

	Page
11.2.2.3 Laboratory Control Samples	11-8
11.2.2.4 Surrogate Recovery	11-8
11.2.2.5 Internal Standards	11-8
11.2.2.6 Furnace Atomic Absorption Quality Control	11-8
11.2.2.7 Calibration	11-8
11.2.2.8 Sample Reanalysis	11-8
11.2.2.9 Secondary Dilutions	11-9
11.2.2.10 Laboratory Case Narratives	11-9
11.3 PROJECT ANALYTICAL DATA SET	11-9
11.4 DATA REPORTING	11-10
12.0 PREVENTIVE MAINTENANCE PROCEDURES	12-1
12.1 FIELD INSTRUMENTS AND EQUIPMENT	12-1
12.2 LABORATORY INSTRUMENTS	12-1
13.0 PERFORMANCE AND SYSTEM AUDITS	13-1
13.1 LABORATORY AUDITS	13-1
14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT	14-1
14.1 DAILY QUALITY CONTROL REPORTS	14-1
14.2 QUALITY ASSURANCE REPORTS	14-1
14.3 QUALITY CONTROL SUMMARY REPORTS	14-1

Appendices

A	References	A-1
B	Data Management Plan	B-1
C	Laboratory Analytical Procedures	C-1

List of Tables

1-1	Sampling and Analytical Requirements for Soil Gas Survey for Bulk Fuel Facility (HAA-09)	1-2
3-1	Soil Gas/Sediment DQO Summary for Soil Gas Survey at Bulk Fuel Facility (HAA-09)	3-2
3-2	Surface Water Investigative DQO Summary for Soil Gas Survey at Bulk Fuel Facility (HAA-09)	3-3
3-3	Analytical Methods, Parameters, and Project Quantitation Limits for Hunter Army Airfield Bulk Fuel Facility (HAA-09)	3-5
11-1	Standard Data Deliverables	11-3
11-2	Standard Electronic Data Deliverables	11-4

	Page
<u>List of Figures</u>	
2-1 Laboratory Project Organizational Chart for the Soil Gas Survey for Bulk Fuel Facility (HAA-09)	2-2
11-1 Savannah District Data Validation Form	11-6
14-1 Quality Control Summary Report Format	14-3

1.0 PROJECT DESCRIPTION

This portion of the Sampling and Analysis Plan presents the Quality Assurance Project Plan (QAPP) for activities to be performed during soil gas survey activities to be performed at the Bulk Fuel Facility (HAA-09) at Hunter Army Airfield (HAAF), Georgia. The U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA) require that all environmental monitoring and measurement efforts mandated or supported by these organizations participate in a centrally managed quality assurance (QA) program. Any party generating data for this project has the responsibility to implement minimum procedures to ensure that the precision, accuracy, completeness, and representativeness of its data are known and documented. To ensure that these responsibilities are met uniformly, each party must adhere to the QAPP.

This QAPP presents the organization, objectives, functional activities, and specific QA and quality control (QC) activities associated with the Field Sampling Plan (FSP) for the Bulk Fuel Facility (HAA-09) Investigations. It describes the specific protocols that will be followed for sampling, sample handling and storage, chain of custody (COC), and laboratory analysis. This plan also presents details regarding data quality objectives (DQOs) for the project, sampling and preservation procedures for samples collected in the field, field and sample documentation, sample packaging and shipping, and laboratory analytical procedures for all media sampled. Analytical activities and methodologies associated with chemical testing of QA split samples to be performed by the government laboratory assigned to this project by the USACE-Savannah District are not addressed within this QAPP.

All QA/QC procedures will be in accordance with applicable professional technical standards, EPA requirements, government regulations and guidelines, and specific project goals and requirements. This QAPP is prepared by Science Applications International Corporation (SAIC) in accordance with EPA QAPP and USACE guidance documents, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (EPA 1991), *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA 1994a), *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 1994), and *USEPA Region IV Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* (SOP/QAM 1996).

The FSP contains the project description and background information. Site history and background information, along with past data collection activities and existing site data, are contained in Section 1.0 of the FSP. Primary project organization and responsibilities are presented in Section 2.0 of the FSP, while the project scope and objectives are found in Section 3.0. Sampling design, procedures, methods, and rationales are discussed in detail in Section 4.0 of the FSP. Sample matrix types, analytical parameters, and analytical methods can be found in Section 4.0 of the FSP and are summarized in Table 1-1 of this QAPP. Specific delineations of sample numbers, QA sample frequencies, and field QC sample frequencies have been designated for each area under investigation.

Table 1-1. Sampling and Analytical Requirements for Soil Gas Survey for Bulk Fuel Facility (HAA-09)

Matrix	No. Field Smples	QC Dup/Splits	No. Field Rsts	QC Trip Blks ¹	Total Smples	QA Dup/Splits	QA Trip Blks	Total QA Smples	Analysis	Protocol	Analytical Procedures	Holding Time	Preservation Requirements	Sample Containers	Total Containers
<i>Lamar Canal Sites</i>															
Sediments	29	3	3	0	35	3	0	3	VOC ²	SW-846	EPA 8260B (5035)	48 hours	Ice to 4°C	EnCore sampler	114
	29	3	3	0	35	3	0	3	SVOC ³	SW-846	EPA 8270 ⁵	14/40 days	Ice to 4°C	8 oz. cwm ⁴	38
	29	3	3	0	35	3	0	3	TPH ⁵ (GRO) ⁶	SW-846	EPA 8015 (5030)	14 days	Ice to 4°C	4 oz. cwm ⁴	38
	29	3	3	0	35	3	0	3	TPH ⁵ (DRO) ⁶	SW-846	EPA 8015 (3550)	28 days	Ice to 4°C	8 oz. cwm ⁴	Use SVOC container
Surface Water	29	3	3	4	36	3	0	3	VOC ¹	SW-846	EPA 8260B	14 days	Ice to 4°C HCL to pH<2	2×40 mL gsv ⁷	81
	29	3	3	0	32	3	0	3	SVOC ³	SW-846	EPA 8270 ⁵	14/40 days	Ice to 4°C	2×1L AG ⁸	38
	29	3	3	4	36	3	0	3	TPH ⁵ (GRO) ⁶	SW-846	EPA 8015 (5030)	14 days	Ice to 4°C	2×40 mL gsv ⁷	81
	29	3	3	0	32	3	0	3	TPH ⁵ (GRO) ⁶	SW-846	EPA 8015 (3550)	28 days	Ice to 4°C	2×1L AG ⁸	38
Soil Gas	300	30	0	15	345	0	0	0	BTEX ⁹		TD/GC/MS ¹¹	14 days	Ice to 4°C	Gore-Sorber®	345
	300	30	0	15	345	0	0	0	PAH ¹⁰		TD/GC/MS ¹¹	14 days	Ice to 4°C	Gore-Sorber®	345

1 One trip blank with each cooler containing water samples for VOC analysis.

2 VOC = volatile organic compounds

3 SVOCs = semivolatile organic compounds

4 CWM = clear widemouth jar

5 TPH = total petroleum hydrocarbons

6 GRO = gasoline-range organics. DRO = diesel-range organics

7 gsv = glass septa vial

8 AG = amber glass

9 BTEX = benzene, toluene, ethylbenzene, and xylene

10 PAH = polynuclear aromatic hydrocarbons

11 TD/GC/MS = thermal desorption/gas chromatography/mass spectrometry

Note: This table is in conformance with EM200-1-3.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The primary project organizational structure and responsibilities are discussed in Section 2.0 of the FSP. This portion of the QAPP focuses on the analytical subcontract organizations' structures and responsibilities. Chemical laboratory support for this investigations has been designated to a single subcontractor, General Engineering Laboratories (GEL), based on a competitive bidding process. The selected subcontract laboratory is validated by the USACE Hazardous, Toxic, and Radioactive Waste (HTRW) Center of Excellence (CX), Omaha, Nebraska. Relevant QA Manual, laboratory qualification statements, certifications, and license documentation are available. Passive soil gas screening sampling and analysis has been directed to W. L. Gore & Associates, Inc.

The organization chart shown in Figure 2-1 outlines the key laboratory personnel and organization within the GEL management structure that will be used for implementation of these studies. The responsibilities of key personnel are described in the following paragraphs. The assignment of personnel to each position will be based on a combination of (1) experience in the type of work being performed, (2) experience working with USACE personnel and procedures, and (3) a demonstrated commitment to high quality and timely job performance.

All sediment and water samples will be analyzed by the following laboratory:

General Engineering Laboratories, Inc.
P.O. Box 30712
2040 Savage Road
Charleston, South Carolina 29417

All soil gas samples will be analyzed by:

W. L. Gore & Associates, Inc.
100 Chesapeake Blvd.
P.O. Box 10
Elkton, Maryland 21911-0010

Prior to commencement of field activities for the project, SAIC will send a complete copy of the work plan, including this QAPP, to GEL.

2.1 SAIC LABORATORY COORDINATOR

The responsibilities of the SAIC Laboratory Coordinator were previously discussed in Section 2.0 of the FSP.

2.2 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL MANAGER

The responsibilities of subcontract laboratory QA/QC Manager were previously discussed in Section 2.0 of the FSP.

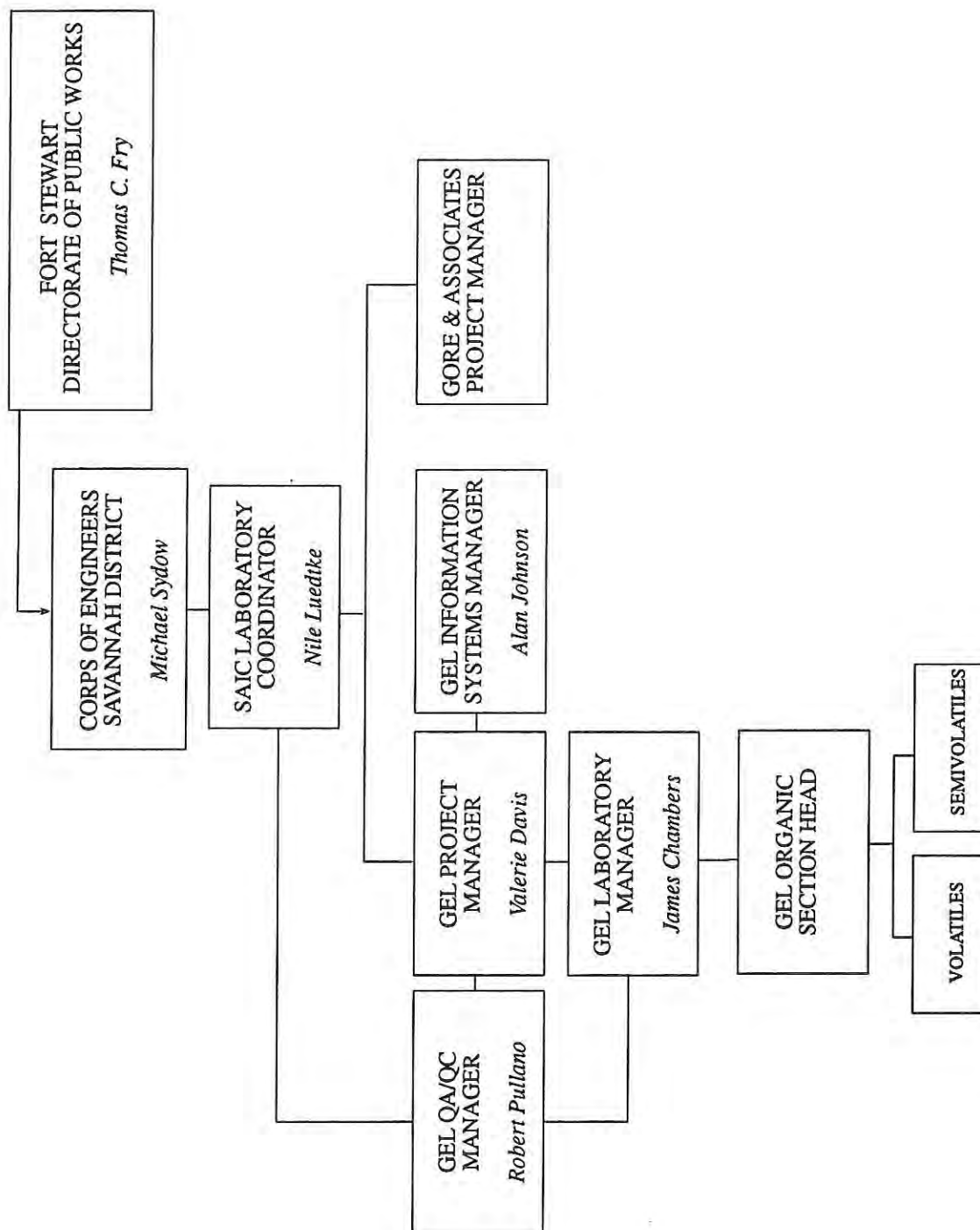


Figure 2-1. Laboratory Project Organizational Chart for the Soil Gas Survey for Bulk Fuel Facility (HAA-09)

2.3 LABORATORY PROJECT MANAGER

The responsibilities of each laboratory Project Manager include the following:

- Initiate and maintain contact with SAIC on individual job tasks.
- Prepare all laboratory-associated work plans, schedules, and manpower allocations.
- Initiate all laboratory-associated procurement for the project.
- Provide day-to-day direction of the laboratory project team including analytical department managers, supervisors, QA personnel, and data management personnel.
- Coordinate all laboratory related financial and contractual aspects of the project.
- Provide formatting and technical review of all laboratory reports.
- Provide day-to-day communication with the client.
- Exercise final review and approval on all laboratory analytical reports to the client.
- Respond to all post-project inquiries.

2.4 LABORATORY MANAGER

The responsibilities of each laboratory's Laboratory Manager include the following:

- Coordinate all analytical production activities conducted within the analytical departments.
- Work with the Laboratory Project Manager to ensure all project objectives are met.
- Provide guidance to analytical department managers.
- Facilitate transfer of data produced by the analytical departments to the report preparation and review staff for final delivery to the client.

2.5 LABORATORY SECTION HEADS, DEPARTMENT MANAGERS, AND TECHNICAL LEADS

The responsibilities of each laboratory section or department include the following:

- Coordinate all analytical functions related to specific analytical areas.
- Provide technical information to and oversight of all analyses being performed.

- Review and approve all analytical results produced by their specific analytical area of expertise.
- Maintain all analytical records and information pertaining to the analysis being performed.

Based on the scope of laboratory analysis to be performed on soil and water samples collected during this project, the GEL sections participating in the project will be Volatiles and Semivolatiles. Technical personnel within these sections will be responsible for preparation, extraction, and analysis of environmental and field QC project samples in accordance with the requirements of this QAPP.

3.0 DATA QUALITY OBJECTIVES

The overall project objective is to develop and implement procedures for field sampling, COC, laboratory analysis, and reporting that will provide results to be used in site evaluation and assessment and that are technically sound and defensible. Specific procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP. The purpose of this section is to address the specific objectives for data accuracy, precision, completeness, representativeness, and comparability.

DQOs are qualitative and quantitative statements that specify the quality of data required to support decisions made during investigation activities, and are based on the end uses of the data being collected.

3.1 PROJECT OBJECTIVES

General objectives are as follows:

- (1) To provide data of sufficient quality and quantity for comparison with State of Georgia criteria and background values, determine the nature and extent of contamination, and complete site evaluations.
- (2) To analyze samples using well defined methods that will provide confident detection limits that are accurate enough to determine the presence or absence of contamination directly related to the site.
- (3) To ensure that samples are collected using approved techniques and are representative of existing environmental conditions.
- (4) To specify QA/QC procedures for both field and laboratory methodology to meet the USACE guidance document requirements.

3.2 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

An analytical DQO summary for these investigations is presented in Tables 3-1 and 3-2. All QC parameters stated in the specific SW-846 methods (i.e., percent recoveries) will be adhered to for each chemical listed. Laboratories are required to comply with all methods as written; recommendations are considered requirements.

As per the new EPA guidance (1993a), which now supersedes all other documents in this discipline, the previously used analytical Levels I through V are changed. These levels are now divided into two categories: (1) screening data with definitive confirmation (replaces Level I and II), and (2) definitive data (replaces Levels III, IV, and V). Definitive data represent data generated under laboratory conditions using EPA-approved procedures. Data of this type, both qualitative and quantitative, are used for determination of source, extent, or characterization and to support evaluation of remedial technologies. Soil gas results are considered screening data, while sediment and surface water data are considered definitive data.

**Table 3-1. Soil Gas/Sediment DQO Summary
for Soil Gas Survey at Bulk Fuel Facility (HAA-09)**

Data use	Sample type	Analytical method	Precision field dups	(RPD)* lab dups	Accuracy laboratory (LCS or MS)	Completeness
Screening for sample site selection	Discrete	FID/PID Volatile org.	+/- comparison	NA	±0.1 ppm	95%
Waterway contamination extent (sediment)	Discrete	SW-8260B VOCs	<50 RPD	<35 RPD	50-150% recovery	90%
	Discrete or composite	SW-8270C SVOCs	<50 RPD	<35 RPD	30-140% recovery	90%
		SW-8015B Mod. GRO	<50 RPD	<35 RPD	30-140% recovery	90%
		SW-8015B Mod. DRO	<50 RPD	<35 RPD	30-140% recovery	90%
Determination of contamination extent (soil gas)	Time composite	TD/GC/MS BTEX	<50 RPD	NA	50-150%	90%
		TD/GC/MS SVOCs	<50 RPD	NA	50-150%	90%

*RPD = relative percent difference; at values within five times the reporting level, comparison is acceptable if values are plus or minus twice the reporting level.

BTEX = benzene, toluene, ethylbenzene, and xylene

DQO = data quality objective

DRO = diesel-range organics

FID = flame ionization detector

GRO = gasoline-range organics

LCS = laboratory control sample

MS = matrix spike

NA = not available

PID = photoionization detector

SVOCs = semivolatile organic compounds

TD/GC/MS = thermal desorption/gas chromatography/mass spectrometry

**Table 3-2. Surface Water Investigative DQO Summary
for Soil Gas Survey at Bulk Fuel Facility (HAA-09)**

Data use	Sample type	Analytical method	Precision field dups	(RPD)* lab dups	Accuracy laboratory (MS)	Completeness
Screening for sample site selection	Discrete	FID/PID Volatile org.	NA	NA	±0.1 ppm	95%
Determination of basic water characteristics	Discrete	EPA-120.1 Conductivity	<10 RPD	NA	±10 µmhos/cm	95%
		EPA-150.1 pH	<10 RPD	NA	±0.1 s.u.	95%
		EPA-170.1 Temperature	<10 RPD	NA	±0.1 °C	95%
		Turbidity meter	<10 RPD	NA	NA	95%
Confirmation of contamination extent	Discrete	SW-8260B VOCs	<30 RPD	<20 RPD	50-150% recovery	90%
	Discrete or composite	SW-8270C SVOCs	<30 RPD	<20 RPD	30-140% recovery	90%
		SW-8015B Mod. GRO	<30 RPD	<20 RPD	35-135% recovery	90%
		SW-8015B Mod. DRO	<30 RPD	<20 RPD	35-135% recovery	90%
IDW characterization	Composite	EPA-420.1 Phenols	<50 RPD	<50 RPD	70-130% recovery	90%
		EPA-413.2 Oil & grease	<50 RPD	50 RPD	70-130% recovery	90%
		EPA-418.1 TPH	<50 RPD	50 RPD	70-130% recovery	90%

*RPD = relative percent difference; at values within five times the reporting level, comparison is acceptable if values are plus or minus twice the reporting level.

DQO = data quality objective

DRO = diesel-range organics

EPA = U.S. Environmental Protection Agency

FID = flame ionization detector

GRO = gasoline-range organics

IDW = investigation-derived waste

MS = matrix spike

NA = not available

SVOCs = semivolatile organic compounds

TPH = total petroleum hydrocarbons

VOCs = volatile organic compounds

General analytical objectives for this work are as follows:

- (1) Analyze soil gas samples to provide data regarding the nature and extent of contamination at the BFF.
- (2) Analyze sediment and surface water samples collected from the adjacent waterway to determine the magnitude of contamination present and its correlation with site contamination.

3.2.1 Level of Quality Control Effort

To assess whether QA objectives have been achieved, analyses of specific field and laboratory QC samples will be required. These QC samples include field blanks, trip blanks, field duplicates, laboratory method blanks, laboratory control samples (LCSs), and laboratory duplicates. Matrix spike/matrix spike duplicate (MS/MSD) samples will be analyzed to assess the quality of the data resulting from the sampling program.

Equipment rinsate blanks and trip blanks will be submitted for analysis along with field duplicate (co-located) samples to provide a means to assess the quality of the data resulting from the field sampling program. Equipment rinsate blanks are used to assess the adequacy of equipment decontamination processes. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage. Criteria and evaluation of blank determinations are provided in Table 3-3 and Section 8.3. Field duplicate samples are analyzed to determine sample heterogeneity and sampling methodology reproducibility.

Laboratory method blanks and LCSs are employed to determine the accuracy and precision of the analytical method implemented by the laboratory. MSs provide information about the effect of the sample matrix on the measurement methodology. Laboratory sample duplicates and MSDs assist in determining the analytical reproducibility and precision of the analysis for the samples of interest.

The general level of QC effort will be at least 1 field duplicate for every 10 investigative samples. One volatile organic compound (VOC) analysis trip blank consisting of analyte-free water will be included along with each shipment of VOC water samples, and trip blanks will accompany all shipments of soil gas-absorbent material.

MS/MSD samples are investigative samples. Soil MS/MSD samples require no extra volume for VOCs or extractable organics. However, aqueous MS/MSD samples must be collected at double the volume for VOC and triple the volume for extractable organics. One MS/MSD sample will be designated in the field and collected for at least every 20 investigative samples per sample matrix (i.e., groundwater, soil).

**Table 3-3. Analytical/Methods, Parameters, and Project Quantitation Limits
for Hunter Army Airfield Bulk Fuel Facility (HAA-09)**

Parameters	Analytical Methods		Project Quantitation Levels ^a	
	Water	Soil/Sediment	Water	Soil/Sediment
Volatile Organic Compounds (VOCs)	SW-846-5030/8260B ^b	SW-846-5035/8260B ^b	(µg/L)	(µg/kg) ^a
Chloromethane			10	10
Bromomethane			10	10
Vinyl chloride			10	10
Chloroethane			10	10
Methylene chloride			5	5
Acetone			10	10
Carbon disulfide			5	5
1,1-Dichloroethene			5	5
1,1-Dichloroethane			5	5
1,2-Dichloroethene (total)			5	5
Chloroform			5	5
1,2-Dichloroethane			5	5
2-Butanone			10	10
1,1,1-Trichloroethane			5	5
Carbon tetrachloride			5	5
Bromodichloromethane			5	5
1,2-Dichloropropane			5	5
cis-1,3-Dichloropropene			5	5
Trichloroethene			5	5
Dibromochloromethane			5	5
1,1,2-Trichloroethane			5	5
Benzene			2	2
trans-1,3-Dichloropropene			5	5
Tribromomethane			5	5
4-Methyl-2-pentanone			10	10
2-Hexanone			10	10

Table 3-3 (continued)

Parameters	Analytical Methods		Project Quantitation Levels ^a	
	Water	Soil/Sediment	Water	Soil/Sediment
Tetrachloroethene			5	5
Toluene			2	2
1,1,2,2-Tetrachloroethane			5	5
Chlorobenzene			5	5
Ethylbenzene			2	2
Styrene			5	5
Xylenes (total)			2	2
Semivolatile Organic Compounds (SVOCs)	SW-846-3520/8270C ^b	SW-846-3550/8270C ^b	(µg/L)	(µg/kg) ^a
Phenol			10	330
bis(2-Chloroethyl) ether			10	330
2-Chlorophenol			10	330
1,3-Dichlorobenzene			10	330
1,4-Dichlorobenzene			10	330
1,2-Dichlorobenzene			10	330
2-Methylphenol			10	330
2,2' - oxybis(1-Chloropropane)			10	330
4-Methylphenol			10	330
N-nitroso-di-n-dipropylamine			10	330
Hexachloroethane			10	330
Nitrobenzene			10	330
Isophorone			10	330
2-Nitrophenol			10	330
2,4-Dimethylphenol			10	330
bis(2-chloroethoxy) methane			10	330
2,4-Dichlorophenol			10	330
1,2,4-Trichlorobenzene			10	330
Naphthalene			10	330
4-Chloroaniline			10	330

Table 3-3 (continued)

Parameters	Analytical Methods		Project Quantitation Levels ^a	
	Water	Soil/Sediment	Water	Soil/Sediment
Hexachlorobutadiene			10	330
4-chloro-3-methylphenol			10	330
2-Methylnaphthalene			10	330
Hexachlorocyclopentadiene			10	330
2,4,6-Trichlorophenol			10	330
2,4,5-Trichlorophenol			25	800
2-Chloronaphthalene			10	330
2-Nitroaniline			25	800
Dimethylphthalate			10	330
Acenaphthylene			10	330
2,6-Dinitrotoluene			10	330
3-Nitroaniline			25	800
Acenaphthene			10	330
2,4-Dinitrophenol			25	800
4-Nitrophenol			25	800
Dibenzofuran			10	330
2,4-Dinitrotoluene			10	330
Diethylphthalate			10	330
4-Chlorophenyl-phenyl ether			10	330
Fluorene			10	330
4-Nitroaniline			25	800
4,6-Dinitro-2-methylphenol			25	800
N-nitrosodiphenylamine			10	330
4-bromophenyl-phenylether			10	330
Hexachlorobenzene			10	330
Pentachlorophenol			25	800
Phenanthrene			10	330
Anthracene			10	330

Table 3-3 (continued)

Parameters	Analytical Methods		Project Quantitation Levels ^a	
	Water	Soil/Sediment	Water	Soil/Sediment
Carbazole			10	330
Di-n-butylphthalate			10	330
Fluoranthene			10	330
Pyrene			10	330
Butylbenzylphthalate			10	330
3,3'-Dichlorobenzidine			10	330
Benzo(a)anthracene			10	330
Chrysene			10	330
bis(2-Ethylhexyl)phthalate			10	330
Di-n-octylphthalate			10	330
Benzo(b)fluoranthene			10	330
Benzo(k)fluoranthene			10	330
Benzo(a)pyrene			10	330
Indeno(1,2,3-cd)pyrene			10	330
Dibenzo(a,h)anthracene			10	330
Benzo(g,h,i)perylene			10	330
Gasoline-range organics (GRO)	SW-846-8015B Modified	SW-846-8015B Modified	(mg/L) 0.1	(mg/kg) 5.0
Diesel-range organics (DRO)	SW-846-8015B Modified	SW-846-8015B Modified	0.1	4.0

^aThese are expected quantitation limits based on reagent-grade water or a purified solid matrix. Actual quantitation limits may be higher depending upon the nature of the sample matrix. The limit reported on final laboratory reports will take into account the actual sample volume or weight, percent solids (where applicable), and the dilution factor, if any. The quantitation limits for additional analytes to this list may vary, depending upon the results of laboratory studies. Soils and sediment analysis will be reported on a dry-weight basis.

^bTest Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, SW-846 Third Edition.

The level of QC effort provided by the laboratory will be equivalent to the level of QC specified in this sampling and analysis plan. The goal is to provide a level of QC effort in conformance with the protocols of the EPA Contract Laboratory Program (CLP) for Routine Analytical Services (RAS) parameters. The level of QC effort for testing and analysis of parameters beyond the scope of the CLP protocols will conform to accepted methods, such as EPA SW-846 protocols (EPA 1993b), American Society for Testing and Materials (ASTM) protocols, and National Institute for Occupational Safety and Health (NIOSH) protocols.

The QC effort for in-field measurements, including temperature, conductivity, pH, oxidation reduction potential, dissolved oxygen, and organic vapor concentration, will include daily calibration of the instrument using traceable standards and documented instrument manufacturer procedures. Field instruments and their method of calibration are discussed in the FSP and will be further identified in task-specific documentation.

3.2.2 Accuracy, Precision, and Sensitivity of Analysis

The fundamental QA objectives for accuracy, precision, and sensitivity of laboratory analytical data are the QC acceptance criteria of the analytical protocols. The accuracy and precision required for the specified analytical parameters are incorporated in Tables 3-1 and 3-2 and are consistent with the analytical protocols. The sensitivities required for the analyses are identified in Table 3-3.

Accuracy and precision goals for field measurements of pH, oxidation reduction potential, conductivity, dissolved oxygen, temperature, and organic vapor concentration are listed in Table 3-2.

Analytical accuracy is expressed as the percent recovery of an analyte that has been added to a blank sample or environmental sample at a known concentration before analysis. Accuracy will be determined in the laboratory through the use of MS analyses, LCS analyses, and/or blank spike analyses. The percent recoveries for specific target analytes will be calculated and used as an indication of the accuracy of the analyses performed.

Precision will be determined through the use of spike analyses conducted on duplicate pairs of environmental samples (MS/MSD) or comparison of positive duplicate pair responses. The relative percent difference (RPD) between the two results will be calculated and used as an indication of the precision of the analyses performed.

Sample collection precision will be measured in the laboratory by the analyses of field duplicates. Precision will be reported as the RPD for two measurements.

3.2.3 Completeness, Representativeness, and Comparability

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under normal conditions. It is expected that laboratories will provide data meeting QC acceptance criteria for all samples tested. Overall project completeness goals are identified in Tables 3-1 and 3-2.

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that depends upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of site conditions. During development of this plan, consideration was

given to site history, past waste disposal practices, existing analytical data, physical setting and processes, and constraints inherent to the investigation of all related sites. The rationale of the sampling design is discussed in detail for each specific site investigation in the FSP.

Representativeness will be satisfied by ensuring that the FSP and its addenda are followed, proper sampling techniques are used, proper analytical procedures are followed, and holding times of the samples are not exceeded. Representativeness will be determined by assessing the combined aspects of the QA program, QC measures, and data evaluations.

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends upon the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of differences in procedures and QA objectives.

4.0 SAMPLING LOCATIONS AND PROCEDURES

It is anticipated that investigations performed during the passive soil gas survey at the BFF will produce soil gas, sediment, surface water, and investigation-derived waste (IDW) samples for analyses. Additional samples will be collected to complete field QC duplicate, field blank, and QA split sample analyses. Specific numbers of samples (including parameters and methods) are incorporated into Table 1-1. Investigation samples will require benzene, toluene, ethylbenzene, and xylene (BTEX); polyaromatic hydrocarbons (PAHs); volatile organic compounds (VOCs); semivolatile organic compounds (SVOCs); gasoline-range organics (GROs); diesel-range organics (DROs); and other determinations, as represented in Tables 1-1, 3-1, 3-2, and 3-3. Sampling procedures for the various media under investigation are discussed in detail in Section 4.0 of the FSP.

Identification of the primary field equipment and supporting materials to be used for these investigations is presented throughout Section 4.0 of the FSP. Several different types of field measurements will be performed during these investigations. Soil field measurements may determine soil classification and characteristics or volatile organic headspace gas concentrations. Surface water field measurements may determine groundwater characteristics (pH, specific conductance, temperature, turbidity, and dissolved oxygen) and volatile organic headspace gas concentrations. A description of the field instruments and associated calibration requirements and performance checks to be used for field measurements is presented in Section 4.0 of the FSP and Section 7.0 of this QAPP.

The locations of sampling stations where soil gas, sediment, and surface water samples will be collected during these investigations, and the rationales for the selection of these stations, are presented in Section 4.0 of the FSP.

4.1 GENERAL INFORMATION AND DEFINITIONS

Contractor Laboratory

The laboratory subcontracted by SAIC for performing analysis of the field samples will be GEL, while soil gas analysis will be performed by W. L. Gore & Associates, Inc.

QA and QC Samples

These samples are analyzed for the purpose of assessing the quality of the sampling effort and of the reported analytical data. QA and QC samples to be used for this project are duplicates, rinsate blanks, trip blanks, and split samples.

QC Samples

These samples are collected by the sampling team for analysis by the contractor laboratory. The identity of duplicate QC samples is held blind to the analysts, and the purpose of these samples is to provide site-specific, field-originated information regarding the homogeneity of the sampled matrix and the consistency of the sampling effort.

QA Split Samples

These samples are collected by the sampling team and sent to a USACE-designated QA laboratory for analysis to provide an independent assessment of SAIC and contractor laboratory performance. SAIC will coordinate with the designated QA laboratory through the South Atlantic Division Laboratory not less than 48 hours before sampling to ensure that the laboratory is alerted to receive the QA samples and process them within the time limits specified by applicable regulations and guidelines.

Field Duplicate Samples

These samples are collected concurrently with the primary environmental samples and equally represent the medium at a given time and location. Duplicate samples will be collected at each of the areas addressed by this project and submitted to the contractor laboratory for analysis.

Trip Blank Samples

These samples consist of containers of organic-free reagent water that are kept with the field sample containers from the time they leave the laboratory until the time they are returned for analysis. The purpose of trip blanks is to determine whether samples are being contaminated during transit or sample collection. For this project, one trip blank will be placed into each cooler used to store and ship water or soil gas samples designated for volatile organic analysis.

4.2 SAMPLE CONTAINERS, PRESERVATION PROCEDURES, AND HOLDING TIMES

Sample containers, chemical preservation techniques, and holding times for sediment, surface water, and soil gas samples collected during these investigations are described in Table 1-1. The specific number of containers required for this study will be estimated and supplied by the analytical facilities. Additional sample volumes will be collected and provided, when necessary, for the express purpose of performing associated laboratory QC (laboratory duplicates, MS/MSD).

All sediment and water sample containers will be provided by GEL, who will provide the required types and volumes of preservatives with new containers as they are required by SAIC. Gore-Sorber® sample modules will be supplied by W. L. Gore & Associates, Inc. Temperature preservation will be maintained at 4°C (±2°C) immediately after collection and will be maintained at this temperature until the samples are analyzed. In the event that sample integrity, such as holding times, cooler temperatures, etc., is compromised, resampling will occur as directed by the USACE-Savannah District Project Manager.

4.3 FIELD DOCUMENTATION

4.3.1 Field Logbooks

Sufficient information will be recorded in the logbooks to permit reconstruction of all drilling and sampling activities conducted. Information recorded on other project documents will not be repeated in the logbooks, except in summary form where determined necessary. All field logbooks will be kept in the possession of field personnel responsible for completing the logbooks, or in a secure

place when not being used during field work. Upon completion of the field activities, all logbooks will become part of the final project evidence file. Refer to Section 5.0 of the FSP.

4.3.2 Sample Numbering System

A unique sample numbering scheme will be used to identify each sample designated for laboratory analysis. The purpose of this numbering scheme is to provide a tracking system for the retrieval of analytical and field data on each sample. Sample identification numbers will be used on all sample labels or tags, field data sheets and/or logbooks, COC records, and all other applicable documentation used during the project. A listing of all sample identification numbers will be maintained in the field logbook. The sample numbers to be used for the project are discussed in Section 5.3 of the FSP.

4.3.3 Documentation Procedures

The tracking procedure to be used for documentation of all samples collected during the project will involve the steps outlined in Section 5.5 of the FSP.

4.4 FIELD VARIANCE SYSTEM

Procedures cannot fully encompass all conditions encountered during a field investigation. Variances from the operating procedures, FSP, and/or safety and health plan may occur. All variances that occur during the field investigation will be documented on a field change order (FCO) form or a nonconformance report (NCR) and will be noted in the appropriate field logbooks. Examples of the FCO and NCR forms to be used for these investigations are presented in Section 10.0 of the FSP. If a variance is anticipated (e.g., because of a change in the field instrumentation), the applicable procedure will be modified and the change noted in the field logbooks. Field changes and corrective actions are outlined in Section 10.0 of the FSP.

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5.0 SAMPLE CUSTODY AND HOLDING TIMES

It is the policy of SAIC and will be the intent of this investigation to follow EPA policy regarding sample custody and COC protocols as described in *NEIC Policies and Procedures* (EPA 1985). This custody is in three parts: sample collection, laboratory analysis, and final evidence files. Final evidence files, including originals of laboratory reports and electronic files, are maintained under document control in a secure area. A sample or evidence file is under your custody when it is

- in your possession;
- in your view, after being in your possession;
- in your possession and you place it in a secured location; or
- in a designated secure area.

5.1 SAMPLE DOCUMENTATION

The sample packaging and shipment procedures summarized below will ensure that samples will arrive at the laboratory with the COC intact. The protocol for specific sample numbering using case numbers and traffic report numbers (if applicable) and other sample designations is included in Section 5.3 of the FSP.

5.1.1 Field Procedures

The field sampler is responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples. Each sample container will be labeled with a sample number, date and time of collection, sampler, and sampling location. Sample labels are to be completed for each sample. The SAIC Project Manager, in conjunction with the USACE, will review all field activities to determine whether proper custody procedures were followed during the field work and to decide if additional samples are required.

5.1.2 Field Logbooks/Documentation

Samples will be collected following the sampling procedures documented in Section 4.0 of the FSP. When a sample is collected or a measurement is made, a detailed description of the location shall be recorded. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers. A sample identification number will be assigned before sample collection. Field duplicate samples and QA split samples, which will receive an entirely separate sample identification number, will be noted under sample description. Equipment employed to make field measurements will be identified along with calibration dates.

5.1.3 Transfer of Custody and Shipment Procedures

Samples are accompanied by a properly completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record will document transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area. An example of the COC form to be used for these investigations is illustrated in Figure 5-3 of the FSP.

All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler for return to project management and the project file. Whenever co-located or split samples are collected for comparison analysis by the USACE QA Laboratory or a government agency, a separate COC is prepared for those samples and marked to indicate with whom the samples are being split.

All shipments will be in compliance with applicable U.S. Department of Transportation (DOT) regulations for environmental samples. SAIC will discourage the shipping of samples on Fridays unless it is absolutely necessary and the laboratory has assured SAIC that personnel will be present on Saturdays to receive and effect any necessary processing within the analytical holding times.

5.2 LABORATORY CHAIN-OF-CUSTODY PROCEDURES

Custody procedures along with the holding time and sample preservative requirements for samples will be described in laboratory QA Plans. These documents will identify the laboratory custody procedures for sample receipt and log-in, sample storage, tracking during sample preparation and analysis, and laboratory storage of data.

5.2.1 Cooler Receipt Checklist

The condition of shipping coolers and enclosed sample containers will be documented upon receipt at the analytical laboratory. This documentation will be accomplished using the cooler receipt checklist presented in Figure 6-2 of the FSP. One of these checklists will be placed into each shipping cooler along with the completed COC form, or provided to the laboratory at the start of the project. A copy of the checklist will be faxed to the SAIC Project Manager immediately after it has been completed at the laboratory. The original completed checklist will be transmitted with the final analytical results from the laboratory.

5.2.2 Letter of Receipt

The laboratory will confirm sample receipt and log-in information through transmission of a Letter-of-Receipt (LOR) to SAIC. This will include returning a copy of the completed COC, a copy of the cooler receipt checklist, and confirmation of the analytical log-in indicating laboratory sample and sample delivery group numbers.

5.3 FINAL EVIDENCE FILES CUSTODY PROCEDURES

SAIC is the custodian of the evidence file and will maintain the contents of evidence files for this investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, correspondence, laboratory logbooks, and COC forms. The evidence file will be stored in a secure, limited-access area and under custody of the SAIC Project Manager.

Analytical laboratories will retain all original raw data information (both hard copy and electronic) in a secure, limited-access area and under custody of the Laboratory Project Manager.

6.0 ANALYTICAL PROCEDURES

All samples collected during the investigation activities will be analyzed by laboratories reviewed and validated by the USACE HTRW CX, Omaha, Nebraska. QA samples shall be collected of sediment and surface water and analyzed through contacts at the USACE South Atlantic Savannah (SAS) District Laboratory in Marietta, Georgia. Each laboratory supporting this work shall provide statements of qualifications including organizational structure, QA Manual, and SOPs.

6.1 LABORATORY ANALYSIS

Samples collected during the project will be analyzed by EPA SW-846 methods. Laboratory SOPs are based on the methods as published by the EPA in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW846*, Third Edition (November 1986; Revision 1, July 1992; Revision 2, November 1992; through Update 3, June 1997). Analytical parameters, methods, and quantitation or detection limits are listed in Table 3-3. Summarized information regarding each analytical method to be employed during these studies is presented in Appendix C.

Principal laboratory facilities will not subcontract or transfer any portion of this work to another facility, unless expressly permitted to do so in writing by SAIC.

If contaminant concentrations are high, or for matrices other than normal waters and soils, analytical protocols may be inadequate. In these cases, sample analysis may require modifications to defined methodology. Any proposed changes to analytical methods specified require written approval from SAIC and USACE. All analytical method variations will be identified in investigation-specific addenda. These may be submitted for regulatory review and approval when directed by the USACE Project Manager.

These SOPs must be adapted from and reference standard EPA SW-846 methods and thereby specify:

- procedures for sample preparation,
- procedures for instrument start-up and performance check,
- procedures to establish the actual and required detection limits for each parameter,
- initial and continuing calibration check requirements,
- specific methods for each sample matrix type, and
- required analyses and QC requirements.

6.2 FIELD SCREENING ANALYTICAL PROTOCOLS

Procedures for field measurement of pH, specific conductivity, temperature, and turbidity are described in Section 4.0 of the FSP and Section 7.0 of this document. Tabulation of the methodologies appears in Tables 3-1 and 3-2.

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7.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment that are used for conducting field tests and laboratory analyses. These instruments and equipment shall be calibrated before each use or on a scheduled, periodic basis according to manufacturer instructions.

7.1 FIELD INSTRUMENTS/EQUIPMENT

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. All field instruments for this purpose will have unique identifiers, and each instrument will be logged in the Material and Testing Equipment (M&TE) Log Book before use in the field. The site safety and health officer, or his/her designate, will be responsible for performing and documenting daily calibration/checkout records for instruments used in the field.

Equipment to be used during the field sampling will be examined to certify that it is in operating condition. This will include checking the manufacturer's operating manual and instructions for each instrument to ensure that all maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that the notation on any prior equipment problems will not be overlooked, and all necessary repairs to equipment will be carried out. Spare parts or duplication of equipment will be available to the sampling effort.

Calibration of field instruments is governed by the specific SOP for the applicable field analysis method, and it will be performed at the intervals specified in the SOP. If no SOP is available, calibration of field instruments will be performed at intervals specified by the manufacturer or more frequently as conditions dictate. Calibration procedures and frequency will be recorded in a field logbook.

Field instruments will include a pH meter, temperature probe, specific conductivity meter, turbidity meter, and flame ionization detector (FID) or photoionization detector (PID) for organic vapor detection. If an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service, and a back-up instrument will be calibrated and used in its place.

Detailed instructions on the proper calibration and use of each field instrument will follow the guidelines established by the manufacturer. The technical procedures for each instrument used on this project include the manufacturer's instructions detailing the proper use and calibration of each instrument.

7.1.1 pH Meter Calibration

The pH meter will be calibrated according to the manufacturer's instructions using traceable standard buffer solutions before work in the field. Calibration will follow these steps:

- Ensure that temperature of sample and buffer are the same.
- Connect pH electrode into pH meter and turn on pH meter.
- Adjust temperature setting based on the temperature of buffer; place electrode in first buffer solution.
- After reading has stabilized, adjust "CALIB" knob to display correct value.
- Repeat procedure for second buffer solution.
- Place pH electrode in the sample and record the pH as displayed.
- Remove pH electrode from sample and rinse off with distilled water.
- Recalibrate the pH meter every time it is turned off and turned back on, or if it starts giving erratic results.

Before use in the field, calibration of the pH meter will be checked against two standard buffer solutions. Calibration procedures, lot numbers of buffer solutions, and other pertinent calibration or checkout information will be recorded in the M&TE Log Book for the project. The calibrations performed, standards used, and sample pH values are to be recorded in the field notebook. Appropriate new batteries will be purchased and kept with the meters to facilitate immediate replacement in the field as necessary.

7.1.2 Temperature Calibration

Temperature measurements are carried out using a temperature probe. Mercury thermometers must be inspected before use to ensure that there is no mercury separation. Thermometers should be rechecked in the field before and after each use to see if the readings are logical and the mercury is still intact. All temperature probes should be checked biannually for calibration by immersing them in a bath of known temperature until equilibrium is reached. Temperature probes should be replaced if found to have more than 10 percent error. The reference thermometer used for bath calibration should be National Institute of Standards and Testing (NIST) traceable. Temperatures will be recorded in the M&TE Log Book, the Sample Log Book, or the Cooler Log Book, as appropriate.

7.1.3 Conductivity Meter Calibration

The conductivity cells of the specific conductivity meter will be cleaned according to the manufacturer's recommendations and specifications, and checked against known conductivity standard solutions before each sampling event. The instrument will be checked daily with NIST-traceable standard solutions. If the instrument is more than 10 percent out of calibration when compared with standard solutions, the instrument will be recalibrated. If this cannot be done in the field, the instrument will be returned to the manufacturer or supplier for recalibration, and a back-up instrument will be used in its place. Daily calibration readings and other relevant information will be recorded daily in the M&TE Log Book.

Daily checks should be as follows:

- Fill a sample cup with the conductivity calibration standard solution.
- Set temperature knob for temperature of standard solution.
- Turn to appropriate scale and set the instrument for the value of calibration standard.
- Rinse out the cup with distilled water.

7.1.4 Organic Vapor Detection

Organic vapor detectors will be checked daily according to the manufacturer's instructions. FIDs will be checked daily by using the internal calibration mechanism. PIDs will be calibrated daily with a gas of known concentration. All daily calibration information will be recorded in the M&TE Log Book.

7.1.5 Turbidity Calibration

The turbidity meter will be calibrated each day against a known and traceable standard supplied by the instrument manufacturer prior to use in the field. In the field the instrument will be checked against the standard and adjusted, if necessary, each time the instrument is turned on. Calibration information will be recorded in the M&TE Log Book; checks made in the field will be recorded in the Sample Log Book.

7.2 LABORATORY INSTRUMENTS

Calibration of laboratory equipment will be based on approved written procedures. Records of calibration, repairs, or replacement will be filed and maintained by laboratory personnel performing QC activities. These records will be filed at the location where the work is performed and will be subject to QA audit. Procedures and records of calibration will follow USACE HTRW CX- and SAIC-reviewed laboratory-specific QA Plans.

In all cases where analyses are conducted according to the EPA CLP or SW-846 protocols, the calibration procedures and frequencies specified in the applicable CLP RAS Statement of Work (SOW) or SW-846 methods will be followed exactly. For analyses governed by SOPs, refer to the appropriate SOP for the required calibration procedures and frequencies.

Records of calibration will be kept as follows:

- If possible, each instrument will have a record of calibration with an assigned record number.
- A label will be affixed to each instrument showing identification numbers, manufacturer, model numbers, date of last calibration, signature of calibrating analyst, and due date of next calibration. Reports and compensation or correction figures will be maintained with each instrument.
- A written, step-wise calibration procedure will be available for each piece of test and measurement equipment.

- Any instrument that is not calibrated to the manufacturer's original specification will display a warning tag to alert the analyst that the device carries only a "Limited Calibration."

7.2.1 Organic Analyses

Summarized information for each analytical method to be employed during these investigations is presented in Appendix C.

7.2.2 Metals and Miscellaneous Analyses

Summarized information for each analytical method to be employed during these investigations is presented in Appendix C.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 FIELD SAMPLE COLLECTION

The assessment of field sampling precision and accuracy will be made by collecting field duplicates and field blanks in accordance with the procedures described in the project FSP and at the frequency indicated in Section 4.0 of the FSP.

8.2 FIELD MEASUREMENT

QC procedures for most field measurements (i.e., pH, conductivity, temperature, dissolved oxygen, headspace, etc.) are limited to checking the reproducibility of the measurement by obtaining multiple readings on a single sample or standard and by calibrating the instruments. Refer to the FSP and Section 7.1 of this document for more detail regarding these measurements.

8.3 LABORATORY ANALYSIS

Analytical QC procedures for these investigations are specified in the individual method descriptions. These specifications include the types of QC checks normally required, method blanks, LCS, MS, MSD, calibration standards, internal standards, surrogate standards, calibration check standards, and laboratory duplicate analysis. Calibration compounds and concentrations to be used and the method of QC acceptance criteria for these parameters have been identified.

To ensure the production of analytical data of known and documented quality, laboratories associated with these investigations will implement all method QA and QC checks.

8.3.1 Quality Assurance Program

All subcontracted analytical laboratories will have a written QA program that provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QA program is coordinated and monitored by the laboratory's QA department, which is independent of the operating departments. For these investigations GEL's Quality Assurance Plan, GL-QS-B-001, Rev. 10, will be implemented in its entirety for all chemical analysis. W. L. Gore & Associates' established QA Program will be implemented for all soil gas determinations.

The stated objectives of the laboratory QA program are to:

- properly subsample, preserve, and store all samples;
- maintain adequate custody records from sample receipt through reporting and archiving of results;
- use properly trained analysts to analyze all samples by approved methods within holding times;
- produce defensible data with associated documentation to show that each system was calibrated and operating within precision and accuracy control limits;

- accurately calculate, check, report, and archive all data using the Laboratory Information Management System; and
- document all the above activities so that all data can be independently validated.

All laboratory procedures are documented in writing as SOPs, which are edited and controlled by the QA department. Internal QC measures for analysis will be conducted with their SOPs and the individual method requirements specified.

External QA shall be provided by the USACE SAS District Laboratory in Marietta, Georgia. The external QA laboratory shall direct the analysis of QA sample splits as identified by Section 4.0 of the FSP and Table 1-1 of this QAPP.

8.3.2 Quality Control Checks

Implementation of QC procedures during sample collection, analysis, and reporting ensures that the data obtained are consistent with their intended use. Both field QC and laboratory QC checks are performed throughout the work effort to generate data confidence. Analytical QC measures are used to determine if the analytical process is in control, as well as to determine the sample matrix effects on the data being generated.

Specifications include the types of QC required (duplicates, sample spikes, surrogate spikes, reference samples, controls, blanks, etc.); the frequency for implementation of each QC measure; compounds to be used for sample spikes and surrogate spikes; and the acceptance criteria for this QC.

Laboratories will provide documentation in each data package that both initial and ongoing instrument and analytical QC functions have been met. Any nonconforming analysis will be reanalyzed by the laboratory, if sufficient sample volume is available. It is expected that sufficient sample volumes will be collected to provide for reanalyses, if required.

8.3.2.1 Analytical Process Quality Control

8.3.2.1.1 Method Blanks

A method blank is a sample of a noncontaminated substance of the matrix of interest (usually distilled/de-ionized water or silica sand) that is then subjected to all of the sample preparation (digestion, distillation, extraction) and analytical methodology applied to the samples. The purpose of the method blank is to check for contamination from within the laboratory that might be introduced during sample preparation and analysis that would adversely affect analytical results. A method blank must be analyzed with each analytical sample batch.

Analytical sensitivity goals are identified in Table 3-3 as practical quantitation limits. Method blank levels should be below these levels for all analytes; criteria are established at 2× these levels.

8.3.2.1.2 Laboratory Control Samples

The LCS contains known concentrations of analytes representative of the contaminants to be determined and is carried through the entire preparation and analysis process. Commercially available LCSs or those from EPA may be used. LCS standards that are prepared in-house must be

made from a source independent of that of the calibration standards. For methods using surrogates, the method blank may be used as the LCS. Each LCS analyte must be plotted on a control chart. The primary purpose of the LCS is to establish and monitor the laboratory's analytical process control. An LCS must be analyzed with each analytical sample batch.

8.3.2.2 Matrix and Sample-Specific Quality Control

8.3.2.2.1 Laboratory Duplicates

Laboratory duplicates are separate aliquots of a single sample that are prepared and analyzed concurrently at the laboratory. This duplicate sample should not be a method blank, trip blank, or field blank. The primary purpose of the laboratory duplicate is to check the precision of the laboratory analyst, the sample preparation methodology, and the analytical methodology. If there are significant differences between the duplicates, the affected analytical results will be re-examined. One in 20 samples will be a laboratory duplicate, with fractions rounded to the next whole number.

8.3.2.2.2 Surrogate Spikes

A surrogate spike is prepared by adding a pure compound to a sample before extraction. The compound in the surrogate spike should be of a similar type to that being assayed in the sample. The purpose of a surrogate spike is to determine the efficiency of recovery of analytes in the sample preparation and analysis. The percent of recovery of the surrogate spike is then used to gauge the total accuracy of the analytical method for that sample.

8.3.2.2.3 Matrix Spikes and Matrix Spike Duplicates

An MS is an aliquot of a sample spiked with known quantities of analytes and subjected to the entire analytical procedure. It is used to indicate the appropriateness of the method for the matrix by measuring recovery or accuracy. Accuracy is the nearness of a result or the mean of a set of results to the true or accepted value. An MSD is a second aliquot of the same sample with known quantities of compounds added. The purpose of the MSD, when compared to the MS, is to determine method precision. Precision is the measure of the reproducibility of a set of replicate results among themselves or the agreement among repeat observations made under the same conditions. MSs and MSDs are performed per 20 samples of similar matrix.

8.3.2.2.4 Method-Specific Quality Control

The laboratory must follow specific quality processes as defined by the method. These will include measures such as calibration verification samples, instrument blank analysis, internal standards implementation, tracer analysis, method of standard additions utilization, serial dilution analysis, post-digestion spike analysis, and chemical carrier evaluation, etc.

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9.0 CALCULATION OF DATA QUALITY INDICATORS

9.1 FIELD MEASUREMENTS DATA

Field data will be assessed by the site Chemical QC (CQC) Representative. The site CQC Representative will review the field results for compliance with the established QC criteria that are specified in the QAPP and FSP. Accuracy of the field measurements will be assessed using daily instrument calibration, calibration check, and analysis of blanks. Precision will be assessed on the basis of reproducibility by multiple readings of a single sample.

Field data completeness will be calculated using Equations (1a) and (1b).

Sample Collection (1a):

$$\text{Completeness} = \frac{\text{Number of Sample Points Sampled}}{\text{Number of Sample Points Planned}} \times 100\% \quad (1a)$$

Field Measurements (1b):

$$\text{Completeness} = \frac{\text{Number of Valid Field Measurements Made}}{\text{Number of Field Measurements Planned}} \times 100\% \quad (1b)$$

9.2 LABORATORY DATA

Laboratory results will be assessed for compliance with required precision, accuracy, completeness, and sensitivity as follows.

9.2.1 Precision

The precision of the laboratory analytical process will be determined through evaluation of LCS analyses. The standard deviation of these measurements over time will provide confidence that implementation of the analytical protocols was consistent and acceptable. These measurements will establish the precision of the laboratory analytical process.

Investigative sample matrix precision will be assessed by comparing the analytical results between MS/MSD for organic analysis and laboratory duplicate analyses for inorganic analysis. The RPD will be calculated for each pair of duplicate analyses using Equation (2). This precision measurement will include variables associated with the analytical process, influences related to sample matrix interferences, and sample heterogeneity.

$$RPD = \frac{|\text{MS} - \text{MSD}|}{\frac{|\text{MS} + \text{MSD}|}{2}} \quad (2)$$

where

S = first sample value (original or MS value),

D = second sample value (duplicate or MSD value).

9.2.2 Accuracy

The accuracy of the laboratory analytical measurement process will be determined by comparing the percent recovery for the LCS versus its documented true value.

Investigative sample accuracy will be assessed for compliance with the established QC criteria that are described in Section 3.0 of this QAPP using the analytical results of method blanks, reagent/preparation blank, MS/MSD samples, field blank, and bottle blanks. The percent recovery (%R) of MS samples will be calculated using Equation (3). This accuracy will include variables associated with the analytical process, influences related to sample matrix interferences, and sample heterogeneity.

$$\text{---} = \frac{\text{---} - \text{---}}{\text{---}} \quad (3)$$

where

A = the analyte concentration determined experimentally from the spiked sample,

B = the background level determined by a separate analysis of the unspiked sample,

C = the amount of the spike added.

9.2.3 Completeness

Data completeness of laboratory analyses will be assessed for compliance with the amount of data required for decision making. The completeness is calculated using Equation (4).

$$\text{Completeness} = \frac{\text{Number of Valid Laboratory Measurements Made}}{\text{Number of Laboratory Measurements Planned}} \times 100\% \quad (4)$$

9.2.4 Sensitivity

Achieving method detection limits depends on sample preparation techniques, instrumental sensitivity, and matrix effects. Therefore, it is important to determine actual method detection limits (MDLs) through the procedures outlined in 40 *Code of Federal Regulations (CFR)* 136, Appendix C. MDLs should be established for each major matrix under investigation (i.e., water, soil) through multiple determinations, leading to a statistical evaluation of the MDL.

It is important to monitor instrument sensitivity through calibration blanks and low concentration standards to ensure consistent instrument performance. It is also critical to monitor the analytical method sensitivity through analysis of method blanks, calibration check samples, and LCSs, etc.

9.3 PROJECT COMPLETENESS

Project completeness will be determined by evaluating the planned versus actual data. Consideration will be given for project changes and alterations during implementation. All data not flagged as rejected by the review, verification, validation, or assessment processes will be considered valid. Overall, the project completeness will be assessed relative to media, analyte, and area of investigation. Completeness objectives are listed in Tables 3-1 and 3-2.

9.4 REPRESENTATIVENESS/COMPARABILITY

Representativeness expresses the degree to which data accurately reflect the analyte or parameter of interest for the environmental media examined at the site. It is a qualitative term most concerned with the proper design of the sampling program. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical holding times, use of standard analytical methods, and determination of matrix or analyte interferences. Sample collection, preservation, analytical holding time, analytical method application, and matrix interferences will be evaluated by reviewing project documentation and QC analyses.

Comparability, like representativeness, is a qualitative term relative to a project data set as an individual. These investigations will employ narrowly defined sampling methodologies, site audits/surveillances, use of standard sampling devices, uniform training, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting units to ensure comparability to other data sets. Through proper implementation and documentation of these standard practices, the project will establish confidence that data will be comparable to other project and programmatic information.

Additional input to determine representativeness and comparability may be gained through statistical evaluation of data populations, chemical charge balances, compound evaluations, or dual measurement comparisons (e.g., total versus dissolved water analysis, field versus fixed laboratory analyses, etc.).

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10.0 CORRECTIVE ACTIONS

Corrective actions may be required for two major types of problems: analytical/equipment problems and noncompliance with criteria. Analytical and equipment problems may occur during sampling, sample handling, sample preparation, laboratory instrumental analysis, and data review.

Noncompliance with specified criteria and analytical/equipment problems will be documented through a formal corrective action program at the time the problem is identified. The person identifying the problem is responsible for notifying the SAIC Project Manager and the USACE Project Manager. When the problem is analytical in nature, information on these problems will be promptly communicated to the SAIC Analytical Laboratory Coordinator. Implementation of corrective action will be confirmed in writing.

Any nonconformance with the established QC procedures in the QAPP or FSP will be identified and corrected in accordance with the QAPP. The SAIC Project Manager, or his/her designee, will issue an NCR for each nonconforming condition (Figure 10-1 of the FSP).

Corrective actions will be implemented and documented in the field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are deemed insufficient, work may be stopped through a stop-work order issued by the SAIC Project Manager and the USACE Project Manager.

10.1 SAMPLE COLLECTION/FIELD MEASUREMENTS

Technical staff and project personnel will be responsible for reporting all suspected technical and QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the SAIC Project Manager or his/her designee. The manager will be responsible for assessing the suspected problems in consultation with the SAIC Project QA Manager to make a decision based on the potential for the situation to impact the quality of the data. When it is determined that the situation warrants a reportable nonconformance and corrective action, then an NCR will be initiated by the manager.

The manager will be responsible for ensuring that corrective actions for nonconformances are initiated by:

- evaluating all reported nonconformances,
- controlling additional work on nonconforming items,
- determining disposition or action to be taken,
- maintaining a log of nonconformances,
- reviewing NCRs and corrective actions taken, and
- ensuring that NCRs are included in the final site documentation project files.

If appropriate, the SAIC Project Manager will ensure that no additional work dependent on the nonconforming activity is performed until the corrective actions are completed.

Corrective action for field measurements may include:

- repeating the measurement to check the error;
- checking for all proper adjustments for ambient conditions such as temperature;
- checking the batteries;
- re-calibrating the equipment;
- checking the calibration;
- modifying the analytical method including documentation and notification (i.e., standard additions);
- replacing the instrument or measurement devices; and
- stopping work (if necessary).

The SAIC Project Manager, or his/her designee, is responsible for all site activities. In this role, he/she may at times be required to adjust the site activities to accommodate site-specific needs. When it becomes necessary to modify a program, the responsible person notifies the SAIC Project Manager of the anticipated change and implements the necessary changes after obtaining the approval of the SAIC Program Manager and the USACE Program Manager. All changes in the program will be documented on the FCO that will be signed by the initiators and the SAIC Project Manager (Figure 10-2 of the FSP). The FCO for each document will be numbered serially as required. The FCO shall be attached to the file copy of the affected document. The SAIC Project Manager must approve the change in writing or verbally before field implementation. If unacceptable, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and actions taken.

The SAIC Project Manager for the site is responsible for the controlling, tracking, and implementation of the identified changes. Reports on all changes will be distributed to all affected parties, including the USACE Project Manager. The USACE will be notified whenever program changes in the field are made.

10.2 LABORATORY ANALYSES

Each project investigation laboratory QA plan provides systematic procedures to identify out-of-control situations and corrective actions. Corrective actions shall be implemented to resolve problems and restore malfunctioning analytical systems. Laboratory personnel have received QA training and are aware that corrective actions are necessary when:

- QC data are outside warning or control windows for precision and accuracy.
- Blanks contain target analytes above acceptable levels and must be investigated (see Table 3-3).
- Undesirable trends are detected in spike recoveries or RPD between duplicates.
- There are unusual changes in detection limits.
- Deficiencies are detected by internal audits, external audits, or from performance evaluation samples results.
- Inquiries concerning data quality are received.

Corrective action procedures are often handled at the bench level by the analyst who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the Laboratory Supervisor, Manager, and/or QA Department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with project records and the QA Department, and the information is summarized within case narratives. Refer to Appendix C for potential method-related corrective actions.

Corrective actions may include

- re-analyzing the samples, if holding time criteria permit;
- evaluating blank contaminant sources, eliminating these sources, and reanalyzing;
- modifying the analytical method (i.e., standard additions) with appropriate notification and documentation;
- resampling and analyzing;
- evaluating and amending sampling procedures; or
- accepting data and acknowledging the level of uncertainty.

If resampling is deemed necessary due to laboratory problems, the SAIC Project Manager will identify the necessary cost recovery approach to implement the additional sampling effort.

The following corrective action procedures will be required:

- Problems noted during sample receipt will be documented in the appropriate laboratory LOR. SAIC and USACE will be contacted immediately to determine problem resolution. All corrective actions will be thoroughly documented.
- When sample extraction/digestion or analytical holding times are not within method-required specifications, SAIC and USACE will be notified immediately to determine problem resolution. All corrective actions will be thoroughly documented.

- All initial and continuing calibration sequences that do not meet method requirements will result in a review of the calibration. When appropriate, re-analysis of the standards or re-analysis of the affected samples back to the previous acceptable calibration check is warranted.
- All appropriate measures will be taken to prepare and clean up samples in an attempt to achieve the practical quantitation limits as stated. When difficulties arise in achieving these limits, the laboratory will notify SAIC and the USACE to determine problem resolution. All corrective actions will be thoroughly documented.
- Any dilutions impacting the practical quantitation limits will be documented in case narratives along with revised quantitation limits for those analytes affected. Analytes detected above the method detection limits, but below the practical quantitation limits, will be reported as estimated values.
- Failure of method-required QC to meet the requirements specified in this project QAPP shall result in review of all affected data. Resulting corrective actions may encompass those identified earlier. SAIC and USACE will be notified as soon as possible to discuss possible corrective actions, particularly when unusual or difficult sample matrices are encountered.
- When calculation and reporting errors are noted within any given data package, reports will be reissued with applicable corrections. Case narratives will clearly state the reasons for reissuance of reports.

11.0 DATA REDUCTION, VALIDATION, AND REPORTING

11.1 DATA REDUCTION

11.1.1 Field Measurements and Sample Collection

Raw data from field measurements and sample collection activities will be appropriately recorded in field logbooks. Data to be used in project reports will be reduced and summarized. The methods of data reduction will be documented.

The SAIC Project Manager, or his/her designee, is responsible for data review of all field-generated data. This includes verifying that all field descriptive data are recorded properly, that all field instrument calibration requirements have been met, that all field QC data have met frequency and criteria goals, and that field data are entered accurately in all logbooks and worksheets.

11.1.2 Laboratory Services

All samples collected for these investigations will be sent to USACE HTRW CX-qualified laboratories. Data reduction, evaluation, and reporting for samples analyzed by the laboratory will be performed according to specifications outlined in the laboratory's QA plan. Laboratory reports will include documentation verifying analytical holding time compliance.

Laboratories will perform in-house analytical data reduction under the direction of the Laboratory QA Officer. The Laboratory QA Officer is responsible for assessing data quality and informing SAIC and USACE of any data which are considered "unacceptable" or that require caution on the part of the data user in terms of their reliability. Data will be reduced, evaluated, and reported as described in the laboratory QA plan. Data reduction, review, and reporting by the laboratory will be conducted as follows:

- Raw data are produced by the analyst who has primary responsibility for the correctness and completeness of the data. All data will be generated and reduced following the QAPP-defined methods and implementing laboratory SOP protocols.
- Level 1 technical data review is completed relative to an established set of guidelines by a peer analyst. The review shall ensure the completeness and correctness of the data while assuring all method QC measures have been implemented and were within appropriate criteria.
- Level 2 technical review is completed by the area supervisor or data review specialist. This reviews the data for attainment of QC criteria as outlined in the established methods and for overall reasonableness. This review will ensure that all calibration and QC data are in compliance and will check at least 10 percent of the data calculations. This review shall document that the data package is complete and ready for reporting and archival.
- Upon acceptance of the raw data by the area supervisor, the report is generated and sent to the Laboratory Project Manager for Level 3 administrative data review. This review will ensure consistency and compliance with all laboratory instructions, the laboratory QA plan, the project laboratory SOW, and the project QAPP.
- The Laboratory Project Manager will complete a thorough review of all reports.

- Final reports will be generated and signed by the Laboratory Project Manager.
- Data will then be delivered to SAIC for data validation.

The data review process will include identification of any out-of-control data points and data omissions, as well as interactions with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analyses may be made by the Project Manager based on the extent of the deficiencies and their importance in the overall context of the project. The laboratory will provide flagged data to include such items as: (1) concentration below required detection limit, (2) estimated concentration due to poor spike recovery, and (3) concentration of chemical also found in laboratory blank.

Laboratories will prepare and retain full analytical and QC documentation for the project. Such retained documentation will be both hard (paper) copy and electronic storage media (e.g., magnetic tape) as dictated by the analytical methodologies employed. As needed, laboratories will supply hard copies of the retained information.

Laboratories will provide the following information to SAIC in each analytical data package submitted:

- cover sheets listing the samples included in the report and narrative comments describing problems encountered in analysis;
- tabulated results of inorganic and organic compounds identified and quantified;
- analytical results for QC sample spikes, sample duplicates, initial and continuous calibration verifications of standards and blanks, standard procedural blanks, LCSs, and other deliverables as identified in Section 11.3; and
- tabulation of instrument detection limits determined in pure water.

11.2 DATA VALIDATION

11.2.1 Data Validation Approach

A systematic process for data verification and validation will be performed to ensure that the precision and accuracy of the analytical data are adequate for their intended use. The greatest uncertainty in a measurement is often a result of the sampling process and inherent variability in the environmental media rather than the analytical measurement. Therefore, analytical data validation will be performed only to the level necessary to minimize the potential of using false-positive or false-negative results in the decision-making process (i.e., to ensure accurate identification of detected versus nondetected compounds). This approach is consistent with the DQOs for the project, with the analytical methods, and for determining contaminants of concern and calculating risk.

Samples will be analyzed through implementation of "definitive" analytical methods. "Definitive data" will be reported consistent with the deliverables identified in Section 11.3, Tables 11-1 and 11-2. This report content is consistent with what is understood as an EPA Level III deliverable (data forms including laboratory QC and calibration information). This "definitive data" will then

Table 11-1. Standard Data Deliverables

Method Requirements	Deliverables
Requirements for all methods:	
- Holding time information and methods requested	Signed COC forms
- Discussion of laboratory analysis, including any laboratory problems	Case narratives
- LCS results (run with each batch of samples processed)	Results
Organics: GC/MS analysis	
- Sample results, including TICs	SW-846 Form 1 or equivalent
- Surrogate recoveries	SW-846 Form 2 or equivalent
- Matrix spike/spike duplicate data	SW-846 Form 3 or equivalent
- Method blank data	SW-846 Form 4 or equivalent
- GC/MS tune	SW-846 Form 5 or equivalent
- GC/MS initial calibration data	SW-846 Form 6 or equivalent
- GC/MS continuing calibration data	SW-846 Form 7 or equivalent
- GC/MS internal standard area data	SW-846 Form 8 or equivalent
Organics: GC and HPLC analysis	
- Sample results	SW-846 Form 1 or equivalent
- Surrogate recoveries	SW-846 Form 2 or equivalent
- Matrix spike/spike duplicate data	SW-846 Form 3 or equivalent
- Method blank data	SW-846 Form 4 or equivalent
- Initial calibration data	SW-846 Form 6 or equivalent
- If calibration factors are used	A form listing each analyte, the concentration of each standard, the relative calibration factor, the mean calibration factor, and the %RSD
- Calibration curve if used	Calibration curve and correlation coefficient
- Continuing calibration data	SW-846 Form 9 or equivalent
- Positive identification (second column confirmation GC)	SW-846 Form 10 or equivalent

COC = chain of custody

GC = gas chromatograph

HPLC = high-performance liquid chromatography

LCS = laboratory control sample

MS = mass spectrometer

TICs = tentatively identified compounds

Table 11-2. Standard Electronic Data Deliverables

Column Position	Length	Field Description
Header Record		
1 - 20	20	Science Applications International Corporation (SAIC) Project Number
21 - 28	8	Data Submission Data (MM/DD/YY)
29 - 33	6	Number of Records (Rows) in the file including header and terminating records
34 - 74	40	Submitting Laboratory Name
Detail Record		
1 - 20	20	SAIC Sample Identification Number
21 - 28	8	Date of Sample Collection (MM/DD/YY)
29 - 33	5	Time of Sample Collection (HH:MM military format)
34 - 48	15	Laboratory Analytical Batch/Sample Delivery Group (SDG) Number
49 - 56	8	Sample Matrix
57 - 76	20	Laboratory Sample Identification Number
77 - 84	8	Sample Extraction/Preparation Date (MM/DD/YY)
85 - 92	8	Sample Analysis Date (MM/DD/YY)
93 - 97	5	Sample Analysis Time (HH:MM military format)
98 - 100	3	Analysis/Result Type - This field is used to designate the type of analysis performed. Valid values are as follows: REG = Regular Sample Analysis DUP = Laboratory Duplicate Analysis DIL = Secondary Dilution Analysis REn = Re-analysis where "n" is a sequential number
101 - 112	12	Chemical Abstract Services (CAS) Number
113 - 142	30	Analysis Name
143 - 157	15	Analysis Method (Method numbers shall be the EPA, SW-846, NIOSH, etc. method number)
158 - 167	10	Result (Report detection limit if not detected)
168 - 172	5	Result Qualifier (U, J, etc.)
173 - 180	8	Unit of measure
181 - 190	10	Instrument Detection Limit
191 - 195	5	Percent Solids (Report "0" for water matrices)
196 - 200	5	Sample Weight/Volume
201 - 202	2	Sample Weight/Volume Units
203 - 207	5	Dilution
Termination Record		
1 - 3	3	\$\$\$

Electronic deliverables must have the file structure defined in this table. The deliverable file may be either an ASCII text file, a dBASE compatible file (.DBF file extension), or an Excel spread sheet file (.XLS file extension). All fields must be present. Fields that are not applicable for the reported method shall be reported as blank.

EPA = U.S. Environmental Protection Agency

NIOSH = National Institute for Occupational Safety and Health

be validated through the review process presented in Section 11.2.2. DQOs identified in Section 3.0 and method-specific criteria will be validated. Comprehensive analytical information will be retained by the subcontract laboratory.

Validation will be accomplished by comparing the contents of the data packages and QA/QC results to requirements contained in the requested analytical methods. The SAIC validation support staff will be responsible for these activities. The protocol for analyte data validation is presented in:

- SAIC Quality Assurance Technical Procedures (SAIC 1995);
- EPA National Functional Guidelines for Organic Data Review (EPA 1994b); and
- EPA National Functional Guidelines for Inorganic Data Review (EPA 1994c).

SAIC validation support staff will conduct a systematic review of the data for compliance with the established QC criteria based on the following categories:

- holding times,
- blanks,
- LCSs,
- surrogate recovery (organic methods),
- internal standards (primarily organic methods),
- furnace atomic absorption QC,
- calibration,
- sample reanalysis,
- secondary dilutions, and
- laboratory case narrative.

Consistent with the data quality requirements as defined in the DQOs, all project data and associated QC will be evaluated on these categories and qualified as per the outcome of the review. Information gathered during this validation process will be consistent with the information demonstrated by the USACE-Savannah District Data Validation Form (Figure 11-1). Either these forms or SAIC validation forms containing equivalent documentation will be completed and presented with the Quality Control Summary Report (QCSR).

11.2.2 Primary Analytical Data Validation Categories

11.2.2.1 Holding Times

Evaluation of holding times ascertains the validity of results based on the length of time from sample collection to sample preparation or sample analysis. Verification of sample preservation must be confirmed and accounted for in the evaluation of sample holding times. The evaluation of holding times is essential to establishing sample integrity and representativeness. Concerns regarding physical, chemical, or biochemical alteration of analyte concentrations can be eliminated or qualified through this evaluation.

11.2.2.2 Blanks

The assessment of blank analyses is performed to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks applies to any blank associated with the samples, including field, trip, equipment, and method blanks. Contamination during sampling or analysis, if not discovered, results in false-positive data.

DATA VALIDATION FORM, USACE, SAVANNAH DISTRICT

Page 1 of 2

DATE: _____
 REVIEWER NAME: _____
 SIGNATURE: _____
 TITLE: _____

DATA VALIDATION CHECKLIST:

PROJECT NAME:	_____
PROJECT NUMBER:	_____
SAMPLE ID (NUMBERS):	_____
SAMPLING TEAM:	_____
SAMPLE MATRIX:	_____
ANALYSES PERFORMED:	_____
CESAS DATA REPORTING LEVEL	_____

FIELD DATA DOCUMENTATION:

FIELD SAMPLING LOGS:	REPORTED		ACCEPTABLE		NOT REQUIRED
	NO	YES	NO	YES	
1. SAMPLING DATES NOTED					
2. SAMPLING TEAM INDICATED					
3. SAMPLE ID TRACEABLE TO LOCATION					
4. SAMPLE LOCATION					
5. SAMPLE DEPTHS FOR SOILS					
6. COLLECTION TECHNIQUE (BAILER, PUMP, ETC.)					
7. SAMPLE TYPE (GRAB, COMPOSITE)					
8. SAMPLE CONTAINER					
9. SAMPLE PRESERVATION					
10. CHAIN-OF-CUSTODY FORM COMPLETED					
11. REQUIRED ANALYTICAL METHODS					
12. FIELD WATER AND SOIL SAMPLE LOGS COMPLETED					
13. NUMBER OF QA & QC SAMPLES COLLECTED					
14. FIELD EQUIPMENT CALIBRATION					
15. FIELD EQUIPMENT DECONTAMINATION					
16. SAMPLE SHIPPING					

COMMENTS:

Figure 11-1. Savannah District Data Validation Form

LABORATORY DATA VALIDATION:	REPORTED		ACCEPTABLE		NOT REQUIRED
	NO	YES	NO	YES	
1. SAMPLE RESULTS					
2. PARAMETERS ANALYZED					
3. ANALYTICAL METHOD					
4. SIMPLE RECEIPT DATE					
5. SAMPLE PREPARATION DATE					
6. HOLDING TIMES					
7. CALIBRATION					
8. MS/MSD RPD OR SAMPLE LD RPD					
9. SURROGATE SPIKE RESULTS					
10. BLANKS					
A. RINSATES					
B. FIELD BLANKS					
C. TRIP BLANKS					
11. SAMPLE pH					
12. SAMPLE TEMPERATURE					
13. DETECTION LIMITS					
14. QC DATA					
A. INORGANIC					
B. ORGANIC					

ANALYTE: _____

FLAG: _____

REMARKS: _____

OVERALL COMMENTS: _____

DEFINITIONS:

- U Analyte not detected
- J Analyte identified, concentration is estimated value
- UJ Analyte not detected above estimated detection limits
- R Rejected value, presence or absence of analyte cannot be verified
- UR Rejected detection limits
- MS Matrix Spike
- MSD Matrix Spike Duplicate
- QA & QC Quality Assurance and Quality Control
- RPD Relative Percent Difference
- LD Laboratory Duplicate

Figure 11-1 (continued)

Blanks will be evaluated against quantitation limit goals as specified in Table 3-3. Analytical method blanks should be below 2× these levels. Field, trip, and equipment rinsate blanks will be evaluated against 5× these levels for most analytes and 10× these levels for common laboratory solvent analytes.

11.2.2.3 Laboratory Control Samples

The LCS serves as a monitor of the overall performance of the analytical process, including sample preparation, for a given set of samples. Evaluation of this standard provides confidence in, or allows qualification of, results based on a measurement of process control during each sample analysis.

11.2.2.4 Surrogate Recovery

System monitoring compounds are added to every sample, blank, matrix spike, MS, MSD, and standard. They are used to evaluate extraction, cleanup, and analytical efficiency by measuring recovery on a sample-specific basis. Poor system performance as indicated by low surrogate recoveries is one of the most common reasons for data qualification. Evaluation of surrogate recovery is critical to the provision of reliable sample-specific analytical results.

11.2.2.5 Internal Standards

Internal standards are utilized to evaluate and compensate for sample-specific influences on the analyte quantification. They are evaluated to determine if data require qualification due to excessive variation in acceptable internal standard quantitative or qualitative performance measures. For example, a decrease or increase in internal standard area counts for organics may reflect a change in sensitivity that can be attributed to the sample matrix. Because quantitative determination of analytes is based on the use of internal standards, evaluation is critical to the provision of reliable analytical results.

11.2.2.6 Furnace Atomic Absorption Quality Control

Duplicate injections and furnace post-digestion spikes are evaluated to establish precision and accuracy of individual analytical determinations. Because of the nature of the furnace atomic absorption technique and because of the detailed decision tree and analysis scheme required for quantitation of the elements, evaluation of the QC is critical to ensuring reliable analytical results.

11.2.2.7 Calibration

The purpose of initial and continuing calibration verification analyses is to verify the linear dynamic range and stability of instrument response. Relative instrument response is used to quantitate the analyte results. If the relative response factor is outside acceptable limits, the data quantification is uncertain and requires appropriate qualification.

11.2.2.8 Sample Reanalysis

When instrument performance-monitoring standards indicate an analysis is out of control, the laboratory is required to reanalyze the sample. If the reanalysis does not solve the problem (i.e., surrogate compound recoveries are outside the limits for both analyses), the laboratory is required to submit data from both analyses. An independent review is required to determine which is the appropriate sample result.

11.2.2.9 Secondary Dilutions

When the concentration of any analyte in any sample exceeds the initial calibration range, a new aliquot of that sample must be diluted and reanalyzed. The laboratory is required to report data from both analyses. When this occurs, an independent review of the data is required to determine the appropriate results to be used for that sample. An evaluation of each analyte exceeding the calibration range must be made, including a review of the dilution analysis performed. Results chosen in this situation may be a combination of both the original results (i.e., analytes within initial calibration range) and the secondary dilution results.

11.2.2.10 Laboratory Case Narratives

Analytical laboratory case narratives are reviewed for specific information concerning the analytical process. This information is used to direct the data validator to potential problems with the data.

11.3 PROJECT ANALYTICAL DATA SET

Analytical data for this project will be screened electronically and validated by qualified chemists. Flags signifying the usability of data will be noted and entered into an analytical database. Deficiencies in data deliverables will be corrected through direct communication with the field or laboratory, generating immediate response and resolution. All significant data discrepancies noted during the validation process will be documented through NCRs, which are sent to the laboratory for clarification and correction. Refer to Figure 10-1 of the FSP for a copy of the NCR form.

Decisions to repeat sample collection and analyses may be made by the SAIC Project Manager based on the extent of the deficiencies and their importance in the overall context of the project.

All data generated for investigations will be computerized in a format organized to facilitate data review and evaluation. The computerized data set will include data flags in accordance with the above-referenced protocols as well as additional comments of the Data Review Team. The associated data flags will include such items as: (1) estimated concentration below required reporting limit; (2) estimated concentration due to poor calibration, internal standard, or surrogate recoveries; (3) estimated concentration due to poor spike recovery; and (4) estimated concentration of chemical that was also determined in the laboratory blank.

SAIC data assessment will be accomplished by the joint efforts of the data validator, the data assessor, and the Project Manager. Data assessment by data management will be based on the criteria that the sample was properly collected and handled according to the FSP and Sections 4.0 and 5.0 of this QAPP. An evaluation of data accuracy, precision, sensitivity and completeness, based on criteria in Section 9.0 of this QAPP, will be performed by a data assessor and presented in the QCSR. This data quality assessment (DQA) will indicate that data are: (1) usable as a quantitative concentration, (2) usable with caution as an estimated concentration, or (3) unusable due to out-of-control QC results.

Project investigation data sets will be available for controlled access by the SAIC Project Manager and authorized personnel. Each data set will be incorporated into investigation reports as required.

11.4 DATA REPORTING

Laboratories will prepare and submit analytical and QC data reports to SAIC in compliance with the requirements of this QAPP, including data forms listed in Table 11-1. An electronic copy of data will be provided in an ASCII data file, CLP format, or other compatible format for entry into the SAIC database. An acceptable configuration is presented in Table 11-2 with all QA/QC sample data being provided in a companion ASCII file.

The landscaped or portrait sheets that contain the sample data will be ruled into columns. From the left, the first column will list, from the top: the table number and title; sample location; field ID; matrix of sample; test method; concentration units; and whether QC, blank, or lab control sample. Below that follows a list of all the compounds or metal elements tested by that test. On the bottom of the page, in the same columns, is listed: lab arrival time, lab name, test lab sample number, dates samples collected, date received, and date extracted. To the right appears a column where either the regulatory limits and/or the quantitation limits, or the recovery or RPD, whatever is appropriate, are listed for each compound or element. To the right of that are listed the sample data in columns with a blank column between each column, where the SAS QA can insert their data for comparison.

An electronic copy in Microsoft Excel will accompany the data report, and will be sent to Mr. James Nowland, SAS Laboratory, 611 South Cobb Drive, Marietta, Georgia 30060-3112, phone 770-919-5271.

The laboratory will be required to confirm sample receipt and log-in information. The laboratory will return a copy of the completed COC and confirmation of the laboratory's analytical log-in to SAIC within three days of sample receipt.

The subcontract analytical laboratory will prepare and retain full analytical and QC documentation similar to that required by CLP. Such retained documentation will include all hard copies and other storage media (e.g., magnetic tape). As needed, the subcontract analytical laboratory will make available all retained analytical data information.

12.0 PREVENTIVE MAINTENANCE PROCEDURES

12.1 FIELD INSTRUMENTS AND EQUIPMENT

The field equipment for this project may include temperature probes; pH meters; conductivity meters; organic vapor detectors (FID or PID); and combustible gas detectors capable of measuring the lower explosive limit, upper explosive limit, and/or oxygen levels. Specific preventative maintenance procedures to be followed for field equipment are those recommended by the manufacturers. These procedures are included in the technical procedures governing the use of these instruments.

Field instruments will be checked and/or calibrated before they are shipped or carried to the field. Each field instrument will be checked daily against a traceable standard or reference with a known value to ensure that the instrument is in proper calibration. Instruments found to be out of calibration will be recalibrated before use in the field. If the instrument cannot be calibrated, it will be returned to the supplier or manufacturer for recalibration, and a back-up instrument will be used in its place. Calibration checks and calibrations will be documented on the Field Meter/Calibration Log Sheets in the M&TE Log Book. Any maintenance conducted on field equipment must be documented in the M&TE Log Book.

Critical spare parts such as tapes, papers, pH probes, electrodes, and batteries will be kept on site to minimize down time of malfunctioning instruments. Back-up instruments and equipment should be available on site or within 1-day shipment to avoid delays in the field schedules.

12.2 LABORATORY INSTRUMENTS

As part of their QA/QC Program, a routine preventive maintenance program will be conducted by all investigation-associated laboratories to minimize the occurrence of instrument failure and other system malfunctions. All laboratory instruments will be maintained in accordance with manufacturers' specifications and the requirements of the specific method employed. This maintenance will be carried out on a regular, scheduled basis and will be documented in the laboratory instrument service log book for each instrument. Emergency repair or scheduled manufacturer's maintenance will be provided under a repair and maintenance contract with factory representatives.

Refer to Appendix C of this QAPP for additional analytical method-related information regarding routine and preventive maintenance for laboratory procedures and methods.

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13.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FSP and QAPP. Audits of laboratory activities will include both internal and external audits.

13.1 LABORATORY AUDITS

The USACE HTRW CX conducts on-site audits and validates laboratories on a regular basis. These USACE independent on-site system audits, in conjunction with performance evaluation samples (performance audits), qualify laboratories to perform USACE environmental analysis every 18 months.

These system audits include examining laboratory documentation of sample receiving, sample log-in, sample storage, COC procedures, sample preparation and analysis, instrument operating records, etc. Performance audits consist of sending performance evaluation samples to USACE laboratories for ongoing assessment of laboratory precision and accuracy. The analytical results of the analysis of performance evaluation samples are evaluated by USACE HTRW CX to ensure that laboratories maintain an acceptable performance.

Internal performance and system audits of laboratories will be conducted by the Laboratory QA Officer as directed in the laboratory QA plan. These system audits will include examination of laboratory documentation of sample receiving, sample log-in, sample storage, COC procedures, sample preparation and analysis, instrument operating records, etc. Internal performance audits are also conducted on a regular basis. Single-blind performance samples are prepared and submitted along with project samples to the laboratory for analysis. The Laboratory QA Officer will evaluate the analytical results of these single-blind performance samples to ensure that the laboratory maintains acceptable performance.

Additional audits of laboratories may be planned and budgeted within specific USACE task scopes. These project-specific laboratory performance review audits would be conducted by SAIC at the direction of, and in conjunction with, the USACE-Savannah District, when requested.

External audits may be conducted in conjunction with, or at the direction of, EPA Region IV or the State of Georgia regulatory agency.

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14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

14.1 DAILY QUALITY CONTROL REPORTS

During the field investigation activities performed for this project, SAIC will prepare Daily Quality Control Reports (DQCRs), which will be signed and dated by the SAIC CQC Representative. An example of the DQCR format to be used by SAIC is illustrated in Figure 9-1 of the FSP. These reports will be submitted to the USACE–Savannah District Project Manager on a weekly basis. The contents of each DQCR will include a summary of activities performed at the project site; weather information; and results of Contractor Chemical Quality Control (CCQC) activities performed, including field instrument calibrations, departures from the approved Work Plan, problems encountered during field activities, and any instructions received from government personnel. Any deviations that may affect the project DQOs will be immediately conveyed to the USACE–Savannah District Project Manager.

14.2 QUALITY ASSURANCE REPORTS

All performance and system audits of laboratory and field operations will be reported directly to SAIC project management, SAIC program management, and the USACE–Savannah District.

Each laboratory will provide LORs and analytical QC summary statements (case narratives) with each data package. All COC forms will be compared with samples received by the laboratory, and an LOR will be prepared and sent to SAIC describing any differences in the COC forms and the sample labels or tags. All deviations will be identified on the receiving report, such as broken or otherwise damaged containers. This report will be forwarded to SAIC within three days of sample receipt and will include the following: a signed copy of the COC form, itemized SAIC sample numbers, laboratory sample numbers, cooler temperature upon receipt, and itemization of analyses to be performed.

Summary QC statements will accompany analytical results as they are reported by the laboratory in the form of case narratives for each sample delivery group.

Any departures from approved plans will receive prior approval from the USACE–Savannah District Project Manager and will be documented with FCOs. These FCOs will be incorporated into the project evidence file.

SAIC will maintain custody of the project evidence file and will maintain the contents of files for this project, including all relevant records, reports, logs, field logbooks, pictures, subcontractor reports, correspondence, and COC forms, until this information is transferred to the USACE–Savannah District Project Manager. These files will be stored in a secure, limited-access area and under custody of the SAIC Project Manager. Analytical laboratories will retain all original analytical raw data information (both hard copy and electronic) in a secure, limited-access area and under custody of the laboratory Project Manager.

14.3 QUALITY CONTROL SUMMARY REPORTS

At the conclusion of field investigation activities and laboratory analysis, SAIC, in addition to any review conducted by the laboratory, will perform its own validation of the submitted data. This activity will include assignment of flags to data, documentation of the reason(s) for the assignments, and description of any other data discrepancies. SAIC will then prepare QCSRs, which will be included as appendices to final reports. These reports will be submitted to the USACE–Savannah District Project Manager as determined by the project schedule. The contents of each QCSR will include data validation documentation and discussion of all data that may have been compromised or influenced by aberrations in the sampling and analytical processes. Both field and laboratory QC activities will be summarized, and all DQCR information will be consolidated. Problems encountered, corrective actions taken, and their impact on project DQOs will be determined.

The following are examples of elements to be included in the QCSR as appropriate.

- Laboratory QC evaluation and summary of the data quality for each analytical type and matrix. Part of the accuracy, precision, and sensitivity summarized in the DQA.
- Field QC evaluation and summary of data quality relative to data usability. Part of the accuracy, precision, and sensitivity summarized in the DQA.
- Overall data assessment and usability evaluation.
- DQCR consolidation and summary.
- Summary of lessons learned during project implementation.

Specific elements to be evaluated within the QCSR include the following:

- sample results,
- field and laboratory blank results,
- LCS percent recovery (method dependent),
- sample MS percent recovery (method dependent),
- MS/MSD or sample duplicate RPD (method dependent),
- analytical holding times, and
- surrogate recovery, when appropriate.

An example of the format that will be used by SAIC for preparation of the project QCSR is presented in Figure 14-1.

QUALITY CONTROL SUMMARY REPORT

1. Introduction
 - 1.1 Project Description
 - 1.2 Project Objectives
 - 1.3 Project Implementation
 - 1.4 Purpose of this Report
2. Quality Assurance Program
 - 2.1 Monthly Progress Reports
 - 2.2 Daily Quality Control Reports (DQCRs)
 - 2.3 Laboratory "Definitive" Level Data Reporting
3. Data Validation
 - 3.1 Field Data Validation
 - 3.2 Laboratory Data Validation
 - 3.3 Definition of Data Qualifiers (Flags)
 - 3.4 Data Acceptability
4. Data Evaluation
 - 4.1 Accuracy
 - Metals
 - Volatile Organic Compounds
 - Total Petroleum Hydrocarbon
 - etc.
 - 4.2 Precision
 - Laboratory Precision
 - Field Precision
 - 4.3 Sensitivity
 - 4.4 Representativeness and Comparability
 - 4.5 Completeness
5. Data Quality Assessment Summary
6. References

Figure 14-1. Quality Control Summary Report Format

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**QUALITY ASSURANCE PROJECT PLAN
FOR
SOIL GAS SURVEY AT BULK FUEL FACILITY (HAA-09)
HUNTER ARMY AIRFIELD, GEORGIA**

**APPENDIX A
REFERENCES**

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**QUALITY ASSURANCE PROJECT PLAN
FOR
SOIL GAS SURVEY AT BULK FUEL FACILITY (HAA-09)
HUNTER ARMY AIRFIELD, GEORGIA**

**APPENDIX B
DATA MANAGEMENT PLAN**

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1.0 INTRODUCTION

This appendix of the Quality Assurance Project Plan (QAPP) represents the Data Management Plan (DMP) for project activities to be performed by Science Applications International Corporation (SAIC) for the Bulk Fuel Facility Investigations at Hunter Army Airfield, Georgia. This plan describes the data management process to be implemented for this project. The DMP presents the process used for the planning, collection, tracking, verification, validation, analysis, presentation, and storage of site characterization data. The plan identifies required data documentation materials and procedures, as well as project file requirements. The plan also provides the reporting requirements for presenting the raw data and conclusions of the investigation.

Project activities will generate data, including sample locations, borehole information, measurements of field parameters, and results of sample analyses and data reviews. Important records regarding the collection and analysis of the samples and data will also be generated. The data management process requires the proper flow of data from field collection and processing by the analytical laboratory to those involved in the project evaluation and decision making. Figure B.1-1 illustrates the flow of information for the project. This DMP will ensure the validity and accessibility of data to support environmental data analysis and the evaluation of corrective measures.

2.0 INVESTIGATION DATA

2.1 DATA TYPES

Sampling activities proposed for the project will result in the collection of multiple data types from multiple sources. Data collection activities will include acquisition of historical data as appropriate, entry of sample collection data and field measurements from logbooks, loading of analytical data from laboratory Electronic Data Deliverables, loading of civil survey results, and entry of data validation result qualifiers. In addition, critical project records, such as chain-of-custody (COC) forms, laboratory data packages, and validation results, will be maintained in the project file.

2.2 KEY IDENTIFIERS

The key identifiers for project sampling data will be the sample location/station and a unique sample identification number. All samples will be assigned an area and station to identify the specific point where the field measurements or samples were collected. Descriptions, geographic coordinates, and elevations will be obtained for these sampling stations.

Unique sample numbers are derived from the location, sampling station within the location, sample medium, sample type, plus a sequential number. Field duplicates represent a separate sample type, and distinct depths receive different sequential numbers so no duplication of sample numbers will occur. The sample identification will appear on the sample collection log sheet, sample label, COC form, and on any correspondence related to the sample.

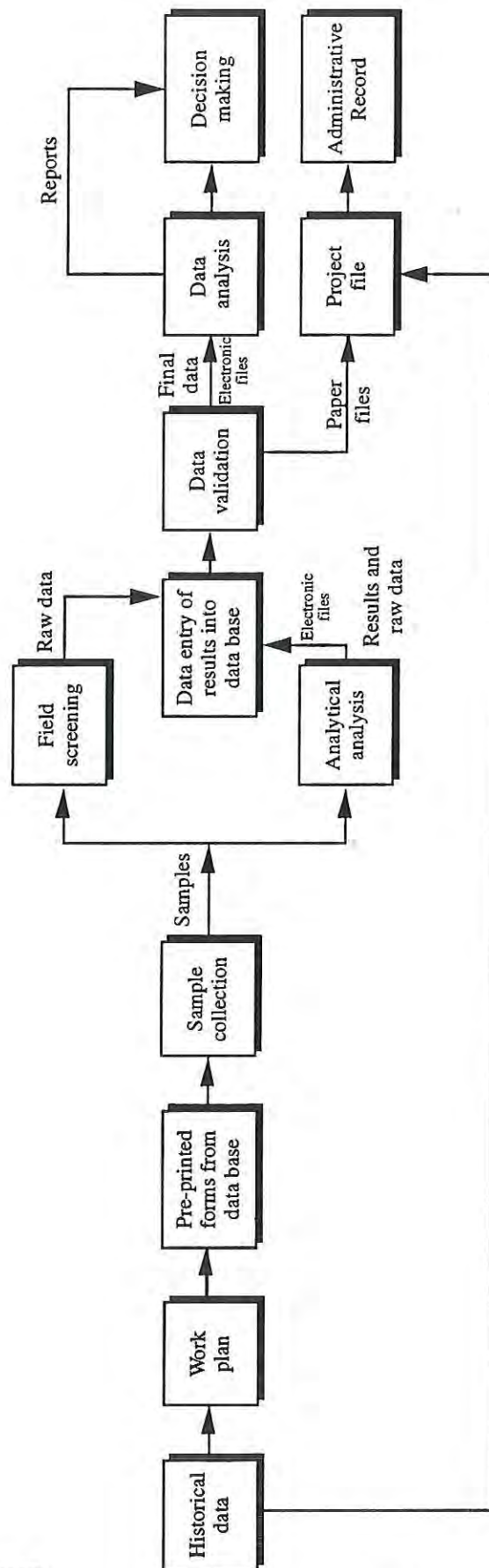


Figure B.1-1. Project Information Flow Diagram for the Bulk Fuel Facility Investigations at HAAF, Georgia

Additional information regarding sample identification is presented in Section 5.3 of the Field Sampling Plan (FSP).

3.0 DATA MANAGEMENT SYSTEM

The data management system facilitates the information flow by providing a means of tracking, organizing, reporting, and archiving data and information. The system has four primary components:

- (1) A multi-disciplinary team of data management professionals.
- (2) A process model that integrates activities relevant to ensuring that data are complete, consistent, and fully qualified, and minimizes the uncertainties associated with the data, data products, or interpretations of results.
- (3) Guidance provided in the SAIC *Quality Assurance Technical Procedures Volume I: Data Management*.
- (4) A standardized database structure to support the collection, management, analysis, and presentation of site characterization data.

4.0 DATA MANAGEMENT AND TRACKING PROCESS

To meet the regulatory requirements for the acquisition of technically sound and legally admissible data, a traceable audit trail will be established from the development of the project Work Plan through the archiving of information and data. Each step or variation of the sampling and analytical process will be documented. Standardized formats for electronic transfer and reporting will be used. To meet this requirement, the following data management process will be followed throughout the collection, management, storage, analysis, and presentation of the site environmental characterization data.

4.1 SAMPLING AND ANALYSIS PLANNING

Plans for the collection of field and laboratory quality control samples are detailed in the FSP and the QAPP. These two plans together specify all applicable sampling and analytical data that will be entered into the database.

The interface with the analytical laboratory is crucial in achieving the goal of generating technically sound data. Based upon the laboratory data quality objectives presented in the QAPP, the laboratory statement of work details analytical methods, validation criteria, deliverables, and deliverable formats required of the analytical laboratory. The analytical laboratories that have been contracted with for chemical and geotechnical testing are identified in the QAPP.

Prior to initiating field work, the project database will be populated with sample locations, sample numbers, analytical parameters and detection limits, and associated sampling and laboratory

information based on the requirements of the FSP. A report of all planned samples will be generated for review by the SAIC Field Manager. After approval of the pre-sampling database, the data coordinator will generate field sampling forms including preprinted sample information, bind and number the logbooks, and print and organize the required sample labels. This process will increase the accuracy of the final database and minimize the amount of information samplers must record in the field.

4.2 FIELD SAMPLE COLLECTION AND MEASUREMENT

Prior to beginning field sampling, field personnel will be trained as necessary and participate in a project-specific readiness review. These activities ensure that standard procedures will be followed in sample collection and in completing field logbooks, COC forms, labels, and custody seals. Documentation of training and readiness is submitted to the project file.

The master field investigation document will be the site field logbooks. The primary purpose of these documents is to record each day's field activities, personnel on each sampling team, and any administrative occurrences, conditions, or activities that may have affected the field work or data quality of any environmental samples for any given day.

Each field sampling team will have a field logbook in which it will record data collected in the field. To the extent possible, preprinted field logbook sheets will be generated from the data management system. If preprinted logbook sheets are not used for a given sample, required information will be recorded manually. As samples are collected in the field, the field sampling team members will complete the logbooks with sample collection data and required field measurements as specified in the FSP and QAPP. Standardized reporting formats will be used to document this information.

The field logbooks will be signed and dated by the data recorder and will specify whether field methods and procedures were followed. Entries will be verified by a sampling team member other than the recorder, or by the SAIC Field Manager, who will perform a quality assurance (QA) review and sign and date the logbook to document the review.

Back-up photocopies of the field logbooks will be made and submitted to the project file. Sample collection and measurement information from the logbooks and data forms will be manually entered into the database and checked for accuracy. Entries will be verified using double entry and comparing protocols. As necessary, the actual forms used will be modified to include the appropriate information codes to facilitate data entry. Completed logbooks and appropriate field forms will be submitted to the project file upon completion of the project.

At any point in the process of sample collection or data or document review, a Nonconformance Report (NCR) may be initiated if nonconformances are identified, and data entered into the database may be flagged accordingly. Additional information regarding NCRs is presented in Section 10.0 of the FSP.

4.3 CHAIN-OF-CUSTODY DOCUMENTATION

Sample containers will be tracked from the field collection activities to the analytical laboratory following proper COC protocols and using standardized COC forms.

When the samples are received at the laboratory, the laboratory receiving staff will check and document the condition of the samples upon arrival, check that the sample identification numbers on containers and COC forms match, and assign laboratory sample identification numbers traceable back to the field identification numbers. Within 3 days of receipt of the sample containers, the laboratory will send a letter of receipt (LOR) to the SAIC Laboratory Coordinator or his designee. This letter will provide the following information:

- sample receipt date,
- problems noted at the time of receipt,
- list of sample identification numbers and corresponding laboratory identification numbers for all samples received,
- analyses requested for each sample received, and
- completed cooler receipt checklists for each cooler received.

The LOR will be accompanied by the completed and signed COC form(s) for the samples, and both documents will be submitted to the project file. Sample information recorded on the COC form and in the LOR will be entered into the sample tracking database. This database will allow for tracking of the status of samples from the time of collection through analysis and validation. The database tracking program will produce reports that will inform the project team of potential delays or problems related to sample analysis and validation.

4.4 ANALYTICAL LABORATORY DOCUMENT AND DATA SUBMISSION

Prior to release of a data package, the analytical laboratory supervisor will review the data package for precision, accuracy, and completeness and will attest that it meets all data analysis and reporting requirements for the specific method used. The supervisor will then sign the hard-copy forms certifying that the data package and any electronic format deliverables were reviewed and are approved for release.

Analytical results will be submitted to the SAIC Laboratory Coordinator, or his/her designee, on standardized forms in data packages in accordance with the subcontract scope of work for analytical services. These forms will contain results and required quality assurance/quality control (QA/QC) information applicable to the analytical laboratory method used for analysis. In addition, as required by the scope of work, results of analyses will also be provided in electronic format on diskettes. The data coordinator receiving laboratory deliverables will make a copy of each data package and/or diskette and submit the originals to the project file. Results will be transferred to the database, either electronically by diskette or manually from the hard copy, into appropriate data tables within the database.

4.5 DATA VERIFICATION AND VALIDATION

All data packages received from the analytical laboratory will be reviewed, verified, and validated by data management personnel. Details regarding the data verification and validation processes are presented in the project QAPP.

With regard to data reduction, any replicate measurements associated with a single sample will be averaged prior to further data reduction. Correction of extreme (outlier) values will be attempted if the cause for the outlier value can be documented. This type of data will be corrected if the outliers are caused by incorrect transcription and the correct values can be obtained and documented from valid records. If the values can be documented as resulting from a catastrophic event or a problem in methodology, the values will be appropriately qualified. Documentation and validation of the cause of outliers will accompany any attempt to correct or delete these data values. Outlier values will not be omitted from the raw data reported to the USACE-Savannah District, and valid values will be included in data summary tables. Analytical values determined to be at or below the detection limit will be reported numerically (e.g., ≤ 0.1 mg/L). The data presentation procedures will cite analytical methods used including appropriate detection limits.

4.6 DATA CENTRALIZATION AND STORAGE

Once the data for a given sample or group of samples are complete and entered into the database, the data coordinator will check that logbooks, other field records, and all analytical data are complete and properly stored, including both the electronic form and associated data packages. Each piece of information will be documented as to its source, and hard-copy information will be appropriately indexed and filed.

Procedure-based routines for establishing data security, backup, archival, and maintaining proper database changes are also used to maintain database integrity. Classes of users will be defined with access levels approved and controlled by the SAIC Data Manager. Once loaded, the database will be secured from physical corruption (i.e., hardware or software failure) or from unauthorized access and illegal updating. Physical security requires recovery procedures, time-stamping, and other related standard operating processes and controls. Any changes made to the completed database will be documented on standardized forms which will be placed into the project file.

4.7 DATA SUMMARIZATION AND REPORTING

When field sampling has been completed and the analytical data have been received, validated, and transferred into the project database, project reports and Quality Control Summary Reports (QCSRs) will be generated for each of the sites investigated. Information regarding the format and content for QCSRs is presented in Section 14.0 of the QAPP.

Project data will be screened for potential data errors, compared to site-specific background values and applicable regulatory limits, and summarized in both tabular and graphical form to facilitate data interpretation. Data reduction and summation will be accomplished using quality-controlled and documentable reporting programs. Data summaries will be generally produced using predefined report formats available within the data management system. Statistical summaries will be generated by transferring data to an SAS data set and adapting existing data analysis programs to include project-specific aggregation or screening criteria. Any new programs developed under this project

will be tested, reviewed, and documented as error-free following SAIC QA technical procedures. Data presented on maps, figures, or tables will be transferred electronically as far as possible to avoid introducing typographical errors.

4.8 RECORDS MANAGEMENT AND DOCUMENT CONTROL

Hard copies of all original site and field logbooks, COC forms, data packages with analytical results and associated QA/QC information, data verification and validation forms, and other project-related information will be indexed, catalogued into appropriate file groups and series, and archived.

The SAIC Data Manager will archive the project data to the appropriate electronic media. A data archive information package will be prepared that describes the data system, file format, and method of archival. Sufficient documentation will accompany the archived data to fully describe the source, contents, and structure of the data to ensure future usability. Computer programs used to manipulate or report the archived data will also be included in the data archive information package to further enhance the data's future usability.

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**QUALITY ASSURANCE PROJECT PLAN
FOR
SOIL GAS SURVEY INVESTIGATION
OF THE
BULK FUEL FACILITY (HAA-09)
HUNTER ARMY AIRFIELD, GEORGIA**

**APPENDIX C
LABORATORY ANALYTICAL PROCEDURES**

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VOLATILE ORGANIC ANALYSIS (EPA SW-846 METHOD 8260B)

This procedure encompasses the determination of low-level purgeable organic compounds in a variety of matrices. The volatile organic compounds (VOCs) are purged from the environmental matrix, absorbed onto a trapping media, desorbed from the trapping media, separated via gas chromatographic (GC) techniques, and then selectively quantified using a mass spectrometer. This method will quantitate most VOCs that have boiling points below 200°C and that are insoluble or slightly soluble in water.

Sample Preparation

U.S. Environmental Protection Agency (EPA) SW-846 Method 5030, Purge-and-Trap, is referenced in the analytical procedure for liquid preparation methodology, and Method 5035 is referenced as the sampling and analytical preparation methodology for solid. In these instances the sampling, preparation and analytical processes are co-dependent. Sample collection, preparation and analysis require containers and sample manipulation to be instrumentally linked and sequentially stepped in the overall analysis. An aliquot of water or solid sample is introduced to a sparging vessel (5 mL or 5 gm, respectively). For solid samples, the sample aliquote is preserved (methanol or sodium persulfate) or containerized in hermetically sealed vessels (EnCore or sparge vessel). These preserved or sealed aliquotes are directly analyzed by sparging in inert gas (normally helium) through the soil/solution mixture to transfer the volatile components to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is complete, the sorbent column is heated and backflushed with the inert gas to desorb the volatile components onto a GC column for analysis. Liquid samples are transferred from sealed sample vials employing gas-tight syringes to sparging vessels, where the same purge and trap analysis is conducted.

Analytical Method

This method will be used to analyze VOCs in soil and water samples. Compounds are extracted using SW-846 Method 5030 or 5035, transferred onto a GC capillary column where they are separated, and then analyzed employing a mass spectrometer (MS). No modifications to the method are anticipated.

In addition to the Target Compound List (TCL) identified, the 10 largest tentatively identified compounds (TICs) will be reported. The non-target peak height must be greater than or equal to 10 percent of the height of the nearest internal standard peak. A TIC is a non-targeted organic compound whose mass spectra has been compared to library spectra to obtain a tentative identification and whose concentration is estimated based on internal standard peak areas, not compound-specific standards.

Method-Specific Data Quality Objectives

Refer to Table 3-1, 3-2, and SW-846 Methods for method-specific data quality objectives (DQOs) for accuracy, precision, and completeness. Table 3-3 identifies objectives for analyte-specific sensitivity (i.e., quantitation limits).

Preventative Maintenance

Preventative maintenance on each gas chromatograph/mass spectrometer (GC/MS) system involves four basic areas; vacuum pumps, GC maintenance, analyzer maintenance, and autosampler maintenance. Vacuum pump maintenance primarily includes oil changes every six months for mechanical, turbomolecular and diffusion pumps. GC maintenance consists of partial removal of frontal column sections, and injection port cleaning or replacement is initiated when system sensitivity drops or air is present in the system. Routine baking of the chromatographic columns is employed on a daily basis. The MS analyzer is maintained through ion source and electron multiplier cleaning or replacement as determined necessary due to the type and quantity of samples analyzed. Autosampler maintenance is performed by backflushing the systems trap and lines with methanol as needed based on the types and quantities of sample processed. GC/MS volatile organic analysis also requires periodic cleaning of the glass jet separator dependent on sample types and quantities.

Each instrument has a maintenance logbook that includes the following information:

- Instrument model and serial number
- Instrument manufacturer
- Instrument identification number
- Service contact personnel and contract information
- Instrument maintenance records
- Service call documentation

Instrument Calibration and Frequency

Instrumentation is calibrated through a sequence of events. The MS is tuned daily to ensure an acceptable spectral pattern for p-bromofluorobenzene (BFB). Relative ion abundance criteria for BFB are listed in the method, and criteria must be demonstrated each 12-hour shift. Prior to tuning or multi-point calibration of instrumentation, precautions are taken to ensure that the instrument is clean and functioning properly.

A minimum of five standard concentration levels are run to establish average relative response factors (RRFs) for each target compound and internal standard. System performance is verified by ensuring that the minimum average response factor (RF) criteria are met in the initial and continuing calibrations for specified system performance check compounds (SPCCs)—specifically, chloromethane; bromoform; 1,1-dichloroethane; 1,1,2,2-tetrachloroethane; and chlorobenzene. The minimum acceptable RF will be 0.300 (.250 for bromoform).

An initial calibration will be monitored through the use of the following calibration check compounds (CCCs) each 12-hour shift: 1,1-dichloroethene; chloroform; 1,2-dichloropropane; toluene; ethylbenzene; and vinyl chloride. The maximum allowable percent relative standard deviation (%RSD) for these CCCs will be 30 percent. Continuing calibrations will be assessed using percent difference (%D) values. The maximum allowable %D value for CCCs will be 25.0 percent.

Internal Quality Control Checks

Quality control (QC) checks employed during analysis include initial and continuing calibration, method blank analysis, spike and spike duplicate analysis, Laboratory Control Standard (LCS)

analysis, and surrogate spikes added to all standards, blanks, spikes, duplicates, and samples. Frequency of initial calibrations is determined from the analysis of continuing calibration performance, while continuing calibration standards are analyzed every 12 hours. Method blanks are required to be analyzed every 12 hours as are LCS samples. Matrix spike/matrix spike duplicate (MS/MSD) analyses are performed with each analytical sample batch (maximum of 20 samples), and which are analyzed within the 12-hour tune window. Criteria as defined in SW-846 will apply.

Corrective Action

When method calibration or QC criteria are not met, corrective action will be taken. When analytes do not meet initial calibration criteria, only those compounds failing need to be reanalyzed. If calibration is still not successful, new standards or instrument maintenance may be required. If continuing calibration criteria are not achieved, retuning, reanalysis of the standard, purge flow adjustment, or instrument maintenance may be warranted. If all attempts fail, a new multi-point calibration must be performed. When method blanks fail criteria, the source or cause of contamination must be identified and eliminated. In any event, another method blank must be successfully analyzed prior to sample analysis. If any surrogate of the three fails criteria, the sample must be reanalyzed. If the surrogate fails a second time, the failure is attributed to matrix effects.

Data Reduction, Validation, and Documentation

Compounds are identified by comparison of the sample mass spectrum to the mass spectrum of the standard reference for the suspected compound on the same GC/MS system, and comparison of sample component elution relative retention time (RRT) to that of the standard compound. RRT values must compare within 30 seconds, run during the same 12-hour period. Particular attention must be given to potential co-elution possibilities.

For components not associated with targeted calibrated compounds, a library search may be performed to tentatively identify the component. A library search of all method blanks must be performed for contamination evaluation.

When a compound has been identified, the quantification of that compound will be based on the integrated abundance of the primary characteristic ions for that compound. Quantification will occur employing the internal standard nearest to the retention time of a given analyte, as defined by the SW-846 protocol.

Sediment and soil samples are reported on a dry-weight basis, while sludges and wastes are reported on a wet-weight basis. Spike and spike duplicate data are reported for all results. Results are reported to the nearest one hundredth. Data are reported in units of $\mu\text{g/L}$ for waters and $\mu\text{g/kg}$ for soils, sediments, sludges, and wastes. All data are stored by date, instrument, and analyst, and are routinely "backed up" on magnetic tape.

Analytical data review, validation, and reporting criteria are established in the laboratories' Quality Assurance Plan (QAP).

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SEMIVOLATILE ORGANIC ANALYSIS (EPA SW-846 METHOD 8270C)

This procedure is used to determine low-level solvent extractable organic compounds in a variety of matrices. Semivolatile organic compounds (SVOCs) are extracted from the environmental matrix, concentrated in an organic solvent, separated via GC techniques, and then selectively quantified using an MS. This method will quantitate many SVOCs that are soluble in methylene chloride and are able to be separated employing a slightly polar fused silica capillary GC column.

Sample Preparation

EPA SW-846 Methods 3510 (Separatory Funnel Liquid-Liquid Extraction) and 3520 (Continuous Liquid-Liquid Extraction) are referenced in the analytical procedure for liquid sample preparation methodologies. In both instances a measured volume of sample, usually one liter, is adjusted to a specified pH, and organic constituents are extracted into methylene chloride solvent. The extract is then chemically dried to remove residual water content, concentrated through evaporative techniques, subject to chemical cleanup procedures (if necessary), and finally placed into a sealed ampule prior to instrumental analysis.

EPA SW-846 Methods 3540 (Soxhlet Extraction) and 3550 (Ultrasonic Extraction) are referenced in the analytical procedure for solid sample preparation methodologies. In both instances a weighed portion of sample, usually 30 grams for low-level concentrations and 2 grams for medium-/high-level concentrations, is mixed with anhydrous sodium sulfate and subsequently extracted with methylene chloride solvent. The Soxhlet extraction allows a continuous washing of the solid with solvent employing a refluxing apparatus, while an ultrasonic probe is used to extract organic compounds into sequential solvent aliquots during the ultrasonic extraction. The extract is then chemically dried to remove residual water content, concentrated through evaporative techniques, subject to chemical cleanup procedures (if necessary), and finally placed into a sealed ampule prior to instrumental analysis.

Analytical Method

This method will be used to analyze SVOCs in soil and water samples. Compounds are extracted using SW-846 Methods 3510, 3520, 3540, or 3550, transferred onto a GC capillary column where they are separated, and then analyzed employing an MS. No modifications to the method are anticipated.

In addition to the TCL identified, the 10 largest TICs will be reported. The non-target peak height must be greater than or equal to 10 percent of the height of the nearest internal standard peak. A TIC is a non-targeted organic compound whose mass spectra has been compared to library spectra to obtain a tentative identification and whose concentration is estimated based on internal standard peak areas, not compound-specific standards.

Method-Specific Data Quality Objectives

Refer to Table 3-1, 3-2, and SW-846 Methods for method-specific DQOs for accuracy, precision, and completeness. Table 3-3 identifies objectives for analyte-specific sensitivity.

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TOTAL PETROLEUM HYDROCARBON ANALYSIS (EPA SW-846 MODIFIED METHOD 8015B)

Modifications to SW-846 Method 8015 will be implemented to determine the concentration of low-boiling- and high-boiling-range organics in water and solid matrices. The sample after purge and trap or methylene chloride extraction is subjected to GC analysis. All chromatographic peaks within specified ranges are then integrated, and quantification is based on direct comparison to integrated areas over the same ranges for either a gasoline standard (low boiling) or a diesel fuel standard (high boiling).

Sample Preparation

Low-Boiling-Range Organics

EPA SW-846 Method 5030, Purge-and-Trap, is utilized in the analytical procedures for both solid and liquid preparation methodology. In this instance both the preparation and analytical processes are instrumentally linked and sequential steps in the overall analysis. An aliquot of water or solid sample is introduced to a sparging vessel (5 mL or 5 gm, respectively). For solid samples, 5 mL of organic free water is added to the vessel. An inert gas (normally helium) is bubbled through the solution to transfer the volatile components to the vapor phase. The vapor is swept through a sorbent column where the low-boiling organic components are trapped. After purging is complete, the sorbent column is heated and backflushed with the inert gas to desorb the low-boiling organic components onto a GC column for analysis.

Solid samples with high concentrations of analytes can be extracted into methanol. An aliquot of the methanol extract is then combined with 5 mL of water in the sparge vessel, and the mixture is purged as described.

High-Boiling-Range Organics

One liter of solution, or approximately 25 grams of solid material, is extracted with methylene chloride. The extracted solution is concentrated to a volume of 1 mL. A surrogate compound is added prior to extraction with an optional internal standard.

Analytical Method

Low-boiling organic components correspond to an alkane range of approximately C6 through C10 and a boiling point range between approximately 60 and 170°C. High-boiling organic components correspond to an alkane range of approximately C10 through C24. Organic components are either purged onto (low boiling) or injected into (high boiling) a chromatographic column where integration of a selected suite of chromatographic peaks are compared to either a gasoline standard or a diesel fuel standard, respectively.

Method-Specific Data Quality Objectives

Refer to Tables 2-1, 2-2, and SW-846 Methods for method-specific DQOs for accuracy, precision, and completeness. Table 6-1 identifies objectives for analyte-specific sensitivity.

Preventative Maintenance

Preventative maintenance on each GC system involves daily injection port maintenance and periodic column maintenance. Column maintenance may consist of partial removal of frontal column sections, while injection port cleaning or replacement is initiated when system sensitivity drops or air is present in the system. Routine baking of the chromatographic columns is employed on a routine basis or when the types and quantities of samples analyzed warrant. Autosampler maintenance is performed by backflushing the system's trap and lines with methanol as needed based on the types and quantities of samples processed.

Each instrument has a maintenance logbook that includes the following information:

- Instrument model and serial number
- Instrument manufacturer
- Instrument identification number
- Service contact personnel and contract information
- Instrument maintenance records
- Service call documentation

Instrument Calibration and Frequency

GC instrumentation is calibrated relative to selected gasoline or diesel standards. Precautions are taken to ensure that the instrument is clean and functioning properly. A single-point or multiple-point standardization may be performed to establish comparison-integrated ranges for the targeted component ranges.

Internal Quality Control Checks

QC checks employed during analysis include a gasoline or diesel control standard, surrogate standard additions, method blank analysis, and LCS analysis. Sample spike and spike duplicate determination may also be employed. These control samples are performed with each analytical sample batch (maximum of 20 samples), and which are analyzed within the 12-hour tune window. Criteria as defined in SW-846 will apply.

Corrective Action

When method calibration or QC criteria are not met, corrective action will be taken. When initial continuing calibration criteria are not met, reanalysis of the standard may be attempted. If calibration is still not successful, new standards or instrument maintenance may be required.

Data Reduction, Validation, and Documentation

Integrated values for the range of components are identified by comparison of the standard employed.

Sediment and soil samples are reported on a dry-weight basis, while sludges and wastes are reported on a wet-weight basis. Spike and spike duplicate data are reported for all results. Data are reported in units of mg/L for waters and mg/kg for soils, sediments, sludges, and wastes. All data are stored by date, instrument, and analyst, and are routinely "backed up" on magnetic tape.

Analytical data review, validation, and reporting criteria are established in the laboratories' QAP.