Chem Refrigerator	Semi-Annual
Spectrophotometer (includes Cyanide, Phenol, Phosphate, MBAS, Chloride, Sulfate, Nitrate, and Nitrite):			
ORION, Banco, Mallinkrodt, EPA and Ricca Prepared Solutions	No Preparation Necessary	Wet Chem Refrigerator	Semi-Annual
Miscellaneous (includes COD/BOD, Acidity, Alkalinity, Turbidity, Hardness):			
Ricca, Hach and Mallinkrodt Prepared Solutions	No Preparation Necessary	Wet Chem Refrigerator	Semi-Annual

9.3 Calibration

Quanterra Tampa maintains specific procedures for the operation and calibration of all analytical instruments. Along with proper maintenance, these practices ensure optimum instrument performance and accuracy. These procedures include proper operator training and supervision, mandatory instrument performance specifications, and systematic instrument calibration, verification, and monitoring schedules.

9.3.1 Field Instrument Calibration

Calibrations will be performed in the field before analysis of any samples, every four hours, and at the end of the day. When multiple sites are to be sampled in the same day, a calibration verification before subsequent analysis at a different site is all that is required. All calibration, verification and sample analysis data will be recorded in the field sampler's logbook.

Automatic samplers are calibrated prior to each use by collecting a sample into a container with graduations and determining sample volume taken. Adjustments may then be made as appropriate to collect the correct sample volume for that event.

Dissolved oxygen meters will be calibrated against saturated air daily or before use and against the winkler titration on an annual basis. The OVA meter will be calibrated daily or before each use using a single calibration span gas per manufacturers instructions. Carbon filters will be employed to distinguish between VOHs and methane when appropriate and if necessary background correction will be made for ambient air measurements.

9.3.2 Laboratory Instrument Calibration

The laboratory utilizes mandatory instrument performance specifications to constantly ensure optimum instrumental performance. These performance specifications require acceptable instrument response to specific performance standards prior to initiating further instrument calibration and analyses. Acceptable instrument response criteria are based upon EPA or manufacturer analytical method specifications. Initial instrument calibration curves are generated, verified, and routinely monitored throughout the duration of all instrumental analyses. All calibration and verification data is documented and filed chronologically. In the case of a method or project calibration requirement that is more stringent than those listed, the most stringent will be used. Specific calibration procedures for laboratory instruments, including the frequency and standards used, are listed below.

1. Gas Chromatography & HPLC

a) A multi-point calibration curve shall be generated initially, each time method-specified continuing calibration criteria are not met, or a minimum of once per month. For EPA 600 series methods the initial calibration will consist of 3 standards covering the linear range of the instrument to be utilized for analysis. For EPA SW846 methods a curve consisting of 5 standards will be similarly produced initially. Criteria for acceptable calibration curve responses shall be followed as specified in the appropriate method.

b) Continuing calibration standards shall be analyzed when initial calibration is not performed, and after every 10 samples. Specifications for acceptance criteria for EPA 600 series and EPA SW846 methods will be followed for each analyte detected in the sample.

c) Internal standards are added to each standard and sample.

d) System cleanliness is verified with analysis of a method blank prior to system calibration.

2. Gas Chromatography/Mass Spectrometry

a) The instrument shall be tuned to meet EPA established abundance criteria for DFTPP or BFB to assure acceptable library search capabilities. For EPA 600 series methods the GC/MS shall be tuned a minimum of once per 24 hours. For EPA SW846 methods the GC/MS shall be tuned a minimum of once per 12 hours.

b) A multi-point calibration curve shall be generated initially, each time method-specified continuing calibration criteria are not met, or a minimum of once per month. For EPA 600 series methods the initial calibration will consist of 3 standards covering the linear range of the instrument to be utilized for analysis. For EPA SW846 methods a curve consisting of 5 standards will be similarly produced initially. Criteria for acceptable calibration curve responses shall be followed as specified in the appropriate method.

c) Continuing calibration standards shall be analyzed once per tune (when initial calibration is not performed). Specifications for acceptance criteria for EPA 600 series and EPA SW846 methods will be followed for each analyte detected in the sample.

d) Internal standards are added to each standard and sample.

e) System cleanliness shall be verified by the analysis of a method blank after tuning and prior to system calibration.

3. Selected Ion Monitoring by Gas Chromatography/Mass Spectrometry (Dioxin Screen)

a) The GC/MS shall be operated as described above for base/neutral determinations.

b) The instrument shall be set up to acquire data in the SIM mode using the ions specific for 2,3,7,8- TCDD at m/z 257, 320 and 322.

c) A single standard at 1 mg/L is analyzed to verify screening efficiency.

d) An instrument blank is analyzed to verify system cleanliness.

4. Inductively Coupled Plasma Atomic Emission Spectrophotometry

a) A multi-point calibration curve shall be generated initially, each time method-specified continuing calibration criteria are not met, or a minimum of once per week. The initial calibration will consist of 3 standards covering the linear range of the instrument to be utilized for analysis. The curve will be accepted if the calculated standard values deviate more than ±10% from their true values. The curve will be verified before each sample set by analyzing an Initial Calibration Verification standard which must be within 10% of the true value.

b) Continuing calibration standards shall be analyzed after every 10 samples. The calibration curve shall be re-sloped when continuing calibration standards indicate a RSD in excess of 10%.

c) Elemental interferences shall be evaluated by the analysis of an interference check sample at the beginning and end of each sample set.

d) System cleanliness shall be verified by the analysis of an instrument blank prior to system calibration and after every 10 samples.

5. Atomic Absorption Spectrophotometry

a) A multi-point calibration curve shall be generated each time the method is performed. The initial calibration will consist of 5 standards covering the linear range of the instrument to be utilized for analysis. The curve will be verified before samples are analyzed by analyzing an Initial Calibration Verification standard which must be detected at ±10% of the true value or the curve will be regenerated.

b) Continuing calibration standards shall be analyzed after every 10 samples. The calibration curve shall be re-sloped when continuing calibration standards indicate a RSD in excess of 10%. The calibration curve shall be regenerated if the re-slope standard is not within 20% of the original curve.

c) System cleanliness shall be verified by the analysis of an instrument blank prior to system calibration and after every 10 samples.

6. Ion Selective Electrodes

a) A multi-point calibration curve shall be generated initially, each time samples are to be analyzed. The initial calibration will consist of 3 standards (5 when directly reading millivolt values) covering the linear range of the instrument to be utilized for analysis.

1. When reading concentrations from the meter, the calibration curve is calculated and contained within the meter. The efficiency of such a curve must be greater than 0.96 and two verification standards must be detected at ±10% of their true value.

2. When reading millivolts from the meter, the values are entered into a Lotus 123® spreadsheet which calculates a concentration curve based on the method of least squares. The correlation coefficient of this curve must be 0.996 or greater and the Initial Calibration Verification standard must be within 10% of the true value or the curve must be regenerated.

b) Continuing calibration standards shall be analyzed after every 10 samples. The calibration curve shall be regenerated when continuing calibration standards indicate a RSD in excess of 10%.

c) System cleanliness shall be verified by the analysis of a method/instrument blank prior to system calibration and after every 10 samples.

7. UV/VIS Spectrophotometer

a) A multi-point calibration curve shall be generated initially and/or each time samples are to be analyzed. The initial calibration will consist of 3 standards covering the linear range of the instrument. The initial calibration curve must have a RSD of less than or equal to 20%.

b) Continuing calibration standards shall be analyzed after every 10 samples. The calibration curve shall be regenerated when continuing calibration standards indicate a RSD in excess of 10%.

c) System cleanliness shall be verified by the analysis of an instrument/method blank prior to system calibration and after every 10 samples.

8. Infrared Spectrophotometer

a) A multi-point calibration curve shall be generated initially and/or each time samples are to be analyzed. The initial calibration will consist of 3 standards covering the linear range of the instrument. The initial calibration curve must have an RSD of less than or equal to 20%.

b) Continuing calibration standards shall be analyzed after every 10 samples. The calibration curve shall be regenerated when continuing calibration standards indicate a RSD in excess of 10%.

c) System cleanliness shall be verified by the analysis of a method blank prior to system calibration and after every 10 samples.

9. Balances

a) Balances are calibrated and certified annually by a vendor-certified technician utilizing paired Class S weights. Daily checks using Class S weights verifies the continuing accuracy of the calibration.

10. Flow Injection Ion Analyzer

a) A multi-point calibration curve shall be generated initially and/or each time samples are to be analyzed. The initial calibration will consist of at least 3 standards covering the linear range of the instrument. The initial calibration curve must have a correlation coefficient greater than or equal to 0.995.

b) Continuing calibration standards shall be analyzed after every 10 samples. The calibration curve shall be regenerated when continuing calibration standards indicate a % difference in excess of 10%.

c) System cleanliness shall be verified by the analysis of an instrument/method blank prior to system calibration and after every 10 samples.

11. Ion Chromatography

a) A multi-point calibration curve shall be generated initially and/or each time samples are to be analyzed. The initial calibration will consist of at least 3 standards covering the linear range of the instrument. The initial calibration curve must have a correlation coefficient greater than or equal to 0.995.

b) Continuing calibration standards shall be analyzed after every 10 samples. The calibration curve shall be regenerated when continuing calibration standards indicate a % difference in excess of 10%.

c) System cleanliness shall be verified by the analysis of an instrument/method blank prior to system calibration and after every 10 samples.

12 Miscellaneous Instruments

a) Additional inorganic analyses using a single-point standard for quantitation include COD, BOD, Alkalinity, Acidity, Turbidity, Hardness, and Specific Conductance. Specifications listed in the individual methods and/or instrument manuals shall be followed for these analyses.
b) All refrigerators, freezers, and oven temperatures are monitored twice daily (Monday through Friday, excluding Holidays).

9.3.3 Mobile Laboratory Calibration Requirements

The calibration procedures detailed in Section 9.3 will be followed in the mobile laboratory.

An initial calibration and method verification will be performed each time an instrument is placed into service in the mobile laboratory. Method verification will include a method detection limit study to ensure the operational integrity of the instrumentation. This data will be supplied in the tables in Section 5 of the CompQAP, or in a site specific quality assurance plan at the time of data generation. Instrument calibration will be verified according to method specification and as outlined in Section 9.3.

FIGURE 9-1

LABORATORY STANDARD TRACKING LOGBOOK

QUANTERRA ENVIRONMENTAL SERVICES, TAMPA
LABORATORY STANDARDS TRACKING FORM

		Source				Preparation						
Prep Date	Analyst	Supplier	Lot No.	Purity	Expiration	Initial	Final	Diluent	Final Concentration	Analyte(s)	Standard #	Exp. Date

113 NOTE: QC checks are required before using any new standard to prepare or analyze samples.

FL #113
308/bil/SO/stctrack.xls

250077

10.0 Preventative Maintenance

Quanterra Tampa maintains a routine training and laboratory equipment maintenance program for all major instrumentation. Laboratory Instrument Service Logbooks are assigned to each instrument to detail and document the service of all equipment included within this program. A program of routine maintenance procedures ensures minimal downtime, as well as proper performance of analytical instruments. A substantial spare parts inventory is also maintained to assure timely repair of instruments. Specific preventive maintenance procedures for field equipment are listed in Table 10-1 and for laboratory equipment in Table 10-2.

10.1 Documentation of Maintenance and Repair Activities

Routine and non-routine maintenance procedures for laboratory instrumentation are documented in instrument-specific maintenance logbooks. Each logbook is kept near the associated instrument and is updated as necessary to indicate maintenance and repair activities. Logbook entries include the date, initials of the person(s) performing the maintenance and/or repair, a description of the problem or reason for the action, a brief summary and the result of the activity.

A logbook containing information pertaining to daily checks of various laboratory equipment is also maintained by the QA Manager. This logbook is used daily to document performance of analytical balances, the laboratory D.I. water system, refrigerator temperatures and oven temperatures. If necessary, repairs and/or maintenance to each of these systems is effected before use by the laboratory each day. Defective equipment is removed from service when timely repair is not possible. Vendor-specific files are maintained which document routine service and repair of laboratory equipment not performed by laboratory personnel.

10.2 Contingency Plans for Equipment Failure

In the event of equipment failure which may affect the proper performance of any laboratory activity, the QA Manager and Laboratory Director are immediately notified. The cause of the failure, and any affect on the quality assurance associated with that particular activity prior to and at the time of the failure are determined. Appropriate corrective action is implemented. If necessary, laboratory data associated with the period of inferior equipment performance will be qualified or invalidated. The affected client will be notified in the case that final data is impacted.

If available, work will be switched to backup equipment until necessary repairs are completed. Factors such as sample holding time and integrity, client urgency and anticipated repair time will be monitored. If necessary, a subcontractor will be chosen to complete the task. Appropriate consideration will be given to necessary approvals, certifications, and client acceptance of the subcontractor.

10.3 Mobile Laboratory Set-Up and Preventative Maintenance Requirements

The preventative maintenance schedule outlined in Section 10.0 will be followed in the mobile laboratory. Maintenance logs will be maintained for each instrument in the mobile laboratory outlined in Section 10.1. A complete system check will be performed before the instrument or equipment is used for analysis in the mobile laboratory. At a minimum, maintenance points listed in Table 10-1 and Table 10-2 will be checked. All power will be provided by the contractor at the mobile facility location.

TABLE 10-1

PREVENTATIVE MAINTENANCE PROCEDURES
FIELD INSTRUMENTATION/EQUIPMENT

INSTRUMENT	ACTIVITY	FREQUENCY
pH Meter	Check Probe Solutions	Daily
	Check for Cracks	Daily
	Check Reference Junctions	Daily
	Clean Probe	Each Use
Conductivity Meter	Clean Probe	Each Use
	Check Standard Solutions	Daily
Dissolved Oxygen Meter	Check Membrane	Daily
	Change Membrane	As Needed
OVA Meter	Check Filters	Each Use
	Check Concentration Alarm	Each Use
	Check Flame Ignition	Each Use
	Check Pump	Each Use
	Check Battery	Daily
	Check Gas Supply	Each Use
	Check Lead Wire	Each Use
	Check Connectors	Each Use
Grundfos Submersible Pump	Check Converter	Each Use
	Check Converter Connector	Each Use
	Check Lead Wires	Each Use
	Check Inner Rings	Bi-Weekly
	Check Inner Impeller	Bi Weekly
	Check Inner Shaft	Bi-Weekly
Masterflex Perisaltic Pump	Check Battery	Each Use
	Check Inner-Housing Pumb Bed	Each Use
	Check Inner-House Tubing	Each Use
Water Level Indicator	Check Wire	Each Use
	Check Probe	Each Use
	Check Battery	Each Use

TABLE 10-2

PREVENTATIVE MAINTENANCE PROCEDURES
LABORATORY INSTRUMENTATION/EQUIPMENT

INSTRUMENT	ACTIVITY	FREQUENCY
Gas Chromatography - Mass Spectrometer	Replace Septa	Daily
	Clean Inj. Port	Daily
	Clean Source	Weekly
	Change Pump Oil	Quarterly
	Clip Column Leader	Daily
	Check Gasses	Daily
	Check for Leaks	*As Needed
	Check Autosampler Alignment	Daily
Gas Chromatography & HPLC	Replace Septa	Weekly
	Clean Inj. Port	As Needed
	Clip Column Leader	As Needed
	Check Reagents (HECD)	Weekly
	Replace Nickel Tube (HECD)	Monthly
	Clean Lamp (PID)	Monthly
	Clean and Refoil (ECD)	Annually
	Clean Jet (FID)	Monthly
	Check Gasses	Daily
	Check for Leaks	*As Needed
	Check Autosampler Alignment	Daily
Purge and Trap	Replace Trap	Monthly
	Bake Lines	Monthly
	Clean Sample Vessels	Each Use
	Check Gasses	Daily
	Perform Leak Check	*As Needed
S-EVAP Steambath	Empty Solvent Reservoirs	Daily
	Check Condenser Tubing	Daily
	Check Water Level	Daily
	Monitor Temperature	Each Use
N-EVAP Blowdown	Check Water Level	Daily
	Monitor Temperature	Each Use
	Check Gas	Daily
	Check Gas Tips	Each Use
Sonic Disrupter	Clean Horn	Each Use
	Tighten Horn/Tip	Daily
	Check Tuning Frequency	Each Use

*Whenever gas pathway is altered or as needed.

TABLE 10-2

PREVENTATIVE MAINTENANCE PROCEDURES
LABORATORY INSTRUMENTATION/EQUIPMENT
(continued)

INSTRUMENT	ACTIVITY	FREQUENCY
Centrifuge	Check Balance	Each Use
	Lubricate Bearings	As Needed
Atomic Absorption Furnace	Clean Windows	Weekly
	Change Graphite Tube	Daily
	Check Gasses	Daily
	Check Optics	Annually
	Check Autosampler Tubing	Daily
	Check Autosampler Alignment	Daily
	Check Rinse/Drain Bottles	Daily
	Change Graphite Contacts	Semi-Annually
	Flush Autosampler Tubing	Each Use
Inductively Coupled Plasma	Check Aspiration Tubing	Daily
	Clean Torch Assembly	Monthly
	Clean Spray Chamber	Monthly
	Check Gasses	Daily
	Clean/Lube Pump Rollers	As Needed
	Check O-Rings	Monthly
Spectrophotometer, Infrared	Clean Cell	After each Use
	Clean Windows	Weekly
	Calibrate Wavelengths	As Needed
Spectrophotometer, UV/Visible	Clean Cell	After each Use
	Clean Windows	Weekly
	Calibrate Wavelengths	As Needed
	Check Aspiration Tubing	Before Each Use
Mercury Cold Vapor Analyzer	Check Tubing	Daily
	Clean Sparger	After Each Sample
	Clean Windows	Monthly
	Change Source Lamp	As Needed
Microwave Oven	Check Turntable	Daily
	Clean Interior	Monthly
	Check Exhaust	Daily

TABLE 10-2

PREVENTATIVE MAINTENANCE PROCEDURES
LABORATORY INSTRUMENTATION/EQUIPMENT
(continued)

INSTRUMENT	ACTIVITY	FREQUENCY
ISE Meter	Clean Probe	After Each Use
	Check Probe for Cracks	Daily
	Check Reference Junctions	Daily
	Check Probe Solutions	Daily
Conductivity Meter	Clean Probe	Each Use
	Check Standard Solutions	Daily
Dissolved Oxygen Meter	Check Membrane	Daily
	Change Membrane	As Needed
Bomb Calorimeter	Clean Interior Parts	After Each Use
	Resurface Interior	Quarterly/As Needed
	Replace Platinum Wire	After Each Use
	Check Oxygen Tubing	Before Each Use
Turbidimeter	Clean Cell	Each Use
Ion Chromatograph	Check Tubing	Daily
	Check for Bubbles	Each Use
	Check for Leaks	Each Use
	Check Pump	Daily
Autoanalyzer	Check Tubing	Each Use
	Check for Leaks	Each Use
	Check Bubbles	Each Use
	Check Pump	Each Use
	Check Valves	Each Use
	Check Detector Heads	Each Use
Digestion Block	Check/Adjust Temperature	Monthly/As Needed
Flashpoint Tester	Check Tubing	Daily
	Clean Sample Cup	Each Use
	Check Gas	Daily
	Clean Flash Assembly	Daily
	Check Stirrer	Daily

TABLE 10-2

PREVENTATIVE MAINTENANCE PROCEDURES
LABORATORY INSTRUMENTATION/EQUIPMENT
(continued)

INSTRUMENT	ACTIVITY	FREQUENCY
Hot Water Baths	Check Temperature	Daily
	Check Water Level	Daily
ZHE Vessels	Check O-Rings	Each Use
	Check For Leaks	Each Use
	Check Piston	Each Use
Filtration Apparatus	Check O-Rings	Daily
	Check For Leaks	Each Use
	Replace Screen	As Needed
Rotary Extractor	Check RPMs	Before Each Use
	Tighten Screws/Bolts	Weekly/As Needed
Laboratory Balances	Check Accuracy/Linearity	Daily
	Calibrate/Certify	Annually/As Needed
Laboratory Ovens	Temperature Monitoring	Daily
	Temperature Adjustments	As Needed
Incubators	Temperature Monitoring	Daily
	Temperature Adjustments	As Needed
Laboratory Refrigerators	Temperature Monitoring	Daily
	Temperature Adjustments	As Needed
D.I. Water System	Conductance Monitoring	Daily
	Resin and Carbon Tank Changes	As Needed

11.0 Quality Control Checks, Routines to Assess Pre-cision and Accuracy and Calculation of Method Detection Limits

11.1 Quality Control Checks

11.1.1 Field Quality Control Checks

Minimum requirements for Field Quality Control Checks and the frequency at which the check is performed are outlined below.

Type of QC Check	Minimum Frequency	Procedure
Equipment Blank (Pre-Cleaned)	5% per analyte group per equipment type used, or 1 per sampling event of same matrix, whichever is more frequent.	Fill or rinse pre-cleaned equipment with analyte-free water. Fill appropriate container, preserve, document, and transport in same manner as samples.
Equipment Blank (Field Cleaned)	When equipment is cleaned in the field, 5% per analyte group, per equip. type used, or 1 per field cleaning procedure per sampling event of same matrix, whichever is more frequent.	Fill or rinse pre-cleaned equipment with analyte-free water. Fill appropriate container, preserve, document, and transport in same manner as samples.
Trip Blank	One per VOC method, per shipping container.	Fill appropriate container with analyte-free water, preserve and document. Place in container for transport with bottles to and from site and analyzed for VOCs
Field Duplicate	One per sampling event with 5 or more samples of similar matrix at a 10% frequency thereafter.	Fill the appropriate container with a successively collected volume or portion of the original sample. Preserve, document, and transport in the same manner as samples.

11.1.2 Laboratory Quality Control Checks

Method specific Quality Control Checks will be followed where applicable. Where QC checks are not outlined in the appropriate method, or are less stringent, minimum requirements for Laboratory Quality Control Checks and the frequency with which the check is performed are outlined below.

Type of QC Check	Minimum Frequency	Procedure
Method Reagent Blank	One per sample set.	Analyte-free matrix is processed in same manner as samples.
Matrix Spike/Duplicate	5% of samples received per matrix.	Sample and duplicate fortified with known mount of analyte, processed in same manner as samples. Duplicate and spike recovery data is obtained and assessed.
Sample Duplicate	10% of samples received per matrix: applicable when spiking is not feasible.	Duplicate aliquot of sample is processed same manner as sample. Precision data is obtained.
Reagent Matrix Spikes (Laboratory Control Sample)	One per sample set or 5%, whichever is greater.	Analyte-free matrix, fortified with known amount of analyte obtained from an independent source is processed in same manner as samples.
Blind QC Check Samples	Semi-annually	Duplicate samples containing a known amount of analyte are submitted to the laboratory as blind checks are processed as routine unknown samples. Known concentrations are made available after submission of reported results.
Calibration Check Standards	After calibration, then 5% of analytical determinations in a sequence	Calibration reference standard is used to check validity of standard curve used for calibration during a sequence of determinations.
Analytical Spike(Post Spike)	All GFAA determinations	Sample fortified with known amount of analyte at the time of analysis. Analyzed immediately after the corresponding sample. Spike recovery is obtained and assessed.

Type of QC Check	Minimum Frequency	Procedure
Standard at 1-2 PQL	As part of the initial calibration curve or quality control check of the initial calibration. Alternatively, a continuing calibration standard may be used. The minimum frequency will be once per method on the days that analysis is performed.	An initial calibration, continuing calibration, or quality control standard will be fortified with the appropriate analytes. The number of analytes in the standard will be determined by the type of standard. In addition the criteria placed on this standard will be consistent with the type of standard.
Surrogate Spikes	All GC and GC/MS	All samples and QC samples are fortified determinationswith known amounts of analyte compound analogs prior to processing. Recovery data is obtained.
Internal Standards	All GC and GC/MS	All samples, standards and QC checks are determinations fortified with compound(s) of similar characteristic to analyte(s) prior to analysis. Internal standard response is used to assess and correct for variances during analysis.

11.2 Assessment of Precision and Accuracy

Quanterra Tampa uses specific routine procedures to assess the precision and accuracy of field and laboratory data. These procedures include the use of statistical data, quality control charts and detection limit studies, as outlined in the following sections.

11.2.1 Laboratory Data Precision and Accuracy Assessment

Procedures used to determine precision and accuracy targets are listed below.

Method	Purpose	Concentration Level	Method References
Matrix Spike/ Duplicate	Matrix Precision and Accuracy Data	Low Level	All water methods when feasible.
		Mid Level	All soil methods including those applied to waste samples, when feasible.
Sample Duplicate	Matrix Precision	NA	All methods where it is not feasible to spike analyte or or parameter of interest.
Reagent Matrix Spike (Laboratory Control Sample)	Method Accuracy Data	Low Level	All methods where spiking is feasible.
Blind QC Check Sample	Method Accuracy and Precision	Low Level	All methods.
Calibration Check Standard	Calibration Accuracy and Stability	Low Level	All methods.
Surrogate Spike	Method Efficiency for Each Sample	Low Level	All GC and GC/MS methods.
		Mid Level	GC & GC/MS VOA medium level.
Internal Standards	Chromatographic Efficiency	Low Level	All Chromatographic analyses.

Explanations:

Low level concentrations are the levels which fall between the minimum detection limit and 3 to 5 times that detection limit.

Mid level concentrations are at or about the mean concentration between the minimum detection limit and the upper end of the linear range.

High level concentrations which fall at or about the upper end of the linear range.

11.2.2 Formulas Used to Calculate Precision and Accuracy

Formulas used to calculate Precision and Accuracy of each type of QC Check are presented below.

a. Precision = Relative Percent Difference $=|C_1-C_2|/[(C_1+C_2)/2] \times 100$
(RPD)

where, C_1 and C_2 are concentrations of duplicate spikes or samples.

b. Accuracy (Percent Recovery) = $\frac{\text{(observed Concentration)}}{\text{(expected Concentration)}} \times 100$
(% R)

c. Analytical Control Limits:

	Accuracy	Precision
Upper Control Limit	Mean %R + 3S	Mean RPD + 3S
Upper Warning Limit	Mean %R + 2S	Mean RPD + 2S
Lower Warning Limit	Mean %R - 2S	
Lower Control Limit	Mean %R - 3S	

Where, S = Standard Deviation

d. For Atrazine and Simazine in water (Method 8141A), accuracy is calculated as % Recovery ± (3*Standard Deviation). Percent Recovery and Standard Deviation are from SW846, 3rd Edition, "Test Methods for Evaluating Solid Waste, Physical /Chemical Methods". Internally-derived accuracy will be evaluated as data becomes available. Precision is calculated as 2*(Standard Deviation) for the purposes of this revision. Standard Deviation is from SW846, 3rd Edition. Internally-derived precision will be evaluated as Mean Relative Percent Deviation + 3 (Standard Deviation) as data becomes available. For Atrazine and Simazine in solid matrices (Method 8141A), no literature targets for accuracy and precision were available, and thus, limits in Section 5.0 are advisory only. Internally-derived accuracy and precision will be evaluated as data becomes available.

e. For Method 8151, where method limits were available, accuracy is calculated as % Recovery ± (3*Standard Deviation). Percent Recovery and Standard Deviation are from SW846, 3rd Edition, "Test Methods for Evaluating Solid Waste, Physical /Chemical Methods". Internally-derived accuracy will be evaluated as data becomes available. Precision is calculated as 2*(Standard Deviation) for the purposes of this revision. Standard Deviation is from SW846, 3rd Edition. Internally-derived precision will be evaluated as Mean Relative Percent Deviation + 3 (Standard Deviation) as data becomes available. For Method 8151, where no method limits are available in the literature, yet internally-derived Method 8150 limits were available, precision and accuracy are from Method 8150 in the CompQAP. Internally-derived accuracy and precision will be evaluated for Method 8151 as data becomes available. Where no literature targets are available and where no internally-derived data is available for Method 8150 from the CompQAP, limits in Section 5.0 are advisory only. Internally-derived accuracy and precision will be evaluated as data becomes available.

11.2.3 Quality Control Charts

Quality control charts are computer generated, graphical representations of the mean percent recovery and mean relative percent difference for each method commonly used in the laboratory. These charts also delineate the warning and control limits established by historical laboratory data. The quality control charts provide a continuous indication of method performance by visibly comparing actual control recovery data to acceptable method performance criteria. Control charts will be generated and reviewed for trends, by the QA Manager, in evaluation of recurring nonconformances in a particular analytical area.

11.3 Method Detection Limits

The method detection limit (MDL) is the lowest concentration of an element or compound that can be measure with 99% confidence that the analyte concentration is greater than zero. It is determined that by analyzing a sample of a particular matrix which contains the analyte as outlined below and in 40 CFR Part 136 Appendix B. MDL determinations are performed annually or upon acquisition of new instrumentation.

a) Estimate the detection limit using one of the following:

1. The concentration value that corresponds to an instrument signal/noise ratio 2.5 to 5.
2. The concentration equal to three times the standard deviation of replicate measurements of the analyte in reagent water.
3. The region of the standard curve that shows a significant change in sensitivity.
4. Instrument limitations.

b) After the detection limit has been estimated it must also be calculated using the following procedure.

1. If the MDL is to be determined in analyte-free water, prepare a standard at a concentration between one and five times the estimated MDL.
2. If the MDL is to be determined in another sample matrix, analyze the sample. If the measured level of analyte is less than the MDL, add a known amount of analyte to bring the level between one and five times the estimated MDL. Then proceed to step c).
3. If the level of analyte in sample is between one and five times the MDL, proceed to step c).
4. If the measured concentration of analyte is greater than five times the estimated MDL, either:
   a. Obtain a different sample with a lower level of analyte, or
   b. Use the original sample as is if the analyte level does not exceed ten times the MDL of the analyte in reagent water.

c) Process a minimum of seven aliquots of the sample through the entire analytical procedure.

1. These seven aliquots may be processed at one time if the estimated MDL is thought to closely approach the value of the true MDL.

2. Where the estimate is in question, two aliquots may be processed at this time.

   a. If these measurements indicate that the sample is in the approximate range for MDL determination, five additional aliquots will be processed. All seven measurements are then used for calculation of the MDL.
   b. If the measurements show that the sample is not in the correct range, re-estimate the MDL and repeat the process.

d) Calculate the variance (S^2) and standard deviation (S) of the replicate measurements as follows:

$$S^2 = \frac{1}{n-1}\left[\frac{n\sum_{i=1}^{n} X_i^2 - \left(\sum_{i=1}^{n} X_i\right)^2}{n}\right]$$

$$S = \left(S^2\right)^{\frac{1}{2}}$$

where X_i(i= 1 to n) are the analytical results in the method reporting units obtained from the "n" sample aliquots and S refers to the sum of the X values from i = 1 to n.

e) Compute the MDL as follows:

$$MDL = t_{(n-1,\ 1-a = 0.99)}{}^{(S)}$$

where:

MDL =	the method detection limit
$t_{(n-1,\ 1-a = 0.99)}$ =	the student's t value appropriate for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom.
S =	Standard deviation of the replicate analyses.

f) The detection limit will be verified on a yearly basis. If the above criteria are not met during the verification, the detection limit study will be done again in full.

g) Student's t values are shown in Table 11-1.

h) For Atrazine and Simazine in water (Method 8141A), MDLs are from SW846, 3rd Edition, "Test Methods for Evaluating Solid Waste, Physical /Chemical Methods". Internally-derived MDLs will be evaluated as data becomes available. For Atrazine and Simazine in solid matrices (Method 8141A), no literature targets for MDLs were available, and thus, MDLs in Section 5.0 are advisory only. Internally-derived MDLs will be evaluated as data becomes available.

i) For Method 8151, where MDLs were available, they are from SW846, 3rd Edition, "Test Methods for Evaluating Solid Waste, Physical /Chemical Methods". Where no MDLs are available in the literature, yet internally-derived Method 8150 MDLs were available, MDLs listed in Section 5.0 are from Method 8150 in the CompQAP. Where no literature targets are available and where no internally-derived data is available for Method 8150 from the CompQAP, MDLs in Section 5.0 are advisory only. Internally-derived MDLs will be evaluated as data becomes available.

TABLE 11-1

STUDENT's t VALUES AT THE 99% CONFIDENCE LEVEL

Number of Replicates	Freedom	Degrees of t.99
7	6	3.143
8	7	2.998
9	8	2.896
10	9	2.821
11	10	2.764
16	15	2.602
21	20	2.528
26	25	2.485
31	30	2.457
61	60	2.390

12.0 Data Reduction, Validation and Reporting

Quanterra Tampa utilizes the laboratory computerized data management system to record, document, and assimilate pertinent laboratory technical and administrative data. This computerized system provides data management functions for a number of component laboratory activities including: laboratory sample acceptance, sample analytical results, sample status and tracking, analytical QA/QC, final report generation, and client invoicing. The data management system enhances efficient coordination among these component laboratory activities by providing a highly automated, standardized communication network for data transfer and correlation. This system is summarized below.

The computerized laboratory data management system (QuantIMS) assigns a unique laboratory identification number to each sample and records pertinent technical and administrative sample data. Technical sample data includes client sample identification, sample description, sampling date, required analytical parameters, and requested completion date. Administrative data is necessary for the final reporting and invoicing of sample results.

The data system assimilates data recorded by the sample custodian and generates laboratory worksheets for distribution to the appropriate analyst. These worksheets identify the analytical parameters and associated methods necessary to complete the requested sample analyses, along with the appropriate completion due dates. The due date requirements not only specify requested completion dates, but identify maximum allowable holding times for samples and/or extracts prior to analysis. The data system also automatically generates appropriate worksheets for the analysis of systematic quality control samples in accordance with laboratory QC procedures.

Specified laboratory personnel enter all completed sample analytical results and associated QC data into the data management system. The system's various data processing capabilities then automatically provide a number of component laboratory data management functions such as statistical evaluations and associated quality control charts, final sample analytical result reports, and sample tracking and status reports.

12.1 Data Reduction

Quanterra Tampa completes laboratory documentation measures to ensure the integrity and legal validity of all sample analytical results. These documentation measures encompass all sampling and analytical activities to create a traceable, legal history of each sample and subsequent analysis. All documented information is recorded in bound, consecutively-numbered analytical logbooks and/or the computerized data system. Raw data files and associated data reduction records are maintained by the laboratory in appropriately labelled files to allow systematic retrieval.

12.1.1 Data Reduction - Documentation Records

Component analytical documentation measures pertaining to data generation and reduction are outlined below and in Section 7.

Field Sample Logbooks

Data from all samples taken by laboratory personnel is entered in a hard-cover, bound laboratory field sample logbook consisting of consecutively-numbered 8 1/2" x 11" pages. This laboratory field sample logbook contains entries which document pertinent field data for each sample including:

Client
Name and address of field client
Project or sampling location
Exact location of sample point
Sampling methodology
Process generating sample (as applicable)
Sample container numbers and volumes
Date and time of collection
Field sample identification number or designation
Field observations and/or measurements
References such as maps, sketches, or photographs
Preservation and transport statement
Name(s) and signature(s) of sample collector(s)

Location of sample points is referenced to an established system, or if this is not available, given in such a manner that it can be clearly identified.

Laboratory Worksheets

The analytical specifications and subsequent results of each sample submitted to the laboratory are recorded on various Laboratory worksheets. The worksheets are generated by the laboratory computerized data management system from sample information initially entered into the computer by the Sample Custodian. Pertinent information on the worksheets includes sample identification, specified analytical parameters and methodology, holding times and due date requests, pertinent sample manipulation and preparation information, quality control data, and final analytical results as reported by the appropriate analyst. These worksheets are retained by the laboratory and stored alphabetically (by client) and sequentially in files to allow systematic retrieval. Worksheets are retained by the laboratory or the controlled off-site storage facility for seven years after completion.

Laboratory Method Logbooks

All laboratory analyses are entered into various laboratory method logbooks which categorically record and document the raw data for each analytical parameter routinely determined by the laboratory. Each analytical parameter and/or activity is assigned a particular logbook which records pertinent preparation, extraction, and instrumental data for each sample, as applicable. This information can include laboratory identification number, initial sample volume or weight, extraction volumes, dilution factors, instrument values and analyst name(s). These logbooks also

systematically include and facilitate sample manipulations required by the laboratory quality control plan. Method logbooks are retained by the QA Manager and stored sequentially at the laboratory or the controlled off-site storage facility for seven years after completion.

Laboratory Instrument Logbooks

All laboratory analyses requiring analytical instrumentation are recorded in various laboratory instrument logbooks which categorically record and document analytical instrument settings and performance data. These logbooks record instrument calibration data, specific sample amounts, instrument parameters, dates, analyst identification, and corresponding performance data for each sample. Where possible, laboratory method logbooks and laboratory instrument logbooks are consolidated into one logbook and laboratory instrument logbooks are consolidated into one unit. Instrument logbooks are retained by the QA Manager and stored sequentially at the laboratory or the controlled off-site storage facility for seven years after completion.

Laboratory Raw Data File

All raw data generated by laboratory equipment (such as integrating recorders, strip chart recorders, instrument data systems and secondary computer systems) pertaining to sample analytical data collection and reduction procedures are categorically filed in the laboratory raw data file. The files and the data included within are appropriately labelled with client and sample identification information to allow systematic retrieval and assessment of necessary information. Data files are filed alphabetically and sequentially by the analyst and are retained by the laboratory or the controlled off-site storage facility for seven years after completion.

Laboratory Electronic Data File

In addition to the laboratory raw data file, all raw data generated by instrument-specific computerized data systems are maintained on magnetic media for a period of one year after completion. Tape backups are sequentially numbered, and stored at the laboratory or the off-site storage facility in a climate-controlled environment. A categorized file containing full directory listings of each stored tape is maintained sequentially to allow systematic retrieval of magnetic data.

12.1.2 Data Reduction - Field Reportable Data

Field measurements may include pH, specific conductance, temperature, dissolved oxygen and/or residual chlorine. All of these parameters will be read directly from the instruments and the results entered into the legally bound field notebook by the field sampler. Conductivity and pH meters will be internally compensated for temperature and the conductivity cell constant is one. The only possible data calculation for field personnel would be a sample dilution, if necessary, when testing for residual chlorine or conductivity.

12.1.3 Data Reduction - Laboratory Reportable Data

All calculations in the laboratory are carried out as specified in the particular methods. Linear and logarithmic regressions are performed by computers with either instrument specific software and formulas or Lotus 123® or Microsoft EXCEL® spreadsheet package. A list of those instruments/methods which provide a direct readout are listed below. Following this are typical formulas used to reduce raw data to a reportable form.

Direct Reading Measurements

Measurements that typically do not require any particular calculation are Turbidity, pH, Flash Point, Residual Chlorine, Color, Ammonia (EPA 350.3), Fluoride, Odor. In addition, the ICP and Graphite Furnace AA provide data which is often in the final reportable form. Temperature compensations for all applicable measurements in the lab are performed internally by the measurement device.

Conductivity Cell Constant

The cell constant for the laboratory conductivity meter is calculated as follows:

$$C=(0.001413)(R_{KCl})[1 + 0.0191(t-25)]$$

Where, R_{KCl} = measured resistance in ohms
t = observed temperature in ^{0}C.

Method of Least Squares

The Method of Least Squares is a type of linear regression analysis which assumes a linear relationship between the variables. It is used with the Lotus 123® or Microsoft EXCEL® program to provide a calibration curve and calculate sample concentrations from instrument responses. The formula for this analysis is as follows:

$$y = a + bx$$

Where, y = the dependent variable (measured value, response factor, etc.)
a = the y intercept when x = 0 (calculated)
b = slope of the line (calculated)
x = independent variable (analyte amount or concentration, etc.)

External Standard Calibration

These calculations are utilized in chromatographic analyses to provide an approximation of the analyte concentration based on the response of a single standard or the mean value of a series of standards, without the use of an internal standard. The calculation is used as follows:

$$\text{Concentration (ug/g or ug/l)} = [Rf \times A_x \times V_f]/[V_s \times V_i] \times \text{dilution}$$

Where, Rf = standard amount (ng) / std response (counts)
A_x = sample response (counts)
V_s = initial sample volume (ml) or weight (g)
V_f = final sample volume (ml); N/A for Purge and Trap analysis
V_i = sample volume injected (ul); N/A for Purge and Trap analysis

Internal Standard Calibration

The internal standard is used to assess the variations which occur during a particular chromatographic analysis. The calculation used is described in the methodology as follows:

Concentration (ug/g or ug/l) = $[C_{is} \times A_x]/[V_s \times Rf \times A_{is}] \times$ dilution

Where, Rf = standard amount (ng) / std response (counts)

A_x = sample response (counts)

V_s = initial sample volume (ml) or weight (g)

C_{is} = amount of internal standard added to extract or sample

A_{is} = response of internal standard (counts)

12.1.4 Data Reduction - Analyst Responsibilities

All analytical results are calculated using equations specified in the methodology being performed. Values are calculated by the analyst performing the test using either a manual calculator, Lotus spreadsheet, or instrument-specific computerized data system.

Specific duties of the analyst regarding data reduction include:

Generation and compilation of raw data generated by proper use of the appropriate methodology.
Programming of calculators and/or computers with the proper equation, as specified in the applicable methodology.
Data entry into the appropriate formula.
Generation of final results and detection limits from the raw data using the appropriate formula.
Documentation of the above steps in the form of written calculations or computer printouts which specify raw data, formulas used, and final results.
Generation and proper storage of the raw data file associated with the analysis of particular sample.
Data entry of the reportable results onto the appropriate worksheet with analyst's initials and the date of analysis.

12.2 Data Validation

Quanterra Tampa's Quality Assurance/ Quality Control Program is designed to ensure the scientific and legal validity of all samples and analytical results. The QA/QC Program consists of a thorough laboratory documentation network in combination with systematic inclusion of various analytical quality control practices and checks.

The data validation process includes a series of checks designed to ensure adherence to standard QC protocol during the data collection, interpretation, calculation, and reporting process. Specific duties of each person in the process are assigned as follows:

12.2.1 Data Validation - Field

Field Analyst

The field analyst is responsible for sample procurement which follows the appropriate methodology and associated QC protocol. The field analyst is also responsible for performing the necessary field analytical procedures with the proper QC samples. The analyst is responsible for making the proper entries into the field sample logbook so that all necessary information is clearly identified and documented. The analyst is responsible for evaluating the entries, QC data, and all supporting documentation for completeness and accuracy.

Field Supervisor

The field supervisor is responsible for reviewing the field sample logbook and any supporting documentation (such as chain-of-custody) on a daily basis. This review should cover calculations, accuracy of any maps, appropriateness of any QC samples taken or analyzed, any calibrations performed and completeness. The field supervisor is also responsible for evaluating all QC data from the sampling event to ensure that it is within the given control limits. Any deviations from standard sampling protocol or from the established QC program in place for that sampling event should be noted in the logbook and on the chain-of-custody documentation. If the deviations affect the integrity of the samples or the quality of the field measurements then the QA Manager and the appropriate laboratory personnel are notified as soon as possible.

Sample Custodian

The sample custodian is responsible for receiving the samples from the field personnel and logging the samples into the laboratory data management system. The custodian is also responsible for reviewing the chain-of-custody and condition of the samples upon receipt. Any discrepancies are noted on a sample/cooler evaluation form and brought to the attention of the quality control coordinator and project manager. The custodian is responsible for generating the appropriate laboratory worksheets and an analytical request summary.

Project Manager

The project manager reviews the summary, sample/cooler evaluation form and chain-of-custody to ensure they are congruous and correct. Any discrepancies are noted on the summary and brought to the attention of the client and the QA Manager.

12.2.1 Data Validation - Laboratory

Laboratory Analyst

The laboratory analyst is responsible for performing analyses following the appropriately approved methodology and associated QC protocol. Raw data generated as such is then interpreted, calculated and assimilated into final results. Associated quality control data is assessed by the analyst for compliance with the QC Plan. This includes verification of the standardization process, assessment of method blank results, method blank spike results, and matrix spike duplicate results, and where applicable, internal standard and surrogate spike recoveries. In order to facilitate the validation process, the worksheets provided to the analyst for reporting purposes contain all quality control limits needed to assess compliance of the barious QC check samples. Upon completion of reporting, the analyst places all worksheets of a particular sample set along with the associated raw data into a file. The file is then submitted to a trained data review analyst for approval. Before submittal, the analyst is required to clearly identify any deviations to standard QC protocol on the worksheet associated with the affected sample.

Data Review Analyst

The data review analyst is responsible for verifying the content of the data file submitted by the Laboratory Analyst. Data review analysts are assigned based upon amount of experience in a particular laboratory section, knowledge of QC protocols and corrective action procedures, and training in the data review and reporting process. Review analysts are chosen by and receive training from the QA Manager and laboratory manager. Specific duties of the review analyst include verifying completeness and accuracy of all necessary raw data, identifying any obvious data anomalies, verifying the proper interpretation of the data, spot checking of calculations, proofing result entries on worksheets, and assessing compliance of applicable QC check samples. Any deviations from standard QC protocol are discussed with the analyst and brought to the attention of the QA Manager. Any necessary qualifications to the data are documented on the sample worksheets and are carried through the reporting process in a manner similar to the sample results to be included in the final report. The data review analyst may request the analyst to review and/or re-analyze samples if he/she feels that verification of sample data is warranted.

Quality Assurance Manager

The QA Manager oversees the data review process. This person is responsible for training, assigning and supporting data review analysts. The QA Manager investigates any deviations in QC protocol and ensures appropriate corrective action procedures are taken when necessary. The QA Manger has oversight of all narratives to reports which contain any anomalous sample or QC sample data.

Data Entry Analyst

The data entry analyst receives laboratory worksheets for entry into the computerized data reporting system. Duties include verifying the data reviewer's initials are on the worksheet, entering sample and associated QC data into the system, printing out results in the final report format, and proofreading the results for any data entry errors which may have occurred. This person is also responsible for maintaining the current copies of any corrective action worksheets associated with the sample data, which have been included by the analyst, data review analyst, and/or QA Manager.

Project Manager

The project manager is responsible for proofing the data entry of all sample and QC sample results. The project manager reviews all results in the final reporting format and draws comparisons to the analytical worksheets. The project manager is also trained to assess compliance of presented data with proper QC protocols. This person verifies that any deviations to acceptable procedures have been addressed in a narrative by the quality control officer, to be included in the final report. A copy of all applicable chain-of-custodies associated with the samples being reported is reviewed by the project manager for completeness. At this point, overall project data is assessed for completeness and accuracy. Site historical data is reviewed (if applicable), and any anomalies are investigated. The project manager may request the analyst to review and/or reanalyze samples if he/she feels that verification of sample data is warranted. The project manager reviews the final report copy before submission to the lab director for final review and then the client.

Laboratory Director

The laboratory director may conduct the final review and comparison of worksheets and reported data. This person may confirm that the appropriate QC checks and data validation have been carried out by reviewing and comparing data and narrations contained on the worksheets and the final report.

12.3 Data Reporting

As detailed in previous sections, all laboratory and field analytical results are reviewed by involved analyst(s), reporting personnel, and the project manager, and possibly the QA Manager and the Laboratory Director prior to final reporting. These individuals confirm that all analytical requests have been satisfied, associated quality control data are within acceptable performance limits, and any anomalies have been appropriately investigated and addressed.

The final analytical results report includes appropriate introductory comments, any QC narratives (when applicable), an analytical methods summary, sample analytical results, a QA/QC program summary, and associated QC data results. The sample results and QC results are generated in a uniform format by the laboratory computerized data management system. When the report is assembled it is copied onto letterhead paper and sent for review by the project manager and possibly the Laboratory Director. A sample final report is presented in Figure 12-1 pages 1 through 22.

FIGURE 12-1

SAMPLE FINAL REPORT
(Total 65 pages)

ANALYTICAL REPORT

PROJECT NO. PERF. EVAL.

WP034

KEVIN BULL

QUANTERRA, INC.

QUANTERRA INCORPORATED
Certification Numbers: E84059,HRS84297
FDEP CompQAP: 870270G

Project Manager

June 14, 1995

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
TRACE METALCONC 1 05/09/95				
Aluminum	928	1.0	ug/L	MCAWW 200.7
Arsenic	122	1.0	ug/L	MCAWW 200.7
Beryllium	13.3	1.0	ug/L	MCAWW 200.7
Cadmium	13.2	1.0	ug/L	MCAWW 200.7
Cobalt	130	1.0	ug/L	MCAWW 200.7
Chromium	92.6	1.0	ug/L	MCAWW 200.7
Copper	47.8	1.0	ug/L	MCAWW 200.7
Iron	650	1.0	ug/L	MCAWW 200.7
Mercury	1.8	0.20	ug/L	MCAWW 245.1
Manganese	288	1.0	ug/L	MCAWW 200.7
Nickel	82.6	1.0	ug/L	MCAWW 200.7
Lead	190	1.0	ug/L	MCAWW 200.7
Selenium	198	1.0	ug/L	MCAWW 200.7
Vanadium	5,220	1.0	ug/L	MCAWW 200.7
Zinc	493	1.0	ug/L	MCAWW 200.7
TRACE METALCONC 2 05/09/95				
Aluminum	2,470	1.0	ug/L	MCAWW 200.7
Arsenic	452	1.0	ug/L	MCAWW 200.7
Beryllium	91.8	1.0	ug/L	MCAWW 200.7
Cadmium	214	1.0	ug/L	MCAWW 200.7
Cobalt	329	1.0	ug/L	MCAWW 200.7
Chromium	354	1.0	ug/L	MCAWW 200.7
Copper	873	1.0	ug/L	MCAWW 200.7
Iron	967	1.0	ug/L	MCAWW 200.7
Mercury	1.3	0.20	ug/L	MCAWW 245.1
Manganese	1,430	1.0	ug/L	MCAWW 200.7
Nickel	797	1.0	ug/L	MCAWW 200.7
Lead	493	1.0	ug/L	MCAWW 200.7
Selenium	427	1.0	ug/L	MCAWW 200.7
Vanadium	9,170	1.0	ug/L	MCAWW 200.7
Zinc	966	1.0	ug/L	MCAWW 200.7
TRACE METALCONC 3 05/09/95				
Silver	35.4	1.0	ug/L	MCAWW 200.7
Molybdenum	30.9	1.0	ug/L	MCAWW 200.7
Antimony	123	1.0	ug/L	MCAWW 200.7
Strontium	43.9	1.0	ug/L	MCAWW 200.7
Titanium	36.3	1.0	ug/L	MCAWW 200.7
Thallium	228	1.0	ug/L	MCAWW 200.7

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
TRACE METALCONC 3 05/09/95				
TRACE METALCONC 4 05/09/95				
Silver	251	1.0	ug/L	MCAWW 200.7
Molybdenum	250	1.0	ug/L	MCAWW 200.7
Antimony	425	1.0	ug/L	MCAWW 200.7
Strontium	290	1.0	ug/L	MCAWW 200.7
Titanium	134	1.0	ug/L	MCAWW 200.7
Thallium	860	1.0	ug/L	MCAWW 200.7
MINERALS CONC 1A & 1B 05/09/95				
Specific Conductance	420	0.050	umhos/cm	MCAWW 120.1
Hardness	80.0	0.90	mg/L	MCAWW 130.2
Total Dissolved Solids	245	5.0	mg/L	MCAWW 160.1
Fluoride	2.1	0.010	mg/L	MCAWW 340.2
Chloride	58.5	2.0	mg/L	MCAWW 325.3
Sulfate	50.8	2.0	mg/L	MCAWW 375.4
Alkalinity, Total	47.0	5.0	mg/L	MCAWW 310.1
Calcium	22,400	1.0	ug/L	MCAWW 200.7
Potassium	33,000	1.0	ug/L	MCAWW 200.7
Magnesium	6,380	1.0	ug/L	MCAWW 200.7
Sodium	30,300	1.0	ug/L	MCAWW 200.7
MINERALS CONC 2A & 2B 05/09/95				
Specific Conductance	867	0.050	umhos/cm	MCAWW 120.1
Hardness	312	1.8	mg/L	MCAWW 130.2
Total Dissolved Solids	675	5.0	mg/L	MCAWW 160.1
Fluoride	0.57	0.010	mg/L	MCAWW 340.2
Chloride	253	10.0	mg/L	MCAWW 325.3
Sulfate	7.5	1.0	mg/L	MCAWW 375.4
Alkalinity, Total	10.0	5.0	mg/L	MCAWW 310.1
Calcium	82,900	1.0	ug/L	MCAWW 200.7
Potassium	9,830	1.0	ug/L	MCAWW 200.7
Magnesium	29,600	1.0	ug/L	MCAWW 200.7
Sodium	18,200	1.0	ug/L	MCAWW 200.7
MINERALS CONC 3 05/09/95				
pH Aqueous	7.6	0.050	su	MCAWW 150.1
MINERALS CONC 4 05/09/95				
pH Aqueous	8.8	0.050	su	MCAWW 150.1

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
NUTRIENT CONC 1 05/09/95				
Nitrogen, Ammonia	7.1	0.20	mg/L	MCAWW 350.2
Phosphorous, Ortho	0.94	0.10	mg/L	MCAWW 365.2
Nitrate	6.0	0.050	mg/L	MCAWW 353.3
NUTRIENT CONC 2 05/09/95				
Nitrogen, Ammonia	3.8	0.10	mg/L	MCAWW 350.2
Phosphorous, Ortho	0.46	0.10	mg/L	MCAWW 365.2
Nitrate	22.7	0.25	mg/L	MCAWW 353.3
NUTRIENT CONC 3 05/09/95				
Nitrogen, Total Kjeldahl	3.8	1.0	mg/L	MCAWW 351.3
Phosphorous, Total	4.1	0.040	mg/L	MCAWW 365.2
NUTRIENT CONC 4 05/09/95				
Nitrogen, Total Kjeldahl	16.2	1.0	mg/L	MCAWW 351.3
Phosphorous, Total	2.1	0.040	mg/L	MCAWW 365.2
DEMAND CONC 1 05/09/95				
Biochemical Oxygen Demand - 5 Day	28.8	0.40	mg/L	MCAWW 405.1
Carbon, Total Organic	20.8	1.0	mg/L	MCAWW 415.1
Chemical Oxygen Demand	53.9	14.0	mg/L	MCAWW 410.1
DEMAND CONC 2 05/09/95				
Biochemical Oxygen Demand - 5 Day	10.4	0.40	mg/L	MCAWW 405.1
Carbon, Total Organic	7.3	1.0	mg/L	MCAWW 415.1
Chemical Oxygen Demand	19.0	14.0	mg/L	MCAWW 410.1
PCB IN WATER CONC 1 05/09/95				
PCB-1260	1.4	1.0	ug/L	USEPA 608
PCB IN WATER CONC 2 05/09/95				
PCB-1016	4.9	1.0	ug/L	USEPA 608
PCB IN OIL CONC 1 05/09/95				
PCB-1260	35	5.0	ug/L	USEPA 608

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
PCB IN OIL CONC 2 05/09/95				
PCB-1254	15	5.0	ug/L	USEPA 608
PESTICIDE CONC 1 05/09/95				
Aldrin	1.5	0.10	ug/L	USEPA 608
4,4'-DDD	4.1	0.14	ug/L	USEPA 608
4,4'-DDE	2.7	0.060	ug/L	USEPA 608
4,4'-DDT	2.7	0.10	ug/L	USEPA 608
Dieldrin	4.4	0.16	ug/L	USEPA 608
Heptachlor	2.1	0.12	ug/L	USEPA 608
Heptachlor epoxide	1.9	0.080	ug/L	USEPA 608
PESTICIDE CONC 2 05/09/95				
Aldrin	0.30	0.050	ug/L	USEPA 608
4,4'-DDD	1.3	0.070	ug/L	USEPA 608
4,4'-DDE	1.1	0.030	ug/L	USEPA 608
4,4'-DDT	1.4	0.050	ug/L	USEPA 608
Dieldrin	1.7	0.080	ug/L	USEPA 608
Heptachlor	0.36	0.060	ug/L	USEPA 608
Heptachlor epoxide	0.35	0.040	ug/L	USEPA 608
PESTICIDE CONC 3 05/09/95				
Chlordane	2.2	1.0	ug/L	USEPA 608
PESTICIDE CONC 4 05/09/95				
Chlordane	5.1	5.0	ug/L	USEPA 608
VOLATILE HALOCARBON CONC 1 05/09/95				
Bromodichloromethane	74	1.0	ug/L	USEPA 601
Bromoform	54	0.20	ug/L	USEPA 601
Carbon tetrachloride	69	0.80	ug/L	USEPA 601
Chlorobenzene	58	0.40	ug/L	USEPA 601
Dibromochloromethane	66	1.0	ug/L	USEPA 601
Chloroform	65	0.60	ug/L	USEPA 601
1,2-Dichloroethane	72	1.0	ug/L	USEPA 601
Methylene chloride	65	1.0	ug/L	USEPA 601
Tetrachloroethene	60	0.60	ug/L	USEPA 601
1,1,1-Trichloroethane	50	0.50	ug/L	USEPA 601

5

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
Trichloroethene	65	0.70	ug/L	USEPA 601
VOLATILE HALOCARBON CONC 2 05/09/95				
Bromodichloromethane	19	1.0	ug/L	USEPA 601
Bromoform	18	0.20	ug/L	USEPA 601
Carbon tetrachloride	16	0.80	ug/L	USEPA 601
Chlorobenzene	15	0.40	ug/L	USEPA 601
Dibromochloromethane	15	1.0	ug/L	USEPA 601
Chloroform	16	0.60	ug/L	USEPA 601
1,2-Dichloroethane	14	1.0	ug/L	USEPA 601
Methylene chloride	11	1.0	ug/L	USEPA 601
Tetrachloroethene	15	0.60	ug/L	USEPA 601
1,1,1-Trichloroethane	15	0.50	ug/L	USEPA 601
Trichloroethene	11	0.70	ug/L	USEPA 601
VOLATILE AROMATICS CONC 1 05/09/95				
Benzene	12	0.50	ug/L	USEPA 602
1,2-Dichlorobenzene	15	0.70	ug/L	USEPA 602
1,3-Dichlorobenzene	17	0.80	ug/L	USEPA 602
1,4-Dichlorobenzene	19	0.80	ug/L	USEPA 602
Ethylbenzene	20	0.20	ug/L	USEPA 602
Toluene	21	0.20	ug/L	USEPA 602
VOLATILE AROMATICS CONC 2 05/09/95				
Benzene	50	0.50	ug/L	USEPA 602
1,2-Dichlorobenzene	66	0.70	ug/L	USEPA 602
1,3-Dichlorobenzene	61	0.80	ug/L	USEPA 602
1,4-Dichlorobenzene	60	0.80	ug/L	USEPA 602
Ethylbenzene	48	0.20	ug/L	USEPA 602
Toluene	64	0.20	ug/L	USEPA 602
TOTAL CYANIDE CONC 1 05/09/95				
Cyanide, Total	0.12	0.0010	mg/L	MCAWW 335.2
TOTAL CYANIDE CONC 2 05/09/95				
Cyanide, Total	0.86	0.0050	mg/L	MCAWW 335.2
NON-FILTERABLE RESIDUE (TSS) CONC 1 05/09/95				
Solids, Total Suspended	35.6	2.3	mg/L	MCAWW 160.2

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
NON-FILTERABLE RESIDUE (TSS) CONC 2 05/09/95				
Solids, Total Suspended	19.8	2.3	mg/L	MCAWW 160.2
OIL & GREASE CONC 1 05/09/95				
Oil and Grease, Gravimetric	10.3	5.0	mg/L	MCAWW 413.1
OIL & GREASE CONC 2 05/09/95				
Oil and Grease, Gravimetric	15.0	5.0	mg/L	MCAWW 413.1
TOTAL PHENOLICS CONC 1 05/09/95				
Phenolics	0.050	0.030	mg/L	MCAWW 420.1
TOTAL PHENOLICS CONC 2 05/09/95				
Phenolics	0.37	0.030	mg/L	MCAWW 420.1
TOTAL RESIDUAL CHLORINE CONC 1 05/09/95				
Chlorine, Total Residual	0.092	0.030	mg/L	MCAWW 330.5
TOTAL RESIDUAL CHLORINE CONC 2 05/09/95				
Chlorine, Total Residual	0.14	0.030	mg/L	MCAWW 330.5

ANALYTICAL METHODS SUMMARY

Parameters	Methods
Volatile Organics	USEPA 601
Volatile Organics	USEPA 602
Pest/PCB	USEPA 608
PCB Effluent Samples	USEPA 608
Specific Conductance	MCAWW 120.1
Hardness	MCAWW 130.2
pH Aqueous	MCAWW 150.1
Total Dissolved Solids	MCAWW 160.1
Solids, Total Suspended	MCAWW 160.2
Silver	MCAWW 200.7
Aluminum	MCAWW 200.7
Arsenic	MCAWW 200.7
Beryllium	MCAWW 200.7
Calcium	MCAWW 200.7
Cadmium	MCAWW 200.7
Cobalt	MCAWW 200.7
Chromium	MCAWW 200.7
Copper	MCAWW 200.7
Iron	MCAWW 200.7
Potassium	MCAWW 200.7
Magnesium	MCAWW 200.7
Manganese	MCAWW 200.7
Molybdenum	MCAWW 200.7
Sodium	MCAWW 200.7
Nickel	MCAWW 200.7
Lead	MCAWW 200.7
Antimony	MCAWW 200.7
Strontium	MCAWW 200.7
Titanium	MCAWW 200.7
Thallium	MCAWW 200.7
Vanadium	MCAWW 200.7
Zinc	MCAWW 200.7
Mercury	MCAWW 245.1
Chlorine, Total Residual	MCAWW 330.5
Cyanide, Total	MCAWW 335.2
Fluoride	MCAWW 340.2
Nitrogen, Ammonia	MCAWW 350.2
Nitrogen, Total Kjeldahl	MCAWW 351.3
Phosphorous, Ortho	MCAWW 365.2
Phosphorous, Total	MCAWW 365.2
Biochemical Oxygen Demand - 5 Day	MCAWW 405.1
Carbon, Total Organic	MCAWW 415.1
Nitrate	MCAWW 353.3
Oil and Grease, Gravimetric	MCAWW 413.1
Selenium	MCAWW 200.7
Chemical Oxygen Demand	MCAWW 410.1

ANALYTICAL METHODS SUMMARY

Parameters	Methods
Chloride	MCAWW 325.3
Phenolics	MCAWW 420.1
Sulfate	MCAWW 375.4
Alkalinity, Total	MCAWW 310.1

References:

MCAWW Methods for Chemical Analysis of Water and Wastes, EMSL: Cincinnati, OH: March 1983 and subsequent revisions

USEPA Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, 40CFR, Part 136, Appendix A, October 26,1984 and subsequent revisions

SAMPLE SUMMARY

The analytical results of the samples listed below are presented on the following pages.

WO #	LABORATORY ID	SAMPLE IDENTIFICATION	DATE/TIME SAMPLED
A4F69	B5E090003-001	TRACE METALCONC 1	5/09/95
A4F6C	B5E090003-002	TRACE METALCONC 2	5/09/95
A4F6D	B5E090003-003	TRACE METALCONC 3	5/09/95
A4F6F	B5E090003-004	TRACE METALCONC 4	5/09/95
A4F6J	B5E090003-005	MINERALS CONC 1A & 1B	5/09/95
A4F6L	B5E090003-006	MINERALS CONC 2A & 2B	5/09/95
A4F6N	B5E090003-007	MINERALS CONC 3	5/09/95
A4F6P	B5E090003-008	MINERALS CONC 4	5/09/95
A4F6V	B5E090003-009	NUTRIENT CONC 1	5/09/95
A4F73	B5E090003-010	NUTRIENT CONC 2	5/09/95
A4F77	B5E090003-011	NUTRIENT CONC 3	5/09/95
A4F7A	B5E090003-012	NUTRIENT CONC 4	5/09/95
A4F7C	B5E090003-013	DEMAND CONC 1	5/09/95
A4F7F	B5E090003-014	DEMAND CONC 2	5/09/95
A4F7W	B5E090003-015	PCB IN WATER CONC 1	5/09/95
A4F7X	B5E090003-016	PCB IN WATER CONC 2	5/09/95
A4F82	B5E090003-017	PCB IN OIL CONC 1	5/09/95
A4F83	B5E090003-018	PCB IN OIL CONC 2	5/09/95
A4F84	B5E090003-019	PESTICIDE CONC 1	5/09/95
A4F85	B5E090003-020	PESTICIDE CONC 2	5/09/95
A4F86	B5E090003-021	PESTICIDE CONC 3	5/09/95
A4F87	B5E090003-022	PESTICIDE CONC 4	5/09/95
A4F89	B5E090003-023	VOLATILE HALOCARBON CONC 1	5/09/95
A4F8A	B5E090003-024	VOLATILE HALOCARBON CONC 2	5/09/95
A4F8C	B5E090003-025	VOLATILE AROMATICS CONC 1	5/09/95
A4F8D	B5E090003-026	VOLATILE AROMATICS CONC 2	5/09/95
A4F8E	B5E090003-027	TOTAL CYANIDE CONC 1	5/09/95
A4F8F	B5E090003-028	TOTAL CYANIDE CONC 2	5/09/95
A4F8G	B5E090003-029	NON-FILTERABLE RESIDUE (TSS) CONC 1	5/09/95
A4F8H	B5E090003-030	NON-FILTERABLE RESIDUE (TSS) CONC 2	5/09/95
A4F8J	B5E090003-031	OIL & GREASE CONC 1	5/09/95
A4F8K	B5E090003-032	OIL & GREASE CONC 2	5/09/95
A4F8L	B5E090003-033	TOTAL PHENOLICS CONC 1	5/09/95
A4F8M	B5E090003-034	TOTAL PHENOLICS CONC 2	5/09/95
A4F8N	B5E090003-035	TOTAL RESIDUAL CHLORINE CONC 1	5/09/95
A4F8R	B5E090003-036	TOTAL RESIDUAL CHLORINE CONC 2	5/09/95

QUANTERRA, INC.

TRACE METALCONC 1

WO #: A4F69
LAB #: B5E090003-001
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - REQUESTED METALS - - - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Aluminum	928	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Arsenic	122	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Beryllium	13.3	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Cadmium	13.2	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Cobalt	130	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Chromium	92.6	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Copper	47.8	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Iron	650	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Manganese	288	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Nickel	82.6	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Lead	190	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Vanadium	5,220	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Zinc	493	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Mercury	1.8	0.20	ug/L	MCAWW 245.1	5/25- 5/26/95	5138121
Selenium	198	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171

NOTE: AS RECEIVED

QUANTERRA, INC.

TRACE METALCONC 2

WO #: A4F6C
LAB #: B5E090003-002
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - REQUESTED METALS - - - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Aluminum	2,470	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Arsenic	452	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Beryllium	91.8	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Cadmium	214	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Cobalt	329	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Chromium	354	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Copper	873	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Iron	967	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Manganese	1,430	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Nickel	797	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Lead	493	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Vanadium	9,170	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	513[illegible]71
Zinc	966	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Mercury	1.3	0.20	ug/L	MCAWW 245.1	5/25- 5/26/95	5138121
Selenium	427	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171

NOTE: AS RECEIVED

QUANTERRA, INC.

TRACE METALCONC 3

WO #: A4F6D
LAB #: B5E090003-003
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - - REQUESTED METALS - - - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Silver	35.4	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Molybdenum	30.9	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Antimony	123	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Strontium	43.9	1.0	ug/L	MCAWW 200.7	5/15- 5/26/95	5135171
Titanium	36.3	1.0	ug/L	MCAWW 200.7	5/15- 5/26/95	5135171
Thallium	228	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171

NOTE: AS RECEIVED

QUANTERRA, INC.

TRACE METALCONC 4

WO #: A4F6F
LAB #: B5E090003-004
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - - REQUESTED METALS - - - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Silver	251	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Molybdenum	250	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Antimony	425	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Strontium	290	1.0	ug/L	MCAWW 200.7	5/15- 5/25/95	5135171
Titanium	134	1.0	ug/L	MCAWW 200.7	5/15- 5/26/95	5135171
Thallium	860	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171

NOTE: AS RECEIVED

QUANTERRA, INC.

MINERALS CONC 1A & 1B

WO #: A4F6J
LAB #: B5E090003-005
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - - REQUESTED METALS - - - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Calcium	22,400	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Potassium	33,000	1.0	ug/L	MCAWW 200.7	5/15- 5/25/95	5135171
Magnesium	6,380	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Sodium	30,300	1.0	ug/L	MCAWW 200.7	5/15- 5/25/95	5135171

NOTE: AS RECEIVED

QUANTERRA, INC.

MINERALS CONC 2A & 2B

WO #: A4F6L
LAB #: B5E090003-006
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - REQUESTED METALS - - - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Calcium	82,900	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Potassium	9,830	1.0	ug/L	MCAWW 200.7	5/15- 5/26/95	5135171
Magnesium	29,600	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95	5135171
Sodium	18,200	1.0	ug/L	MCAWW 200.7	5/15- 5/25/95	5135171

NOTE: AS RECEIVED

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
Trichloroethene	65	0.70	ug/L	USEPA 601
VOLATILE HALOCARBON CONC 2 05/09/95				
Bromodichloromethane	19	1.0	ug/L	USEPA 601
Bromoform	18	0.20	ug/L	USEPA 601
Carbon tetrachloride	16	0.80	ug/L	USEPA 601
Chlorobenzene	15	0.40	ug/L	USEPA 601
Dibromochloromethane	15	1.0	ug/L	USEPA 601
Chloroform	16	0.60	ug/L	USEPA 601
1,2-Dichloroethane	14	1.0	ug/L	USEPA 601
Methylene chloride	11	1.0	ug/L	USEPA 601
Tetrachloroethene	15	0.60	ug/L	USEPA 601
1,1,1-Trichloroethane	15	0.50	ug/L	USEPA 601
Trichloroethene	11	0.70	ug/L	USEPA 601
VOLATILE AROMATICS CONC 1 05/09/95				
Benzene	12	0.50	ug/L	USEPA 602
1,2-Dichlorobenzene	15	0.70	ug/L	USEPA 602
1,3-Dichlorobenzene	17	0.80	ug/L	USEPA 602
1,4-Dichlorobenzene	19	0.80	ug/L	USEPA 602
Ethylbenzene	20	0.20	ug/L	USEPA 602
Toluene	21	0.20	ug/L	USEPA 602
VOLATILE AROMATICS CONC 2 05/09/95				
Benzene	50	0.50	ug/L	USEPA 602
1,2-Dichlorobenzene	66	0.70	ug/L	USEPA 602
1,3-Dichlorobenzene	61	0.80	ug/L	USEPA 602
1,4-Dichlorobenzene	60	0.80	ug/L	USEPA 602
Ethylbenzene	48	0.20	ug/L	USEPA 602
Toluene	64	0.20	ug/L	USEPA 602
TOTAL CYANIDE CONC 1 05/09/95				
Cyanide, Total	0.12	0.0010	mg/L	MCAWW 335.2
TOTAL CYANIDE CONC 2 05/09/95				
Cyanide, Total	0.86	0.0050	mg/L	MCAWW 335.2
NON-FILTERABLE RESIDUE (TSS) CONC 1 05/09/95				
Solids, Total Suspended	35.6	2.3	mg/L	MCAWW 160.2

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
PCB IN OIL CONC 2 05/09/95				
PCB-1254	15	5.0	ug/L	USEPA 608
PESTICIDE CONC 1 05/09/95				
Aldrin	1.5	0.10	ug/L	USEPA 608
4,4'-DDD	4.1	0.14	ug/L	USEPA 608
4,4'-DDE	2.7	0.060	ug/L	USEPA 608
4,4'-DDT	3.7	0.10	ug/L	USEPA 608
Dieldrin	4.4	0.16	ug/L	USEPA 608
Heptachlor	3.1	0.12	ug/L	USEPA 608
Heptachlor epoxide	1.9	0.080	ug/L	USEPA 608
PESTICIDE CONC 2 05/09/95				
Aldrin	0.30	0.050	ug/L	USEPA 608
4,4'-DDD	1.3	0.070	ug/L	USEPA 608
4,4'-DDE	1.1	0.030	ug/L	USEPA 608
4,4'-DDT	1.4	0.050	ug/L	USEPA 608
Dieldrin	1.7	0.030	ug/L	USEPA 608
Heptachlor	0.36	0.060	ug/L	USEPA 608
Heptachlor epoxide	0.35	0.040	ug/L	USEPA 608
PESTICIDE CONC 3 05/09/95				
Chlordane	2.2	1.0	ug/L	USEPA 608
PESTICIDE CONC 4 05/09/95				
Chlordane	5.1	5.0	ug/L	USEPA 608
VOLATILE HALOCARBON CONC 1 05/09/95				
Bromodichloromethane	74	1.0	ug/L	USEPA 601
Bromoform	54	0.20	ug/L	USEPA 601
Carbon tetrachloride	69	0.80	ug/L	USEPA 601
Chlorobenzene	58	0.40	ug/L	USEPA 601
Dibromochloromethane	66	1.0	ug/L	USEPA 601
Chloroform	65	0.60	ug/L	USEPA 601
1,2-Dichloroethane	72	1.0	ug/L	USEPA 601
Methylene chloride	65	1.0	ug/L	USEPA 601
Tetrachloroethene	60	0.60	ug/L	USEPA 601
1,1,1-Trichloroethane	50	0.50	ug/L	USEPA 601

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
NUTRIENT CONC 1 05/09/95				
Nitrogen, Ammonia	7.1	0.20	mg/L	MCAWW 350.2
Phosphorous, Ortho	0.94	0.10	mg/L	MCAWW 365.2
Nitrate	6.0	0.050	mg/L	MCAWW 353.3
NUTRIENT CONC 2 05/09/95				
Nitrogen, Ammonia	3.8	0.10	mg/L	MCAWW 350.2
Phosphorous, Ortho	0.46	0.10	mg/L	MCAWW 365.2
Nitrate	22.7	0.25	mg/L	MCAWW 353.3
NUTRIENT CONC 3 05/09/95				
Nitrogen, Total Kjeldahl	3.8	1.0	mg/L	MCAWW 351.3
Phosphorous, Total	4.1	0.040	mg/L	MCAWW 365.2
NUTRIENT CONC 4 05/09/95				
Nitrogen, Total Kjeldahl	16.2	1.0	mg/L	MCAWW 351.3
Phosphorous, Total	2.1	0.040	mg/L	MCAWW 365.2
DEMAND CONC 1 05/09/95				
Biochemical Oxygen Demand - 5 Day	28.8	0.40	mg/L	MCAWW 405.1
Carbon, Total Organic	20.8	1.0	mg/L	MCAWW 415.1
Chemical Oxygen Demand	53.9	14.0	mg/L	MCAWW 410.1
DEMAND CONC 2 05/09/95				
Biochemical Oxygen Demand - 5 Day	10.4	0.40	mg/L	MCAWW 405.1
Carbon, Total Organic	7.3	1.0	mg/L	MCAWW 415.1
Chemical Oxygen Demand	19.0	14.0	mg/L	MCAWW 410.1
PCB IN WATER CONC 1 05/09/95				
PCB-1260	1.4	1.0	ug/L	USEPA 608
PCB IN WATER CONC 2 05/09/95				
PCB-1016	4.9	1.0	ug/L	USEPA 608
PCB IN OIL CONC 1 05/09/95				
PCB-1260	35	5.0	ug/L	USEPA 608

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
TRACE METALCONC 3 05/09/95				
TRACE METALCONC 4 05/09/95				
Silver	251	1.0	ug/L	MCAWW 200.7
Molybdenum	250	1.0	ug/L	MCAWW 200.7
Antimony	425	1.0	ug/L	MCAWW 200.7
Strontium	290	1.0	ug/L	MCAWW 200.7
Titanium	134	1.0	ug/L	MCAWW 200.7
Thallium	860	1.0	ug/L	MCAWW 200.7
MINERALS CONC 1A & 1B 05/09/95				
Specific Conductance	420	0.050	umhos/cm	MCAWW 120.1
Hardness	80.0	0.90	mg/L	MCAWW 130.2
Total Dissolved Solids	245	5.0	mg/L	MCAWW 160.1
Fluoride	2.1	0.010	mg/L	MCAWW 340.2
Chloride	58.5	2.0	mg/L	MCAWW 325.3
Sulfate	50.8	2.0	mg/L	MCAWW 375.4
Alkalinity, Total	47.0	5.0	mg/L	MCAWW 310.1
Calcium	22,400	1.0	ug/L	MCAWW 200.7
Potassium	33,000	1.0	ug/L	MCAWW 200.7
Magnesium	6,380	1.0	ug/L	MCAWW 200.7
Sodium	30,300	1.0	ug/L	MCAWW 200.7
MINERALS CONC 2A & 2B 05/09/95				
Specific Conductance	867	0.050	umhos/cm	MCAWW 120.1
Hardness	312	1.8	mg/L	MCAWW 130.2
Total Dissolved Solids	675	5.0	mg/L	MCAWW 160.1
Fluoride	0.57	0.010	mg/L	MCAWW 340.2
Chloride	253	10.0	mg/L	MCAWW 325.3
Sulfate	7.5	1.0	mg/L	MCAWW 375.4
Alkalinity, Total	10.0	5.0	mg/L	MCAWW 310.1
Calcium	82,900	1.0	ug/L	MCAWW 200.7
Potassium	9,830	1.0	ug/L	MCAWW 200.7
Magnesium	29,600	1.0	ug/L	MCAWW 200.7
Sodium	18,200	1.0	ug/L	MCAWW 200.7
MINERALS CONC 3 05/09/95				
pH Aqueous	7.6	0.050	su	MCAWW 150.1
MINERALS CONC 4 05/09/95				
pH Aqueous	8.8	0.050	su	MCAWW 150.1

EXECUTIVE SUMMARY - Detection Highlights

B5E090003

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD
TRACE METALCONC 1 05/09/95				
Aluminum	928	1.0	ug/L	MCAWW 200.7
Arsenic	122	1.0	ug/L	MCAWW 200.7
Beryllium	13.3	1.0	ug/L	MCAWW 200.7
Cadmium	13.2	1.0	ug/L	MCAWW 200.7
Cobalt	130	1.0	ug/L	MCAWW 200.7
Chromium	92.6	1.0	ug/L	MCAWW 200.7
Copper	47.8	1.0	ug/L	MCAWW 200.7
Iron	650	1.0	ug/L	MCAWW 200.7
Mercury	1.8	0.20	ug/L	MCAWW 245.1
Manganese	288	1.0	ug/L	MCAWW 200.7
Nickel	83.6	1.0	ug/L	MCAWW 200.7
Lead	190	1.0	ug/L	MCAWW 200.7
Selenium	198	1.0	ug/L	MCAWW 200.7
Vanadium	5,220	1.0	ug/L	MCAWW 200.7
Zinc	493	1.0	ug/L	MCAWW 200.7
TRACE METALCONC 2 05/09/95				
Aluminum	2,470	1.0	ug/L	MCAWW 200.7
Arsenic	452	1.0	ug/L	MCAWW 200.7
Beryllium	91.8	1.0	ug/L	MCAWW 200.7
Cadmium	214	1.0	ug/L	MCAWW 200.7
Cobalt	329	1.0	ug/L	MCAWW 200.7
Chromium	354	1.0	ug/L	MCAWW 200.7
Copper	873	1.0	ug/L	MCAWW 200.7
Iron	967	1.0	ug/L	MCAWW 200.7
Mercury	1.3	0.20	ug/L	MCAWW 245.1
Manganese	1,430	1.0	ug/L	MCAWW 200.7
Nickel	797	1.0	ug/L	MCAWW 200.7
Lead	493	1.0	ug/L	MCAWW 200.7
Selenium	427	1.0	ug/L	MCAWW 200.7
Vanadium	9,170	1.0	ug/L	MCAWW 200.7
Zinc	966	1.0	ug/L	MCAWW 200.7
TRACE METALCONC 3 05/09/95				
Silver	35.4	1.0	ug/L	MCAWW 200.7
Molybdenum	30.9	1.0	ug/L	MCAWW 200.7
Antimony	123	1.0	ug/L	MCAWW 200.7
Strontium	43.9	1.0	ug/L	MCAWW 200.7
Titanium	36.3	1.0	ug/L	MCAWW 200.7
Thallium	228	1.0	ug/L	MCAWW 200.7

QUANTERRA, INC.

MINERALS CONC 1A & 1B

WO #: A4F6J
LAB #: B5E090003-005
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Specific Conductance	420	0.050	umhos/cm	MCAWW 120.1	6/06/95	5158084
Hardness	80.0	0.90	mg/L	MCAWW 130.2	6/06/95	5159144
Total Dissolved Solids	245	5.0	mg/L	MCAWW 160.1	6/06- 6/07/95	5159143
Fluoride	2.1	0.010	mg/L	MCAWW 340.2	6/06/95	5158082
Chloride	58.5	2.0	mg/L	MCAWW 325.3	6/06/95	5160089
Sulfate	50.8	2.0	mg/L	MCAWW 375.4	6/06/95	5160088
Alkalinity, Total	47.0	5.0	mg/L	MCAWW 310.1	6/06/95	5159093

NOTE: AS RECEIVED
CHLORIDE WAS RUN BY ION CHROMATOGRAPHY
SULFATE WAS RUN BY ION CHROMATOGRAPHY

QUANTERRA, INC.

MINERALS CONC 2A & 2B

WO #: A4F6L
LAB #: B5E090003-006
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Specific Conductance	867	0.050	umhos/cm	MCAWW 120.1	6/06/95	5158084
Hardness	312	1.8	mg/L	MCAWW 130.2	6/06/95	5159144
Total Dissolved Solids	675	5.0	mg/L	MCAWW 160.1	6/06- 6/07/95	5159143
Fluoride	0.57	0.010	mg/L	MCAWW 340.2	6/06/95	5158082
Chloride	253	10.0	mg/L	MCAWW 325.3	6/06/95	5160089
Sulfate	7.5	1.0	mg/L	MCAWW 375.4	6/06/95	5160088
Alkalinity, Total	10.0	5.0	mg/L	MCAWW 310.1	6/06/95	5159093

NOTE: AS RECEIVED
CHLORIDE WAS RUN BY ION CHROMAGRAPHY
SULFATE WAS RUN BY ION CHROMATOGRAPHY

QUANTERRA, INC.

MINERALS CONC 3

WO #: A4F6N
LAB #: B5E090003-007
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
pH Aqueous	7.6	0.050	su	MCAWW 150.1	6/06/95	5163127

NOTE: AS RECEIVED

QUANTERRA, INC.

MINERALS CONC 4

WO #: A4F6P
LAB #: B5E090003-008
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
pH Aqueous	8.8	0.050	su	MCAWW 150.1	6/06/95	5163127

NOTE: AS RECEIVED

QUANTERRA, INC.

NUTRIENT CONC 1

WO #: A4F6V
LAB #: B5E090003-009
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Nitrogen, Ammonia	7.1	0.20	mg/L	MCAWW 350.2	6/09/95	5160081
Phosphorous, Ortho	0.94	0.10	mg/L	MCAWW 365.2	6/09/95	5160110
Nitrate	6.0	0.050	mg/L	MCAWW 353.3	6/09/95	5160111

NOTE: AS RECEIVED

QUANTERRA, INC.

NUTRIENT CONC 2

WO #: A4F73
LAB #: B5E090003-010
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Nitrogen, Ammonia	3.8	0.10	mg/L	MCAWW 350.2	6/09/95	5160081
Phosphorous, Ortho	0.46	0.10	mg/L	MCAWW 365.2	6/09/95	5160110
Nitrate	22.7	0.25	mg/L	MCAWW 353.3	6/09/95	5160111

NOTE: AS RECEIVED

QUANTERRA, INC.

NUTRIENT CONC 3

WO #: A4F77
LAB #: B5E090003-011
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Nitrogen, Total Kjeldahl	3.8	1.0	mg/L	MCAWW 351.3	6/08/95	5159095
Phosphorous, Total	4.1	0.040	mg/L	MCAWW 365.2	6/08/95	5159140

NOTE: AS RECEIVED

QUANTERRA, INC.

NUTRIENT CONC 4

WO #: A4F7A
LAB #: B5E090003-012
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Nitrogen, Total Kjeldahl	16.2	1.0	mg/L	MCAWW 351.3	6/08/95	5159095
Phosphorous, Total	2.1	0.040	mg/L	MCAWW 365.2	6/08/95	5159140

NOTE: AS RECEIVED

QUANTERRA, INC.

DEMAND CONC 1

WO #: A4F7C
LAB #: B5E090003-013
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Biochemical Oxygen Demand - 5 Day	28.8	0.40	mg/L	MCAWW 405.1	6/07- 6/12/95	5163131
Carbon, Total Organic	20.8	1.0	mg/L	MCAWW 415.1	6/07/95	5159141
Chemical Oxygen Demand	53.9	14.0	mg/L	MCAWW 410.1	6/07/95	5159142

NOTE: AS RECEIVED

QUANTERRA, INC.

DEMAND CONC 2

WO #: A4F7F
LAB #: B5E090003-014
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Biochemical Oxygen Demand - 5 Day	10.4	0.40	mg/L	MCAWW 405.1	6/07- 6/12/95	5163131
Carbon, Total Organic	7.3	1.0	mg/L	MCAWW 415.1	6/07/95	5159141
Chemical Oxygen Demand	19.0	14.0	mg/L	MCAWW 410.1	6/07/95	5159142

NOTE: AS RECEIVED

QUANTERRA, INC.

PCB IN WATER CONC 1

WO #: A4F7W101
LAB #: B5E090003-015
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- GC Semi-Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
PCB-1016	ND	1.0	USEPA 608	05/11-05/16/95	5132045
PCB-1232	ND	1.0	USEPA 608	05/11-05/16/95	5132045
PCB-1248	ND	1.0	USEPA 608	05/11-05/16/95	5132045
PCB-1254	ND	1.0	USEPA 608	05/11-05/16/95	5132045
PCB-1260	1.4	1.0	USEPA 608	05/11-05/16/95	5132045

NOTE: AS RECEIVED
ND NOT DETECTED AT THE STATED REPORTING LIMIT

QUANTERRA, INC.

PCB IN WATER CONC 2

WO #: A4F7X101
LAB #: B5E090003-016
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- GC Semi-Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
PCB-1016	4.9	1.0	USEPA 608	05/11-05/16/95	5132045
PCB-1232	ND	1.0	USEPA 608	05/11-05/16/95	5132045
PCB-1248	ND	1.0	USEPA 608	05/11-05/16/95	5132045
PCB-1254	ND	1.0	USEPA 608	05/11-05/16/95	5132045
PCB-1260	ND	1.0	USEPA 608	05/11-05/16/95	5132045

NOTE: AS RECEIVED
ND NOT DETECTED AT THE STATED REPORTING LIMIT

QUANTERRA, INC.

PCB IN OIL CONC 1

WO #: A4F82101
LAB #: B5E090003-017
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- GC Semi-Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
PCB-1016	ND	5.0	USEPA 608	05/15-05/22/95	5135086
PCB-1232	ND	5.0	USEPA 608	05/15-05/22/95	5135086
PCB-1248	ND	5.0	USEPA 608	05/15-05/22/95	5135086
PCB-1254	ND	5.0	USEPA 608	05/15-05/22/95	5135086
PCB-1260	35	5.0	USEPA 608	05/15-05/22/95	5135086

NOTE: AS RECEIVED
ND NOT DETECTED AT THE STATED REPORTING LIMIT

QUANTERRA, INC.

PCB IN OIL CONC 2

WO #: A4F83101
LAB #: B5E090003-018
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- GC Semi-Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
PCB-1016	ND	5.0	USEPA 608	05/15-05/23/95	5135086
PCB-1232	ND	5.0	USEPA 608	05/15-05/23/95	5135086
PCB-1248	ND	5.0	USEPA 608	05/15-05/23/95	5135086
PCB-1254	15	5.0	USEPA 608	05/15-05/23/95	5135086
PCB-1260	ND	5.0	USEPA 608	05/15-05/23/95	5135086

NOTE: AS RECEIVED
ND NOT DETECTED AT THE STATED REPORTING LIMIT

QUANTERRA, INC.

PESTICIDE CONC 1

WO #: A4F84101
LAB #: B5E090003-019
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

GC Semi-Volatiles

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
Aldrin	1.5	0.10	USEPA 608	05/11-05/16/95	5132048
4,4'-DDD	4.1	0.14	USEPA 608	05/11-05/16/95	5132048
4,4'-DDE	2.7	0.060	USEPA 608	05/11-05/16/95	5132048
4,4'-DDT	2.7	0.10	USEPA 608	05/11-05/16/95	5132048
Dieldrin	4.4	0.16	USEPA 608	05/11-05/16/95	5132048
Heptachlor	2.1	0.12	USEPA 608	05/11-05/16/95	5132048
Heptachlor epoxide	1.9	0.080	USEPA 608	05/11-05/16/95	5132048

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Tetrachloro-m-xylene	78	(33 - 122)
Dibutylchlorendate	83	(18 - 129)

NOTE: AS RECEIVED

QUANTERRA, INC.

PESTICIDE CONC 2

WO #: A4F85101
LAB #: B5E090003-020
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- GC Semi-Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
Aldrin	0.30	0.050	USEPA 608	05/11-05/16/95	5132048
4,4'-DDD	1.3	0.070	USEPA 608	05/11-05/16/95	5132048
4,4'-DDE	1.1	0.030	USEPA 608	05/11-05/16/95	5132048
4,4'-DDT	1.4	0.050	USEPA 608	05/11-05/16/95	5132048
Dieldrin	1.7	0.080	USEPA 608	05/11-05/16/95	5132048
Heptachlor	0.36	0.060	USEPA 608	05/11-05/16/95	5132048
Heptachlor epoxide	0.35	0.040	USEPA 608	05/11-05/16/95	5132048

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Tetrachloro-m-xylene	75	(33 - 122)
Dibutylchlorendate	87	(18 - 129)

NOTE: AS RECEIVED

QUANTERRA, INC.

PESTICIDE CONC 3

WO #: A4F86101
LAB #: B5E090003-021
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- GC Semi-Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
Chlordane	2.2	1.0	USEPA 608	05/11-05/19/95	5132048

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Tetrachloro-m-xylene	91	(33 - 122)
Dibutylchlorendate	103	(18 - 129)

NOTE: AS RECEIVED

QUANTERRA, INC.

PESTICIDE CONC 4

WO #: A4F87101
LAB #: B5E090003-022
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- GC Semi-Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
Chlordane	5.1	5.0	USEPA 608	05/11-05/19/95	5132048

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Tetrachloro-m-xylene	DIL	(33 - 122)
Dibutylchlorendate	DIL	(18 - 129)

NOTE: AS RECEIVED

QUANTERRA, INC.

VOLATILE HALOCARBON CONC 1

WO #: A4F89101
LAB #: B5E090003-023
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- GC Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
Bromodichloromethane	74	1.0	USEPA 601	06/01/95	5153045
Bromoform	54	0.20	USEPA 601	06/01/95	5153045
Carbon tetrachloride	69	0.80	USEPA 601	06/01/95	5153045
Chlorobenzene	58	0.40	USEPA 601	06/01/95	5153045
Dibromochloromethane	66	1.0	USEPA 601	06/01/95	5153045
Chloroform	65	0.60	USEPA 601	06/01/95	5153045
1,2-Dichloroethane	72	1.0	USEPA 601	06/01/95	5153045
Methylene chloride	65	1.0	USEPA 601	06/01/95	5153045
Tetrachloroethene	60	0.60	USEPA 601	06/01/95	5153045
1,1,1-Trichloroethane	50	0.50	USEPA 601	06/01/95	5153045
Trichloroethene	65	0.70	USEPA 601	06/01/95	5153045

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Bromochloromethane	99	(78 - 122)

NOTE: AS RECEIVED

QUANTERRA, INC.

VOLATILE HALOCARBON CONC 2

WO #: A4F8A101
LAB #: B5E090003-024
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- GC Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
Bromodichloromethane	19	1.0	USEPA 601	06/01/95	5153045
Bromoform	18	0.20	USEPA 601	06/01/95	5153045
Carbon tetrachloride	16	0.80	USEPA 601	06/01/95	5153045
Chlorobenzene	15	0.40	USEPA 601	06/01/95	5153045
Dibromochloromethane	15	1.0	USEPA 601	06/01/95	5153045
Chloroform	16	0.60	USEPA 601	06/01/95	5153045
1,2-Dichloroethane	14	1.0	USEPA 601	06/01/95	5153045
Methylene chloride	11	1.0	USEPA 601	06/01/95	5153045
Tetrachloroethene	15	0.60	USEPA 601	06/01/95	5153045
1,1,1-Trichloroethane	15	0.50	USEPA 601	06/01/95	5153045
Trichloroethene	11	0.70	USEPA 601	06/01/95	5153045

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Bromochloromethane	87	(78 - 122)

NOTE: AS RECEIVED

QUANTERRA, INC.

VOLATILE AROMATICS CONC 1

WO #: A4F8C101
LAB #: B5E090003-025
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- GC Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
Benzene	12	0.50	USEPA 602	06/01/95	515304
1,2-Dichlorobenzene	15	0.70	USEPA 602	06/01/95	515304
1,3-Dichlorobenzene	17	0.80	USEPA 602	06/01/95	515304
1,4-Dichlorobenzene	19	0.80	USEPA 602	06/01/95	515304
Ethylbenzene	20	0.20	USEPA 602	06/01/95	515304
Toluene	21	0.20	USEPA 602	06/01/95	515304

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Trifluorotoluene	101	(73 - 131)

NOTE: AS RECEIVED

QUANTERRA, INC.

VOLATILE AROMATICS CONC 2

WO #: A4F8D101 DATE SAMPLED: 5/09/95
LAB #: B5E090003-026 TIME SAMPLED:
MATRIX: PE STAND DATE RECEIVED: 5/09/95

- GC Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	METHOD	EXTRACTION-ANALYSIS DATE	QC BATCH
Benzene	50	0.50	USEPA 602	06/01/95	5153046
1,2-Dichlorobenzene	66	0.70	USEPA 602	06/01/95	5153046
1,3-Dichlorobenzene	61	0.80	USEPA 602	06/01/95	5153046
1,4-Dichlorobenzene	60	0.80	USEPA 602	06/01/95	5153046
Ethylbenzene	48	0.20	USEPA 602	06/01/95	5153046
Toluene	64	0.20	USEPA 602	06/01/95	5153046

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Trifluorotoluene	102	(73 - 131)

NOTE: AS RECEIVED

QUANTERRA, INC.

TOTAL CYANIDE CONC 1

WO #: A4F8E
LAB #: B5E090003-027
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

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PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Cyanide, Total	0.12	0.0010	mg/L	MCAWW 335.2	6/07/95	5163129

NOTE: AS RECEIVED

QUANTERRA, INC.

TOTAL CYANIDE CONC 2

WO #: A4F8F
LAB #: B5E090003-028
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

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PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Cyanide, Total	0.86	0.0050	mg/L	MCAWW 335.2	6/07/95	5163129

NOTE: AS RECEIVED

QUANTERRA, INC.

NON-FILTERABLE RESIDUE (TSS) CONC 1

WO #: A4F8G
LAB #: B5E090003-029
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

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PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Solids, Total Suspended	35.6	2.3	mg/L	MCAWW 160.2	6/12/95	5163128

NOTE: AS RECEIVED

QUANTERRA, INC.

NON-FILTERABLE RESIDUE (TSS) CONC 2

WO #: A4F8H
LAB #: B5E090003-030
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

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PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Solids, Total Suspended	19.8	2.3	mg/L	MCAWW 160.2	6/12/95	5163128

NOTE: AS RECEIVED

QUANTERRA, INC.

OIL & GREASE CONC 1

WO #: A4F8J
LAB #: B5E090003-031
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Oil and Grease, Gravimetric	10.3	5.0	mg/L	MCAWW 413.1	6/08- 6/09/95	5159094

NOTE: AS RECEIVED

QUANTERRA, INC.

OIL & GREASE CONC 2

WO #: A4F8K
LAB #: B5E090003-032
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Oil and Grease, Gravimetric	15.0	5.0	mg/L	MCAWW 413.1	6/08- 6/09/95	5159094

NOTE: AS RECEIVED

QUANTERRA, INC.

TOTAL PHENOLICS CONC 1

WO #: A4F8L
LAB #: B5E090003-033
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Phenolics	0.050	0.030	mg/L	MCAWW 420.1	6/12/95	5163130

NOTE: AS RECEIVED

QUANTERRA, INC.

TOTAL PHENOLICS CONC 2

WO #: A4F8M
LAB #: B5E090003-034
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Phenolics	0.37	0.030	mg/L	MCAWW 420.1	6/12/95	5163130

NOTE: AS RECEIVED

QUANTERRA, INC.

TOTAL RESIDUAL CHLORINE CONC 1

WO #: A4F8N
LAB #: B5E090003-035
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Chlorine, Total Residual	0.092	0.030	mg/L	MCAWW 330.5	6/12/95	5163085

NOTE: AS RECEIVED

QUANTERRA, INC.

TOTAL RESIDUAL CHLORINE CONC 2

WO #: A4F8R
LAB #: B5E090003-036
MATRIX: PE STAND

DATE SAMPLED: 5/09/95
TIME SAMPLED:
DATE RECEIVED: 5/09/95

- - - - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - - -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE	QC BATCH
Chlorine, Total Residual	0.14	0.030	mg/L	MCAWW 330.5	6/12/95	5163085

NOTE: AS RECEIVED

Quality Control Summary

Quanterra QC Program Summary

Method Blanks

Laboratory Control Samples

Matrix Spike/Matrix Spike Duplicates

Chain-of-Custody

Quanterra Quality Control Program Summary

Quanterra Environmental Services considers continuous analytical method performance evaluations to be an integral portion of the data package, and routinely includes the pertinent QA/QC data associated with analytical results. Brief discussions of the various QA/QC procedures utilized to measure acceptable method and matrix performance follow. Further documentation of specific policies and procedures in use are available, upon request, from the Quanterra Quality Control Department.

The program described below provides Quanterra's interpretation of QC requirements described in SW-846, 3rd edition -Final Update II. Additional interpretations specific to other aspects of methods performed, such as instrument calibration and bench procedures, are described in program-specific documents (e.g. US Corps of Engineers, AFCEE, etc.) and associated method standard operating procedures. Where explicit program requirements or project requirements exist, certain elements of the Quanterra QC Program may be superseded by these requirements.

Elements of the Quanterra QC Program

Where other clear regulatory guidance, contract specifications, or client requirements are not available, the Quanterra QC Program provides guidance for Batch QC requirements. The Quality Control Batch is a set of up to 20 field samples of similar matrix, which are processed together under the same conditions, within the same time frame. Included in each Quality Control Batch is a Method Blank, Laboratory Control Sample, and Matrix Spike Duplicate. For methods that require independent sample preparation prior to analysis, the QC Batch is defined at the preparation stage. For methods that do not require independent sample preparation, the QC Batch is defined at the instrument. The QC Batch Number is provided on each result page in association with the parameter(s) presented, and may be used to cross-reference sample results with the associated QC data.

Method Blank Evaluations

Laboratory analytical method blanks are systematically prepared and analyzed in order to continuously evaluate the system interference and background contamination levels associated with each applicable analytical method. Method blanks include all aspects of actual laboratory procedures involving sample preparation and analysis, substituting analyte-free water or solid for the actual sample. Under normal circumstances, the Method Blank should not exhibit analytes of interest above the reported detection limit. Due to the presence of some analytes in a typical laboratory setting, the following common laboratory contaminants are exceptions to this rule, provided they are not present in the method blank at greater than five times the reporting limit.

Volatiles	Semi-Volatiles	Metals
Methylene chloride	Dimethyl phthalate	Calcium
Toluene	Diethyl phthalate	Magnesium
2-Butanone	Di-n-butyl-phthalate	Sodium
Acetone	Butyl benzyl phthalate	
	Bis (2-ethylhexyl) phthalate	

A method blank is performed with each analytical batch. A minimum of 5% of all laboratory analyses are method blanks.

Laboratory Control Sample (LCS) Evaluations

Known concentrations of designated matrix spike (target analyte) compounds are added to a method blank prior to extraction and analysis. Percent recovery determinations of individual target analytes in the LCS demonstrate the laboratory's method performance for the QC Batch relative to these target analytes (or other individual components represented by a subset of control analytes). Percent recovery data is displayed alongside acceptance criteria, that is typically derived from laboratory historical data. Failure of a Laboratory Control Sample to meet established recovery criteria for control analytes is cause for corrective actions to occur, which typically includes re-extraction and re-analysis of all samples associated with the QC Batch. An LCS is performed with each analytical batch. A minimum of 5% of all laboratory analyses are laboratory control samples.

Quanterra Quality Control Program Summary (continued)

Surrogate Spike Recovery Evaluations

For GC and GC/MS analyses, known concentrations of designated surrogate spikes, consisting of a number of similar, non-method compounds or method compound analogues, are added to sample fractions prior to sample extraction and analysis. The percent recovery determinations calculated from the subsequent analysis is one indication of the overall method efficiency for the individual sample. The surrogate spike recovery data is displayed alongside acceptance limits at the bottom of each applicable analytical result report page. Where sufficient laboratory-generated data does not yet exist to determine appropriate control limits, advisory limits may be enacted until sufficient data is collected to allow implementation of control limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Evaluations

In conjunction with the analysis of a client-provided field sample, a known concentration of designated matrix spike compounds (target analytes) are added to two aliquots of the actual sample. Percent recovery determinations are calculated from both spiked aliquots, using target analyte concentrations already present in the actual sample as a baseline. The percent recovery determinations indicate the accuracy of the method specific to the target analytes (or other individual components represented by a subset of control analytes) in the individual sample matrix. Comparison of the percent recoveries in the two spiked aliquots yields a relative percent difference (RPD). Percent recovery and relative percent difference data is displayed alongside historical criteria, that may be used to judge individual sample matrix effects for specific analytes. MS/MSD data is evaluated by the laboratory with respect to the individual sample matrix. In cases where MS/MSD data indicate sample method performance outside of historical criteria, the laboratory control sample results are referenced to ensure acceptable method performance by the laboratory for the sample batch. For analyses which are inappropriately suited for matrix spikes (e.g. pH), non-spiked duplicate analyses are performed to generate precision data. Matrix spike duplicates are typically performed on at least one sample within each analytical batch. A minimum of 10% of all laboratory analyses are matrix spikes or duplicates.

Corrective Action Evaluations

The goal of the Quanterra Quality Control Program is to generate data that demonstrates process control, and allows for client usability of data. Where the analytical process is demonstrated to vary from established criteria, or client requirements have not been met, data evaluation resulting in corrective action may be required. Corrective action may include re-preparation and/or reanalysis of field samples and QC samples. Where appropriate or necessary to allow proper interpretation of results presented in the final report, details of corrective actions taken during the laboratory processing of samples are presented as a case narrative at the front of the report. Alternatively, routine corrective action, such as reanalysis, may be footnoted on individual sample result pages.

Analytical Result Qualifier Flags

Where applicable , data qualifiers may be appended to analytical results in order to allow for proper interpretation of the result presented. Typically, the presence of data qualifier flag on an analytical result page is accompanied by a footnote explaining the qualifier. Common data qualifiers include, but are no limited to the following:

J -indicates an estimated concentration is reported due to method limitations such as matrix interference or instrumental detection limitations.

B -indicates the presence of a particular analyte in the associated laboratory method blank.

DIL -indicates percent recovery determination was not possible due to dilution associated with the sample matrix conditions or high target analyte concentrations.

X -indicates internal standards used for a GC or GC/MS analysis did not meet established criteria, typically due to a sample matrix effect.

E -indicates an estimated concentration is reported due to analyte response beyond the established instrumental calibration range, typically due to presence of a wide range of target analyte concentrations.

INTRA-LAB BLANK REPORT

LAB #: B5F020000-045

- GC Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	PREPARATION - ANALYSIS DATE	QC BATCH
Bromodichloromethane	ND	1.0	6/01/95	5153045
Bromoform	ND	0.20	6/01/95	5153045
Carbon tetrachloride	ND	0.80	6/01/95	5153045
Chlorobenzene	ND	0.40	6/01/95	5153045
Dibromochloromethane	ND	1.0	6/01/95	5153045
Chloroform	ND	0.60	6/01/95	5153045
1,2-Dichloroethane	ND	1.0	6/01/95	5153045
Methylene chloride	ND	1.0	6/01/95	5153045
Tetrachloroethene	ND	0.60	6/01/95	5153045
1,1,1-Trichloroethane	ND	0.50	6/01/95	5153045
Trichloroethene	ND	0.70	6/01/95	5153045

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Bromochloromethane	101	(78 - 122)

NOTE:

ND (NONE DETECTED)

INTRA-LAB BLANK REPORT

LAB #: B5F020000-046

- GC Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	PREPARATION - ANALYSIS DATE	QC BATCH
Benzene	ND	0.50	6/01/95	5153046
1,2-Dichlorobenzene	ND	0.70	6/01/95	5153046
1,3-Dichlorobenzene	ND	0.80	6/01/95	5153046
1,4-Dichlorobenzene	ND	0.80	6/01/95	5153046
Ethylbenzene	ND	0.20	6/01/95	5153046
Toluene	ND	0.20	6/01/95	5153046

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Trifluorotoluene	103	(73 - 131)

NOTE:

ND (NONE DETECTED)

INTRA-LAB BLANK REPORT

LAB #: B5E120000-045

- GC Semi-Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	PREPARATION - ANALYSIS DATE	QC BATCH
PCB-1016	ND	1.0	5/11- 5/16/95	5132045
PCB-1232	ND	1.0	5/11- 5/16/95	5132045
PCB-1248	ND	1.0	5/11- 5/16/95	5132045
PCB-1254	ND	1.0	5/11- 5/16/95	5132045
PCB-1260	ND	1.0	5/11- 5/16/95	5132045

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Tetrachloro-m-xylene	93	(33 - 122)

NOTE:

ND (NONE DETECTED)

INTRA-LAB BLANK REPORT

LAB #: B5E150000-086

- GC Semi-Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	PREPARATION - ANALYSIS DATE	QC BATCH
PCB-1016	ND	0.50	5/15- 5/20/95	5135086
PCB-1232	ND	0.50	5/15- 5/20/95	5135086
PCB-1248	ND	0.50	5/15- 5/20/95	5135086
PCB-1254	ND	0.50	5/15- 5/20/95	5135086
PCB-1260	ND	0.50	5/15- 5/20/95	5135086

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Tetrachloro-m-xylene	103	(32 - 154)

NOTE:

ND (NONE DETECTED)

INTRA-LAB BLANK REPORT

LAB #: B5E120000-048

- GC Semi-Volatiles -

PARAMETER	RESULT (ug/L)	REPORTING LIMIT	PREPARATION - ANALYSIS DATE	QC BATCH
Aldrin	ND	0.050	5/11- 5/16/95	5132048
Chlordane	ND	0.79	5/11- 5/16/95	5132048
4,4'-DDD	ND	0.070	5/11- 5/16/95	5132048
4,4'-DDE	ND	0.030	5/11- 5/16/95	5132048
4,4'-DDT	ND	0.050	5/11- 5/16/95	5132048
Dieldrin	ND	0.080	5/11- 5/16/95	5132048
Heptachlor	ND	0.060	5/11- 5/16/95	5132048
Heptachlor epoxide	ND	0.040	5/11- 5/16/95	5132048

SURROGATE RECOVERY	%	ACCEPTABLE LIMITS
Tetrachloro-m-xylene	78	(33 - 122)
Dibutylchlorendate	87	(18 - 129)

NOTE:

ND (NONE DETECTED)

INTRA-LAB BLANK REPORT

LAB #: B5E090003

- METALS -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATI ANALYSIS
		BATCH:5135171			
Silver	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/2
Aluminum	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/2
Arsenic	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/2
Beryllium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/2
Calcium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/2
Cadmium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/2
Cobalt	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24
Chromium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24
Copper	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24
Iron	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24
Potassium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/25
Magnesium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24
Manganese	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24
Molybdenum	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24
Sodium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/25
Nickel	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24
Lead	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24

NOTE:

ND NOT DETECTED AT THE STATED REPORTING LIMIT

INTRA-LAB BLANK REPORT

LAB #: B5E090003

- METALS -

PARAMETER	RESULT	REPORTING LIMIT	UNIT	METHOD	PREPARATION - ANALYSIS DATE
		BATCH:5135171			
Antimony	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95
Selenium	ND	1.0	mg/L	MCAWW 200.7	5/15- 5/24/95
Strontium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/25/95
Titanium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/26/95
Thallium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95
Vanadium	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95
Zinc	ND	1.0	ug/L	MCAWW 200.7	5/15- 5/24/95
		BATCH:5138121			
Mercury	ND	0.20	ug/L	MCAWW 245.1	5/25- 5/26/95

NOTE:

ND NOT DETECTED AT THE STATED REPORTING LIMIT

CHECK SAMPLE REPORT

LAB #: B5E090003

- - - - - - - - - - - - - - - - INORGANIC ANALYTICAL REPORT - - - - - - - - - - - - - - - -

COMPOUND	SPIKE PERCENT RECOVERY	LIMITS	PREPARATION - ANALYSIS DATE	Q/C BATCH
Specific Conductance	100	(87-105)	6/06/95	5158084
Hardness	100	(95-108)	6/06/95	5159144
pH Aqueous	100	(90-110)	6/06/95	5163127
Total Dissolved Solids	100	(77-115)	6/06- 6/07/95	5159143
Solids, Total Suspended	89	(77-115)	6/12/95	5163128
Cyanide	94	(56-128)	6/07/95	5163129
Fluoride	102	(93-116)	6/06/95	5158082
Nitrogen, Ammonia	100	(78-118)	6/09/95	5160081
Nitrogen, Total Kjeldahl	100	(84-122)	6/08/95	5159095
Phosphorous, Ortho	104	(74-127)	6/09/95	5160110
Phosphorous, Total	105	(74-127)	6/08/95	5159140
Biochemical Oxygen Demand - 5 Day	96	(48-112)	6/07- 6/12/95	516[illegible]31
Carbon, Total Organic	108	(90-117)	6/07/95	5159141
Nitrate	107	(63-130)	6/09/95	5160111
Oil and Grease, Gravimetric	103	(85-125)	6/08- 6/09/95	5159094
Chemical Oxygen Demand	105	(81-114)	6/07/95	5159142
Chloride	94	(86-117)	6/06/95	5160089
Phenolics	96	(64-102)	6/12/95	5163130
Sulfate	100	(80-120)	6/06/95	5160088
Alkalinity, Total	104	(90-110)	6/06/95	5159093

CHECK SAMPLE REPORT

QC BATCH: 5153045
LAB #: B5F020000-045 C

PREPARATION DATE: 6/01/95
DATE ANALYZED: 6/01/95

- GC Volatiles -

COMPOUND	SPIKE PERCENT RECOVERY	Q/C LIMITS
1,1-Dichloroethene	115	(28-167)
Methylene chloride	110	(25-162)
Chloroform	111	(49-133)
1,1,1-Trichloroethane	107	(41-138)
Carbon tetrachloride	127	(43-143)
1,2-Dichloroethane	108	(51-147)
Trichloroethene	107	(35-146)
Bromodichloromethane	124	(42-172)
Tetrachloroethene	109	(26-162)
Dibromochloromethane	128	(24-191)
Chlorobenzene	130	(38-150)
Bromoform	121	(13-159)

CHECK SAMPLE REPORT

QC BATCH: 5153046
LAB #: B5F020000-G46 C

PREPARATION DATE: 6/01/95
DATE ANALYZED: 6/01/95

- GC Volatiles -

COMPOUND	SPIKE PERCENT RECOVERY	Q/C LIMITS
Benzene	112	(39-150)
Toluene	111	(46-148)
Ethylbenzene	114	(32-160)
1,3-Dichlorobenzene	108	(50-141)
1,4-Dichlorobenzene	105	(42-143)
1,2-Dichlorobenzene	107	(37-154)

LCS - DCS REPORT

QC BATCH: 5132045
LAB #: B5E120000-045 C

WO #:
PREPARATION DATE: 5/11/95
DATE ANALYZED: 5/16/95

- GC Semi-Volatiles - - - - - - - - - - - - - - - - - - -

COMPOUND	LCS PERCENT RECOVERY	DCS PERCENT RECOVERY	Q/C LIMITS	RPD	RPD LIMITS
PCB-1016	98	100	(64-122)	1.7	29
PCB-1260	93	96	(28-146)	3.9	27

Calculations are performed before rounding to avoid round-off errors in calculated results

LCS - DCS REPORT

QC BATCH: 5135086
LAB #: B5E150000-086 C

WO #:
PREPARATION DATE: 5/15/95
DATE ANALYZED: 5/20/95

- GC Semi-Volatiles -

COMPOUND	LCS PERCENT RECOVERY	DCS PERCENT RECOVERY	Q/C LIMITS	RPD	RPD LIMITS
PCB-1016	101	102	(64-122)	0.51	29
PCB-1260	93	97	(28-146)	4.2	27

Calculations are performed before rounding to avoid round-off errors in calculated results

LCS - DCS REPORT

QC BATCH: 5132048
LAB #: B5E120000-048 C

WO #:
PREPARATION DATE: 5/11/95
DATE ANALYZED: 5/16/95

- GC Semi-Volatiles -

COMPOUND	LCS PERCENT RECOVERY	DCS PERCENT RECOVERY	Q/C LIMITS	RPD	RPD LIMITS
gamma-BHC (Lindane)	83	80	(68-142)	4.1	44
Heptachlor	75	73	(68-136)	2.2	40
Aldrin	69	65	(65-125)	6.2	32
Dieldrin	78	76	(66-136)	2.2	34
Endrin	81	79	(63-142)	2.1	37
4,4'-DDT	88	97	(62-142)	10	51

Calculations are performed before rounding to avoid round-off errors in calculated results

CHECK SAMPLE REPORT

LAB #: B5E090003

- METALS -

COMPOUND	SPIKE PERCENT RECOVERY	Q/C LIMITS	PREPARATION - ANALYSIS DATE
	BATCH:5135171		
Silver	98	(84-113)	5/15- 5/24/95
Aluminum	98	(83-117)	5/15- 5/24/95
Arsenic	98	(80-120)	5/15- 5/24/95
Beryllium	100	(81-112)	5/15- 5/24/95
Calcium	102	(85-121)	5/15- 5/24/95
Cadmium	101	(83-117)	5/15- 5/24/95
Cobalt	100	(87-115)	5/15- 5/24/95
Chromium	100	(89-117)	5/15- 5/24/95
Copper	97	(90-110)	5/15- 5/24/95
Iron	103	(86-124)	5/15- 5/24/95
Potassium	104	(69-131)	5/15- 5/25/95
Magnesium	100	(81-118)	5/15- 5/24/95
Manganese	102	(86-114)	5/15- 5/24/95
Molybdenum	97	(85-118)	5/15- 5/24/95
Sodium	101	(83-117)	5/15- 5/25/95
Nickel	101	(86-114)	5/15- 5/24/95
Lead	99	(83-117)	5/15- 5/24/95
Antimony	98	(73-118)	5/15- 5/24/95
Selenium	99	(80-120)	5/15- 5/24/95
Strontium	99	(80-120)	5/15- 5/25/95
Titanium	95	(-)	5/15- 5/26/95
Thallium	99	(83-130)	5/15- 5/24/95
Vanadium	101	(90-113)	5/15- 5/24/95
Zinc	100	(75-110)	5/15- 5/24/95
	BATCH:5138121		
Mercury	102	(75-121)	5/25- 5/26/95

13.0 Corrective Action

13.1 Nonconformances and Corrective Action

Corrective action action is a measure taken to rectify conditions that are adverse to quality, and where necessary, to preclude their recurrence. Corrective actions should be timely, determine the root cause and evaluate any propagation of the error or problem. Unplanned deviations from an established protocol or plan, that is, the events that often give rise to corrective actions, are termed nonconformances. The deviation may be the result of Quanterra Tampa's actions, and thus deemed a deficiency, or the result of actions outside of the control of Quanterra Tampa, and then termed an anomaly.

According to Quanterra Tampa's Standard Operating Procedure (SOP) TAMP-QA-0004 (Nonconformance and Corrective Action), all employees are responsible for identifying problems that may affect quality. In addition, individuals outside of Quanterra Tampa (for instance individuals representing the FDEP) can identify conditions adverse to quality through the review of records, audits, or performance audits. Such identification is documented on a Nonconformance Memo (Figure 13-1).

Once identified, laboratory management/supervisory staff are responsible for assigning an individual to perform the corrective action. In addition, project management staff has the responsibility of contacting laboratory clients regarding nonconformances and subsequent corrective actions. Actions by both laboratory and project management are documented by means of the initiating Nonconformance Memo (NCM). The QA Manager is responsible for oversight of the corrective action process, which is to incude the implementation of the NCM, the tracking of NCMs, and confirmation of the corrective action.

13.2 Batch QC Corrective Action

Quality control requirements of methods that are contained within SW846, and methods that are performed when no specific program is specified, are described in QA Policy No. QA-003 (Quanterra Quality Control Program). This document establishes criteria for QC samples/elements associated with a batch of samples (Batch QC), as defined by SW846. The criteria and associated corrective actions are described in Table 13-1. Any deviations from the established criteria are addressed by means of an NCM, described in section 13.1. Corrective actions to the deviations are addressed as previously described.

13.3 Method-Specific Corrective Actions

Method-specific criteria, for methods and procedures performed by Quanterra Tampa, are contained within SOPs developed and implemented by the laboratory. Each employee performing the method or procedure is to document any deviations from the SOP by means of the NCM. Corrective actions to the deviations are addressed as previously described.

TABLE 13.1
CORRECTIVE ACTION

QC Activity	Acceptance Criteria	Corrective Action
Equipment Blank	< LDL (Reporting)	Reprocess equipment and reanalyze or "flag" data.
Trip Blank	< LDL (Reporting)*	Verify contamination and investigate. "Flag" data.
Field Duplicate	Duplicate result must be within 20% of sample value.	Reanalyze then recollect samples and reprocess them.
Field Measurements Precision and Accuracy	Within established control limits.	Reanalyze then reprocess any affected samples.
Initial Instrument Blank	Inst. response < MDL	Prepare another and determine cause.
Calibration Check Standards	± 10% of expected value	Reanalyze then recalibrate and rerun.
Method Reagent Blanks	< LDL (Reporting) *	Reanalyze then reprocess entire batch.
Reagent Matrix Spike (Laboratory Control Sample)	Within established control limits.	Reanalyze then reprocess entire batch.
Matrix Spike and Duplicate	Relative percent deviation must be within established control limits.	Reanalyze then reprocess sample, matrix spike, matrix spike duplicate.
Sample Duplicate	Duplicate result must be within 15% of original sample value.	Reanalyze both sample and duplicate and then reprocess sample and duplicate.

TABLE 13-1
CORRECTIVE ACTION
(continued)

Surrogate Spikes	Within established control limits **.	Reanalyze then reprocess any affected samples.
Internal Standard	-50% to +150% of the calibration check.	Reanalyze then reprocess any affected samples.

Notes:

* Certain common lab contaminants are acceptable provided their concentration does not exceed five times the practical quantitation limit.

** Acceptable method performance for Base/Neutral Acid extractables is indicated by two (2) of three (3) surrogates for each fraction with a minimum recovery of ten (10) percent each. For Pesticides one (1) of two (2) surrogates meeting performance criteria is acceptable.

FIGURE 13-1

NONCONFORMANCE MEMO

LABORATORY NONCONFORMANCE MEMO (NCM)

Tampa Laboratory - May 4, 1995 - Revision 3

Lot: _____ Initiated By/Date: _____

Sample No.: _____

SOP No./Method: _____

Date Of Occurrence: _____

Analytical Group (check appropriate box):

- ☐ Shipping/Receiving
- ☐ Organic Preparation
- ☐ Metals Preparation
- ☐ GC-VOC
- ☐ GC-Semi/HPLC
- ☐ GCMS-VOC
- ☐ GCMS-Semi
- ☐ Wet chemistry
- ☐ Metals
- ☐ Reporting
- ☐ Data review
- ☐ _____

Nonconformance (check appropriate box): *To be completed by initiator of NCM*

Holding Time Violations (exceeded by _____ days)

Category I: Laboratory Independent

- ☐ 1. Holding time expired in transit
- ☐ 2. Sample received > 48 hrs. or ½ holding time has expired
- ☐ 3. Test added by client after expiration

Category II: Laboratory Dependent

- ☐ 4. Instrument failure
- ☐ 5. Analyst error
- ☐ 6. Login error
- ☐ 7. Miscommunication
- ☐ 8. Other (explanation required)

Category III: Analysis Reruns (QA/QC)

- ☐ 9. Surrogates
- ☐ 10. Internal standards
- ☐ 11. Spike recoveries
- ☐ 12. Blank contamination

Category IV: Analysis Reruns (Confirmation)

- ☐ 13. Second column
- ☐ 14. Contamination check
- ☐ 15. Confirmation of matrix effects
- ☐ 16. Other (explanation required)

Quality Assurance/Quality Control

- ☐ 17. QC data reported outside of controls
- ☐ 18. Incorrect procedure used
- ☐ 19. SOP intentionally modified with QA and Tech. approval
- ☐ 20. Invalid instrument calibration
- ☐ 21. Received insufficient sample for proper analysis

Incorrect or Incomplete Client Deliverable

- ☐ 22. Hardcopy deliverable error
- ☐ 23. Electronic deliverable error

Reported detection limits elevated due to:

- ☐ 24. Sample matrix
- ☐ 25. Insufficient sample volume
- ☐ 26. Other (explanation required)

Not Categorized

- ☐ 27. Other (explanation required)

Explanation: _____

Notification (check appropriate box): *To be completed by Project Manager*

Client notified by (name and date): _____

- ☐ In writing
- ☐ By telephone
- ☐ By facsimile
- ☐ Other (explain)

Client's name and response: _____

- ☐ Process "as is"
- ☐ On hold until _____
- ☐ Re-sample
- ☐ Other (explain)

Project Manager (signature and date): _____

QA/QC Logged: _____

FIGURE 13-1

NONCONFORMANCE MEMO
(continued)

LABORATORY NONCONFORMANCE MEMO (NCM) - May 4, 1995 - Revision 0

Corrective Action — *To be completed and reviewed by all associates involved*

Root Cause — Author's initials and date: _____

Corrective Action — Author's initials and date: _____

Responsibility for performing CA assigned to: _____

Actions to prevent recurrence — Author's initials and date: _____

Group Leader/Operations Manager signature: _____ Date: _____

Project Manager signature: _____ Date: _____

Quality Control/Quality Assurance Review — *To be completed by QA Department*

☐ Anomaly ☐ Deficiency

☐ Further action required: _____

Further action assigned to: _____

QA/QC signature: _____ Date: _____

Long Term Corrective Action Verification — *To be completed by QA Department*

☐ Verification not required or requested

Verified by: _____

Nonconformance Memo Closure

QA/QC signature: _____ Date: _____

The Quality Assurance Department maintains a copy of this NCM indicating its final status.

Page 2 of 2 QA/QC Logged: _____

14.0 Performance and Systems Audits

Quanterra Tampa maintains an internal system of performance and systems audits to verify the quality of its measurement systems. These audits are conducted on a regular basis as a part of normal laboratory operations. In addition, the laboratory participates in a number of federal, state, and private laboratory certification audit and/or approval programs in order to demonstrate its analytical capabilities and expertise. Participation in these programs requires the laboratory to demonstrate acceptable laboratory performance through satisfactory completion of routine systems and/or performance audits.

14.1 Systems Audits

14.1.1 Internal Audits

An annual systems audit is performed under the direction of the Corporate Director of Quality Assurance. This audit is performed to assess each laboratory's adherence to the requirements of Quanterra's Quality Management System, as defined by the Quality Management Plan (QMP), and the Quality Assurance Management Plan (QAMP). The systems audit also assesses the status of corrective actions from other audits at Quanterra Tampa. The Corporate Director of Quality Assurance appoints a lead auditor to conduct the systems audit. A corporate check list is used to document the audit (see Figure 14-1 for audit checklist outline).

14.1.2 External Audits

Quanterra Tampa participates in on-site external systems audits by the State of Florida Department of Health and Rehabilitative Services (FDHRS). This annual audit is required for certification by the FDHRS and is also required by the FDEP. The FDEP QA section is at liberty to conduct an on-site audit at their discretion or in conjunction with a site specific QAPP. Additionally, Quanterra Tampa encourages audits by its clients and other regulatory agencies. Agencies that have previously audited Quanterra Tampa include the New Jersey Department of Environmental Protection and Energy, the New York Department of Health, the North Carolina Department of Environment, Health, and Natural Resources, and the Air Force Center for Environmental Excellence.

14.2 Performance Audits

Quanterra Tampa participates in performance audits at a minimum of four times per year. The samples that comprise the performance audit may be supplied internally or externally as blind or double-blind samples. Internal performance audits may be conducted by the QA Manager, or under the guidance of the Corporate Director of Quality Assurance. External performance audits that Quanterra Tampa partakes in are conducted by the EPA (Water Supply and Water Pollution Studies), the Army Corps of Engineers, and the New York Department of Health. All results of performance audits, whether internal or external, are reported to the Regional QA Director and the Laboratory Manager. All performance audits that are identified as unacceptable are investigated. This investigation and the subsequent corrective action are also reported to management.

14.3 Data Audits and Spot Assessments

In addition, data audits are conducted by the QA Manager in accordance with QA Policy No. QA-006. The data audit is used to identify any lab errors that may have occurred during the laboratory activities. The findings (see Figure 14-2 for example of data audit checklist) and corrective actions resulting from the data audit are reported to the Regional QA Director and the Laboratory Manager.

Spot assessments are conducted to monitor or observe a process or activity in order to verify conformance to the specified requirements of that activity. The QA Manager determines the scope of the assessment, but it may be directed by client inquiries, trends in recorded nonconformances, performance audits, or other sources. The results of the spot assessment and any necessary corrective actions are reported to the Laboratory Manager.

Data audits and spot assessments should each be performed on a monthly basis.

FIGURE 14-1

INTERNAL SYSTEMS AUDIT CHECKLIST OUTLINE

Quanterra FY95 Audit Checklist Outline

I. Quality/Operations Files
- A. Quality Assurance Documents
- B. Audit/Spot Assessments
  - 1. Internal Spot Assessments
  - 2. Internal Quality Systems Audits
  - 3. External Audits
- C. Subcontractor Records
- D. PE Sample Records
- E. Nonconformance/Corrective Action
- F. Computer Software Verification/Validation Records
- G. Training Files
  - G Supplement

II. Customer Service

III. Sample Receipt/Log-In/Storage/Disposal
- A. SOPs
- B. Training
- C. Software Verification
- D. Sample Receipt
- E. Sample Log-In
- F. Sample Storage/Internal COC
- G. Sample Bottles
- H. Sample Disposal
- I. Data Recording Practices

IV. Record Management

V. Project Management

VI-VII. Sample Preparation (Inorganic and Organic)
- A. SOPs
- B. Material Procurement and Control
- C. Periodic Equipment Calibration
- D. Standards Preparation and Storage
- E. Sample Storage/Internal Chain of Custody
- F. Data Recording Practices
- G. Data Review
- H. Corrective Action Process
- I. Training
- J. Software Verification

VIII-XIII. Sample Analysis
VIII - Metals, IX - Wet Chemistry, X - GCMS Semivolatiles, XI - GC Semivolatiles, XII - GCMS Volatiles, XIII - GC Volatiles
- A. SOPs
- B. Material Procurement and Control
- C. Standards Preparation and Storage
- D. Sample Storage/Internal COC
- E. Calibrations (Periodic and Operational)
  - 1. Periodic Equipment Calibrations
  - 2. Operational Calibrations
- F. Preventive Maintenance
- G. Testing Initiation/Holding Times
- H. Sample Analysis
- I. QC Sample Analysis
- J. Data Review
- K. Detection Limit Studies
- L. Data Recording Practices
- M. Corrective Action
- N. Training
- O. Software Verification
- P. PE Results
- Q. Other Comments

XIV. Radiochemistry Supplement
- A. Facilities
- B. Sample Receipt and Disposal
- C. Sample/QC Sample Analysis
- D. SOPs

FIGURE 14-2

INTERNAL QA DATA AUDIT CHECKLIST

INTERNAL QA DATA AUDIT CHECKLIST

PROJECT #:_____ Auditor:_____

DATE RECEIVED:_____ Date Audited_____

DATE REPORTED:_____ PROJECT INVOICE AMT:_____

CHAIN OF CUSTODY AND LOG IN	YES	NO	NA
1. Chain of Custody present and properly signed			
2. Chain of Custody and log-in agree			
a. If no, have all discrepancies been resolved			
b. Is there adequate documentation to support any changes....			
3. Client's name and address			
4. Attention/Contact Name			
5. Date sampled			
6. Date received/relogged			
7. Client project #/identifier			
8. Lab assigned sample ID # (as recorded on login sheet)			
9. Client Sample IDs (transcribed correctly)			
10. Analysis Required			

FINAL REPORT REVIEW	YES	NO	NA
11. Cover letter is correct			
12. Anomalies documented in final report as appropriate			
13. Sample ID (sample descriptions/lab IDs correct)			
14. Methods and method numbers are correctly reported			
15. All requested parameters reported for each sample			
16. Report format is consistent with PA/Client request			
17. Noted client requests completed			
18. Data package complete			
19. Comparative data support: (8015 vs 418.1, 8015 vs 602/8020, 601/8010 and 602/8020 vs 624/8240, Phenols vs 604/8040 and 625/8270, TTLC vs STLC, conductivity vs TDS, dissolved metals < total metals, ICP vs GFAA, TDS < TS, TSS < TS, Cr(VI) < Cr, NH3 <TKN, TON < TKN, ortho-P < Total P, COD > 1.5x BOD, Reactive CN < Total CN, Reactive Sulfide < Total Sulfide, COD ~ 2.5x TOC, TDS/SPCD between 0.55-0.81, nitrate < nitrate/nitrite, nitrite < nitrate/nitrite, EPTOX or TCLP < 0.05x Total, pH vs alkalinity, influent vs. effluent, samples from same boring but different depths, data vs sample description, etc.)			

☐Auditor's Signature_____Date_____ (rev 1:7/94)

15.0 Quality Assurance Reports

15.1 External QA Reports

The QA Manager is responsible for filing a report with the FDEP, via the consulting firm that has prepared the Category 4 QAPP. The preparation of the QA Report would be at the request of that firm, and at a frequency of once per project (at completion) or every two years during a project. Typically, projects that Quanterra Tampa participates in do not require scheduled project audits and are usually less than two years in duration. When submitted, the QA Report would outline all criteria specified in Section D of the DEP QA manual.

15.2 Internal QA Reports

The QA Manager is responsible for preparing and submitting an internal report of the laboratory activities on a monthly basis. The report is laboratory specific and is submitted to the Regional QA Director and Laboratory Manager by the tenth day of each month. The report summarizes all quality control related activities of the lab, including percentages of QC samples; evaluations of method detection limit studies; systems audit results or performance evaluation results; a summary of any control problems encountered, and the outcome of any corrective action taken.

15.3 Project QA Reports

At the completion of a sampling and/or analytical project a QA report will accompany the analytical result report (see Figure 12-1). In most cases this will include any QC sample results that support the data presented and a summary of the QA/QC program. In addition, the narrative of the analytical report contains information as to nonconformances and corrective actions that were taken to resolve these nonconformances.

Kevin M. Bull
Quality Assurance Manager

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Quanterra
Environmental Services

January 10, 1996

IMS Environmental & Engineering
115 Metro Park
Rochester, NY 14623

Attention: Praveen Srivastava, Ph.D.

Dear Dr. Srivastava:

Please consider this letter an addendum to the previous letter of January 10, 1996. Included in this follow-up correspondence, are the following:

- TC lists for SW846 Method 8260 and 8270;
- LCS and MS/MSD control limit criteria for SW846 Method 8260;
- LCS and MS/MSD control limit criteria for SW846 Method 8270; and
- LCS and MS/MSD control limit criteria for SW846 Method 6010 and 6010 Trace.

Additionally, the control limit criteria for some analytes not included on the enclosed information are included in the following table.

	LCS			MS/MSD		
Analyte/Method	**LCL**	**UCL**	**RPD**	**LCL**	**UCL**	**RPD**
Carbazole by 8270	34	132	30	34	132	30
Benzo(b)fluoranthene by 8270	39	113	30	43	110	30
TRPH by 9071/418.1	72	120	25	86	143	12

If Quanterra Tampa can be of further assistance on this matter, please call Steve Tafuni or me at (813) 621-0784.

Sincerely,

Kevin M. Bull
Quality Assurance Manager

Enclosure

CIA50110.DOC

Reporting Limits
for
Target Compounds
by
SW846 Method 8260 and 8270

Quote No.: 12959
Revision: 1-00
Dated: 11/30/1995
Printed: 9:09:04 - 1/10/1996
Client Number: 360364
Project Manager: Steve Tafuni
Protocol: A soils
SAC: XX A 15 AF 36
List: 02001
Units: ug/kg
Test Description: SOLID, 8260, Volatile Organics, GC/MS (8

Analytical TAT: 21
Networkable (Y/N): Y
Tics (Y/N): N
Dry Weight (Y/N): Y
Qualifiers (Y/N): N

Synonym	Name	RL
00574	Chloromethane	10
00343	Bromomethane	10
02613	Vinyl chloride	10
00550	Chloroethane	10
01811	Methylene chloride	5
00011	Acetone	20
00459	Carbon disulfide	5
00943	1,1-Dichloroethene	5
00933	1,1-Dichloroethane	5
00952	1,2-Dichloroethene (total)	5
00569	Chloroform	5
00936	1,2-Dichloroethane	5
00372	2-Butanone	20
02518	1,1,1-Trichloroethane	5
00463	Carbon tetrachloride	5
00323	Bromodichloromethane	5
00986	1,2-Dichloropropane	5
00998	cis-1,3-Dichloropropene	5
02525	Trichloroethene	5
00535	Dibromochloromethane	5
02522	1,1,2-Trichloroethane	5
00196	Benzene	5
01000	trans-1,3-Dichloropropene	5
00340	Bromoform	5
01845	4-Methyl-2-pentanone	20
01515	2-Hexanone	20
02445	Tetrachloroethene	5
02439	1,1,2,2-Tetrachloroethane	5
02489	Toluene	5
00521	Chlorobenzene	5
01332	Ethylbenzene	5
02355	Styrene	5
02627	Xylenes (total)	5

Quote No.: 12959
Revision: 1-00
Dated: 11/30/1995
Printed: 9:09:05 - 1/10/1996
Client Number: 360364
Project Manager: Steve Tafuni
Protocol: A soils
SAC: XX A 11 FC 36
List: 02101
Units: ug/kg
Test Description: SOLID, 8270A, Base/Neutrals and Acids (8

Analytical TAT: 21
Networkable (Y/N): Y
Tics (Y/N): N
Dry Weight (Y/N): Y
Qualifiers (Y/N): N

Synonym	Name	RL
02155	Phenol	330
00293	bis(2-Chloroethyl) ether	330
00600	2-Chlorophenol	330
00907	1,3-Dichlorobenzene	330
00910	1,4-Dichlorobenzene	330
00904	1,2-Dichlorobenzene	330
01851	2-Methylphenol	330
00301	2,2'-Oxybis(1-Chloropropane)	330
01857	4-Methylphenol	330
02024	N-Nitrosodi-n-propylamine	330
01497	Hexachloroethane	330
01972	Nitrobenzene	330
01566	Isophorone	330
01998	2-Nitrophenol	330
01145	2,4-Dimethylphenol	330
00289	bis(2-Chloroethoxy)methane	330
00971	2,4-Dichlorophenol	330
02515	1,2,4-Trichlorobenzene	330
01932	Naphthalene	330
00518	4-Chloroaniline	330
01489	Hexachlorobutadiene	330
00578	4-Chloro-3-methylphenol	330
01829	2-Methylnaphthalene	330
01492	Hexachlorocyclopentadiene	330
02559	2,4,6-Trichlorophenol	330
02555	2,4,5-Trichlorophenol	330
00589	2-Chloronaphthalene	330
01960	2-Nitroaniline	1600
01149	Dimethyl phthalate	330
00005	Acenaphthylene	330
01193	2,6-Dinitrotoluene	330
01964	3-Nitroaniline	1600
00001	Acenaphthene	330
01187	2,4-Dinitrophenol	1600
02001	4-Nitrophenol	1600
00863	Dibenzofuran	330
01191	2,4-Dinitrotoluene	330
01082	Diethyl phthalate	330
00602	4-Chlorophenyl phenyl ether	330
01417	Fluorene	330
01968	4-Nitroaniline	1600
01167	4,6-Dinitro-2-methylphenol	1600
02028	N-Nitrosodiphenylamine	330
00348	4-Bromophenyl phenyl ether	330
01482	Hexachlorobenzene	330

Quote No.: 12959
Revision: 1-00
Dated: 11/30/1995
Printed: 9:09:05 - 1/10/1996
Client Number: 360364
Project Manager: Steve Tafuni
Protocol: A soils
SAC: XX A 11 FC 36
List: 02101
Units: ug/kg
Test Description: SOLID, 8270A, Base/Neutrals and Acids (8

Analytical TAT: 21
Networkable (Y/N): Y
Tics (Y/N): N
Dry Weight (Y/N): Y
Qualifiers (Y/N): N

Synonym	Name	RL
02118	Pentachlorophenol	1600
02154	Phenanthrene	330
00122	Anthracene	330
02751	Carbazole	330
00891	Di-n-butyl phthalate	330
01414	Fluoranthene	330
02252	Pyrene	330
00403	Butyl benzyl phthalate	330
00918	3,3'-Dichlorobenzidine	660
00202	Benzo(a)anthracene	330
00633	Chrysene	330
00302	bis(2-Ethylhexyl) phthalate	330
01162	Di-n-octyl phthalate	330
00205	Benzo(b)fluoranthene	330
00208	Benzo(k)fluoranthene	330
00211	Benzo(a)pyrene	330
01535	Indeno(1,2,3-cd)pyrene	330
00860	Dibenz(a,h)anthracene	330
00210	Benzo(ghi)perylene	330

Control Limit Criteria
for
Target Compounds
by
SW846 Method 8260 and 8270
and 6010

Quality Control Limit Summary

QC Type	C	LCS-DCS
Method:	AF	Volatile Organics, GC/MS (8260)
Location:	02	QUANTERRA - TAMPA
Program:	92	US AIR FORCE - AFCEE (9/93)
Extraction:		All, non-specific extractions
Matrix:	S	Solid
List:	02312	

Syn#	Compound Name	LCL	UCL	RPD
00011	Acetone	24.00	188.00	16.00
00196	Benzene	79.00	123.00	18.00
00323	Bromodichloromethane	74.00	115.00	23.00
00340	Bromoform	53.00	119.00	37.00
00343	Bromomethane	23.00	166.00	37.00
00372	2-Butanone	29.00	92.00	44.00
00459	Carbon disulfide	64.00	127.00	26.00
00463	Carbon tetrachloride	71.00	123.00	25.00
00521	Chlorobenzene	72.00	122.00	27.00
00535	Dibromochloromethane	67.00	116.00	33.00
00550	Chloroethane	72.00	149.00	22.00
00569	Chloroform	65.00	120.00	28.00
00574	Chloromethane	56.00	184.00	37.00
00888	Dibromomethane	74.00	137.00	26.00
00924	Dichlorodifluoromethane	84.00	161.00	29.00
00933	1,1-Dichloroethane	62.00	120.00	17.00
00936	1,2-Dichloroethane	76.00	125.00	23.00
00943	1,1-Dichloroethene	66.00	124.00	22.00
00950	trans-1,2-Dichloroethene	66.00	124.00	27.00
00952	1,2-Dichloroethene (total)	66.00	124.00	27.00
00986	1,2-Dichloropropane	79.00	121.00	20.00
00998	cis-1,3-Dichloropropene	76.00	115.00	20.00
01000	trans-1,3-Dichloropropene	68.00	114.00	24.00
01332	Ethylbenzene	73.00	130.00	24.00
01428	Trichlorofluoromethane	67.00	141.00	18.00
01515	2-Hexanone	35.00	119.00	34.00
01811	Methylene chloride	65.00	128.00	16.00
01845	4-Methyl-2-pentanone	32.00	184.00	40.00
02355	Styrene	76.00	125.00	29.00
02437	1,1,1,2-Tetrachloroethane	70.00	121.00	38.00
02439	1,1,2,2-Tetrachloroethane	65.00	124.00	38.00
02445	Tetrachloroethene	69.00	123.00	33.00
02489	Toluene	81.00	121.00	18.00
02518	1,1,1-Trichloroethane	62.00	120.00	28.00
02522	1,1,2-Trichloroethane	80.00	121.00	20.00
02525	Trichloroethene	77.00	121.00	19.00
02563	1,2,3-Trichloropropane	72.00	137.00	42.00
02610	Vinyl acetate	75.00	125.00	35.00
02613	Vinyl chloride	83.00	132.00	25.00
02627	Xylenes (total)	80.00	132.00	30.00
02730	Bromofluorobenzene	74.00	121.00	.00
02863	Dibromofluoromethane	80.00	120.00	.00
02740	Toluene-d8	81.00	117.00	.00

Quality Control Limit Summary

QC Type	S	MS-MSD
Method:	AF	Volatile Organics, GC/MS (8260)
Location:	02	QUANTERRA - TAMPA
Program:	92	US AIR FORCE - AFCEE (9/93)
Extraction:		All, non-specific extractions
Matrix:	S	Solid
List:	02313	

Syn#	Compound Name	LCL	UCL	RPD
00011	Acetone	9.00	97.00	39.00
00196	Benzene	84.00	123.00	14.00
00323	Bromodichloromethane	70.00	116.00	34.00
00340	Bromoform	46.00	85.00	34.00
00343	Bromomethane	39.00	123.00	31.00
00372	2-Butanone	.00	87.00	46.00
00459	Carbon disulfide	51.00	118.00	29.00
00463	Carbon tetrachloride	64.00	122.00	27.00
00521	Chlorobenzene	74.00	119.00	18.00
00535	Dibromochloromethane	54.00	118.00	37.00
00550	Chloroethane	80.00	150.00	24.00
00569	Chloroform	60.00	119.00	22.00
00574	Chloromethane	41.00	166.00	31.00
00888	Dibromomethane	61.00	140.00	24.00
00924	Dichlorodifluoromethane	87.00	153.00	23.00
00933	1,1-Dichloroethane	59.00	125.00	19.00
00936	1,2-Dichloroethane	70.00	129.00	25.00
00943	1,1-Dichloroethene	65.00	133.00	23.00
00950	trans-1,2-Dichloroethene	60.00	126.00	20.00
00952	1,2-Dichloroethene (total)	60.00	126.00	20.00
00986	1,2-Dichloropropane	82.00	121.00	21.00
00998	cis-1,3-Dichloropropene	65.00	106.00	25.00
01000	trans-1,3-Dichloropropene	58.00	100.00	32.00
01332	Ethylbenzene	57.00	144.00	29.00
01428	Trichlorofluoromethane	61.00	138.00	23.00
01515	2-Hexanone	4.00	76.00	48.00
01811	Methylene chloride	67.00	131.00	19.00
01845	4-Methyl-2-pentanone	27.00	109.00	33.00
02355	Styrene	63.00	120.00	18.00
02437	1,1,1,2-Tetrachloroethane	68.00	118.00	27.00
02439	1,1,2,2-Tetrachloroethane	36.00	127.00	38.00
02445	Tetrachloroethene	59.00	123.00	24.00
02489	Toluene	71.00	125.00	21.00
02518	1,1,1-Trichloroethane	50.00	126.00	21.00
02522	1,1,2-Trichloroethane	71.00	116.00	27.00
02525	Trichloroethene	73.00	121.00	17.00
02563	1,2,3-Trichloropropane	33.00	141.00	45.00
02610	Vinyl acetate	75.00	125.00	35.00
02613	Vinyl chloride	71.00	173.00	26.00
02627	Xylenes (total)	68.00	137.00	24.00
02730	Bromofluorobenzene	74.00	121.00	.00
02863	Dibromofluoromethane	80.00	120.00	.00
02740	Toluene-d8	81.00	117.00	.00
00318	Bromobenzene	84.00	117.00	20.00
00321	Bromochloromethane	73.00	107.00	20.00
00393	n-Butylbenzene	77.00	123.00	20.00

Quality Control Limit Summary

QC Type	C	LCS-DCS
Method:	FC	Base/Neutrals and Acids (8270)
Location:	02	QUANTERRA - TAMPA
Program:	92	US AIR FORCE - AFCEE (9/93)
Extraction:		All, non-specific extractions
Matrix:	S	Solid
List:	02314	

Syn#	Compound Name	LCL	UCL	RPD
02155	Phenol	38.00	109.00	30.00
00293	bis(2-Chloroethyl) ether	44.00	106.00	30.00
00600	2-Chlorophenol	44.00	100.00	30.00
00907	1,3-Dichlorobenzene	42.00	99.00	30.00
00910	1,4-Dichlorobenzene	44.00	99.00	30.00
00215	Benzyl alcohol	29.00	115.00	30.00
00904	1,2-Dichlorobenzene	46.00	97.00	30.00
01851	2-Methylphenol	46.00	100.00	30.00
00298	bis(2-Chloroisopropyl) ether	36.00	166.00	30.00
02777	3-Methylphenol & 4-Methylphenol	27.00	108.00	30.00
02024	N-Nitrosodi-n-propylamine	46.00	104.00	30.00
01497	Hexachloroethane	44.00	97.00	30.00
01972	Nitrobenzene	37.00	92.00	30.00
01566	Isophorone	51.00	105.00	30.00
01998	2-Nitrophenol	49.00	105.00	30.00
01145	2,4-Dimethylphenol	39.00	88.00	30.00
00289	bis(2-Chloroethoxy)methane	29.00	125.00	30.00
00971	2,4-Dichlorophenol	50.00	105.00	30.00
02515	1,2,4-Trichlorobenzene	46.00	101.00	30.00
01932	Naphthalene	47.00	104.00	30.00
00518	4-Chloroaniline	40.00	100.00	30.00
01489	Hexachlorobutadiene	46.00	100.00	30.00
00578	4-Chloro-3-methylphenol	58.00	112.00	30.00
01829	2-Methylnaphthalene	50.00	105.00	30.00
01492	Hexachlorocyclopentadiene	41.00	115.00	30.00
02559	2,4,6-Trichlorophenol	51.00	114.00	30.00
02555	2,4,5-Trichlorophenol	45.00	127.00	30.00
00589	2-Chloronaphthalene	55.00	105.00	30.00
01960	2-Nitroaniline	62.00	117.00	30.00
01149	Dimethyl phthalate	63.00	119.00	30.00
00005	Acenaphthylene	56.00	112.00	30.00
01193	2,6-Dinitrotoluene	62.00	116.00	30.00
01964	3-Nitroaniline	50.00	99.00	30.00
00001	Acenaphthene	55.00	110.00	30.00
01187	2,4-Dinitrophenol	43.00	129.00	30.00
02001	4-Nitrophenol	40.00	143.00	30.00
00863	Dibenzofuran	58.00	112.00	30.00
01191	2,4-Dinitrotoluene	56.00	127.00	30.00
01082	Diethyl phthalate	61.00	125.00	30.00
00602	4-Chlorophenyl phenyl ether	56.00	117.00	30.00
01417	Fluorene	58.00	117.00	30.00
01968	4-Nitroaniline	53.00	125.00	30.00
01167	4,6-Dinitro-2-methylphenol	42.00	146.00	30.00
02028	N-Nitrosodiphenylamine	78.00	145.00	30.00
00348	4-Bromophenyl phenyl ether	62.00	115.00	30.00
01482	Hexachlorobenzene	61.00	116.00	30.00

Quality Control Limit Summary

QC Type	C	LCS-DCS
Method:	FC	Base/Neutrals and Acids (8270)
Location:	02	QUANTERRA - TAMPA
Program:	92	US AIR FORCE - AFCEE (9/93)
Extraction:		All, non-specific extractions
Matrix:	S	Solid
List:	02314	

Syn#	Compound Name	LCL	UCL	RPD
02118	Pentachlorophenol	40.00	125.00	30.00
02154	Phenanthrene	63.00	118.00	30.00
00122	Anthracene	63.00	125.00	30.00
00891	Di-n-butyl phthalate	55.00	134.00	30.00
01414	Fluoranthene	58.00	127.00	30.00
02252	Pyrene	68.00	116.00	30.00
00403	Butyl benzyl phthalate	65.00	125.00	30.00
00918	3,3'-Dichlorobenzidine	38.00	107.00	30.00
00202	Benzo(a)anthracene	69.00	119.00	30.00
00633	Chrysene	66.00	119.00	30.00
00302	bis(2-Ethylhexyl) phthalate	66.00	124.00	30.00
01162	Di-n-octyl phthalate	43.00	117.00	30.00
00205	Benzo(b)fluoranthene	45.00	113.00	30.00
00211	Benzo(a)pyrene	44.00	112.00	30.00
01535	Indeno(1,2,3-cd)pyrene	39.00	114.00	30.00
02669	Dibenzo(a,h)anthracene	50.00	98.00	30.00
00210	Benzo(ghi)perylene	38.00	115.00	30.00
02736	Nitrobenzene-d5	10.00	155.00	.00
01425	2-Fluorobiphenyl	12.00	153.00	.00
02738	Terphenyl-d14	13.00	140.00	.00
01426	2-Fluorophenol	24.00	118.00	.00
02737	Phenol-d5	17.00	124.00	.00
02512	2,4,6-Tribromophenol	10.00	156.00	.00
02770	1-Methylnaphthalene	50.00	150.00	30.00
00209	Benzoic acid	10.00	121.00	30.00

Quality Control Limit Summary

QC Type	S	MS-MSD
Method:	FC	Base/Neutrals and Acids (8270)
Location:	02	QUANTERRA - TAMPA
Program:	92	US AIR FORCE - AFCEE (9/93)
Extraction:		All, non-specific extractions
Matrix:	S	Solid
List:	02315	

Syn#	Compound Name	LCL	UCL	RPD
02155	Phenol	37.00	110.00	30.00
00293	bis(2-Chloroethyl) ether	10.00	138.00	30.00
00600	2-Chlorophenol	37.00	106.00	30.00
00907	1,3-Dichlorobenzene	36.00	99.00	30.00
00910	1,4-Dichlorobenzene	36.00	100.00	30.00
00215	Benzyl alcohol	36.00	114.00	30.00
00904	1,2-Dichlorobenzene	40.00	101.00	30.00
01851	2-Methylphenol	43.00	109.00	30.00
00298	bis(2-Chloroisopropyl) ether	42.00	102.00	30.00
02777	3-Methylphenol & 4-Methylphenol	27.00	108.00	30.00
02024	N-Nitrosodi-n-propylamine	39.00	108.00	30.00
01497	Hexachloroethane	36.00	101.00	30.00
01972	Nitrobenzene	39.00	92.00	30.00
01566	Isophorone	42.00	110.00	30.00
01998	2-Nitrophenol	42.00	112.00	30.00
01145	2,4-Dimethylphenol	45.00	128.00	30.00
00289	bis(2-Chloroethoxy)methane	41.00	110.00	30.00
00971	2,4-Dichlorophenol	42.00	116.00	30.00
02515	1,2,4-Trichlorobenzene	41.00	102.00	30.00
01932	Naphthalene	41.00	107.00	30.00
00518	4-Chloroaniline	35.00	88.00	30.00
01489	Hexachlorobutadiene	42.00	102.00	30.00
00578	4-Chloro-3-methylphenol	47.00	125.00	30.00
01829	2-Methylnaphthalene	44.00	109.00	30.00
01492	Hexachlorocyclopentadiene	41.00	115.00	30.00
02559	2,4,6-Trichlorophenol	43.00	117.00	30.00
02555	2,4,5-Trichlorophenol	44.00	123.00	30.00
00589	2-Chloronaphthalene	48.00	113.00	30.00
01960	2-Nitroaniline	55.00	124.00	30.00
01149	Dimethyl phthalate	54.00	123.00	30.00
00005	Acenaphthylene	48.00	119.00	30.00
01193	2,6-Dinitrotoluene	53.00	121.00	30.00
01964	3-Nitroaniline	55.00	124.00	30.00
00001	Acenaphthene	48.00	115.00	30.00
01187	2,4-Dinitrophenol	24.00	143.00	30.00
02001	4-Nitrophenol	29.00	143.00	30.00
00863	Dibenzofuran	50.00	116.00	30.00
01191	2,4-Dinitrotoluene	50.00	128.00	30.00
01082	Diethyl phthalate	52.00	126.00	30.00
00602	4-Chlorophenyl phenyl ether	54.00	115.00	30.00
01417	Fluorene	52.00	119.00	30.00
01968	4-Nitroaniline	44.00	114.00	30.00
01167	4,6-Dinitro-2-methylphenol	41.00	107.00	30.00
02028	N-Nitrosodiphenylamine	66.00	154.00	30.00
00348	4-Bromophenyl phenyl ether	53.00	114.00	30.00
01482	Hexachlorobenzene	61.00	115.00	30.00

Quality Control Limit Summary

QC Type	S	MS-MSD
Method:	FC	Base/Neutrals and Acids (8270)
Location:	02	QUANTERRA - TAMPA
Program:	92	US AIR FORCE - AFCEE (9/93)
Extraction:		All, non-specific extractions
Matrix:	S	Solid
List:	02315	

Syn#	Compound Name	LCL	UCL	RPD
02118	Pentachlorophenol	19.00	125.00	30.00
02154	Phenanthrene	61.00	117.00	30.00
00122	Anthracene	65.00	119.00	30.00
00891	Di-n-butyl phthalate	42.00	132.00	30.00
01414	Fluoranthene	56.00	125.00	30.00
02252	Pyrene	62.00	119.00	30.00
00403	Butyl benzyl phthalate	55.00	131.00	30.00
00918	3,3'-Dichlorobenzidine	26.00	92.00	30.00
00202	Benzo(a)anthracene	65.00	121.00	30.00
00633	Chrysene	60.00	124.00	30.00
00302	bis(2-Ethylhexyl) phthalate	56.00	131.00	30.00
01162	Di-n-octyl phthalate	33.00	123.00	30.00
00205	Benzo(b)fluoranthene	37.00	120.00	30.00
00211	Benzo(a)pyrene	47.00	110.00	30.00
01535	Indeno(1,2,3-cd)pyrene	40.00	113.00	30.00
02669	Dibenzo(a,h)anthracene	37.00	109.00	30.00
00210	Benzo(ghi)perylene	37.00	115.00	30.00
02736	Nitrobenzene-d5	10.00	155.00	.00
01425	2-Fluorobiphenyl	12.00	153.00	.00
02738	Terphenyl-d14	13.00	140.00	.00
01426	2-Fluorophenol	24.00	118.00	.00
02737	Phenol-d5	17.00	124.00	.00
02512	2,4,6-Tribromophenol	10.00	156.00	.00
02770	1-Methylnaphthalene	50.00	150.00	30.00
00209	Benzoic acid	16.00	72.00	30.00

Quality Control Limit Summary

QC Type	C	LCS-DCS
Method:	DQ	Inductively Coupled Plasma (6010A)
Location:	02	QUANTERRA - TAMPA
Program:	92	US AIR FORCE - AFCEE (9/93)
Extraction:		All, non-specific extractions
Matrix:	S	Solid
List:	02322	

Syn#	Compound Name	LCL	UCL	RPD
02285	Silver	79.00	110.00	25.00
00088	Aluminum	78.00	104.00	25.00
00140	Arsenic	81.00	110.00	25.00
00194	Barium	87.00	111.00	25.00
00222	Beryllium	81.00	110.00	25.00
00413	Calcium	87.00	110.00	25.00
00411	Cadmium	84.00	110.00	25.00
00637	Cobalt	82.00	110.00	25.00
02952	Chromium	81.00	112.00	25.00
00643	Copper	82.00	110.00	25.00
01539	Iron	84.00	110.00	25.00
02214	Potassium	80.00	110.00	25.00
01618	Magnesium	81.00	110.00	25.00
01659	Manganese	84.00	112.00	25.00
01906	Molybdenum	81.00	110.00	25.00
02315	Sodium	82.00	110.00	25.00
01956	Nickel	86.00	110.00	25.00
01605	Lead	84.00	110.00	25.00
00128	Antimony	84.00	110.00	25.00
02281	Selenium	76.00	110.00	25.00
02477	Thallium	85.00	110.00	25.00
02607	Vanadium	83.00	110.00	25.00
02649	Zinc	81.00	110.00	25.00

Quality Control Limit Summary

QC Type	C	LCS-DCS
Method:	JH	Inductively Coupled Plasma (6010A Trace)
Location:	02	QUANTERRA - TAMPA
Program:	92	US AIR FORCE - AFCEE (9/93)
Extraction:		All, non-specific extractions
Matrix:	S	Solid
List:	02323	

Syn#	Compound Name	LCL	UCL	RPD
00128	Antimony	84.00	110.00	25.00
00140	Arsenic	81.00	110.00	25.00
01605	Lead	84.00	110.00	25.00
02281	Selenium	76.00	110.00	25.00
02477	Thallium	85.00	110.00	25.00

Quality Control Limit Summary

QC Type	S	MS-MSD
Method:	DQ	Inductively Coupled Plasma (6010A)
Location:	02	QUANTERRA - TAMPA
Program:	92	US AIR FORCE - AFCEE (9/93)
Extraction:		All, non-specific extractions
Matrix:	S	Solid
List:	02233	

Syn#	Compound Name	LCL	UCL	RPD
02285	Silver	80.00	120.00	20.00
00088	Aluminum	80.00	120.00	20.00
00140	Arsenic	80.00	120.00	20.00
00194	Barium	80.00	120.00	20.00
00222	Beryllium	80.00	120.00	20.00
00413	Calcium	80.00	120.00	20.00
00411	Cadmium	80.00	120.00	20.00
00637	Cobalt	80.00	120.00	20.00
02952	Chromium	80.00	120.00	20.00
00643	Copper	80.00	120.00	20.00
01539	Iron	80.00	120.00	20.00
02214	Potassium	80.00	120.00	20.00
01618	Magnesium	80.00	120.00	20.00
01659	Manganese	80.00	120.00	20.00
01906	Molybdenum	80.00	120.00	20.00
02315	Sodium	80.00	120.00	20.00
01956	Nickel	80.00	120.00	20.00
01605	Lead	80.00	120.00	20.00
00128	Antimony	80.00	120.00	20.00
02281	Selenium	80.00	120.00	20.00
02477	Thallium	80.00	120.00	20.00
02607	Vanadium	80.00	120.00	20.00
02649	Zinc	80.00	120.00	20.00

Quality Assurance Manual

Analytical Services
Asbestos Analysis
Quality Assurance/Quality Control
Description of Policy and Programs

February 1995

O'BRIEN & GERE
LABORATORIES, INC.

QUALITY ASSURANCE MANUAL
ASBESTOS ANALYSIS

FOR

OBG LABORATORIES, INC.
5000 BRITTONFIELD PARKWAY
SUITE 4942
SYRACUSE, NEW YORK 13221
(315) 437-0200

Revision 0: February 1995

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APPENDIX

A. State Certifications

1. Statement of Policy

O'Brien & Gere Laboratories, Inc. (Laboratories) is located in the corporate headquarters of O'Brien & Gere Limited in Syracuse, New York. The firm is engaged in the analysis of friable and non friable bulk materials, water, and air samples for asbestos along with the chemical and microbiological analysis of environmental contaminants in a variety of matrices. The ability of the laboratory to accurately identify and quantify these contaminants is important. The decisions or conclusions based on these data are only as good as the documented quality of the data. The purpose of this manual is to document the procedures used to verify the high quality of the data.

1.1 Quality Assurance/Quality Control Program Objectives

Quality control is the routine application of procedures used in the laboratory and in the field for controlling the measurement process. Quality assurance is the total program for assuring the reliability of field and analytical data.

The goal of the laboratory Quality Assurance/Quality Control (QA/QC) Program is to produce data of adequate quality and to provide documentation to verify these results. The data have adequate quality if the data have consistency (precision) and the uncertainty is small when compared to specific requirements (accuracy). These objectives are accomplished through the use of quality control samples such as duplicates, blanks, replicates, verified counts, and knowns. Use of this program maximizes the validity of the data. Thus, the data can provide a reliable foundation on which to base decisions.

An effort of the QA/QC Program is to provide control charts and control limits for monitoring the laboratory's daily performance and to plot trends over a period of time. These charts provide documentation that data collected, reported, or used by the laboratory are of known precision and accuracy. The QA/QC activities performed at Laboratories are carried out in accordance with established federal and state protocols.

1.2 Laboratory Policy on QA/QC

Laboratories fully supports the QA/QC program outlined in this manual. This program has been implemented and is maintained to demonstrate that data reported by the laboratory are of known and documented quality. The technical and support personnel who contribute to any portion of the laboratory analyses follow the QA/QC procedures outlined in this manual.

The QA/QC manual is an integral part of routine laboratory practice. The contents of this manual will be reevaluated and revised regularly.

Requirements listed in a Quality Assurance Project Plan will override this document.

2. Organization and Responsibility

Any organization consists of a number of people whose skill and responsibilities determine the quality of the final product. The product of Laboratories is analytical services. The laboratory functions as a chemical laboratory only. Personnel have sufficient training in their appointed positions to contribute to the analysis and reporting of high quality data. The training is achieved through internal training, experience, and selected specialty courses.

Figure 2-1 is an organization chart of the laboratory staff.

The senior vice president's responsibilities include the development and monitoring of the internal systems necessary to assure quality of the analytical data. His duties include the planning necessary to support methods development and for the acquisition of personnel and instrumentation.

The day-to-day scheduling and coordination is handled by the asbestos manager who reports to the senior vice president. The manager monitors the daily work load and redirects the section resources to complete project deadlines. The manager coordinates and distributes the project information to the section staff and reviews the output to verify its completeness and technical acceptability.

The manager's responsibilities include verification that analyses are conducted within contract holding times and implementation of corrective action procedures recommended by the QA/QC Coordinator. The manager works with the QA/QC Coordinator to keep the quality control procedures accurate and up to date. Together the manager and the QA/QC Coordinator work on revisions of procedures. In addition, the manager coordinates with the client to answer any complaints or any questions related to the analytical requirements of the projects.

Project supervisors, who are part of the customer service group, are responsible for monitoring individual projects and project specific QC. They handle client contact and work with the section supervisors to coordinate sample receipt schedules and report turn around times.

Weekly, the managers, section supervisors and project supervisors meet to discuss the progress of in-house programs, staffing, the schedule of analytical programs, instrument problems, and analytical quality control. This information is also forwarded to the senior vice president for consideration and planning.

The QA/QC Coordinator is responsible for the implementation, monitoring, and supervision of the QA/QC program. The QA/QC Coordinator reports to the administrative manager. The QA/QC Coordinator verifies that the analyses are conducted in strict adherence to the procedures set forth in this manual. The QA/QC Coordinator's duties include:

- Developing and implementing new QA/QC programs, including statistical techniques and procedures
- Conducting regular audits and inspections of analytical procedures and applications
- Daily monitoring of analytical parameter accuracy and precision
- Discussing necessary corrective action procedures with the laboratory manager

- Generating control charts and setting control and warning limits
- Advising management of the status of the QA/QC program and giving recommendations for improvement
- Writing, submitting and updating Quality Assurance Plans

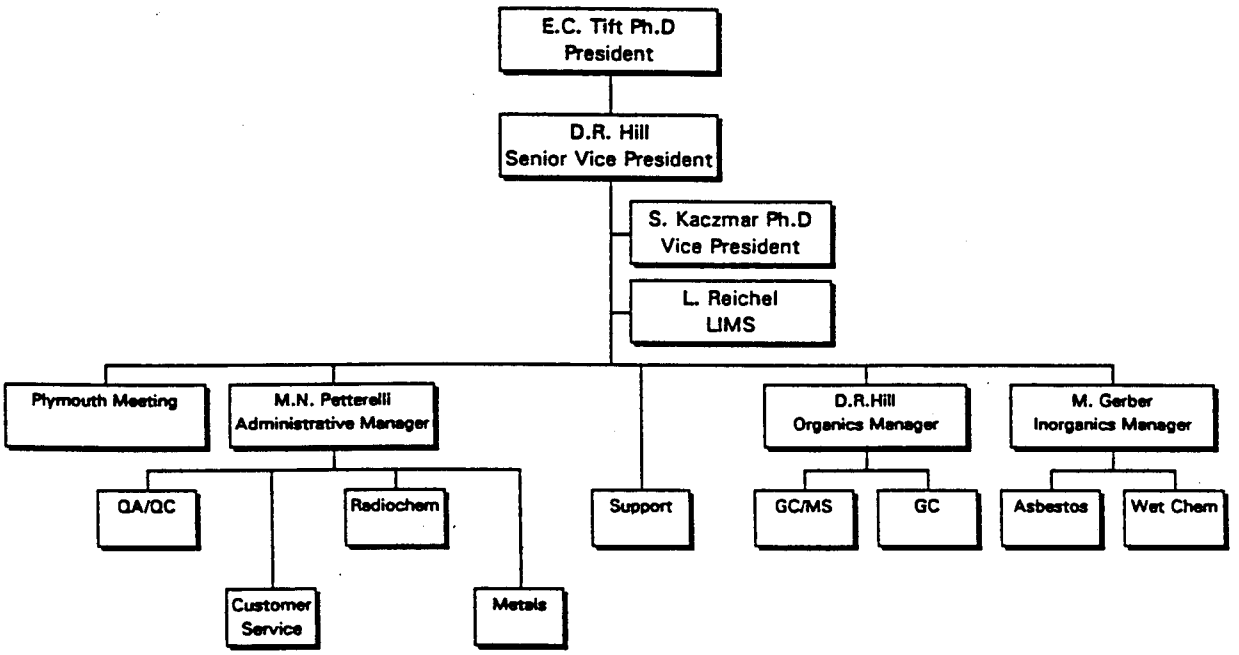
The sample custodians, who are part of the support staff, are responsible for initiating chain of custody procedures. Upon receipt of samples, they verify that the samples have been properly collected. After receipt of samples, they are responsible for keeping them in a secure and restricted location.

Laboratories has a safety officer who is responsible for the distribution of the safety manual and the scheduling of safety training sessions for new employees. The safety manual outlines safety policies, procedures, and guidelines. The safety officer, the section supervisors and the manager meet periodically to review the safety manual and update it as necessary.

Figure 2-1

Organization Chart

OBG LABORATORIES ORGANIZATIONAL CHART



3. QA Limits for Precision and Accuracy

The following table lists the detection limits and methods used in the laboratory.

Detection limits for airborne asbestos analysis depend on the volume of air collected. Therefore detection limit for airborne asbestos analysis by phase contrast microscopy is listed in units of fibers/mm^2.

In the case of airborne asbestos by transmission electron microscopy or waterborne asbestos by transmission electron microscopy, minimum detection limits are specifed by the method. In both cases, adequate grid openings are analyzed to achieve these detection limits.

Table 3-1 *Methods and Detection Limits*

Method	Matrix	Detection Limit
EPA 600/4-83-043	Waterborne	10 MFL >0.5µm 0.2 MFL > 10µm
Federal Register, Appendix A to Subpart E, Interim Transmission Electron Microscopy Analytical Methods - Mandatory and Nonmandatory - and Mandatory Section to Determine Completion of Response Actions	Airborne (TEM)	0.005 struc/cc
NIOSH 7400 Federal Register, Appendix A, 29 CFR 1926.58, OSHA Reference Method - Mandatory	Airborne (PCM)	12.7 fibers/mm^2
EPA-600/M4-82-020 ELAP 198.1	Friable Bulk	1. %
ELAP 198.1 ELAP 198.4	Non-friable Bulk	1. %

4. Sampling Procedures

A critical concern in any project, especially those where a large number of samples are required, is the maintenance of sample integrity. A sample is physical evidence of a situation in the environment at a specific place and time. Therefore, an essential part of sampling projects is proper collection and handling of the samples. Representative samples are collected through well-defined protocols. The client performs most of the sampling and thus assumes responsibility for properly obtaining, handling, and shipping the sample. If Laboratories is requested to collect samples, a well defined sampling protocol is followed. This sampling protocol includes the following elements:

- Sampling team members are competent and qualified
- Proper sampling methods are used in the collection of a representative sample
- Equipment is accurately calibrated
- Samples are properly handled to prevent contamination from outside sources or cross contamination between samples, ie, bulk samples are shipped in a separate container from air samples
- Samples are properly identified
- Samples analyzed are the samples collected under reported conditions.

Laboratories does not routinely provide sampling services. The lab will give recommendations for proper sampling plans. Sampling will be subcontracted with a sampling plan being provided by the subcontractor.

4.1 Sample Containers

The laboratory, on occasion, will send out sample containers for the collection of waterborne asbestos samples. Since a preservative is not added to the sample containers for waterborne asbestos, it is imperative that samples be received by the laboratory within 24 hours of collection. The client is responsible for verifying that the proper containers were received.

Each sample is collected in a new, pre-cleaned container to minimize contamination.

4.2 Holding Times and Preservatives

Laboratories follows the holding time requirements outlined in the method being utilized. Holding times vary depending upon matrix, protocol, and regulatory requirements. Expedient delivery and scheduling are paramount to obtain compliance with holding times. The LIMS assists in the monitoring of holding times by incorporating a due date on the schedule queue. The analysts, when reviewing their schedule, are aware not only of the workload, but also of holding time requirements.

If samples are received over their holding times, the client is notified so that resampling can be scheduled.

4.3 Shipment

Sample containers are shipped in coolers to the clients by common carrier or are picked up at the lab by the client. Glass bottles are wrapped in styrofoam to prevent breakage. Containers are put into plastic zip-lock bags to prevent cross contamination or leakage in case one or more of the containers should break during shipment. When the samples are returned to the lab, they are repacked into the coolers in the same manner in which they were shipped and crushed ice is added to maintain the temperature at 4° C. Jars are wrapped in styrofoam sheets and put in plastic bags to help prevent breakage and cross-contamination.

Laboratories adheres to regulations governing the shipment of hazardous materials.

5. Sample Custody

5.1 Chain of Custody Procedures

The laboratory follows a strict chain of custody procedure. This procedure creates an accurate and legally defensible document that can be used to trace possession of a sample from its collection through analysis and final disposal. The chain of custody form is signed by all handlers of the sample. An example of a chain of custody is included as Figure 5-1.

A sample is considered in custody if it is:

- In actual physical possession
- In view after being in physical possession
- In a locked repository
- In a secure, restricted area

Formal custody begins with the shipment of pre-cleaned properly preserved containers. The client contacts a project supervisor for sample bottles and the project supervisor submits a form requesting the proper containers to the sample custodian. An example of the sample bottle request form is included as Figures 5-2a and 5-2b. After the request is completed and signed, the form is filed in a binder and kept in the sample tagging room for future reference.

Chain of custody forms are shipped with sample bottles. The field sampler/client is responsible for filling in the sample location, date and time sampled, sample matrix, and analysis required on the chain of custody. The field sampler signs the chain of custody when relinquishing custody and includes the form with the sample containers. Any comments that the sampler has are also listed on the chain of custody form. The field sampler is also responsible for filling in the sample labels that are present on every sample bottle. An example of a sample label is included as Figure 5-3.

5.2 Control of Incoming Samples

Laboratories employs several sample custodians who are responsible for verifying the receipt of samples. When samples are received, the sample custodians follow the steps outlined below.

1. Packages are checked to verify that the samples listed on the chain of custody were received. A notation is made of any missing or mislabeled samples.

2. Samples are checked and a notation is made of any samples that were received broken or damaged, or if bulk samples were shipped in the same container as air samples.

3. The Chain of Custody is signed and dated to verify time of sample receipt.

4. Each sample is assigned a unique laboratory identification number to make tracking of samples easier. Numbers are assigned sequentially. Each project is also assigned a unique project number that contains the client ID and job number.

5. Samples are logged into the LIMS and the analyses are scheduled.

The observations of the sample custodians and any comment that they have are noted on the chain of custody form or on the case file form. An example of the case file form is included as Figure 5-4. Samples are not routinely rejected by the laboratory. When problems arise the client is notified of the deficiency and a decision is made to continue or resample. The decision is noted on the final report.

The sample custodian tags each sample with a unique laboratory sample number that is input into the computer and recorded onto the sample log-in form. An example of the sample log-in form is included as Figure 5-5. The sample log-in form is filed in a three-ring binder and functions as a sample receipt log book.

The chain of custody effort is intensified at the request of the client. The intensified procedure starts with the use of red evidence tape in the field. Each container is sealed with the tape at the sampling site and shipped in sealed containers to the laboratory. When the samples are received by the laboratory, the condition of the sealed containers is recorded on part one of the sample control record and the laboratory numbers are assigned. An example of part one of the sample control record is included as Figure 5-6. Samples with red evidence tape must be signed in and out of the locked secured cooler using part two of the sample control record. An example of part two of the sample control record is included as Figure 5-7.

Samples are stored in the asbestos laboratory.

Any errors made while completing the chain of custody forms are corrected by deleting the entry with one line through it, correcting the error, and dating and initialing the correction.

5.3 Scheduling

The purpose of scheduling is to notify the manager, section supervisors, chemists and technicians of the arrival of a sample and the tests to be performed.

Analyses are scheduled on the LIMS by the sample custodians. A package/sample schedule is printed for every batch of samples received. An example of the package/sample schedule is included as Figure 5-8. The analysts use the package/sample schedule to identify what samples they are required to analyze. The section supervisors review the package/sample schedule with the analysts to ensure priorities and holding times are being met.

5.4 Sample Tracking

Our tracking system relies on project numbers and sample numbers. Therefore, laboratory sample numbers and client ID numbers are recorded on raw data and preparation logs. Samples are primarily tracked using the laboratory sample numbers. Project status is tracked using project numbers and sample numbers.

5.5 Location and Disposal

Samples are stored in asbestos laboratory. Unless otherwise requested by the client, phase contrast samples are discarded immediately after analysis has been completed. Bulk samples for polarized light microscopy and airborne asbestos samples for transmission electron microscopy are retained for a period of six months before being discarded in an appropriate manner. Waterborne asbestos samples are retained for a period of one month after analysis has been completed.

5.6 Sample Transfer

If analysis of the samples is not possible at Laboratories, then the samples will be subcontracted to another approved laboratory. The samples will be packed in appropriate containers and shipped by common carrier or delivered by Laboratory personnel. A chain of custody listing Laboratories sample number, sample preparation date and tests required will accompany the samples.

5.7 Computer Services

Laboratories has a LIMS system in place. The system is used for scheduling, reporting and QC purposes.

The project supervisors are responsible for verifying that samples were scheduled properly. It is up to them to approve and distribute the sample schedule so that it will appear on the proper worklists.

The QA/QC Coordinator is responsible for verifying that the QC data was input properly and that it is being calculated properly by the computer. Whenever control charts are printed or control limits generated, the information is checked for accuracy.

Each analyst has a unique sign-on code and all data that they enter in the data base is associated with their sign-on code. A password has to be entered to gain access to the data base. System management also has several passwords that need to be entered in order to gain access to programs that allow changes to be made to the data base.

A full backup of the data base is done weekly and a partial backup is done daily in order to protect against data lose in case of a system failure.

Figure 5-1

Chain of Custody

CHAIN OF CUSTODY RECORD

O'BRIEN & GERE LABORATORIES, INC.

SURVEY:

LOCATION:

SAMPLED BY:

ORGANIZATION:

STATION NUMBER	SAMPLE LOCATION	DATE COLLECTED	TIME COLLECTED	SAMPLE MATRIX	COMP OR GRAB	NO. OF CONTAINERS	ANALYSIS REQUIRED

Relinquished By:	DATE	TIME	Received By	DATE	TIME
Relinquished By:	DATE	TIME	Received By:	DATE	TIME
Relinquished By:	DATE	TIME	Received by Laboratory:	DATE	TIME

COMMENTS:

METHOD OF SHIPMENT:

O'BRIEN & GERE LABORATORIES, INC. an O'Brien & Gere Company
5000 Brittonfield Parkway / P.O. Box 4942 / Syracuse, NY 13221 / (315) 437-0200 FAX (315) 463-7554

Figure 5-2a

Sample Bottle Request Form

O'BRIEN & GERE LABORATORIES, INC.

O'Brien & Gere Laboratories, Inc.
Sample Container Request Form

PROGRAM INFORMATION

Client/ Affiliate:	Company Name _____ Div. ____
	Project Eng. _____
Program or Survey:	Program Title _____
	Name of Sampler _____
Level of QC Documentation	1 2 3 4 5 6 7 8 (circle one)

SAMPLE BOTTLE PREPARATION

Samples:

Sites	Matrix	Analysis Required

Bottles:

Analysis	No. of Bottles	Size of Bottle	Glass or Plastic	Preservative

Bottle Type: _____ Standard _____ I Chem (Check One)

(more information required on back)

Figure 5-2b

Sample Bottle Request Form

Shipping and Billing Information

Address:	Shipping	Billing
Person	_____	_____
Company	_____	_____
Street	_____	_____
City/St./Zip	_____	_____
Telephone #	_____	_____
P.O. / Job #	_____	_____

Method of Shipment & Due Date		Pickup	Regular	2 Day	Overnight
	Day:	_____	_____	_____	_____
	Date:	_____	_____	_____	_____
	Time:	_____	_____	_____	_____

Who will Pay Freight ?	_____ OBG Laboratories, Inc. _____ Client (record client job # under shipping address)	(any method of freight other than routine mail is paid by the Client)
Secondary Contain-ment ?	_____ Yes _____ No	(check one)

Comments

Laboratory Approvals and Signatures

Submitted By: _____ Date Submitted: _____

Approved By: _____ OBG Project No: _____

Prepared By: _____ Date Sent: _____

Figure 5-3

Sample Label

O'BRIEN & GERE LABORATORIES, INC.

Sample Description:_____

_____

_____

_____ Initials:_____

Sample Date:_____ Sample Time:_____

Project No.:_____ Lab No.:_____

Date Received:_____ Time Received:_____

Preservation:_____

Figure 5-4

Case File Form

OBG LABORATORIES, INC.
CASE FILE FORM

PROGRAM INFORMATION

Client: _____ Div. _____ Ref. No. _____

Program: _____

Location: City/Town _____ State _____

Date Rec'd: _____ Time Rec'd: _____ Sampler: _____

Custody Seal: _____ Intact _____ Not Intact _____ NA

AFTER HOURS CUSTODY

RELINQUISHED BY:	DATE	TIME	RECEIVED BY SECURITY GUARD:	DATE	TIME
RELINQUISHED BY SECURITY GUARD TO COOLER:	DATE	TIME	RECEIVED BY SAMPLE CUSTODIAN:	DATE	TIME

COMMENTS/DISCREPANCY:

RESOLUTION/CLIENT COMMENT:

Signed: _____ Project Manager Approval: _____

Date: _____ QA/QC Approval: _____

SAMPLE DISPOSAL

Disposal Procedure: _____

Signed: _____

Date: _____

Figure 5-5

Sample Login Form

SAMPLES RECEIVED _____

PAGE NO. _____ OF _____

SAMPLE LOG

CLIENT NAME	PROJECT DESCRIPTION	PROJECT NUMBER	LAB NO.	SITE DESCRIPTION	COLLECTION DATE	COLLECTION TIME	BIN NO	PRESERVATION CHECKS: NUTRIENTS	DEMANDS	METALS	CYANIDE	RADIOCHEM	OIL & GREASE	PHENOLICS	SULFIDE	PESTICIDES	TYPE	LEVEL	METALIX	SCTN LOR	# OF CONTAINERS	ANALYSIS REQUIRED

Figure 5-6

Sample Control Record

SAMPLE CONTROL RECORD

CLIENT: _____ JOB #: _____ DATE RECEIVED: _____

BIN #: _____ PROJECT MANAGER: _____ SAMPLE NUMBER(S): _____

Laboratory Sample Number	Removed By	Date and Time Removed	Reason	Date and Time Returned

Figure 5-7

Sample Control Record

Sample Custodian Signature: _____ Client Name: _____

Date of Sample Login: _____ Project No.: _____

Airbill Number: _____ Bin Number : _____

Circle The Appropriate Response:

1) Custody Seal — Present/Absent, Intact/Not Intact
2) Chain-of-Custody — Present/Absent
3) Sample Tags — Present/Absent
4) Sample Tag #'s — Listed/Not Listed
5) SMO Forms — Present/Absent

Date Rec'd.	Time Rec'd.	Chain-of Custody Record #	SMO Sample Numbers	CORRESPONDING Sample Tag Numbers	CORRESPONDING Assigned Lab Numbers	Does Information On Custody Forms Traffic Reports & Sample Tags Agree ?	Remarks

Figure 5-8

Package/Sample Schedule

PACKAGE/SAMPLE SCHEDULE
Saturday, Feb 4,1995
Project Manager: NJG
Page 1 of 1

PACKAGE

Job No.: [redacted] Client: [redacted]
Project: [redacted] Description: Miscellaneous Analytical Services
Scheduled: Feb-6.95 Pkg Due: Feb-10.95
Package number: 4502 QC Level: 1
Samples: V00089 - 00090 Number of samples: 2
Certification: 10859
Comments:

SCHEDULED SAMPLES

Samples	Number	Group	Parameter	ID	Method	Matrix	Schedule Comments
V00089 - 00089	1		ASB-TEM-Air	1632	EPA - AMERA	Air	
V00090 - 00090	1		ASB-PLM-Bulk	1620	ELAP 198.2	Solid	

LIST OF ALL SAMPLES IN PACKAGE:

Sample	Description	Bin	Type	Collected	Received	Sample Log Comments
V00089	NUC-131-5		TEM AIR		Feb-3 12:30	
V00090	CES-5		PLM		Feb-3 12:30	

6. Analytical Procedures

6.1 Analytical Methods

A list of analytical methods used in the laboratory is included in Appendix B. Method numbers are cited from the following manuals:

- U.S. EPA, Federal Register, 40CFR, Part 136, (1-1-87 edition).
- U.S. EPA, Federal Register, Appendix A, 29 CFR 1926.58.
- New York State Department of Health, *Environmental Laboratory Approval Program - Certification Manual.*
- NIOSH - NIOSH Manual of Analytical Methods, Fourth Edition.

6.2 Waste Disposal

Laboratory workers are trained to be cautious when handling samples, spent chemicals, toxic, or dangerous materials. Laboratories has a hazardous waste officer who is responsible for coordinating and overseeing the disposal of waste and the cleanup of any accidental spills. The laboratory has a hazardous waste room where waste is stored in DOT- approved 55-gallon drums until disposal. Laboratory hazardous wastes are manifested and disposed off-site at NYSDEC- and U.S. EPA-approved disposal facilities.

The method of sample disposal depends on the analytical data generated. The results are compared to RCRA criteria and local disposal ordinances and a decision is made in coordination with the hazardous waste officer as to the means of disposal. If the sample is classified as hazardous, it is placed in the appropriate drum in the hazardous waste room. Upon filling the drum, the hazardous waste officer manifests the drum, arranges for disposal and files the disposal logs.

6.3 Cleaning of Glassware

Glassware is cleaned in an Alconox solution. It is then rinsed with tap water followed by DI water and allowed to dry. Glassware is stored inverted in drawers or a cabinet in the asbestos lab.

6.4 Quality of Lab Water

Deionized (DI) water filtered through a 0.2 micron filter is used for asbestos analysis.

7. Calibration Procedures and Frequency

7.1 Instrumentation

Laboratories maintains state-of-the-art instrumentation. The following equipment is currently in use:

- One Philips CM-12 transmission electron microscope equipped with an EDAX PV9800 x-ray detector.
- Two Olympus BH-2 polarized light microscopes.
- One Nikon Labophot-Pol polarized light microscope.
- Six Olympus CH-2 phase contrast microscopes.
- One Denton Vacuum DV-502A Carbon Coater.
- One BioRad PT7150 RF Plasma Barrel Etcher.
- One Mettler AE100 analytical balance.

7.2 Calibration

Accurately calibrated instruments are a major concern at Laboratories. A brief explanation of the calibration procedures used at Laboratories is summarized below. Detailed calibration procedures are described in the laboratory Standard Operating Procedures, which are available for procedures used in the laboratory.

7.2.1 TEM

Every day that the TEM is used, the instrument is aligned, and the response of the x-ray detector for silicon and iron is checked by analyzing an amosite standard. On a monthly basis the magnification and the camera constant are determined. On a quarterly basis the spot size is determined, and the beam current checked. Also on a quarterly basis, the x-ray detector response for the sodium peak in crocidolite and the magnesium and silicon peaks in chrysotile are checked. On a semi-annual basis the x-ray k-factors and resolution for manganese are determined

7.2.2 PCM

The resolution, diameter of the graticle, and the centering of the phase rings is checked every day that the phase contrast microscopes used..

7.2.3 PLM

Every day that the polarized light microscopes are used, the iris and condenser diaphrams are focused and centered, the alignment of the polarizers and the crosshairs are checked and the objectives are centered. On a monthly basis the dispersion staining colors for amosite in 1.680 RI liquid are determined.

7.2.4 Balances

Analytical balances are professionally calibrated and cleaned once a year. When the balances are professionally calibrated, a document stating the specific balance model and serial number and the date calibrated is provided by the company doing the calibration. The balances are

checked daily with Class S weights. The weights must read within 0.05% of the true value. If the weight is out of the control limits, it will be professionally recalibrated. The analyst performing the check, the date the balance was checked and the weights at which the balance was checked are recorded in a laboratory notebook.

7.3 Standards

Reference standards are obtained from third party sources such as NIST. In addition, performance evaluation samples are retained for use as knowns/standards.

8. Preventive Maintenance

8.1 Instrument Maintenance

The lab has maintenance contracts on most major pieces of equipment. If the lab experiences a problem with an analytical instrument, a service call is made, and a certified technician is sent to correct the problem. The analysts are also trained in "troubleshooting" their instruments to determine if outside assistance is needed.

Routine maintenance as outlined by the manufacturers are followed on laboratory instrumentation.

In the event of equipment failure, in most cases there is an alternate piece of equipment that can be substituted. If there is no alternate equipment available, the sampling will be delayed if possible, or samples will be subcontracted to an alternate approved laboratory.

8.2 Maintenance Log

Maintenance logs are kept on every instrument in the lab. The logs are located near their respective instruments. Maintenance, whether performed by laboratory personnel or by professional maintenance personnel, is documented as an entry in the appropriate logbook. Entries include the reason for maintenance, maintenance that was performed, individual performing the maintenance, the date of maintenance, and the initials of the analyst in charge during the maintenance.

9. Quality Control Checks, Routines to Assess Precision and Accuracy, and Calculation of Method Detection Limits

When analyzing samples, the accuracy and precision of the data generated are determined through the analysis of duplicates, replicates, knowns, and field and laboratory blanks with each set of samples. In addition, verified asbestos analysis is performed for airborne asbestos by TEM. Results of QC samples are charted against established limits.

9.1 Method Detection Limits

In the case of bulk asbestos analysis, detection limits are established by the method. For phase contrast analysis, the detection limit is dependent on the volume of air collected. A minimum detection limit is specified for both airborne TEM and waterborne asbestos analysis and adequate grid openings are analyzed to achieve these detection limits.

9.2 Method Accuracy and Precision

Method accuracy is the ability to determine that the measurement of a known reference standard will be acceptably close to the defined true value. This is measured by the analysis of a "known". The result of the known sample must meet established criteria. A known not meeting criteria signifies an "out of control" situation and requires corrective action.

Method Precision is the ability to limit the spread of duplicate measurements performed by the same analyst (duplicates) relative to their average in a manner which approximates the bell-shaped normal distribution. The analytical method precision is determined by reanalyzing a sample. Ideally, the analytical results will be identical; however, differences occur due to variations in the procedure. A quantitative measure of these differences is assessed by determining the absolute differences between duplicate results. In addition, method precision is checked by the reanalysis of a sample by a different analyst (replicates). Samples which do not meet laboratory established criteria signify an "out of control" situation and corrective action is required.

9.3 Intralaboratory QA/QC Program

One of the main goals of this QA/QC manual is to establish guidelines for intralaboratory QC (QC that is performed within the laboratory). In addition, this manual provides a mechanism where QC procedures can be documented for review.

A quality control program is a systematic attempt to maintain the precision and accuracy of analyses by detecting and preventing the recurrence of errors. By identifying the sources of errors, confidence in the precision and accuracy of analytical results can be established, and improvements in the analytical methods can be made.

In general, Laboratories quality control program incorporates the concepts of: a) calibration to attain accuracy, b) duplication and replication to establish precision limits, and c) use of knowns to confirm accuracy.

Table 9-1 contains a list of laboratory QC checks and the frequency at which they are done. If method QC requirements are more stringent than the routine measures typically followed, the method QC requirements will be followed.

9.3.1 Definitions of Basic Terms

There are some basic terms that are frequently used when discussing asbestos QA/QC. Below are the definitions of some common terms.

1. Laboratory Blank - The laboratory blank is a filter which is prepared and analyzed in the same manner as the samples. These blanks are analyzed along with the samples to verify that: a) no false positives occur, and b) results are accurate and do not reflect contamination.

2. Field Blank - Field blanks are collected to determine the extent of contamination in the handling of the filters in the field. In the case of PCM analysis, they are treated in the same manner as the field samples. Field blanks are not routinely analyzed in the case of airborne TEM analysis.

3. Filter Lot Blanks - Filter lot blanks are prepared and analyzed to determine if filters are contaminated in the manufacturing process. One percent of newly received cassettes are marked with the manufacturers lot number and submitted for analysis.

4. Duplicates - Duplicates are the reanalysis of a field sample by the same analyst. The results of duplicate analyses provide information on overall precision of the analytical methodology. Quantitative results are obtained by calculating the absolute difference of the samples.

5. Replicates - Replicates are the reanalysis of a field sample by a different analyst. The results of replicate analyses provide information on overall precision of the analytical methodology. Quantitative results are obtained by calculating the absolute difference of the samples.

6. Knowns - A known is a performance evaluation sample which is routinely analyzed by the laboratory as a measure of overall accuracy. Results for a known are compared to the acceptable results for that performance evaluation sample.

7. Verified Asbestos Analysis - Verified asbestos analysis is a procedure in which a TEM grid opening is independently analyzed for asbestos by two or more TEM operators and in which a comparison and evaluation of the correctness of the analyses are made by a verifying analyst.

8. Performance Evaluation Samples - A set of samples sent to the laboratory by a certifying agency to be analyzed. The laboratory is unaware of the concentration of asbestos in the samples and the results must fall within certain limits. Up to ten sets of Performance Evaluation (P.E.) samples are analyzed per year (For example for PCM analysis: PAT's - quarterly, AAR's - quarterly, ELAP's - semi-annually). If P.E. sample analysis is unacceptable, responses will be reported in a QA report if required.

9. Interlaboratory Exchange - Routinely, samples analyzed by the laboratory are submitted to an independent laboratory for reanalysis as a measure of accuracy. Results are evaluated and discrepancies are resolved between the laboratories.

9.3.2 Analytical Errors

The laboratory is dedicated to minimizing errors that cause inaccurate results. There are three types of errors: determinate, indeterminate, and systematic. Determinate errors are caused by improper technique such as contamination. Indeterminate errors are those in which no cause can be assigned. Systematic errors are a bias common to a sequence or batch of results frequently induced by an indeterminate or determinate error.

QC data is plotted on a daily basis and results are compared to established criteria to minimize out of control situations and analytical errors. The analysts are familiar with the methods they are running, and can detect when calibration standards and QC checks are not providing the proper results.

Errors are reduced by properly training the analysts and having written standard operating procedures for the analysts to use. The analysts are trained in good laboratory practices. Every effort is made to keep contamination to a minimum. Blanks are run with every group of samples to check for contamination from glassware or standards.

9.4 Control Charts

Control charts provide the necessary tools for detecting quality variations in the various analytical methodologies used. They are a continuous graphic indication of the state of an analytical procedure with respect to quality. Control charts indicate when corrective action procedures are necessary and often assist in defining what corrective action procedures should be taken.

The control limits on QC charts set the criteria for assessing the significance of variations in the analytical results. When the plotted QC data fall within these limits, the analytical methodologies are considered under control. If a data point falls outside the control limits, there is an indication that some assignable cause is present which has thrown the system out of control.

Control limits can be considered action limits. They enable the laboratory to detect significant deviations in analytical procedures and to take corrective action before producing erroneous results.

9.4.1 Precision QC Charts

Precision QC charts are used for graphing the absolute difference of duplicate and replicate samples. The charts are developed using up to 50 data points, depending on how often the parameter is analyzed by a particular method. Once these data points have been collected, the warning and control limits on the QC charts are calculated by using the following method:

1. For each pair of duplicate/replicate samples calculate the absolute difference.
2. Calculate the mean absolute difference by summing the absolute differences and divide by the total number (n) of duplicate sets.
3. Calculate the standard deviation (s).
4. Calculate the warning and control limits.

$$UCL = \overline{\text{Absolute Diff.}} + 3s$$
$$UWL = \overline{\text{Absolute Diff.}} + 2s$$
$$LWL = \overline{\text{Absolute Diff.}} - 2s$$
$$LCL = \overline{\text{Absolute Diff.}} - 3s$$

The LCL is always zero since it is impossible to have a negative RPD.

9.4.2 Accuracy QC Charts

Accuracy QC charts are used for graphing the results of knowns. The control limits are based on the results for the individual performance evaluation samples.

Table 9-1 *Laboratory QC Checks and Frequency*

Laboratory Section	QC Sample	Frequency
PCM	Known	Daily
	Duplicate	5%
	Field Blank	Every batch
	Interlaboratory Exchange	Quarterly
	P.E. Samples	Up to ten/year
PLM	Duplicate	5%
	Replicate	5%
	Interlaboratory Exchange	0.5%
	Blank	Daily
	P.E. Samples	Up to eight/year
NOB	Duplicate	10%
	Known	Each batch
	Blank	Each batch
	Interlaboratory Exchange	0.5%
	P.E. Samples	As submitted
TEM - Airborne	Duplicate	5%
	Replicate	5%
	Verified Count	0.5%
	Laboratory Blank	10% - (4% analyzed)
	Interlaboratory Exchange	0.5%
	P.E. Sample	Up to four/year
TEM - Waterborne	Duplicate	5%
	Replicate	5%
	Verified Count	0.5%
	Laboratory Blank	10% - (4% analyzed)
	P.E. Sample	Up to four/year

10. Data Reduction, Validation and Reporting

10.1 Data Reduction

Data is generated from several different sources (scientific equipment, manual calculations, or computer generated). Most of the raw data is stored in hardcopy form and calculations are done to generate a final result. In several instances, the bench chemist performs calculations in a laboratory notebook and transfers the final result onto the laboratory report form.

Calculations are either performed manually or by computer programs. Calculations are performed according to the method employed. They are based on sample matrix, method detection limits and dilutions or concentrations that may have been done. A brief description of some calculations used follows:

1. Volume for PCM analysis:

$$Volume = Flow\ Rate \times Time$$

Where:

Flow Rate is in liters/minutes
Time is in minutes

2 Average Count for PCM analysis:

$$Avg\ Ct = \frac{Fibers}{Fields}$$

Where:

Avg Ct = Average count for sample.
Fibers = The total number of fibers counted.
Fields = The total number of fields counted

3 Fibers/cc for PCM analysis:

$$Fibers/cc = \frac{(Avg\ Ct - Blk\ Ct.) \times (Filter\ Area)}{Volume \times Field\ Area \times 1000}$$

Where:

Avg Ct = Average count for sample.
Blk Ct = Average count for blank.
Filter Area = The area of the filter in mm^2 (Generally 385 mm^2).
Field Area = The area of the graticule field in mm^2 (Generally 0.00785 mm^2).
Volume = Volume of air collected in liters.

4 Fibers/mm^2 for PCM analysis:

$$Fibers/mm^2 = \frac{Avg\ Ct}{Field\ Area}$$

Where

Avg Ct = Average count for sample.
Field Area = The area of the graticule fields in mm^2 (Generally 0.00785 mm^2).

5 Structures/cc for TEM analysis:

$$Struc/cc = \frac{S_i\ X\ FA}{GO\ X\ GA\ X\ Vol\ X\ 1000}$$

Where:

S_i = Total number of structures in the sample.
FA = The effective filter area in mm^2.
GO = Number of grid openings analyzed.
GA = The area of the grid opening in mm^2.
Vol = The volume of air collected in liters.

6 Structures/mm^2 for TEM analysis:

$$Struc/mm^2 = \frac{S_i}{GA \ X \ GO}$$

Where:

S_i = Number of structures counted.
GA = The area of the grid opening in mm^2.
GO = Number of grid openings analyzed.

7 Z-Test:

$$Z = \frac{Y_i - Y_o}{0.8 \ X \sqrt{(1/N_i + 1/N_o)}}$$

Where:

Y_i = The average of the natural log of the indoor sample asbestos concentration.
Y_o = The average of the natural log of the outdoor sample asbestos concentration.
N_i = The total number of indoor samples.
N_o = The total number of outdoor samples.

8 Percent combustible material for NOB analysis:

$$\% \ Combustible \ Material = 100 \times \frac{W_2 - W_3}{W_2 - W_1}$$

Where:

W_3 = Weight of crucible with ash.
W_2 = Weight of crucible with NOB material
W_1 = Weight of crucible

9 Percent Acid Soluble Material for NOB analysis:

$$\% \ Acid\ Soluble\ Material = 100 \times \frac{W_5 - W_4}{W_2 - W_1}$$

Where:

W_5 = Weight of filter paper with dissolved ash.
W_4 = Weight of filter paper.
W_2 = Weight of crucible with NOB material
W_1 = Weight of crucible

10 Percent Asbestos for NOB analysis:

$$\% \ Asbestos = P_1 \times \frac{W_5 - W_4}{W_2 - W_1}$$

Where:

P_1 = Percentage asbestos as determined from the PLM or TEM examination.
W_5 = Weight of filter paper with dissolved ash.
W_4 = Weight of filter paper.
W_2 = Weight of crucible with NOB material
W_1 = Weight of crucible

Other calculations performed in the laboratory are similar in nature.

Raw data is labeled with the sample number and date analyzed. An instrument log book serves as a table of contents for each analytical run. An example of an instrument log book sheet for TEM analysis is included as Figure 10-1. An example of an analysis log sheet for PLM analysis is included as Figure 10-2.

The analysts are responsible for transcribing the final results onto the preliminary laboratory report forms for the test parameters that they analyze and documenting the analyses in the appropriate logbooks. The analysts are also responsible for entering their analytical data into the LIMS.

10.2 Data Validation

The first step of the data validation process is when QC data are entered onto the appropriate forms. The analyst compares the results to the established control limits. The analyst informs the section supervisor of an out-of-control situation and the section supervisor insures that the analyst takes corrective action. Sample results are not reported until QA/QC criteria have been met.

The QA/QC Coordinator reviews QC results monthly to verify that corrective measures are being taken and documented.

The second step is after the data had been entered into the LIMS system. The data is checked by the section supervisor in charge of the laboratory section that generated the data. The section supervisor checks calculations, raw data, and QC samples. Any errors detected are reviewed with the analyst who made the error.

10.3 Data Storage

A copy of the final laboratory report is retained by the laboratory. Laboratory reports are filed by client ID number and project number. This allows for data belonging to a specific client and project to be filed together. Reports are kept at the laboratory for one year and are then stored at an access-restricted warehouse.

The original chain of custody forms and case file forms are filed with the final report. If the client requested specific QC be performed, copies of the QC will also be filed with the report.

Figure 10-1

TEM Instrument Log

Date	Initials	Client/Location	Client #	Lab #	Protocol

Figure 10-2

PLM Analysis Log

BULK SAMPLING ANALYSIS RESULTS REPORTING FORM

Client Name: _____ Project Number: _____

Project Location: _____ Analyst/Date: _____

Lab ID #								
Sample ID #								
Sample Date								
Homogeneous?								
Layers?								
Fibrous?								
Color:								
Asbestos?								
RI Liquid								
Morphology								
Color/Pleochlor								
Extinction								
Sign of Elon.								
DS Colors ⊥/∥								
RI ⊥/∥								
Birefringence								
Point Count								
Type - %								
RI Liquid								
Morphology								
Color/Pleochlor								
Extinction								
Sign of Elon.								
DS Colors ⊥/∥								
RI ⊥/∥								
Birefringence								
Point Count								
Type - %								
Non-Fibrous Material								

Asbestos Fibers

1 - Amosite
2 - Chrysotile
3 - Crocidolite
4 - Other, Specify

Other Fibrous Material

5 - Mineral Wool
6 - Glass Wool
7 - Cellulose
8 - Synthetic
9 - Other, Specify

Non-Fibrous Material

10 - Talc
11 - Gypsum
12 - Kaolin
13 - Calcite
14 - Quartz
15 - Other, Specify

11. Corrective Actions

QC samples must meet established criteria. If they fail to meet these criteria, corrective actions are taken. If the alignment fails to meet QC criteria, the problem is located and corrected and the system realigned. Samples cannot be analyzed until the alignment meets the QC criteria. If duplicates are out of control, the data may be rejected and the samples reanalyzed. Alternatively, the sample data may be accepted, depending upon many circumstances. The client is notified if QC data fails criteria and ultimately makes the decision on whether or not to accept the data. If the data are accepted, they are marked with qualifiers to document that the QC did not meet established criteria.

The analyst who is responsible for running the samples is the first to assess the quality of the data. If a problem is detected, the section supervisor is immediately notified. The quality of the data is also checked by the section supervisor, followed by the QA/QC Coordinator, the project supervisor and the laboratory manager. If samples need to be reanalyzed, the section supervisor is first consulted, and the procedure is rescheduled. The analyst will compare the new result with the old one and note any differences. The results are then discussed with the section supervisor. If the new results meet the QC criteria, the results are then reported. If QC criteria still are not met, the results are reviewed with the project supervisor, the QA/QC Coordinator, and the client. A decision is then made to accept the data or to resample. The decision-making process varies depending on the type of project and the ultimate use of the data.

If QC data fails any of the limits, a corrective action log is filled out by the analyst and signed by the section supervisor, the QA/QC Coordinator and the project supervisor. A copy of a corrective action log is included as Figure 11-1. The corrective action logs are then filed in a three-ring binder and kept in the laboratory.

Figure 11-1

Corrective Action Log

CORRECTIVE ACTION LOG
ASBESTOS

Analyst: _____

Date of Analysis: _____

Instrument: _____

Method: _____

PROJECT NUMBER(S)/BATCH NUMBER(S)	EXCURSIONS	AFFECTED SAMPLES	CRITERIA COMPARISON	CORRECTIVE ACTION/EXPLANATION

Reviewed by: _____ Section Supervisor _____ Date

_____ QA/QC Officer _____ Date

_____ Project Supervisor _____ Date

12. Performance and Systems Audits

12.1 Internal System Audits

An internal audit is performed quarterly on each section of the laboratory for overall adherence to the guidelines and procedures outlined in this manual. Laboratory notebooks are checked to verify signatures and dates. QC samples are checked for the proper frequency and compliance with established control limits. Procedures are reviewed to verify compliance with specific methods and SOP's.

The QA/QC Coordinator is responsible for scheduling each audit. The results of the audit are discussed with the section supervisors and the manager. Changes or updates are implemented as needed.

12.2 External System Audits

External system audits are performed yearly by several certifying agencies including New York State Department of Health, and the National Voluntary Laboratory Accreditation Program. Some audits are unannounced, while others are scheduled in advance. The laboratory will allow audits, either planned or unplanned, during normal business hours.

Any excursions or deficiencies that are noted during an external audit, are resolved to the satisfaction of the agency conducting the audit. A copy of the audit report and our responses to the deficiencies are kept on file in the laboratory.

12.3 Performance Audits

The laboratory also participates in the analysis of Performance Evaluation (P.E.) Samples. These are sent out up to ten times a year by many certifying agencies. Results must fall within certain limits in order to be acceptable. It is by successfully completing the P.E. sample analysis that the laboratory obtains certification to perform sample analysis. The P.E. sample analysis also serves as a means of comparison with other laboratories performing similar work. The laboratory participates in the following P.E. studies:

1. New York State Department of Health Asbestos in Water and/or Air by TEM Proficiency Tests, Fibers in Air (PCM) Proficiency Test, and Asbestos in (Bulk) Friable Material (PLM) Proficiency Test
2. American Industrial Hygiene Association Asbestos Analyst Registry and Bulk Asbestos Quality Assurance Program
3. National Institute for Occupational Safety & Health Proficiency Analytical Testing Program
4. National Voluntary Laboratory Accreditation Program Bulk Asbestos Analysis and Airborne Asbestos Analysis.

Data related to the P.E. sample analysis and the results of the analysis are maintained by the lab and filed in binders according to agency administering the P.E. samples. If any parameters are failed, the

problem is investigated and an explanation/corrective action is written up and filed with the P.E. sample results.

12.4 Certifications

Appendix A is a table listing the agencies with which Laboratories holds certifications. Complete certification information is available from the laboratory.

13. Quality Assurance Reports

The QA/QC Coordinator is responsible for making periodic reports to management concerning QA activities. These reports serve to document lab personnel adherence to QA requirements and to discuss any updates or changes necessary to the QC program. There are informal oral reports and formal written reports. Oral reports are given weekly during a meeting with the administrative manager. Formal written reports are given monthly to document QC activity in the PLM and TEM sections. Formal written reports are also given periodically to document results of section audits and review of control charts. The QA/QC Coordinator keeps a copy of quality assurance reports, whether informal or formal.

14. Resumes

Resumes of key personnel are available from the laboratory.

Appendix A *State Certifications*

State Agency	Cert. No.	Category*							Comments
		WS	WP	HW	SW	M	R	A	
New York	10155	X	X	X	X	X	X	X	
NVLAP	1343							X	Airborne and bulk asbestos
New Jersey	73361	X	X						Hazardous/Solid Waste certification not available
Connecticut	PH0634	X	X						Hazardous/Solid Waste certification nor available
Pennsylvania	68-285	X						X	Drinking Water certification only
Massachusetts	NY034	X	X						Hazardous/Solid Waster certification not available
Rhode Island									State certification not required to perform analysis
Tennessee	02942	X							Drinking Water certification only
North Carolina	315	X	X						Hazardous/Solid Waste certification not available
Ohio									State certification not required to perform analysis
Missouri									State certification not required to perform analysis
South Carolina	91007	X	X	X	X				
Florida	E87280	X	X	X	X				
Michigan		X							Drinking Water certification only
Virginia	00244	X							Drinking Water certification only
Colorado									State certification not required to perform analysis
Wyoming									State certification not required to perform analysis
Georgia									State certification not required to perform analysis

WS=Water Supply, WP=Water Pollution, HW=Hazardous Waste, SW=Solid Waste, M=Microbiological, R=Radiochemistry, A=Asbestos

1 SHEO 988
SHELL OIL COMPANY
840076
ASBESTOS
WWWWW

09/10/95

SHELL MATERIAL SAFETY DATA SHEET
BE SAFE. READ OUR PRODUCT SAFETY INFORMATION ... AND PASS IT ON.
PRODUCT LIABILITY LAW REQUIRES IT!

********** MATERIAL SAFETY DATA SHEET 840076 - 04 **********

ASBESTOS SH MSDS: 840076 - 04 09/10/95

MANUFACTURER'S NAME AND ADDRESS
SHELL OIL COMPANY
PRODUCT SAFETY & COMPLIANCE
P.O. BOX 4320
HOUSTON, TX 77210

TELEPHONE NUMBERS:
24 HOUR EMERGENCY ASSISTANCE
SHELL: 713-473-9461 CHEMTREC: 800-424-9300

GENERAL MSDS ASSISTANCE
SHELL: 713-241-4819

SECTION I | NAME

PRODUCT: ASBESTOS
CHEM NAME: AMOSITE, CHRYSOTILE, CROCIDOLITE AND OTHER FORMS COVERED BY THE OSHA HEALTH STANDARD
ACUTE HEALTH HAZARD: 1
CHEM FAMILY: WASTE
FIRE HAZARD: 0
SHELL CODE: WWWWW
REACTIVITY: 0

SECTION II-A | PRODUCT/INGREDIENT

NO.	COMPOSITION	CAS	PERCENT
P	ASBESTOS	1332-21-4	100

SECTION II-B | ACUTE TOXICITY DATA

NO.	ACUTE ORAL LD50	ACUTE DERMAL LD50	ACUTE INHALATION LC50
P	NONE		

SECTION III | HEALTH INFORMATION

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1 SHEO 988
SHELL OIL COMPANY
ASBESTOS
THE HEALTH EFFECTS NOTED BELOW ARE CONSISTENT WITH REQUIREMENTS UNDER THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200).

EYE CONTACT:
DUST MAY CAUSE MECHANICAL IRRITATION TO THE EYES.

SKIN CONTACT:
HIGH CONCENTRATIONS OF DUST ARE IRRITATING TO THE SKIN AND MAY CAUSE "ASBESTOS CORNS," BENIGN, WART-LIKE GROWTHS.

INHALATION:
INHALATION OF ASBESTOS FIBERS MAY CAUSE ASBESTOSIS (FIBROSIS OF THE LUNGS). LUNG CANCER OR MESOTHELIOMA (SEE OTHER HEALTH EFFECTS).

INGESTION:
ASBESTOS HAS A LOW LEVEL OF ACUTE TOXICITY UPON INGESTION.

SIGNS AND SYMPTOMS:
IRRITATION AS NOTED ABOVE. LUNG DAMAGE (SCARRING, AND TUMORS) MAY BE EVIDENCED BY SHORTNESS OF BREATH, COUGH, CHEST PAIN, CYANOSIS (BLUISH DISCOLORATION OF THE SKIN), CLUBBING OF THE FINGERS, FATIGUE AND WEIGHT LOSS.

AGGRAVATED MEDICAL CONDITIONS:
PREEXISTING SKIN AND RESPIRATORY DISORDERS MAY BE AGGRAVATED BY EXPOSURE TO THIS MATERIAL. IMPAIRED LUNG FUNCTION FROM PREEXISTING DISORDERS MAY BE AGGRAVATED BY EXPOSURE TO THIS MATERIAL.

OTHER HEALTH EFFECTS:
THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, THE NATIONAL TOXICOLOGY PROGRAM AND THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER HAVE DETERMINED THERE IS SUFFICIENT EVIDENCE FOR THE CARCINOGENICITY OF ASBESTOS IN BOTH HUMANS AND EXPERIMENTAL ANIMALS. THEREFORE, THE HANDLING PROCEDURES AND SAFETY PRECAUTIONS IN THIS MSDS SHOULD BE FOLLOWED TO MINIMIZE EMPLOYEE'S EXPOSURE.

SEE SECTION VI FOR ADDITIONAL HEALTH INFORMATION.

SECTION IV | OCCUPATIONAL EXPOSURE LIMITS

	OSHA		ACGIH		
NO.	PEL/TWA	PEL/CEILING	TLV/TWA	TLV/STEL	OTHER
P	0.1 F/CC	1 F/CC*	2 F/CC,A1		
P1			0.5 F/CC,A1		
P2			2 F/CC,A1		
P3			0.2 F/CC,A1		

P4	2 F/CC,A1

F/CC= FIBERS/CUBIC CENTIMETER; *30-MINUTE EXCURSION LIMIT. P1= AMOSITE; P2= CHRYSOTILE; P3= CROCIDOLITE; P4= OTHER FORMS.

SECTION V ¦ EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT: FLUSH EYES WITH PLENTY OF WATER FOR 15 MINUTES WHILE HOLDING EYELIDS OPEN. GET MEDICAL ATTENTION.

SKIN CONTACT: FLUSH SKIN WITH WATER WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. IF IRRITATION OCCURS, GET MEDICAL ATTENTION. DO NOT REUSE CLOTHING OR SHOES UNTIL CLEANED.

INHALATION: REMOVE VICTIM TO FRESH AIR AND PROVIDE OXYGEN IF BREATHING IS DIFFICULT. GIVE ARTIFICIAL RESPIRATION IF NOT BREATHING. GET MEDICAL ATTENTION.

INGESTION: DO NOT INDUCE VOMITING. IN GENERAL, NO TREATMENT IS NECESSARY UNLESS LARGE QUANTITIES OF MATERIAL ARE INGESTED. HOWEVER, GET MEDICAL ADVICE.

NOTE TO PHYSICIAN:

SECTION VI ¦ SUPPLEMENTAL HEALTH INFORMATION

ASBESTOS CAUSED NO DOSE-RELATED INCREASE IN SISTER-CHROMATID EXCHANGE LEVELS IN CHO-K1 CELLS, HUMAN FIBROBLASTS OR HUMAN LYMPHOBLASTOID CELLS. HOWEVER, MITOTIC DELAY WAS INDUCED IN CHO-K1 CELLS AND HUMAN FIBROBLASTS. CHINESE HAMSTER OVARIAN FIBROBLASTS SHOWED AN INCREASE IN THE SISTER CHROMATID EXCHANGE RATE UPON EXPOSURE TO ASBESTOS. ESCHERICHIA COLI AND SALMONELLA TYPHIMURIUM SHOWED ASBESTOS NOT TO BE MUTAGENIC. CYTOGENETICS IN VITRO ASSAY FINDINGS WERE POSITIVE; ASBESTOS WAS NOT METABOLICALLY ACTIVATED.

MARKED TO EXTREME HYPERPLASIA OF THE BONE MARROW AND ABERRATIONS OF HUMORAL AND CELLULAR IMMUNITY HAVE BEEN REPORTED IN INDIVIDUALS EXPOSED TO ASBESTOS.

THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER HAS CONCLUDED THE FOLLOWING: "CIGARTETTE SMOKING AND OCCUPATIONAL EXPOSURE TO ASBESTOS FIBERS INCREASES LUNG CANCER INCIDENCE INDEPENDENTLY; WHEN THEY OCCUR TOGETHER, THEY ACT MULTIPLICATIVELY." THE HANDLING PROCEDURES AND SAFETY PRECAUTIONS IN THIS MSDS SHOULD BE FOLLOWED TO MINIMIZE EMPLOYEE EXPOSURE.

SECTION VII | PHYSICAL DATA

BOILING POINT (DEG F): NOT APPLICABLE

SPECIFIC GRAVITY (H2O=1): >1

VAPOR PRESSURE (MM HG): NOT APPLICABLE

MELTING POINT (DEG F): NOT APPLICABLE

SOLUBILITY (IN WATER): NEGLIGIBLE

VAPOR DENSITY (AIR=1): NOT APPLICABLE

EVAPORATION RATE (NORMAL BUTYL ACETATE = 1): NOT APPLICABLE

APPEARANCE AND ODOR: FIBROUS SOLID, NO ODOR.

SECTION VIII | FIRE AND EXPLOSION HAZARDS

FLASH POINT AND METHOD:
NONE

FLAMMABLE LIMITS/% VOLUME IN AIR:
LOWER: - UPPER: -

EXTINGUISHING MEDIA:
USE WATER FOG, FOAM, DRY CHEMICAL OR CO2.

SPECIAL FIRE FIGHTING PROCEDURES AND PRECAUTIONS:
MATERIAL WILL NOT BURN. DO NOT ENTER CONFINED FIRE SPACE WITHOUT FULL BUNKER GEAR (HELMET WITH FACE SHIELD, BUNKER COATS, GLOVES AND RUBBER BOOTS), INCLUDING A POSITIVE PRESSURE NIOSH APPROVED SELF-CONTAINED BREATHING APPARATUS. COOL FIRE EXPOSED CONTAINERS WITH WATER.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

SECTION IX | REACTIVITY

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS AND MATERIALS TO AVOID:

HAZARDOUS DECOMPOSITION PRODUCTS:
THERMAL DECOMPOSITION PRODUCTS ARE HIGHTLY DEPENDENT ON THE COMBUSTION CONDITIONS. A COMPLEX MIXTURE OF AIRBORNE PARTICULATES AND GASES WILL EVOLVE

WHEN THIS MATERIAL UNDERGOES PYROLYSIS OR COMBUSTION.

SECTION X | EMPLOYEE PROTECTION

RESPIRATORY PROTECTION:
DO NOT BREATHE DUST. IF EXPOSURE MAY OR DOES EXCEED OCCUPATIONAL EXPOSURE LIMITS (SEC. IV) USE A NIOSH-APPROVED RESPIRATOR TO PREVENT OVEREXPOSURE. IN ACCORD WITH 29 CFR 1910.1001 OR 1926.58 USE EITHER AN ATMOSPHERE-SUPPLYING RESPIRATOR OR AN AIR-PURIFYING RESPIRATOR EQUIPPED WITH HIGH-EFFICIENCY PARTICULATE CARTRIDGES. FOR ADDITIONAL REQUIREMENTS, REFER TO 29 CFR 1926.58(H).

PROTECTIVE CLOTHING:
AVOID CONTACT WITH EYES. WEAR SAFETY GLASSES OR GOGGLES AS APPROPRIATE. AVOID CONTACT WITH SKIN AND CLOTHING. WEAR CHEMICAL-RESISTANT GLOVES AND PROTECTIVE CLOTHING. FOR ADDITIONAL REQUIREMENTS, REFER TO 29 CFR 1926.58(I).

ADDITIONAL PROTECTIVE MEASURES:
FOR ADDITIONAL REQUIREMENTS, REFER TO 29 CFR 1926.58(G).

SECTION XI | ENVIRONMENTAL PROTECTION

SPILL OR LEAK PROCEDURES:
PREVENT BODILY CONTACT WITH SPILLED MATERIAL. WEAR PROTECTIVE CLOTHING AND APPROPRIATE RESPIRATOR. VACUUM THE AREA WITH VACUUM CLEANER EQUIPPED WITH HIGH-EFFICIENCY PARTICULATE AEROSOL (HEPA) FILTERS. FOR ADDITIONAL REQUIREMENTS ON CLEANUP AND DISPOSAL, REFER TO 29 CFR 1926.58(L) AND 40 CFR 61.150. AVOID GENERATING DUST. PUT INTO CONTAINERS FOR DISPOSAL.

SECTION XII | SPECIAL PRECAUTIONS

FOR ADDITIONAL REQUIREMENTS, REFER TO 29 CFR 1926.58, 29 CFR 1910.1001, 40 CFR 61.145, AND 40 CFR 61.150.

SECTION XIII | TRANSPORTATION REQUIREMENTS

DEPARTMENT OF TRANSPORTATION CLASSIFICATION:
CLASS 9 (MISCELLANEOUS HAZARDOUS MATERIAL), III

D.O.T. PROPER SHIPPING NAME: ASBESTOS

OTHER REQUIREMENTS: NA 2212, GUIDE 31. NONFRIABLE ASBESTOS AND FRIABLE ASBESTOS IN QUANTITIES OF LESS THAN 1 POUND PER CONTAINER ARE NOT REGULATED BY DOT.

SECTION XIV | OTHER REGULATORY CONTROLS

THIS MATERIAL IS LISTED ON THE EPA/TSCA INVENTORY OF CHEMICAL SUBSTANCES.

IN ACCORDANCE WITH SARA TITLE III, SECTION 313, THE ATTACHED ENVIRONMENTAL DATA SHEET (EDS) SHOULD ALWAYS BE COPIED AND SENT WITH THE MSDS.

SECTION XV | STATE REGULATORY INFORMATION

THE FOLLOWING CHEMICALS ARE SPECIFICALLY LISTED BY INDIVIDUAL STATES; OTHER PRODUCT SPECIFIC HEALTH AND SAFETY DATA IN OTHER SECTIONS OF THE MSDS MAY ALSO BE APPLICABLE FOR STATE REQUIREMENTS. FOR DETAILS ON YOUR REGULATORY REQUIREMENTS YOU SHOULD CONTACT THE APPROPRIATE AGENCY IN YOUR STATE.

STATE LISTED COMPONENT	CAS NUMBER	PERCENT	STATE CODE
ASBESTOS	1332-21-4	100	CA, FL, IL, MA, ME, MN, PA, RI, CA65C

CA = CALIFORNIA HAZ. SUBST. LIST; CA65C, CA65R, CA65C/R = CALIFORNIA SAFE DRINKING WATER AND TOXICS ENFORCEMENT ACT OF 1986 OR PROPOSITION 65 LIST; CT = CONNECTICUT TOXIC. SUBST. LIST; FL = FLORIDA SUBST. LIST; IL = ILLINOIS TOX. SUBST. LIST; LA = LOUISIANA HAZ. SUBST. LIST; MA = MASSACHUSETTS SUBST. LIST; ME = MAINE HAZ. SUBST. LIST; MN = MINNESOTA HAZ. SUBST. LIST; NJ = NEW JERSEY HAZ. SUBST. LIST; PA = PENNSYLVANIA HAZ. SUBST. LIST; RI = RHODE ISLAND HAZ. SUBST. LIST.

CALIFORNIA PROPOSITION 65 FOOTNOTE: CA65C = THE CHEMICAL IDENTIFIED WITH THIS CODE IS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER. CA65R = THE CHEMICAL IDENTIFIED WITH THIS CODE IS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM. CA65C/R = THE CHEMICAL IDENTIFIED WITH THIS CODE IS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BOTH CANCER AND BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

SECTION XVI | SPECIAL NOTES

1 SHEO 988
SHELL OIL COMPANY
ASBESTOS

IIS MSDS REVISION HAS CHANGES IN SECTION XV - STATE REGULATORY INFORMATION

THE INFORMATION CONTAINED HEREIN IS BASED ON THE DATA AVAILABLE TO US AND IS BELIEVED TO BE CORRECT. HOWEVER, SHELL MAKES NO WARRANTY, EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF. SHELL ASSUMES NO RESPONSIBILITY FOR INJURY FROM THE USE OF THE PRODUCT DESCRIBED HEREIN.

WE ARE PROVIDING OUR MOST RECENT MATERIAL SAFETY DATA SHEET AND/OR ENVIRONMENTAL DATA SHEET. IF YOU WISH TO RECEIVE UPDATES TO THIS INFORMATION, PLEASE CALL SHELL'S GENERAL MSDS ASSISTANCE LINE (713-241-4819) TO ENSURE THAT YOU ARE ADDED TO SHELL'S REGULAR MSDS DISTRIBUTION SYSTEM.

BE SAFE. READ OUR PRODUCT
SAFETY INFORMATION...AND
PASS IT ON. (PRODUCT
LIABILITY LAW REQUIRES IT)

SHELL OIL COMPANY
PRODUCT SAFETY AND COMPLIANCE
P. O. BOX 4320
HOUSTON, TX. 77210

********** ENVIRONMENTAL DATA SHEET 840076 - 00 **********

EDS: 840076 - 00 09/10/95

RODUCT NAME: ASBESTOS
PRODUCT CODE: WWWWW

MANUFACTURER'S NAME AND ADDRESS
SHELL OIL COMPANY
P.O. BOX 4320
HOUSTON, TX 77210

TELEPHONE NUMBERS:
24 HOUR EMERGENCY ASSISTANCE
SHELL: 713-473-9461 CHEMTREC: 800-424-9300

FOR ADDITIONAL INFORMATION ON THIS ENVIRONMENTAL DATA PLEASE
CALL 713-241-2252

SECTION I ¦ PRODUCT COMPOSITION

NO.	COMPOSITION	CAS	PERCENT
P	ASBESTOS	1332-21-4	100

SECTION II ¦ SARA TITLE III INFORMATION

NO.	EHS RQ*	EHS TPQ*	SEC-313	313 CATEGORY	311/312 CATEGORY

1 SHEO 988
SHELL OIL COMPANY
ASBESTOS

(*1)	(*2)	(*3)	(*4)	(*5)
P		YES		H-1, H-2

*1 = REPORTABLE QUANTITY OF EXTREMELY HAZARDOUS SUBSTANCE, SEC 302
*2 = THRESHOLD PLANNING QUANTITY, EXTREMELY HAZARDOUS SUBSTANCE, SEC 302
*3 = TOXIC CHEMICAL, SEC 313
*4 = CATEGORY AS REQUIRED BY SEC 313 (40 CFR 372.42), MUST BE USED ON TOXIC RELEASE INVENTORY FORM
*5 = HAZARD CATEGORY FOR SARA SEC. 311/312 REPORTING
HEALTH: H-1 = IMMEDIATE (ACUTE) HEALTH HAZARD
H-2 = DELAYED (CHRONIC) HEALTH HAZARD
PHYSICAL: P-3 = FIRE HAZARD
P-4 = SUDDEN RELEASE OF PRESSURE HAZARD
P-5 = REACTIVE HAZARD

SECTION III ¦ ENVIRONMENTAL RELEASE INFORMATION

EPA - COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT. UNDER EPA-CERCLA ("SUPERFUND") RELEASES TO AIR, LAND OR WATER WHICH EXCEED THE REPORTABLE QUANTITY MUST BE REPORTED TO THE NATIONAL RESPONSE CENTER, 800-424-8802.

THE REPORTABLE QUANTITY (RQ) FOR A RELEASE OF THIS MATERIAL IS 1 LB.

SECTION IV ¦ RCRA INFORMATION

IF THIS MATERIAL BECOMES A WASTE, IT WOULD NOT BE A HAZARDOUS WASTE BY RCRA CRITERIA (40 CFR 261). FOR DISPOSAL REQUIREMENTS, SEE 40 CFR 61.150.

WE ARE PROVIDING OUR MOST RECENT MATERIAL SAFETY DATA SHEET AND/OR ENVIRONMENTAL DATA SHEET. IF YOU WISH TO RECEIVE UPDATES TO THIS INFORMATION, PLEASE CALL SHELL'S GENERAL MSDS ASSISTANCE LINE (713-241-4819) TO ENSURE THAT YOU ARE ADDED TO SHELL'S REGULAR MSDS DISTRIBUTION SYSTEM.

SHELL OIL COMPANY
P.O. BOX 4320
HOUSTON, TX 77210

FOR ADDITIONAL INFORMATION ON THIS ENVIRONMENTAL DATA PLEASE CALL
(713) 241-2252

FOR EMERGENCY ASSISTANCE PLEASE CALL
SHELL: (713) 473-9461
CHEMTREC: (800) 424-9300

1 SHEO 988
SHELL OIL COMPANY
ASBESTOS

****
THIS MSDS HAS BEEN PROVIDED IN AN ELECTRONIC FORMAT FOR USE IN THE CHEMTREC EMERGENCY RESPONSE PROGRAM AND/OR OTHER APPROVED PROGRAMS. THIS FORMAT MAY CONTAIN BLANKS WHERE INFORMATION WAS NOT AVAILABLE OR NOT APPLICABLE AND THEREFORE MAY NOT BE FULLY COMPLIANT WITH THE OSHA HAZARD COMMUNICATION STANDARD. IF YOU PURCHASE OR USE THIS SHELL PRODUCT AND HAVE NOT RECEIVED A MSDS FROM SHELL PLEASE CONTACT US AND WE WILL PROVIDE ONE. THIS WILL ENSURE THAT YOU RECEIVE UPDATES OF THIS INFORMATION.
****

OPERATING PROCEDURE

SAFETY GUIDELINES FOR DRILLING INTO SOIL AND ROCKS

PURPOSE

The purpose of this operating procedure is to provide guidelines for safe conduct of drilling operations with truck-mounted and other engine-powered, drill rigs. The procedure addresses off-road movement of drill rigs, overhead and buried utilities, use of augers, rotary and core drilling, and other drilling operations and activities.

APPLICATION

The guidelines shall be applied in all projects in which truck-mounted, or other engine-powered, drill rigs are used. The guidelines are applicable to employees and award rigs. For drill rigs operated by contractors, drill rig safety is the responsibility of the contractor.

RESPONSIBILITY AND AUTHORITY

Drill rig safety and maintenance is the responsibility of the drill rig operator.

MOVEMENT OF DRILL RIGS

Before moving a rig, the operator must do the following:

1. To the extent practical, walk the planned route of travel and inspect it for depressions, gullies, ruts, and other obstacles.

2. Check the brakes of the truck/carrier, especially if the terrain along the route of travel is rough or sloped.

3. Discharge all passengers before moving on rough or steep terrain.

4. Engage the front axle (on 4x4, 6x6, etc. vehicles) before traversing rough or steep terrain.

Driving drill rigs along the sides of hills or embankments should be avoided; however, if side-hill travel becomes necessary, the operator must conservatively evaluate the ability of the rig to remain upright while on the hill or embankment. The possibility that the presence of drilling tools on the rig may reduce the ability of the rig to remain upright by raising the center of mass of the rig must be considered.

Logs, ditches, road curbs, and other long and horizontal obstacles should be normally approached and driven over squarely, not at an angle.

When close lateral or overhead clearance is encountered, the driver of the rig should be guided by another person on the ground.

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Loads on the drill rig and truck must be properly stored while the truck is moving, and the mast must be in the fully lowered position.

After the rig has been positioned to begin drilling, all brakes and/or locks must be set before drilling begins. If the rig is positioned on a steep grade and leveling of the ground is impossible or impractical, the wheel of the transport vehicle should be blocked and other means of preventing the rig from moving or topping over employed.

BURIED AND OVERHEAD UTILITIES

The location of overhead and buried utility lines must be determined before drilling begins, and their locations should be noted on boring plans or assignment sheets.

When overhead power lines are close by, the drill rig mast should not be raised unless the distance between the rig and the nearest power line is at least 20 feet or other distance as required by local ordinances, whichever is greater. The drill rig operator or assistant should walk completely around the rig to make sure that proper distance exists.

When the drill rig is positioned near an overhead line, the rig operator should be aware that hoist lines and power lines can be moved towards each other by wind. When necessary and approved by the PM and the utility, powerlines may be shielded, shut down, or moved by the appropriate personnel.

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CLEARING THE WORK AREA

Before a drill rig is positioned to drill, the area on which the rig is to be positioned should be cleared of removable obstacles and the rig should be leveled if sloped. The cleared/leveled area should be large enough to accommodate the rig and supplies.

SAFE USE OF AUGERS

Never place hands or fingers under the bottom of an auger flight or drill rods when hoisting the augers or rods over the top of another auger or rod in the ground or other hard surfaces, such as the drill rig platform.

Never allow feet to get under the auger or drill rod while they are being hoisted.

When drill is rotating, stay clear of the drill string and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.

Move auger cuttings away from the auger with a long-handled shovel or spade; never use hands or feet.

Never clean an auger attached to the drill rig unless the transmission is in neutral or the engine is off, and the auger has stopped rotating.

SAFE USE OF HAND TOOLS

OSHA regulations regarding hand tools should be observed in addition to the guidelines provided below:

1. Each tool should be used only to perform tasks for which it was originally designed.

2. Damaged tools should be repaired before use or discarded.

3. Safety goggles or glasses should be worn when using a hammer or chisel. Nearby co-workers and by-standers should be required to wear safety goggles or glasses also or to move away.

4. Tools should be kept cleaned and stored in an orderly manner when not in use.

SAFE USE OF WIRE LINE HOISTS, WIRE ROPE, AND HOISTING HARDWARE

Safety rules described in 29 CFR 1926.552 and guidelines contained in the Wire RPE User's Manual published by the American Iron and Steel Institute shall be used whenever wire line hoists, wire rope, or hoisting hardware are used.

PROTECTIVE GEAR

MINIMUM PROTECTIVE GEAR

Items listed below should be worn by all members of the drilling team while engaged in drilling activities.

- Hard Hat;
- Safety Shoes (shoes or boots with steel toes and shanks); and
- Gloves.

OTHER GEAR

Items listed below should be worn when conditions warrant their use. Some of the conditions are listed after each item.

1. <u>Safety Goggles or Glasses:</u> Use when: (1) driving pins in and out of drive chains, (2) replacing keys in tongs, (3) handling hazardous chemicals, (4) renewing or tightening gauge glasses, (5) breaking concrete, brick, or cast iron, (6) cleaning material with chemical solutions, (7) hammering or sledging on chisels, cold cuts, or bars, (8) cutting wire lines, (9) grinding on abrasive wheels, (10) handling materials in powered or semi-powered form, (11) scraping metal surfaces, (12) sledging rock bits or core heads to tighten or loosen them, (13) hammering fittings and connections, and (14) driving and holding rivets.

2. <u>Safety Belts and Lifelines:</u> Safety belts and lifelines should be worn by all persons working on top of an elevated derrick beam. The lifeline should be secured at a position that will allow a person to fall no more than eight feet.

3. <u>Life Vests:</u> Use for work over water.

TRAFFIC SAFETY

Drilling in streets, parking lots or other areas of vehicular traffic requires definition of the work zones with cones, warning tape, etc. and compliance with local police requirements.

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FIRE SAFETY

1. Fire extinguishers shall be kept on or near drill rigs for fighting small fires.

2. If methane is suspected in the area, a combustible gas instrument (CGI) shall be used to monitor the air near the borehole with all work to stop at 25 percent of the Lower Explosive Limit.

3. Work shall stop during lightning storms.

/H&S2

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COLD STRESS

The cold stress TLVs are intended to protect workers from the severest effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body temperature from falling below 36°C (96.8°F) and to prevent cold injury to body extremities (deep body temperature is the core temperature of the body determined by conventional methods for rectal temperature measurements). For a single, occasional exposure to a cold environment, a drop in core temperature to no lower that 35°C (95°F) should be permitted. In addition to provisions for total body protection, the TLV objective is to protect all parts of the body with emphasis on hands, feet, and head from cold injury.

Introduction

Fatal exposures to cold among workers have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is the fall in the deep core temperature of the body. The clinical presentations of victims of hypothermia are shown in Table 1. Workers should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96.8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F). This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air, or to immersion in cold water, at temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

1. Adequate insulating dry clothing to maintain core temperatures above 36°C (96.8°F) must be provided to workers if work is performed in air temperatures below 4°C (40°F). Wind chill cooling rate and the cooling power of air are critical factors. [Wind chill cooling rate is defined as heat loss from a body expressed in watts per meter squared which is a function of the air temperature and wind velocity upon the exposed body.] The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required. An equivalent chill temperature chart relating the actual dry bulb air temperature and the wind ve

TABLE 1. Progressive Clinical Presentations of Hypothermia*

Core Temperature °C	°F	Clinical Signs
37.6	99.6	"Normal" rectal temperature
37	98.6	"Normal" oral temperature
36	96.8	Metabolic rate increases in an attempt to compensate for heat loss
35	95.0	Maximum shivering
34	93.2	Victim conscious and responsive, with normal blood pressure
33	91.4	Severe hypothermia below this temperature
32	89.6	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases
31	87.8	
30	86.0	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases
29	84.2	
28	82.4	Ventricular fibrillation possible with myocardial irritability
27	80.6	Voluntary motion ceases; pupils nonreactive to light; deep tendon and superficial reflexes absent
26	78.8	Victim seldom conscious
25	77.0	Ventricular fibrillation may occur spontaneously
24	75.2	Pulmonary edema
22	71.6	Maximum risk of ventricular fibrilation
21	69.8	
20	68.0	Cardiac standstill
18	64.4	Lowest accidental hypothermia victim to recover
17	62.6	Isoelectric electroencephalogram
9	48.2	Lowest artificially cooled hypothermia patient to recover

* Presentations approximately related to core temperature. Reprinted from the January 1982 issue of *American Family Physician*, published by the American Academy of Family Physicians

only [illegible] presented in Table [illegible]. The equivalent chill temperature should be used when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the deep body core temperature.

2. Unless there are unusual or extenuating circumstances, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered. The precautionary actions to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

Evaluation and Control

For exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of −32°C (25.6°F). Superficial or deep local tissue freezing will occur only at temperatures below −1°C (30.2°F) regardless of wind speed.

At air temperatures of 2°C (35.6°F) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

Recommended limits for properly clothed workers for periods of work at temperatures below freezing are shown in Table 3.

Special protection of the hands is required to maintain manual dexterity for the prevention of accidents:

1. If fine work is to be performed with bare hands for more than 10–20 minutes in an environment below 16°C (60.8°F), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below −1°C (30.2°F).
2. If the air temperature falls below 16°C (60.8°F) for sedentary, 4°C (39.2°F) for light, −7°C (19.4°F) for moderate work and fine manual dexterity is not required, then gloves should be used by the workers.

To prevent contact frostbite, the workers should wear anti-contact gloves.

1. When cold surfaces below −7°C (19.4°F) are within reach, a warning should be given to each worker by the supervisor to prevent inadvertent contact by bare skin

TABLE 2. Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)										
	50	40	30	20	10	0	−10	−20	−30	−40	−50
	Equivalent Chill Temperature (°F)										
calm	50	40	30	20	10	0	−10	−20	−30	−40	−50
5	48	37	27	16	6	−5	−15	−26	−36	−47	−57
10	40	28	16	4	−9	−24	−33	−46	−58	−70	−83
15	36	22	9	−5	−18	−32	−45	−58	−72	−85	−99
20	32	18	4	−10	−25	−39	−53	−67	−82	−96	−110
25	30	16	0	−15	−29	−44	−59	−74	−88	−104	−118
30	28	13	−2	−18	−33	−48	−63	−79	−94	−109	−125
35	27	11	−4	−20	−35	−51	−67	−82	−98	−113	−129
40	26	10	−6	−21	−37	−53	−69	−85	−100	−116	−132
(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* In < hr with dry skin. Maximum danger of false sense of security					*INCREASING DANGER* Danger from freezing of exposed flesh within one minute.			*GREAT DANGER* Flesh may freeze within 30 seconds.		
	Trenchfoot and immersion foot may occur at any point on this chart.										

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

TABLE 3. Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shift*

Air Temperature — Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph
°C (approx.)	°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period
-26° to -28°	-15° to -19°	(Norm. Breaks)	1	(Norm. Breaks)	1	75 min	2	55 min	3	[illegible]
-29° to -31°	-20° to -24°	(Norm. Breaks)	1	75min	2	55 min	3	40 min	4	[illegible]
-32° to -34°	-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease
-35° to -37°	-30° to -34°	55 min	3	40 min	4	30 min	5	Non-emergency work should cease		
-38° to -39°	-35° to -39°	40 min	4	30 min	5	Non-emergency work should cease				
-40° to -42°	-40° to -44°	30 min	5	Non-emergency work should cease						
-43° & below	-45° & below	Non-emergency work should cease								

Notes for Table 3:

1. Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For Lo-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -35°C (-30°F) no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period minutes with 4 breaks in a 4-hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blows drifting snow.
3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill cooling rate of 1750 W/m²; 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m². In general the up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimat and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual tempe in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.
4. TLVs apply only for workers in dry clothing.

* Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labour.

[illegible] the air temperature is [illegible] °C ([illegible]) or [illegible], the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below 4°C (39.2°F). The workers should wear cold protective clothing appropriate for the level of cold and physical activity:

1. If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.
2. If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing in use may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and the outerwear should be changed as it becomes wetted. The outer garments should include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, the employee should make sure that clothing is not wet as a consequence of sweating. If clothing is wet, the employee should change into dry clothes before entering the cold area. The workers should change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change should be determined empirically and will vary individually and according to the type of shoe worn and how much the individual's feet sweat.
3. If exposed areas of the body cannot be protected sufficiently to prevent sensation of excessive cold or frostbite, protective items should be supplied in auxiliary heated versions.
4. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.
5. Workers handling evaporative liquid (gasoline, alcohol or cleaning fluids) at air temperatures below 4°C (39.2°F) should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point that is just above ambient temperature.

Work-Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below −7°C (19.4°F), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The workers should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter. When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing should be provided as necessary to prevent workers from returning to work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of the diuretic and circulatory effects.

For work practices at or below −12°C (10.4°F) ECT, the following should apply:

1. The worker should be under constant protective observation (buddy system or supervision).
2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods must be taken in heated shelters and opportunity for changing into dry clothing should be provided.
3. New employees should not be required to work fulltime in the cold during the first days of employment until they become accustomed to the working conditions and required protective clothing.
4. The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the worker.
5. The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The worker should be protected from drafts to the greatest extent possible.
6. The workers should be instructed in safety and health procedures. The training program should include as a minimum instruction in:
   a. Proper rewarming procedures and appropriate first aid treatment.
   b. Proper clothing practices.
   c. Proper eating and drinking habits.
   d. Recognition of impending frostbite.
   e. Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
   f. Safe work practices

Special Workplace Recommendations

Special design requirements for refrigerator rooms include the following:

1. In refrigerator rooms, the air velocity should be minimized as much as possible and should not exceed 1 meter/sec (200 fpm) at the job site. This can be achieved by properly designed air distribution systems.
2. Special wind protective clothing should be provided based upon existing air velocities to which workers are exposed.

Special caution should be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits.

Eye protection for workers employed out-of-doors in a snow and/or ice-covered terrain should be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.

Workplace monitoring is required as follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60.8°F) so that overall compliance with the requirements of the TLV can be maintained.
2. Whenever the air temperature at a workplace falls below −1°C (30.2°F), the dry bulb temperature should be measured and recorded at least every 4 hours.
3. In indoor workplaces, the wind speed should also be recorded at least every 4 hours whenever the rate of air movement exceeds 2 meters per second (5 mph).
4. In outdoor work situations, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below −1°C (30.2°F).
5. The equivalent chill temperature should be obtained from Table 2 in all cases where air movement measurements are required; it should be recorded with the other data whenever the equivalent chill temperature is below −7°C (19.4°F).

Employees should be excluded from work in cold at −1°C (30.2°F) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below −24°C (11.2°F) with wind speeds less than five miles per hour, or air temperatures below −18°C (0°F) with wind speeds above five miles per hour, should be medically certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissues in addition to providing for first aid treatment.