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FINAL WORK PLAN CHEMICAL DATA ACQUISITION PLAN REMEDIAL INVESTIGATION
FIREFIGHTER TRAINING AREA, LIGHTER AMPHIBIOUS RESUPPLY CARGO (LARC) 60
MAINTENANCE AREA, AND AUTO CRAFT AREA FORT STORY VA
12/1/1994
MALCOLM PIRNIE



Final Work Plan 0131

CHEMICAL DATA ACQUISITION PLAN

Remedial Investigation
For
Fort Story, Virginia

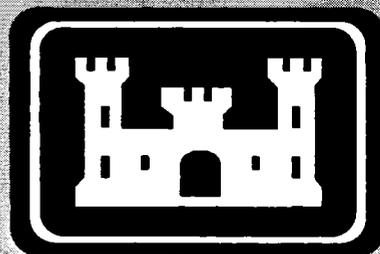
**U. S. Army Transportation Center
Fort Eustis, Virginia**

and

**U. S. Army Corps of Engineers
Baltimore District**

December 1994

0285-588



**FINAL WORK PLAN:
CHEMICAL DATA ACQUISITION PLAN**

**FIREFIGHTER TRAINING AREA (FTSTY-04)
LARC 60 MAINTENANCE AREA (FTSTY-06)
AUTO CRAFT BUILDING AREA (FTSTY-07)**

**FORT STORY
VIRGINIA BEACH, VIRGINIA**

PREPARED FOR:

**U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND**

**CONTRACT DACA31-94-D-0017
DELIVERY ORDER NO. 0017, 0020, 0024**

DECEMBER 1994

**MALCOLM PIRNIE, INC.
11832 Rock Landing Drive, Suite 400
Newport News, Virginia 23606**

CHEMICAL DATA ACQUISITION PLAN

FORT STORY, VIRGINIA

SCOPE

Malcolm Pirnie, Inc. is under contract to the U.S. Army Corps of Engineers (ACE) to conduct remedial investigations for the Firefighter Training Area, LARC 60 Maintenance Area and the Auto Craft Building Area at Fort Story. This Chemical Data Acquisition Plan (CDAP) has been developed to address requirements for quality assurance/quality control for sampling to be performed on site. The CDAP shall be used in conjunction with Field Investigation Plan and Site Safety and Health Plans.

ACKNOWLEDGEMENTS

1. Chemical Data Acquisition Plan - Reviewed by:

<u>Title</u>	<u>Signature</u>	<u>Date</u>
Project Officer	_____	_____
Project Manager	_____	_____
Technical Director	_____	_____
Site QA/QC Officer	_____	_____

2. Employee Acknowledgment (To be signed by all MPI and subcontractor employees prior to performing sampling on-site):

I acknowledge that I have reviewed the information in this Chemical Data Acquisition Plan and understand the required activities and procedures necessary to ensure QA/QC for sampling activities at Fort Story.

<u>Employee Signature</u>	<u>Company</u>	<u>Date</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

CHEMICAL DATA ACQUISITION PLAN ADDENDA RECORD

Addendum Number	Transmittal	Issue Date	Addendum Number	Transmittal	Issue Date
1	Apply Pressure Sensitive Label Here After Updating Plan		8	Apply Pressure Sensitive Label Here After Updating Plan	
2	Apply Pressure Sensitive Label Here After Updating Plan		9	Apply Pressure Sensitive Label Here After Updating Plan	
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6	Apply Pressure Sensitive Label Here After Updating Plan		13	Apply Pressure Sensitive Label Here After Updating Plan	
7	Apply Pressure Sensitive Label Here After Updating Plan		14	Apply Pressure Sensitive Label Here After Updating Plan	

Instructions: The Addendum Number in the first column corresponds with the number of each CDAP Addendum issued. Remove the Addendum Record Label each time an Addendum is received and affix it to the corresponding box on this form, after updating the CDAP.

ADDENDA LIST

The Addenda List will be updated each time an addendum is issued. The Addenda List will list, by addendum and date, the revisions to the Plan.

REVISION LIST

The Revision List will be updated each time an addendum is issued. The Revision List will list the revisions by Plan and date; i.e., a separate list will be generated for the General Plan and any Attachment which has been revised.

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A	Lab Procedures
B	Equipment Calibration and Maintenance Procedures

LIST OF ATTACHMENTS

Attachment No.	Description
I	Site Specific Chemical Data Acquisition Plan Firefighter Training Area
II	Site Specific Chemical Data Acquisition Plan LARC Maintenance Area
III	Site Specific Chemical Data Acquisition Plan Auto Craft Building Area

LIST OF ABBREVIATIONS AND ACRONYMS

ACE	U.S. Army Corps of Engineers
ACNED	U.S. Army Corps of Engineers New England Division
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BARC	Barge amphibious resupply cargo
CDAP	Chemical Data Acquisition Plan
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFT	Code of Federal Regulations
CGI	Combustible gas indicator
CIH	Certified Industrial Hygienist
CLP	Contract Laboratory Program
CPR	Cardiopulmonary resuscitation
CPT	Cone penetrometer test
CRQL	Contract required quantitation limit
CRZ	Contamination reduction zone
CSHM	Corporate Safety and Health Manager
CSP	Certified Safety Professional
1,2-DCA	1,2-Dichloroethane
1,1-DCE	1,1-Dichloroethene
DEQ	Virginia Department of Environmental Quality
DI	Deionized
DMP	Data Management Plan
DNAPL	Dense non-aqueous phase liquid
DOD	Department of Defense
DOT	Department of Transportation
DPT	Direct push technology
DQCR	Daily Quality Control Report
DQO	Data quality objective
FID	Flame ionization detector
FIP	Field Investigation Plan
FS	Feasibility Study
FTA	Firefighter Training Area
FTP	Fire Training Pit
GC	Gas chromatograph
GSSHPP	General Site Safety and Health Plan
HTRW	Hazardous, Toxic and Radioactive Waste
I.D.	Inside diameter
IDLH	Immediately dangerous to life and health
IRP	Installation Restoration Program
JMM	James M. Montgomery, Inc.
LARC	Lighter amphibious resupply cargo
LEL	Lower explosive limit
LNAPL	Light non-aqueous phase liquid
LOTS	Logistics Over-the-Shore
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration

MS/MSD	Matrix spike/matrix spike duplicate
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric turbidity unit
OSHA	Occupational Safety and Health Administration
PA/SI	Preliminary Assessment/Site Investigation
PCB	Polychlorinated biphenyl
PE	Professional Engineer
PID	Photoionization detector
PPB	Parts per billion
PPE	Personal protective equipment
PPM	Parts per million
PVC	Polyvinyl chloride
QA/QC	Quality assurance/quality control
RI	Remedial Investigation
RPD	Relative percent difference
SCBA	Self contained breathing apparatus
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SSSHP	Site-specific Safety and Health Plan
SOP	Standard operating procedure
SOW	Scope of Work
TAL	Target Analyte List
TCA	1,1,1-Trichloroethane
TCL	Target Compound List
TEGD	Technical Enforcement Guidance Document
TPH	Total petroleum hydrocarbon
ug/L	Micrograms per liter
USAEHA	U.S. Army Environmental Hygiene Agency
USCG	U.S. Coast Guard
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
UST	Underground storage tank
VOA	Volatile organic aromatic
VOC	Volatile organic compound

1.0 PROJECT DESCRIPTION

1.1 PURPOSE

The purpose of this Chemical Data Acquisition Plan (CDAP) is to provide procedures for the collection, analysis and evaluation of environmental samples data for Hazardous, Toxic, and Radioactive Wastes (HTRW) projects at Fort Story, Virginia that will be legally and scientifically defensible. The CDAP addresses overall QA/QC issues, such as sampling protocols, sample handling and shipment, and laboratory standard operating procedures (SOPs). Site specific information is also provided to address issues specific to a site, such as sample locations, number of samples, analytical parameters and required QA/QC samples.

1.2 ORGANIZATION OF CHEMICAL DATA ACQUISITION PLAN

This plan is comprised of a general CDAP and site-specific CDAPs which are included as attachments to the General CDAP. The general CDAP addresses general base-wide information such as data quality objectives, field activities (i.e., equipment, containers, and supply requirements), sampling and preservation methods, field documentation, laboratory procedures and deliverables. The site-specific CDAPs discuss the site-specific protocols and procedures and sampling locations to be followed in the field.

1.3 FACILITY LOCATION AND DESCRIPTION

Fort Story is located in southeastern Virginia within the city of Virginia Beach, Virginia. Fort Story occupies an area of approximately 1,450 acres and is situated on Cape Henry which roughly divides the waters of the Chesapeake Bay to the north and the Atlantic Ocean to the east. Figure 1-1 provides the location of Fort Story.

Land features encountered at Fort Story consist of linear sand ridges, sand flats and wetland areas. The topography is dominated by a series of prominent linear, well-drained sand ridges that roughly bisect the Fort Story area. The central ridges trend parallel to the coastline and are characterized by maximum elevations in excess of 85 feet, National Geodetic Vertical Datum (NGVD) of 1929. A second series of sand ridges located on Fort

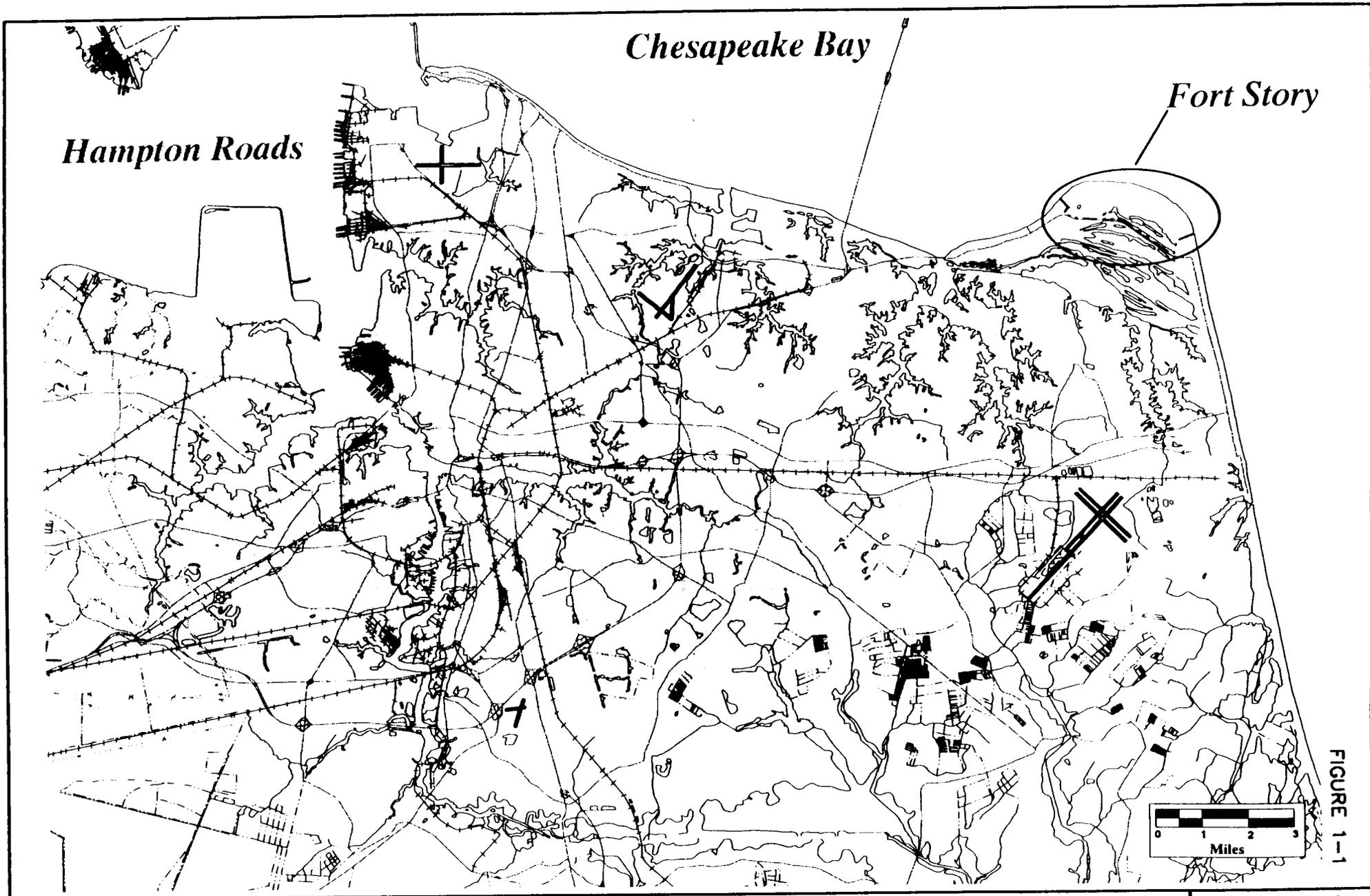


FIGURE 1-1

**MALCOLM
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FORT STORY, VIRGINIA
CHEMICAL DATA ACQUISITION PLAN
FORT STORY LOCATION MAP

MALCOLM PIRNIE, INC.

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Story are comprised of an active dune complex located adjacent to the coastline. The coastal sand ridges attain maximum elevation in excess of 25 feet NGVD. Broad, poorly drained sand flats are located adjacent to the sand ridge areas. Land surface elevations in the sand flat areas typically range between 5 and 10 feet, NGVD. Wetland areas, which are common features of the sand flats, occur locally in closed depressions. South of the central sand ridges, the Fort Story topography consists of an extensive wooded, wetland area, formerly a back-bay, lagoonal feature. Most of the installation's facilities and operations are confined to the sand ridge and sand flat areas.

The chief potable water supply in the region is the surface water reservoir system operated by the City of Norfolk. The system includes in-town lakes located near the Norfolk Airport and western reservoirs (Lake Prince, Western Branch, and Burnt Mills) located in Suffolk, Virginia. The in-town lakes are located over 5 miles from Fort Story while the western reservoirs are located over 20 miles from the facility. To a minor extent, potable water is obtained from groundwater sources located near these lakes and reservoirs. Based on these location of the reservoir system in relation to Fort Story, it is unlikely that impacts to Norfolk's potable water system could occur from on-site conditions. Groundwater use at Fort Story is restricted to withdrawal from a single well located at the Lighter Amphibious Resupply Cargo (LARC) maintenance area. The unavailability of construction data for this well precludes a determination of which aquifer unit provides the groundwater withdrawn from this well. Water is obtained from the well for nonpotable uses only.

The Virginia Department of Environmental Quality (DEQ), Division of Water, Tidewater Region, regulates wells in the region. Information obtained by Montgomery-Watson during performance of the PA/SI indicated that groundwater use is discouraged because of poor quality and withdrawal restrictions. High dissolved iron and manganese and total solids characterize the groundwater in the upper aquifers.

1.4 FACILITY HISTORY

Fort Story began as a military installation in 1914. On 10 March 1914, the Virginia General Assembly ceded 343.1 acres, located at Cape Henry in Princess Anne County, to the U.S. Government "to erect fortifications and for other military purposes." On 14 June 1914, the U.S. District Court acquired title for the land by condemnation proceedings against the Cape Henry Syndicate and other landowners in the Cape Henry subdivision.

War Department General Order No. 31, dated 24 July 1916, named this newly acquired tract of land Fort Story in honor of Major General John Patton Story.

Construction of powder magazines and projectile rooms got underway during the latter part of 1916 and by February 1917, construction of the 16-inch howitzer fortifications had begun. Also, during February 1917, the 2nd and 5th Coast Artillery Companies established the military garrison at Fort Story. From 1917 through 1925, the installation continued to develop as a small coast artillery garrison consisting of little more than its armament. The only land expansion which occurred during the period was the acquisition of 9.38 acres from the Norfolk and Southern Railway Company in March 1917.

During World War I, Fort Story was integrated into the Coast Defenses of Chesapeake Bay which included Fort Monroe (Headquarters) and Fort Wool (located at the east entrance of the Hampton Roads Bridge Tunnel). On 9 June 1925, Fort Story was designated a Harbor Defense Command by War Department General Order No. 13, but the change in designation added little to the dwindling post-war activity of the garrison.

As World War II approached, Fort Story began an extensive development. Many of the facilities which exist at Fort Story today were constructed then, and the installation increased in size to 1,439 acres. An additional 11.82 acres were acquired in 1963 which increased its size to its present 1,451 acres. In the 1940s, the construction included temporary artillery batteries, theater, chapel, fire station, mess halls, barracks, Officer and NCO clubs, shops, additional powder magazines and projectile rooms, six underground storage bunkers and 19 seacoast searchlights.

In December 1941, the Headquarters of the Harbor Defense Command was moved from Fort Monroe to Fort Story. Two harbor defense installations were added to the network in 1941; Fort John Curtis and a mine base. On March 1, 1944, the Chesapeake Bay sector of the Harbor Defenses was inactivated, and control passed to Headquarters, Southeastern Sector, Eastern Defense Command, Raleigh, North Carolina.

By September 1944, Fort Story began a transition from a heavily fortified coast artillery garrison to a convalescent hospital. At the time of its closing on 15 March 1946, the hospital had accommodated over 13,472 patients.

At the closing of World War II, Fort Story again changed missions. This time it assumed the role which it still has today, to train units and individuals for amphibious operations. Fort Story was officially transferred to the Transportation Corps in July 1948 as a subpost of the Transportation Training Command, Fort Eustis, Virginia.

Fort Story trains army personnel in amphibious and Logistics Over-the-Shore (LOTS) operations. Fort Story is the only available facility which has the necessary natural terrain features and beaches, sand, surf, variable tide conditions (bay and ocean) and hinterlands, all of which are normally experienced by amphibious and LOTS operations. In addition, Fort Story contains beach training areas, tactical training areas and a series of trails throughout the installation. The deep water ship anchorage, off-road driving areas and soil of sufficient bearing strength for the heavy vehicles are indispensable in amphibious training, LOTS training and the testing of new equipment, doctrines and techniques.

1.5 PREVIOUS INVESTIGATIONS

Numerous studies have been performed, by others, for various sites at the Fort Story. These studies include preliminary assessments/site investigations and removal actions. A discussion of the previous investigations are provided in Section 2.0 of the Field Investigation Plan.

2.0 CHEMICAL DATA QUALITY OBJECTIVES

2.1 PURPOSE

Data quality objectives (DQOs) are developed to achieve the level of data quality required for the anticipated data use and are implemented so, that for each task, the data is legally and scientifically defensible. The development of DQOs for a specific site and measurement takes into account project needs, data uses and needs, and data collection. These factors determine whether the quality and quantity of data are adequate for its end use. Sampling protocols have been developed and sample documentation and handling procedures have been identified to realize the required data quality.

Analytical DQO levels have been established by USEPA in Data Quality Objectives for Remedial Response Actions, USEPA/540/G-87/003, March 1987. These levels are described below.

- **Level V. Non-standard Methods.** Analyses which may require method modification and/or development.
- **Level IV. Contract Laboratory Program (CLP) Routine Analytical Services.** This level is characterized by rigorous QA/QC protocols and documentation and provides qualitative and quantitative analytical data.
- **Level III. Laboratory analyses using methods other than the CLP Routine Analytical Services.** This level is used primarily in support of engineering studies using standard EPA approved procedures. Some procedures may be equivalent to CLP Routine Analytical Services, without the CLP requirements for documentation.
- **Level II. Field analysis.** This level is characterized by the use of portable analytical instruments which can be used on-site, or in mobile laboratories stationed near a site (close-support labs). Depending upon the types of contaminants, sample matrix, and personnel skills, qualitative and quantitative data can be obtained.
- **Level I. Field screening.** This level is characterized by the use of portable instruments which can provide real-time data to assist in the optimization of sampling point locations and for health and safety support. Data can be generated regarding the presence or absence of certain contaminants (especially volatiles) at sampling locations.

2.2 SITE DATA QUALITY OBJECTIVES

The DQO levels for samples collected at the project sites will be Level I for field screening (e.g., HNu readings), Level II for on-site portable GC analysis and Level III for chemical analyses. Modified EPA 8010 methodology will be used by the on-site GC to identify and quantify chlorinated volatile organic compounds while modified EPA 8020 methodology will be used for petroleum and other non-halogenated compounds. Chemical analyses will be for Target Compound List (TCL)/Target Analyte List (TAL) compounds, unless otherwise noted. Methodologies to be used include SW-846 6010 for TAL metals, SW-846 9010 for TAL Cyanide, SW-846 8240 for TCL volatiles, SW-846 8270 for TCL semivolatiles, and modified EPA 8015 for total petroleum hydrocarbons. Level III data, combined with Quality Assurance monitoring by the U.S. Army Corps of Engineers (ACE), will result in the desired data quality and confidence to support decisions regarding each site.

The objective of the laboratory analytical quality control program is to provide data of acceptable quality. The DQOs for accuracy, precision, completeness, representativeness and comparability are as follows:

- **Accuracy** is the degree of agreement of a measurement with an accepted reference or true value. This objective is to meet or exceed the demonstrated accuracy for the analytical methods on similar samples, and should be within established control limits for the methods.
- **Precision** is a measure of mutual agreement among individual measurements of the same property, usually under prescribed conditions. The objective for precision is to equal or exceed the precision demonstrated for similar samples, and should be with the established control limits for the methods.
- **Completeness** is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The objective is to generate a sufficient database with which to make informed decisions. Completeness should exceed 90 percent.

- **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. The objective of obtaining representativeness of samples will be met through the implementation of the work plan and CDAP.
- **Comparability** expresses the confidence with which one data set can be compared to another. This objective will be met by using standard methods for sampling procedures and analyses and by following techniques and methods set forth in the project specific work plan and CDAP.
- **Sensitivity** is a measure of a method's detection limit and ability to distinguish between two values. The sensitivity and detection limits of a method will be reviewed to determine a methods's applicability.

The objective of the on-site GC screening quality control program is to provide data of acceptable quality. The DQOs for accuracy, precision and representativeness are as follows:

- **Accuracy.** Accuracy will be determined by the analysis of lab blanks, check standards and matrix spikes. Retention times of the compounds in the standards are used to identify the unknown compounds in field samples, and their response factors are used in calculating actual concentrations. Accuracy will be estimated by comparing of measured check standard concentrations of each analyte with known concentrations in the stock standard and comparing the results of duplicate analyses. Matrix spikes will be used to determine the effect of the matrix on the analyte recovery. The percent recovery must be within 50 to 150 percent. The data quality objective with respect to field and lab blanks is to achieve analytical concentrations below the quantification limit for all analytes. Lab blanks will be analyzed after every tenth sample. Check standards will be run at the beginning of the day and at the end of the day. Replicate analyses will be performed on at least every tenth field sample. Matrix spikes will be performed on every twentieth field sample. In addition, equipment reinsate blanks will be collected and analyzed at the beginning and end of each day.
- **Precision.** Precision will be assessed by the comparison of replicate analyses. A replicate analysis will be conducted on every tenth sample (10 percent). The variation between replicate analysis must be equal to or less than 20 percent.
- **Representativeness.** Representativeness of data collection should be addressed by careful preparation of the sampling program. A sufficient number, frequency and location of samples, must be chosen to assure that sample data accurately and precisely represent selected characteristics of the samples.

DQOs will be attained through sound chemical quality management, achieved through the implementation of the Chemical Data Acquisition Plan (CDAP) during sampling and characterization activities. The CDAP is in accordance with ACE document ER-1110-1-263, particularly Appendix E; Sample Handling Protocol for Low, Medium and High Concentration samples of Hazardous Waste; and applicable EPA, and DOT standards and regulations.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

3.1 PROJECT ORGANIZATION

The Malcolm Pirnie organizational structure for this project is shown on Figure 3-1. Steve Cho of the U.S. Army Corps of Engineers (ACE) is the ACE Project Manager, in charge of providing technical direction and monitoring the technical performance of Malcolm Pirnie, Inc.

From Malcolm Pirnie, Inc., Paul L. Busch, President, is the Senior Company Officer and Phillip K. Feeney, Vice President, is the Officer providing overall project direction. Richard P. Brownell, Vice President, is the Officer providing technical direction and review.

The Project Manager from Malcolm Pirnie, Inc., is Franco E. Godoy, Associate, specializing in hazardous waste investigations and remediation. Mary K. Mullen is the field manager, responsible for implementing the field investigations. Health and safety and quality assurance will be the responsibility of Scott A. Bailey and Anthony K. Pace, respectively.

Project personnel will be drawn from Malcolm Pirnie, Inc. irrespective of group or locational assignment. The project personnel are selected on the basis of appropriate skills, experience and availability. For purposes of this project, tasks and subtasks will be assigned to Task Managers. Personnel working on specific tasks will report on a daily basis to their respective Task Managers. Task Managers, in turn, will work under the daily direction of the Project Manager.

The project personnel responsibilities are summarized below. Information regarding the laboratory qualifications is provided in Section 3.2.

Senior Company Officer: Paul L. Busch, Ph.D., President, is the Senior Company Officer at the top of the QA/QC chain of command. He interfaces with the Project Officer on QA/QC issues for the project.

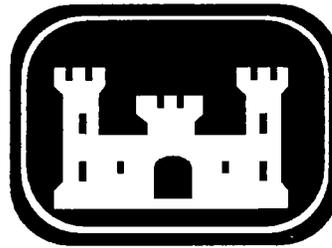
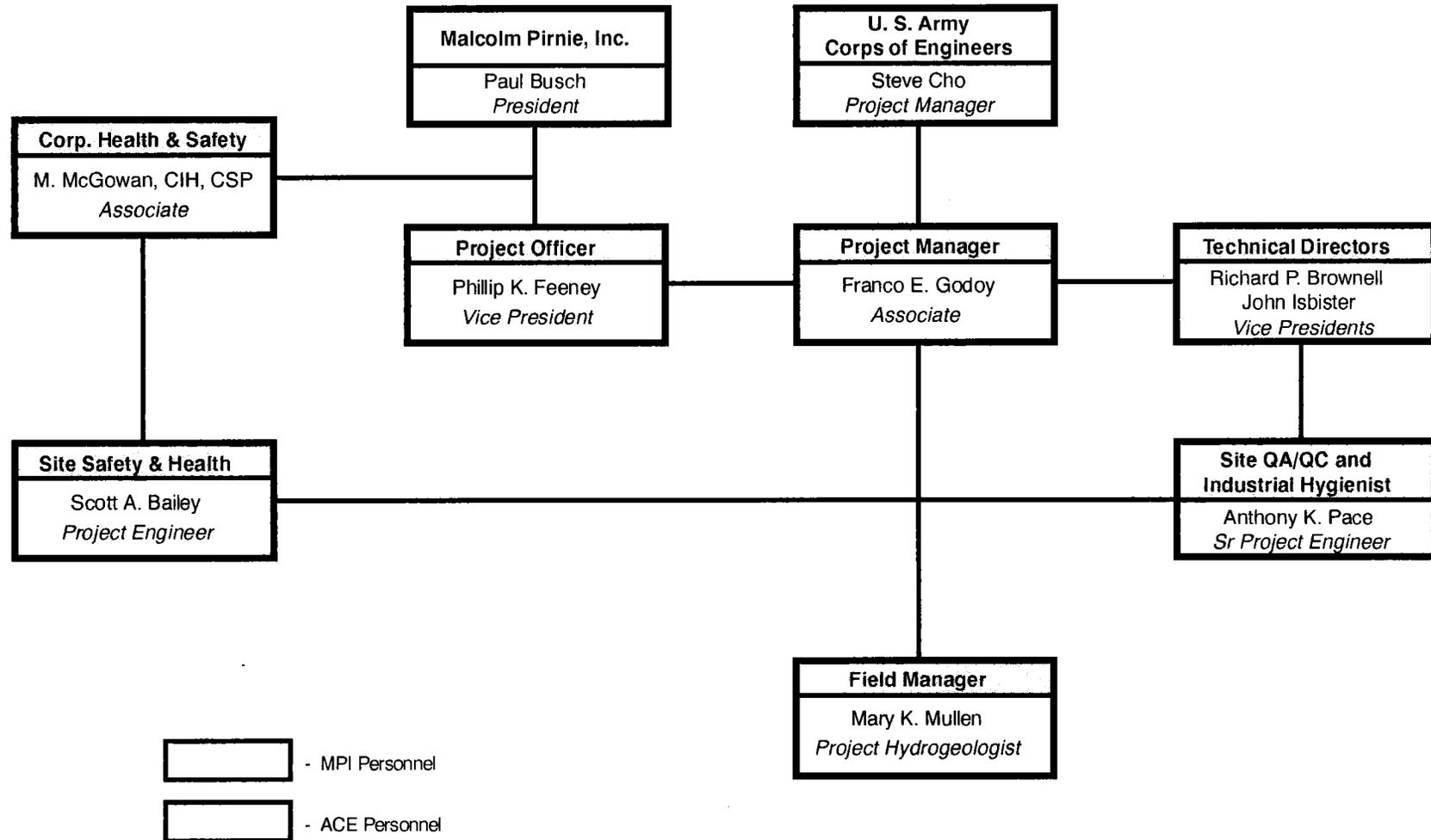


FIGURE 3-1
ORGANIZATIONAL CHART



Project Officer: The Project Officer is the representative of Malcolm Pirnie with contract authority. The Project Officer is responsible for the commitment of the resources required to fulfill Malcolm Pirnie's obligation to the ACE. The Project Officer is accountable to both the ACE and Malcolm Pirnie's President.

Technical Director: The Technical Director provides guidance on technical matters and reviews all technical documents relating to the project. The Technical Director may delegate technical guidance to specially trained individuals under his direction.

Project Manager: The Project Manager is accountable to the Project Officer throughout the duration of the project, and utilizes the Technical Director for any technical assistance. The Manager may delegate authority to expedite and facilitate the implementation of the project plan. The Project Manager is responsible for:

- Coordination with ACE,
- Budget control,
- Subcontractor performance,
- Project coordination to implement Work Plan,
- Allocation of resources and staffing to implement the QA/QC program,
- Allocation of resources and staffing to implement the Site Safety and Health Plan (SSHP), and
- Review of engineering and interim reports.

Corporate Health and Safety Manager: The Corporate Health and Safety Manager, Mark A. McGowan, serves as the administrator of Malcolm Pirnie's Corporate Health and Safety program. He is accountable directly to Malcolm Pirnie's President for project health and safety concerns and is responsible for:

- Administering OSHA and DOT compliance training for Malcolm Pirnie field personnel.
- Administering the medical surveillance program.

- Ensuring field personnel having adequate experience with personal protective equipment.
- Providing guidance on data interpretation.
- Reviewing proposed levels of worker protection.

Task Managers: Various Task Managers will provide technical support to the Project Manager for implementation of the Work Plan relative to their respective tasks and have the following responsibilities:

- Preparing task reports and outlining field investigation requirements
- Reviewing daily reports and field notebooks
- Task scheduling
- Task budget management
- Task Work Plan coordination
- Data validation

Project Quality Control Officer: The Project QC Officer is responsible for project specific supervision and monitoring of the QC program and reports to the Technical Director. Additional responsibilities include:

- Ensuring that field personnel are familiar with and adhere to proper sampling procedures, field measurement techniques, and sample identification and chain-of-custody procedures.
- Coordinating with the analytical laboratory for the receipt of samples, the reporting of analytical results and recommending corrective actions to correct deficiencies in the analytical protocol or sampling.
- Preparing QC reports to management.

Site Field Manager: The Site Field Manager will serve as the on-site contact person for Malcolm Pirnie for field investigations and tests. The coordinator will be responsible for the logistics of the field activities. The Field Manager will:

- Inspect and replace equipment
- Prepare daily and interim reports
- Prepare samples for shipment
- Coordinate field activities
- Schedule sampling and other field activities

Site Safety and Health Officer: The Site Safety and Health Officer (SSHO) is responsible for ensuring that the field activities are carried out in accordance with the SSHP. The SSHO will provide technical assistance to the Project Manager and field personnel to help assure site safety. In addition, the SSHO will:

- Monitor field activities
- Monitor personal exposure to chemical toxins
- Develop emergency response procedures
- Monitor for temperature stress
- Establish personnel and equipment decontamination procedures
- Stop work in the event unsafe work conditions are encountered

Field Sampling Team: Field sampling teams will be provided by Malcolm Pirnie, Inc. Personnel will follow the procedures described in the following sections to assure consistency in sample collection.

3.2 LABORATORY QUALIFICATIONS

Savannah Laboratories & Environmental Services, Inc. will perform chemical analyses of environmental samples collected at the project site. The primary laboratory is located in Savannah, Georgia with an alternate laboratory in Tallahassee, Florida. The laboratory facilities are capable of providing complete environmental analytical services consistent with USEPA protocols and has been validated by the ACE. A copy of the validation letter is provided in Appendix A. Detailed information regarding the laboratory facilities and procedures is also presented in Appendix A.

4.0 FIELD ACTIVITIES

This section discusses the general requirements and procedures for the field investigations including equipment and sample container requirements and general sampling and preservation methods.

4.1 FIELD EQUIPMENT, CONTAINERS AND SUPPLIES

A list of field equipment that may be used for sample collection is presented in Table 4-1. Specific equipment to be used at each site is discussed in the attachments. Required field supplies for a particular sampling techniques are provided in each of the sampling procedures subsections. Required containers by analyte and matrix are listed in Table 4-2. Sample containers will be certified pre-cleaned.

To avoid cross-contamination of samples, equipment used in sampling must be clean and free from the residue of previous samples. Non-dedicated sampling equipment must be cleaned initially and prior to being reused. The following is the procedure for decontamination and does not apply to heavy equipment or drilling equipment, with the exception of split spoon samplers.

- Wash and scrub with low phosphate, laboratory grade detergent
- Tap water rinse
- Methanol rinse (For oil-contaminated soils, hexane rinse followed by methanol rinse)
- Thorough rinse with deionized demonstrated analyte-free water
- Dilute nitric acid rinse (when metals analysis is to be conducted)
- Air dry
- Wrap in aluminum foil for transport

Heavy equipment and drilling equipment will be steam cleaned in a predesignated location prior to use and between locations. Well casings and screens will also be steam cleaned.

TABLE 4-1

FIELD EQUIPMENT REQUIREMENTS

Field Analytical Equipment:

- pH Meter - Orion Model 230A
- Explosimeter - MSA Model 62S
- Photovac PID - Microtip HL-200 or HL-2000
- Specific Conductance and Temperature Meter - YSI Model 33
- Electronic water level indicator

Field Sample Collection Devices:

- 2" Disposable teflon bailers
- Stainless steel hand augers
- Stainless steel scoops
- Stainless steel bowls and spoons
- Glass Beaker or Dipper
- Portable Filtering System

Decontamination Solutions:

- Deionized demonstrated analyte-free water
- Non-phosphate laboratory grade detergent
- Methanol
- Dilute nitric acid

Sample Collection Containers:

- Pre-cleaned glass jars and vials, equipped with teflon-lined lids

TABLE 4-2

SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

ANALYSIS	CONTAINER	PRESERVATION	HOLDING TIME
SOIL AND SEDIMENT			
TAL Metals	8 ounce glass	4 C	6 months
TAL Mercury	4 ounce glass	4 C	28 days
TAL Cyanide	4 ounce glass	4 C	14 days
TCL Volatiles	2 - 40 ml glass vials with septa caps	4 C	14 days
TCL Semivolatiles	8 ounce glass	4 C	14 days/40 days ⁽¹⁾
TPH Heavy/Light	2 - 8 ounce glass	4 C	28 days
GROUNDWATER AND SURFACE WATER			
TAL Metals	1 liter plastic	HNO ₃ to pH < 2	6 months
TAL Mercury	1 liter plastic	HNO ₃ to pH < 2	28 days
TAL Cyanide	1 liter plastic	NaOH to pH > 12, 4 C	14 days
TCL Volatiles	2 - 40 ml glass vials with septa caps	4 drops HCl or NaHSO ₄ to pH < 2, 4 C	14 days
TCL Semivolatiles	2 - 1 liter amber glass	4 C	7 days/40 days ⁽²⁾
TPH Heavy/Light	2 - 1 liter amber glass	4 C, HCl to pH < 2	28 days

Notes:

- (1) 14 days/40 days - Holding times are 14 days for extraction and 40 days for analysis.
(2) 7 days/40 days - Holding times are 7 days for extraction and 40 days for analysis.

Well evacuation tubing and equipment such as submersible pumps and screened augers which are put into the borehole will be decontaminated by thoroughly washing internal and external surfaces with low-phosphate, laboratory grade detergent and rinsing with deionized demonstrated analyte-free water prior to use.

If oil-contaminated soils are encountered, sampling equipment will be steam-cleaned prior to performing the decontamination procedures outlined above or be dedicated and disposed of after use.

Field instrumentation should be cleaned according to manufacturer's instructions. Probes, such as those used in pH and conductivity meters, and thermometers must be rinsed prior to and after use with deionized water.

4.2 GENERAL INFORMATION AND DEFINITIONS

Field Sample - The total sample collected at a specific site location. This sample may be any matrix and may be divided to provide material for quality assurance/quality control (QA/QC) analysis.

Quality Control (QC) Samples - Samples analyzed to help identify potential problems related to sample collection or analysis. QC samples include replicate and split samples, trip blanks, rinsate blanks and filtration blanks. QC replicates/splits shall be approximately 10 percent of the field samples.

Quality Assurance (QA) Samples - Split samples sent to U.S. Army Corps of Engineers New England Division (CENED) laboratory for analysis to evaluate the contractor laboratory performance. QA samples represent approximately 10 percent of the field samples.

Matrix Spike/Matrix Spike Duplicates - Aqueous VOA and extractable organic samples collected at three times their standard volume at the frequency of approximately five percent (5%) of the field samples. After sample analysis, the additional sample volume is spiked with a known quantity and quality and reanalyzed. The percent recovery will be used to calculate accuracy. The relative percent difference (RPD) for each component will be used to calculate precision.

Split Samples - Samples collected as a single sample, homogenized, divided into two or more equal parts and placed into separate containers. The sample shall be split in the field prior to delivery to the laboratory. Split samples will be taken at a frequency of at least 10 percent per matrix.

Replicate (duplicate, triplicate, etc.) Samples - Multiple grab samples, collected separately, that equally represent a medium at a given time and location. This is the type of co-located sample required for volatile organic analyses and most ground water and surface water samples. Replicate samples will be taken at a frequency of 10 percent per matrix.

Filtration Blank - When ground water samples are filtered before analysis, a filtration blank shall be taken at a rate of 10 percent of the total samples. Deionized water is run through the filter and submitted as a blank sample to assess the potential for contamination by the filter/filtration process.

Field Rinse Blank - Samples collected from a final rinse of sampling equipment with deionized demonstrated analyte-free water after the decontamination procedure has been performed. The purpose of the field rinse blank is to determine whether the sampling equipment is causing cross-contamination of samples. The frequency of field blank collection is dependent on the number of decontamination events, i.e., one field blank per decontamination event per equipment type. The number of field blanks should not exceed one per day. Field blanks must be preserved in the same manner as aqueous environmental samples.

Trip Blank - 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 to the laboratory. The purpose of the trip blank is to assess the potential of sample contamination during transit or sample collection. Trip blanks are only required to accompany aqueous VOC samples, and will be analyzed with the associated VOC samples. Each cooler containing aqueous VOC samples for shipment to the laboratory will have a trip blank packed and sent with the cooler. Because trip blanks are used for volatile organic analyses, the containers must contain no headspace.

Deionized Demonstrated Analyte-Free Water - Deionized demonstrated analyte-free (DI) water is water of a known quality which has been demonstrated through analysis not to possess any contaminants of concern at levels greater than the CLP contract required quantitation limits (CRQLs), as defined in the current CLP Statements of Work (SOW). DI water is used in the final rinse step of decontamination and in the preparation of field rinsate blanks.

4.3 SAMPLING AND PRESERVATION METHODS

Data quality depends, in part, on proper collection and preservation to guarantee representativeness. Unless otherwise stated, the order of sample collection will be:

1. In-situ measurements
2. Volatile organic compounds (VOCs)
3. Extractable organics: semi-volatiles and pesticides/PCBs
4. Total metals, geotechnical parameters, etc.

Samples will be immediately placed in a cooler and held at 4°C. Disposable gloves will be worn by the sampling personnel and changed between sampling points. The information presented in Section 4.4 shall be recorded in the field logbook at the time of sampling.

Sampling equipment will be decontaminated as discussed in Section 4.1. While performing any equipment decontamination, phthalate-free gloves (neoprene or natural rubber) will be worn in order to prevent phthalate contamination of the sampling equipment by interaction between the gloves and the organic solvent(s).

Each sampling location shall be marked with a stake and labelled with the sample ID.

4.3.1 Sediment and Surface Water Sampling

4.3.1.1 Sampling Equipment

- pH, dissolved oxygen, temperature, and specific conductivity meters

- Photoionization Detector (PID) or Flame Ionization Detector (FID)
- Stainless steel spatula
- Roll of polyethylene sheeting or aluminum foil
- Glass beaker
- Stainless steel dipper
- Modified piston-type sampler
- Stainless steel bowls

4.3.1.2 Sampling Procedures - Surface Water Samples

The surface water samples shall be collected prior to the sediment samples and in approximately the same locations as the proposed sediment samples. Collecting the samples before the sediment samples helps to avoid collecting suspended sediments in the surface water samples. The samples shall be collected in a downstream-to-upstream order. If the water is sufficiently deep, collect the sample with the sample container. Otherwise, collect the sample with a dipper or beaker. If the exterior of sample bottles become grossly contaminated during sample collection due to highly contaminated surface waters, the exterior of the bottles will be washed down with low phosphate, laboratory grade detergent and rinsed with deionized water after the bottles have been capped and before placing the samples in the cooler for shipment.

Samples should be preserved in the field immediately following sample collection. All required preservatives will be specified by the particular analytical method to be used. When an aqueous sample requires pH adjustment, the following procedure shall be followed:

1. An extra volume of sample, in the same size sample jar, shall be obtained.
2. Determine the number of drops of preservative required to adjust the pH of the equal volume of water to the desired pH.
3. Adjust the pH of the sample by carefully adding, drop by drop, the quantity of preservative determined in Step 2.

If acidification of the sample causes effervescence, the sample should be submitted without pH adjustment, but should be cooled to 4°C.

Sample Container Collection Procedure:

1. Stand downstream of the sampling location.
2. Submerge the sample container with its opening facing upstream, making sure to avoid any floating or submerged debris.
3. When sampling for volatile organics, after the container is full and while it is still submerged, cap the sample container. Otherwise, the container may be capped after it is removed from the water.

Dipper or Beaker Collection Procedure:

1. Submerge a precleaned stainless steel dipper or glass beaker with minimal surface disturbance.
2. Allow the device to fill slowly and continuously.
3. Retrieve the dipper/beaker from the surface water with minimal disturbance.
4. Remove the cap from the sample bottle and slightly tilt the mouth of the bottle below the dipper/beaker edge.
5. Empty the dipper/beaker slowly, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence.

Field Observations: At each surface water sampling location record estimated flow velocity, odor, pH, dissolved oxygen content, temperature, specific conductivity, and approximate water depth in addition to the information presented in Section 4.4.

4.3.13 Sampling Procedures - Sediment Samples

1. Sediment samples shall be collected in downstream-to-upstream order.
2. Samples from areas with shallow water (depths less than 4 feet) will be collected using a modified piston-type sampler equipped with disposable aluminum tubes measuring 5 inches in diameter and 40 inches in length.

3. Samples from areas with deep water (depths greater than 4 feet) will be collected using a modified piston-type sampler, a boat/raft mounted vibratory corer, or other appropriate methods determined by field conditions.
4. After collecting the sediment, lay the sampling device on a piece of polyethylene sheeting or aluminum foil.
5. Sediment samples requiring volatile organic analysis will be immediately placed into two 40 ml VOA vials and placed in a cooler at 4°C. Volatile sample fractions are not homogenized.
6. After collecting the VOA sample, the physical characteristics of each sample will be described in the field logbook and the sample will be homogenized in accordance with the procedure described in Section 4.3.2.2. The sample will be transferred to certified pre-cleaned jars and will be sent to the laboratory for analysis.

Field Observations: The physical characteristics of each core, including the difference between penetration (as evidence by material adhering to the core barrel) and recovery for each sample, will be described in the field logbook, in addition to the information presented in Section 4.4.

4.3.2 Surface Soil Sampling

4.3.2.1 Sampling Equipment

- Stainless steel hand auger or stainless steel scoop
- Roll of polyethylene sheeting
- Stainless steel bowl
- Stainless steel spoon
- PID or FID.

4.3.2.2 Sampling Procedures

1. Clear the surface debris (e.g., rocks, twigs, grass) from the sampling location.
2. Semi-volatile and inorganic aliquots of the surface soil samples will be collected from the upper six inches (6") of soil using a stainless steel scoop, trowel or hand auger and homogenized as described below.

3. Volatile organic aliquots of the surface soils will be collected from a depth of approximately six to twelve inches (6" - 12") below the ground surface. The volatile organic samples will be collected directly from the sampling device, with no homogenization, tightly packed into VOA vials, avoiding air spaces, and immediately stored at 4°C.
4. Each of the sample locations will be screened using a PID or FID and the results recorded.

Soil Sample Homogenization:

1. Remove rocks, twigs, leaves and other debris if they are not considered part of the sample.
2. Remove the soil from the sampling device, place it in a stainless steel pan, and thoroughly mix using a stainless steel spoon. The sediment in the pan should be scraped from the sides and bottom of the pan, rolled to the middle of the pan and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample should be mixed individually and then rolled to the center of the container and the entire sample mixed again.
3. The sample will then be transferred to the appropriate sample containers.

Field Observations: At each sampling location, the information presented in Section 4.4, a soil description and the PID or FID readings will be recorded in the field log book.

4.3.3 Groundwater Sampling

4.3.3.1 Sampling Equipment

- Electric water level indicator and spare battery
- Interface probe
- Submersible pump (of appropriate dimensions and power)
- Polyethylene or nalgene tubing
- Generator
- Bailer and bailer cord
- Teflon-coated leader

- Temperature, pH (with buffer solutions), dissolved oxygen, specific conductivity and turbidity meters (and spare batteries)
- PID or FID
- Explosimeter
- Roll of polyethylene sheeting, paper towels, chemwipes
- Well keys
- Well location map
- Trip blanks
- Sample containers
- Cooler and shipping packaging
- Preservatives
- Field tools (pipe wrench, hammer, chisel, hack saw, etc.)
- Chain-of-Custody forms
- Field notebook
- Buckets (5 gallon capacity)
- Personal protection equipment
- Project CDAP, FIP (tables of sample holding times, preservatives and analyte order of collection)

The submersible pump will be water cooled and constructed of stainless steel. Neoprene, PVC, Tygon, silicone rubber or viton will not be used in the pump construction.

4.3.3.2 Sampling Procedures

1. A piece of polyethylene sheeting will be fitted over the monitoring well and laid on the ground. The sampling equipment will be placed on the polyethylene sheeting. The well cap will be removed, and the concentration of volatile organic vapors and explosive gases emanating from the well will be measured with a PID or FID, and explosimeter. This step may be modified as needed in those wells which have already demonstrated in the previous rounds of water

level measurement that they contain no or insignificant amounts of vapors or gases.

2. The water volume in the boring will be calculated using the following equations or by using the table below (based on well construction with Schedule 40 PVC):

$$V_1 = \pi(D_1/2)^2 H_1$$

$$V_2 = N\pi H_2(D_3/2)^2 - (D_2/2)^2$$

$$V_1 + V_2 = \text{Volume of Water}$$

where:

- V_1 = volume of water in well casing (ft³)
- V_2 = volume of water in filter pack (ft³)
- H_1 = height of water column (ft)
- H_2 = saturated length of filter pack or the height of the water column in water table wells (ft)
- N = porosity of filter pack
- D_1 = casing internal diameter (ft)
- D_2 = casing outside diameter (ft)
- D_3 = diameter of borehole (ft)

Calculation of Purge Volume

$$\text{Purge Volume} = V_1 + V_2$$

Calculation of V_1 ; Volume of Water in Well

$$V_1 = V_s H_1$$

where:

- V_1 = volume of water in well
- V_s = volume conversion factor from table below (gal/lf)
- H_1 = height of water in well casing (ft)

VOLUME OF WATER IN WELL			
Diameter (in)	O.D. (in)	I.D. (in)	Volume gal/lf (V_a)
1½	1.660	1.380	0.08
2	2.375	2.067	0.17
3	3.600	3.068	0.38
4	4.500	4.026	0.66
6	6.625	6.065	1.5
8	8.625	7.981	2.6
12	12.750	11.938	5.81

Calculation of V_2 ; Volume of Water in Annulus

$$V_2 = V_b H_1$$

where:

V_2 = volume of water in Annulus

V_b = volume conversion factor from table below (gal/lf)

H_1 = height of water volume in watertable or saturated length of filter pack in Annulus

VOLUME OF OPEN BOREHOLE AND ANNULUS BETWEEN CASING AND HOLE ⁽¹⁾⁽²⁾ (V_2)					
Hole Diameter (in)	Volume/Linear Ft. of Hole		Nominal Casing Diameter (in)	(V_2) Volume/LF of Annulus	
	Gal.	Cu.Ft.		Gal.	Cu.Ft.
7¼	2.14	.29	1¼	2.03	0.27
7¼	2.14	.29	2	1.91	0.26
7¾	2.45	.33	2	2.22	0.30
8¼	2.76	.37	2	2.55	0.34
10¼	4.29	.57	2	4.06	0.54
8¼	2.78	.37	3	2.28	0.30
10¼	4.29	.57	3	3.79	0.51
12¼	6.13	.82	3	5.62	0.75
8¼	2.76	.37	4	1.95	0.26
10¼	4.29	.57	4	3.46	0.46
12¼	6.13	.82	4	5.30	0.71
12¼	6.13	.82	6	4.33	0.58

Notes:

- (1) For wells constructed of Schedule 40 PVC pipe.
- (2) This method does not incorporate porosity (N) of sand pack.

In calculating the water volume be careful to keep the units consistent; i.e., make sure the diameters and the length are all measured in feet. To convert cubic feet into gallons, multiply the number of cubic feet by 7.4805. (Note: a two-inch bailer holds approximately one liter or 0.26 gallons.)

- 3. The monitoring wells will be purged with either a two-inch diameter stainless steel submersible pump, centrifugal pump, or stainless steel or teflon bailer. If the water level is greater than 25 feet below ground surface, a submersible pump shall be used; if the water level is less than 25 feet below ground surface, a centrifugal pump or bailer shall be used. A bailer can be used to purge the well when a pump is not available.

Field measurements of pH, dissolved oxygen, specific conductance, temperature and water level will be made in each well prior to, during, and after purging (just before sampling). pH, dissolved oxygen, specific conductance, and temperature should be measured during purging at 10, 30, 50, and 80 percent of purge volume. Readings should be made more frequently after removal of 80 percent of the purge volume. Both the pH and the specific conductivity meters will be calibrated for water temperature before each sampling round.

Each well will be purged of a total of three to five volumes of water or more if required for stabilization of field parameters. Stabilization of field parameters is defined as less than 10 percent variation for turbidity, temperature, conductivity, pH and temperature over the purge volume. All steps possible (adjustment to flowrates) will be taken to prevent the monitoring well from purging to dryness. When the field parameters have stabilized, the volume of water will be recorded, and, within two hours of purging, the well will be sampled.

- 3a. Purging Well with a Submersible Pump - New dedicated polyethylene tubing will be attached to the submersible pump, which will be decontaminated between well locations, as described in Section 4.1. The pump will be lowered into the well to the top of the water column. The well will be purged from the top of the water column at a pumping rate that is less than that used for well development to prevent excessive siltation.
- 3b. Purging Well with a Centrifugal Pump - Centrifugal pumps are used at the ground surface with clean, new polyethylene tubing inserted into the well. The tubing should be fitted with a foot valve to avoid having aerated water fall back into the well. The well will be purged from the top of the water column. Following purging, the pump casing should be rinsed with tap then distilled water and the tubing replaced.

- 3c. **Purging Well with Bailer** - Either a two-inch dedicated or decontaminated PVC or decontaminated stainless steel bailer will be used. Using a teflon coated bailer cord, the bailer shall be slowly lowered into the well cautiously to avoid aerating the well. Lower the bailer to a level opposite the well screen and pull up the cord to set the check valve. Once retrieved, the water should be transferred into a container to measure the volume being evacuated.
4. **Groundwater Sample Collection with Bailer** - A teflon, two-inch bailer with a teflon coated leader, at least five feet in length, attached between the bailer and the bailer cord, will be cautiously lowered into the well. The bailer will be retrieved, and the sample will be transferred to the appropriate sample containers. The two 40-ml VOA vials will be filled first, leaving no head space or air bubbles. All other sample bottles will be filled such that some headspace remains in the bottle.

If dense non-aqueous phase liquids (DNAPL) are present, as detected by the visual inspection on split-spoon samples during drilling or inspection of the well with an interface probe, point source and double check valve bailers will be employed to collect samples. Stainless steel bailers will be used whenever product (DNAPL or LNAPL) or high concentrations of solvents are present.

5. **Groundwater samples requiring filtration** will be transferred from the sampling device (bailer) into the sample containers via a vacuum filter system. The unfiltered water will be drawn through a 0.45 micron filter by the vacuum and will accumulate in a receiving container. Upon completion of filtering each sample, the tubing and filter membrane will be disposed.

Field Observations: Data to be recorded in the field logbook will include the information presented in Section 4.4, PID or FID and explosimeter readings, and the data below.

ITEMS TO BE DOCUMENTED IN FIELD NOTEBOOK

Identities and responsibilities of sampling team members
Purpose of sampling (e.g., surveillance, compliance, etc.)
Name and location/address of sampling project
Location references (maps, photographs, etc.)
Type of site (landfill, underground storage tanks, etc.)
Name and address of field contact
Declared waste components and concentrations (if available)
Well data (well depth, depth of water, well construction material, etc.)
Purging data (type of equipment, volume removed, rate of removal)
Purging parameters (changes in temperature, Eh, pH, and specific conductance during purging)
Sampling device

Field-measured parameters for sample (temperature, Eh, pH, dissolved oxygen, specific conductance, etc., obtained during purging)
Sample appearance (color, turbidity, oils)
Sample odors, if noticed
Sample containers (type, size, and number; field identification numbers)
Sample filtration, if any (method, filter pore size)
Preservatives, if any (type and in which sample bottles)
Thermal preservation (e.g., transportation in an ice chest)
Pertinent field observations (e.g., bent well, odor in the air, etc.)
Deviations from established sampling protocol (including problems encountered, such as malfunctioning equipment)
Other quality control measures such as decontamination of equipment and collection of field blanks

4.3.4 Split-Spoon Soil Sampling

4.3.4.1 Sampling Equipment

- PID or FID
- Drill rig
- Roll of polyethylene sheeting
- Stainless steel spatula or spoon
- Stainless steel bowl
- Aluminum foil

4.3.4.2 Sampling Procedures

1. Split-spoon soil samples will be collected from soil borings drilled using stainless steel split-spoons by ASTM Standard D 1586-84.
2. After a sample is collected, the split-spoon sampling tool will be opened and laid on a piece of clean polyethylene sheeting, and the soil cut along its length into two equal halves.
3. The field staff will screen the sample for organic vapors by passing the probe of a PID or FID over the length of the sample.
4. Soil samples will be removed from the central, least disturbed portion of soil contained within the sampler using a stainless steel spatula or spoon.

5. Soil samples for volatile organic analysis will be immediately placed in two 40 ml vials and placed in a cooler at 4°C and held for laboratory analysis.
6. Prior to homogenizing the remaining sample volume, a representative sample will be transferred to glass jars which will be labelled with the job name, date, and boring and sample identification number. The jars will be sealed with aluminum foil, capped and allowed to stand for one-half hour in order to allow time for any gases to accumulate in the jar head space. One-half hour after the soil sample has been collected, the head space in the jar will be monitored using the PID or FID.
7. The remaining soil will be homogenized and placed in the appropriate jars for analysis.
8. Soils will be visually classified according to the Unified Soils Classification System.

Field Observations: Data to be recorded in the field log will include the information contained in Section 4.4 and method of drilling and sample acquisition, blow counts, soil description and PID or FID readings. Additionally, borings will be logged on standard ACE borehole logs in accordance with ACE protocols.

4.3.5 Drum Sampling

4.3.5.1 Sampling Equipment

- PID or FID
- Non-sparking drum opening tools
- Clear sampling tube, Coliwasa, and/or stratified sample thief
- pH paper

4.3.5.2 Sampling Procedures

1. The drum opening area will be physically separated by a minimum of 25 feet from drum removal and drum staging operations in order to prevent a possible explosive or chemical chain reaction.
2. The drum bung or lid will be opened using non-sparking tools and removed slowly to allow any built up pressure to be released. The drum should be

allowed to equilibrate. The headspace measurement within the drum will then be taken using a PID or FID and the results recorded.

3. A clear sampling tube will be inserted into the bottom of the drum or top of a solid layer and the liquid material allowed to reach its natural level. The exposed end of the tube will be capped with a stopper or a gloved finger, and the tube removed.
4. The tube will be inspected for separate phase liquids and a description written in the field book. If two or more phases are contained within the drum each phase will be analyzed separately.
5. The uncapped end of the sampling tube will then be placed in the precleaned laboratory sample jars. The capped end will be carefully released and the contents allowed to drain carefully.
6. Should leakage problems occur with the open tube sampler due to sample viscosity, a Coliwasa or stratified sample thief will be used to collect representative samples of stratified liquids.
7. Solids, when encountered, will be sampled by means of a dedicated tube. The sample will be obtained by coring the tube into the solid. The tube will then be removed from the drum and the sample extruded into the sample jars.
8. Samples will not be preserved using acids or bases, due to the possibility of reactions.

Field Observations: Data to be recorded in the field logbook will include the information presented in Section 4.4 and a description of the drum contents and quantity, pH paper reading, and PID or FID reading.

4.3.6 Soil Sampling Using Direct Push Technology

4.3.6.1 Sampling Equipment

- Direct Push Technology (DPT)
- DPT Sampler (Soil)

4.3.6.2 Sampling Procedures

1. The Soil Sampler will be connected to the DPT drill rods via a sub-assembly and pushed into the undisturbed soils below the augers, in a similar manner as a split spoon sampler.
2. The tip is advanced to the top of the interval to be sampled. The tip is retracted and the sampler is pushed through the desired interval to collect the sample. The sample is contained inside a stainless steel sampling tube located in the sampling tip.
3. The unit is withdrawn from the hole, as the unit is brought to the surface.
4. When at the surface, the sample is removed from the chamber and placed into the appropriate pre-cleaned laboratory supplied sample jars. Samples requiring volatile organic analysis will be immediately placed into two 40 ml VOA vials and placed in a cooler at 4°C. Volatile sample fractions are not homogenized. The remainder of the samples will be homogenized prior to filling sample containers.
5. A tremie line is then inserted into the borehole and a bentonite grout is pumped into the borehole beginning at the base of the borehole. As the borehole fills, the tremie line is simultaneously withdrawn.

Field Observations: Data to be recorded in the field logbook will include the information presented in Section 4.4 and the depth of sampling.

4.3.7 Groundwater Sampling Using Direct Push Technology (DPT)

4.3.7.1 Sampling Equipment

- DPT Rig
- Groundwater Sampler
- Electric Water Level Indicator

4.3.7.2 Sampling Procedures

1. The groundwater will be connected to DPT drill rods via a sub-assembly and driven/pushed into the undisturbed soils below the augers to the desired sampling depth. As the unit is pushed through the soils, the sample intake is

shielded from the formation in a watertight housing, preventing contamination from entering the sample chamber.

2. The tip is advanced below the water table to the bottom of the interval to be sampled. The push rod is retracted exposing a 0.005 inch slotted stainless steel screen. The sample is collected from the push rod using a 0.75 inch bailer or pump.
3. The unit is withdrawn from the hole.
4. When at the surface, the sample is removed from the bailer and placed into the appropriate pre-cleaned laboratory supplied sample jars.
5. The two 40 ml vials for volatile organic analysis will be filled first, leaving no head space or air bubbles. All other sample bottles will be filled such that some head space remains in the bottle.
6. A tremie line is inserted into the borehole. A bentonite grout is pumped into the borehole beginning at the base of the borehole. The tremie line is removed simultaneously as the borehole is filled with bentonite grout.

Field Observations: Data to be recorded in the field logbook will include the information presented in Section 4.4, the depth of sampling, and volume of water removed.

4.3.8 Groundwater Sampling at DPT Well Points

4.3.8.1 Sampling Equipment

- 0.75-inch Disposable Teflon Bailer
- Electric water level indicator and spare battery
- Interface probe
- Submersible pump (of appropriate dimensions and power)
- Polyethylene or nalgene tubing
- Generator
- Bailer and bailer cord
- Teflon-coated leader
- Temperature, pH (with buffer solutions), dissolved oxygen, specific conductivity and turbidity meters (and spare batteries)

- PID or FID
- Explosimeter
- Roll of polyethylene sheeting, paper towels, chemwipes
- Well keys
- Well location map
- Trip blanks
- Sample containers
- Cooler and shipping packaging
- Preservatives
- Field tools (pipe wrench, hammer, chisel, hack saw, etc.)
- Chain-of-Custody forms
- Field notebook
- Buckets (5 gallon capacity)
- Personal protection equipment
- Project CDAP, FIP (tables of sample holding times, preservatives and analyte order of collection)

4.3.8.2 Sampling Procedures

1. A piece of polyethylene sheeting will be fitted over the well point and laid on the ground. The sampling equipment will be placed on the polyethylene sheeting. The well cap will be removed, and the concentration of volatile organic vapors and explosive gases emanating from the well will be measured with a PID or FID, and explosimeter. This step may be modified as needed in those wells which have already demonstrated in the previous rounds of water level measurement that they contain no or insignificant amounts of vapors or gases.
2. The water volume in the boring will be calculated using the following equations or by using table below (based on well construction with Schedule 40 PVC):

$$V_1 = \pi(D_1/2)^2 H_1$$

$$V_2 = N\pi H_2(D_3/2)^2 - (D_2/2)^2$$

$$V_1 + V_2 = \text{Volume of Water}$$

where:

V_1 = volume of water in well casing (ft³)

V_2 = volume of water in filter pack (ft³)

H_1 = height of water column (ft)

H_2 = saturated length of filter pack or the height of the water column in water table wells (ft)

N = porosity of filter pack

D_1 = casing internal diameter (ft)

D_2 = casing outside diameter (ft)

D_3 = diameter of borehole (ft)

Calculation of Purge Volume

$$\text{Purge Volume} = V_1 + V_2$$

Calculation of V_1 ; Volume of Water in Well

$$V_1 = V_s H_1$$

where:

V_1 = volume of water in well

V_s = volume conversion factor from table below (gal/lf)

H_1 = height of water in well casing (ft)

VOLUME OF WATER IN WELL			
Diameter (in)	O.D. (in)	I.D. (in)	Volume gal/lf (V_2)
1¼	1.660	1.380	0.08
2	2.375	2.067	0.17
3	3.600	3.068	0.38
4	4.500	4.026	0.66
6	6.625	6.065	1.5
8	8.625	7.981	2.6
12	12.750	11.938	5.81

Calculation of V_2 ; Volume of Water in Annulus

$$V_2 = V_b H_1$$

where:

V_2 = volume of water in Annulus

V_b = volume conversion factor from below table (gal/lf)

H_1 = height of water volume in watertable or saturated length of filter pack in Annulus

VOLUME OF OPEN BOREHOLE AND ANNULUS BETWEEN CASING AND HOLE ⁽¹⁾⁽²⁾ (V_2)					
Hole Diameter (in)	Volume/Linear Ft. of Hole		Nominal Casing Diameter (in)	(V_b) Volume/LF of Annulus	
	Gal.	Cu.Ft.		Gal.	Cu.Ft.
7¼	2.14	.29	1¼	2.03	0.27
7¼	2.14	.29	2	1.91	0.26
7¾	2.45	.33	2	2.22	0.30
8¼	2.76	.37	2	2.55	0.34
10¼	4.29	.57	2	4.06	0.54
8¼	2.78	.37	3	2.28	0.30
10¼	4.29	.57	3	3.79	0.51
12¼	6.13	.82	3	5.62	0.75
8¼	2.76	.37	4	1.95	0.26
10¼	4.29	.57	4	3.46	0.46
12¼	6.13	.82	4	5.30	0.71
12¼	6.13	.82	6	4.33	0.58

Notes:

- (1) For wells constructed of Schedule 40 PVC pipe.
- (2) This method does not incorporate porosity (N) of sand pack.

In calculating the water volume be careful to keep the units consistent; i.e., make sure the diameters and the length are all measured in feet. To convert cubic feet into gallons, multiply the number of cubic feet by 7.4805. (Note: a 0.75-inch bailer five feet in length holds approximately one liter or 0.22 gallons.)

3. The well point will be purged with a 0.75-inch disposable PVC or teflon bailer. Field measurements of pH, dissolved oxygen, specific conductance, temperature and water level will be made in each well prior to, during, and after purging (just before sampling). Field measurements should be measured at 10, 30, 50, and 80 percent of estimated purge volume. Readings should be measured more frequently after removal of 80 percent of the purge volume. Both the pH and the specific conductivity meters will be calibrated for water temperature before each sampling round.

Each well point will be purged of a total of three to five volumes of water or more if required for stabilization of field parameters. Stabilization of field parameters is defined as less than 10 percent variation for turbidity, temperature, conductivity, pH, and temperature over the estimated purge volumes. All steps possible (adjustment to flowrates) will be taken to prevent the well point from purging to dryness. When the field parameters have stabilized, the volume of water will be recorded, and, within two hours of purging, the well will be sampled.

Purging Well with Bailer - Either a disposable 0.75-inch PVC or teflon bailer will be used. Using the teflon coated bailer cord, the bailer shall be slowly lowered into the well cautiously to avoid aerating the well. Lower the bailer to a level opposite the well screen and pull up the cord to set the check valve. Once retrieved, the water should be transferred into a container to measure the volume being evacuated.

4. The groundwater samples will be collected by gently lowering a teflon bailer into the well. A teflon coated leader, at least five feet in length, will be attached between the bailer and the bailer cord. The bailer will be retrieved, and the sample will be transferred to the appropriate sample containers. The two 40-ml VOA vials will be filled first, leaving no head space or air bubbles. All other sample bottles will be filled such that some headspace remains in the bottle.

If dense non-aqueous phase liquids (DNAPL) are present, as detected by the visual inspection on split-spoon samples during drilling or inspection of the well with an interface probe, point source and double check valve bailers will be employed to collect samples. Stainless steel bailers will be used whenever product (DNAPL or LNAPL) or high concentrations of solvents are present.

5. Groundwater samples requiring filtration will be transferred from the sampling device (bailer) into the sample containers via a vacuum filter system. The unfiltered water will be drawn through a 0.45 micron filter by the vacuum and will accumulate in a receiving container. Upon completion of filtering each sample, the tubing and filter membrane will be disposed of.

Field Observations: Data to be recorded in the field logbook will include the information presented in Section 4.4, PID or FID and explosimeter readings, and the data listed in Section 4.3.3.2.

4.3.9 On-site GC Screening

4.3.9.1 Equipment

- Mobile laboratory - grade gas chromatograph
- Capillary columns
- Thermal oven
- Data processor

4.3.9.2 Screening Procedure

Direct push collection and analysis of samples from the groundwater will provide data on the identity and concentrations of any volatile organic compounds which may be present, without generating waste from monitoring wells.

A gas chromatograph equipped with an electron capture detector (GC/ECD), following modified EPA 8010 methodology, is used to identify and quantify chlorinated compounds typically found in industrial solvents, while a flame ionization detector (GC/FID), following a modified EPA 8020 methodology, is used for petroleum and other non-halogenated compounds. EPA method 3810 will be used to prepare the water and soil samples for analysis.

The water or soil sample is placed in a 40 mL EPA approved screw cap glass vial with a teflon-faced septum and is stored at less than or equal to 4°C until analysis. An aliquot of 15 mL of water or 5 g of soil is placed into a 30 mL EPA clean vial and then capped with a self-sealing septum. The vial is heated in a 90°C block for 10 minutes, in order for an equilibrium to be established between the soil or water sample and the headspace above it.

The autosampler gas-tight syringe pierces the septum of the vial and a portion of the headspace is removed and immediately injected into the GC for analysis. Standards are prepared in the same manner as the samples. Methanolic stock solutions purchased from AccuStandard (New Haven, CT) are used to prepare standards.

Samples will be analyzed on a laboratory-grade gas chromatograph equipped with capillary columns, thermal oven, and with a data processor and associated hardware. Each instrument is appropriately calibrated at the beginning of the project, and as needed for the duration of the project using an instrument-response curve and injection of standards of known concentrations. Calibration checks will be performed at a minimum of twice a day. Retention times of the compounds in the standards are used to identify the unknown compounds in field samples, and their response factors are used in calculating actual concentrations. Replicate analyses will be performed on at least every tenth field sample.

Sometimes, more than one compound will elute at the same retention time. When this happens, the results will be reported as a coelutant pair. If further resolution is desired, a representative sample from any given area of interest will be selected for analysis by GC/MS.

The results of the analyses will be interpreted and reported in the form of a written report including a summary of background information, descriptions of sampling and analytical procedures, tabulated analytical results (including QA/QC), a scaled base map with labelled sample locations, contoured maps (as appropriate) of individual component concentrations, and a discussion and interpretation of the findings.

4.4 FIELD DOCUMENTATION

A bound field log book will be maintained in which to record the daily activities. All entries will be made in indelible ink. The field notebook pages shall be prenumbered. Incorrect entries will be corrected by a single stroke through the error and will be verified with the recorder's initials. Entries to the log book, in addition to the required sampling entries, will include:

- Date
- Start and finish times

- Summary of work performed (including samples collected)
- Names of personnel present
- Names of visitors
- Weather
- Level of personnel protection used during various activities
- Calibration of equipment
- Observations and remarks

The following information will be recorded in a field notebook at the time of sampling:

- Sample designation
- Name of sampler
- Method of collection
- Time and date of sampling
- Type of sample
- Depth of sample
- Analyses required and sample container types
- Field measurements and calibration (if applicable)
- Stratigraphy and/or observed conditions which may impact the chemistry of the sample
- Observations and remarks

4.5 CORRECTIVE ACTION

At the end of each sampling day, the sampling team shall report any problems requiring corrective action which were encountered during the day. Corrective action will be undertaken when a non-conforming condition is identified. A non-conforming condition occurs when QA objectives for precision, accuracy, completeness, representativeness or comparability are not met, or when procedural practices or other conditions are not acceptable. A report shall be filed which documents the problems encountered and the corrective action implemented. A stop-work order may be issued by the QC Officer, upon authorization by the Project Manager, if corrective action does not adequately address a problem, or if no resolution can be reached. Additional information regarding nonconformance is presented in Section 6.0.

5.0 SAMPLE CUSTODY PROCEDURES

5.1 OVERVIEW

Sample custody during the field investigations will be performed in three phases. The first phase encompasses sample collection, pre-laboratory treatment procedures (preservation), packaging, and shipping field custody procedures. The second custody phase involves sample shipment, which mode of shipment, airbill numbers, dates and times are documented. The third phase involves the custody procedures employed by the laboratory.

All three phases of sample custody will be performed to provide that:

- All samples are uniquely identified.
- The correct samples are tested and are traceable to their source.
- Important sample characteristics are preserved.
- Samples are protected from loss or damage.
- A record of sample integrity is established and maintained through the entire custody process.

Custody and shipping procedures are in accordance with US Army Corps of Engineers Guidance ER 1100-1-263, Chemical Data Quality Management for Hazardous Waste Remedial Activities and are modeled after standard USEPA procedures.

5.2 FIELD CUSTODY PROCEDURES

5.2.1 Sample Identification

All samples collected from each site must be identified with a sample label in addition to an entry on a chain-of-custody record. Indelible ink will be used to complete sample labels, then labels will be covered with clear plastic waterproof tape.

5.2.1.1 Sample Labels

Sample labels will require the field team to complete the following information for each sample bottle:

1. Site Name
2. Sample Number
3. Sample Matrix
4. Parameters to be Analyzed
5. Date of Collection
6. Time of Collection
7. Preservation Technique Employed
8. Sampler's Name

Sample labels will be attached to the sample bottles.

5.2.1.2 Sample Numbering

Samples will be labelled according to the numbering system described below for each type of sample:

- **Surface Soil.** Surface soil samples will be labeled as follows:

SSL - XXX - ZZ

SS:	Surface soil sample
LL:	Site Location (e.g., 01 for Site 1)
XXX:	Identifies sample location
ZZ:	Identifies the depth of sample.

- **Subsurface Soils.** Subsurface soil samples will be labeled as follows:

SBL - XXX - ZZ

SB:	Subsurface soil (soil boring) sample
LL:	Site Location (e.g., 01 for Site 1)
XXX:	Identifies sample location
ZZ:	Identifies the depth of sample.

- **Sediment.** Sediment samples will be labeled as follows:

SDLL - XXX - ZZ

SD: Sediment sample
LL: Site Location (e.g., 01 for Site 1)
XXX: Identifies sample location
ZZ: Identifies the depth of sample.

- **Surface Water.** Surface water samples will be labeled as follows:

SWLL - XXX

SW: Surface water sample
LL: Site Location (e.g., 01 for Site 1)
XXX: Indicates sample location

- **Groundwater.** Groundwater samples will be labeled as follows:

MWXX - LL - DDDDDD

MW: Monitoring well groundwater sample
XX: Identifies well location
LL: Site Location (e.g., 01 for Site 1)
DDDDDD: Date of Sampling Round

- **Field Blanks.** Field blanks will be labeled as follows:

FBLL - DDDDDD

FB: Field blank
LL: Site Location (e.g., 01 for Site 1)
DDDDDD: Date of Sampling

- **Trip Blanks.** Trip blanks will be labeled as follows:

TBLL - DDDDDD

TB: Trip blank
LL: Site Location (e.g., 01 for Site 1)
DDDDDD: Date of Sampling

5.2.2 Chain-of-Custody Record

The chain-of-custody guidelines creates an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection

through analysis. Chain-of-custody forms will be completed for each sample at the time of collection and will be maintained while shipping the sample to the laboratory. A sample copy of the chain-of-custody form is provided in Appendix A. A person is in custody of a sample if the sample is:

- In that person's physical possession
- In view after being in that person's physical possession
- Placed in a locked repository by that person
- Placed in a secure, restricted area by that person

As soon as practical after sample collection, the following information must be entered on the chain-of-custody form. All information is to be recorded in ink.

1. **Project number.** Enter the alphanumeric designation that uniquely identifies the project site.
2. **Project name.** Enter the site name.
3. **Samplers.** Sign the name(s) of the sampler(s).
4. **Sample number.** Enter the sample number for each sample in the shipment. This number appears on the sample identification label.
5. **Date.** Enter a six-digit number indicating the year, month, and day of sample (YYMMDD).
6. **Time.** Enter a four-digit number indicating the time of collection based on the 24-hour clock; for example, 1354.
7. **Sample matrix.** Enter the matrix (e.g., soil, aqueous, drum waste, etc.) of the sample.
8. **Parameters for analysis.** Enter the analyses to be performed for each sample.
9. **Number of containers.** For each sample number, enter the number of sample bottles that are contained in the shipment by parameter for analysis.
10. **Remarks.** Enter any appropriate remarks.

5.3 SAMPLE SHIPMENT

Custody of samples must be maintained through the shipment of samples to the selected laboratory. All samples will be packaged and shipped daily so that no sample is held at each site more than 24 hours. Samples will be delivered directly to the laboratory by sampling personnel or shipped via the following procedures.

- Use waterproof high-strength plastic ice chests or coolers only.
- After filling out the pertinent information on the sample label and tag, put the sample in the bottle or vial and screw on the lid. For all samples except VOA vials, secure the bottle lid with strapping tape.
- Tape cooler drain shut.
- Place about 3 inches of inert cushioning material such as vermiculite or styrofoam "popcorn" in the bottom of the cooler. Styrofoam packing cannot be used when sampling for volatile organics.
- Enclose the bottles in clear plastic bags through which sample labels are visible, and seal the bag. Place bottles upright in the cooler in such a way that they do not touch and will not touch during shipment.
- Put in additional inert packing material to partially cover sample bottles (more than half-way). Place bags of ice or ice-gel packs around, among, and on top of the sample bottles. If gel packs are to be used, some ice must also be included for cooling.
- Fill cooler with cushioning material.
- If sending the samples by common carrier, sign the chain-of-custody under "Relinquished by," enter the carrier name and airbill number, retain a copy for field records and put the chain-of-custody record in a waterproof plastic "ziplock" bag and tape it with masking tape to the inside lid of the cooler. If sending the samples by courier or field team shipper, follow the above procedures, but also have the receiving carrier sign under "Received by."
- Apply custody seals to the front and back of the cooler.
- Secure lid by taping. Wrap the cooler completely with strapping tape at a minimum of two locations. Do not cover any labels.
- Attach completed shipping label to top of the cooler. The shipping label shall have a return address.

- Ship the cooler by overnight express or courier to the respective laboratory.

Quality Assurance (QA) samples shall be shipped to U.S. Army Corps of Engineers New England Division (ACNED) laboratory at the following address:

U.S. Army Corps of Engineers
Environmental Laboratory
New England Division
476 Coldbrook Road
Hubbardston, MA 01452
ATTN: Sample Custodian

ACNED shall be notified of estimated number of samples and analytical parameters a minimum of one week prior to shipment.

Specific documentation is required for preservatives, decontamination solutions or preserved samples (which may be considered corrosive) which are considered hazardous materials. Shipping papers must describe the hazardous material and its hazard class, and must include the international (UN) or North American (NA) identification number. The following documentation must accompany all hazardous materials shipped:

- A complete Hazardous Material Bill of Lading,
- Material Safety Data Sheets (MSDS) for undiluted acids, caustics, solvents, gases, or radioactive materials;
- Chain-of-custody forms for environmental samples with field testing results for specific hazardous classes; e.g., corrosive (pH < 2 or pH > 12.5);
- A copy of the appropriate pages of the emergency response guide form the *1993 DOT Emergency Response Guidebook* for the material being transported; and
- A copy of the appropriate pages of the emergency response guide from the *1988 Emergency Care for Hazardous Materials Exposure Guidebook* for the material being transported.

This documentation must be with the shipment when the shipment is picked up or, for hazardous materials being transported by company or personal vehicles, must be kept in the passenger compartment on the passenger seat or in the driver's side door pocket. In

the event of an emergency, Malcolm Pirnie's 24-hour emergency response telephone number, (914) 654-3446, shall be called.

Additional documentation and labelling are required when transporting preserved environmental samples by air. For Federal Express shipment of hazardous materials, a Federal Express Airbill for restricted articles/dangerous goods must be completed. The form may be obtained from Federal Express at (800) 238-5355. Additionally, a shipping label, "corrosive" label, an "Inner Packages Comply with Prescribed Specifications" label, a "Dangerous Goods Declaration" label, and "Environmental Samples" label, a "Cargo Aircraft Only" label, and two (2) "This Side Up" labels must be affixed to the cooler.

5.4 LABORATORY CUSTODY PROCEDURES

When the sample arrives at the laboratory following shipment, the sample is received by the sample custodian. The label will be identified upon receipt by the laboratory and cross-referenced to the chain-of-custody record. Any inconsistencies will be noted on the custody record. Laboratory personnel will notify the Malcolm Pirnie Quality Control Officer, Field Manager or the Project Manager immediately if any inconsistencies exist in the paper work associated with the samples.

6.0 LABORATORY AND FIELD ANALYTICAL PROCEDURES

6.1 ANALYTICAL METHODS

6.1.1 Laboratory Procedures

Savannah Laboratories is responsible for sample analysis. Table 6-1 lists the proposed laboratory analytical methods for field samples. Test Methods for Evaluating Solid Waste, USEPA Office of Solid Waste, SW-846, 3rd Edition, Revision No. 2, June 1990; Methods for Chemical Analysis of Water and Wastes, USEPA Office of Research and Development, March 1983; and American Society for Testing and Materials, Annual Book of ASTM Standards are incorporated by reference into this CDAP for the purpose of describing the standard analytical methods. Table 6-2 summarizes the proposed investigative and QA/QC samples for the field program.

6.1.2 On-Site GC Screening Procedures

A gas chromatograph equipped with an electron capture detector (GC/ECD), following modified EPA 8010 methodology, will be used to identify and quantify chlorinated compounds in the field, while a flame ionization detector (GC/FID), following a modified EPA 8020 methodology, will be used for petroleum and other non-halogenated compounds. EPA method 3810 will be used to prepare the samples for analysis.

6.2 PREVENTATIVE MAINTENANCE

6.2.1 Introduction

A preventative maintenance program is necessary to help prevent delays in project schedules, poor output performance or erroneous results in investigative operations. Preventative maintenance on laboratory analytical equipment used in this program will be performed contractually by qualified personnel. Maintenance of field equipment will be performed routinely for sampling events. More extensive maintenance will be performed based on hours of use, by a qualified servicing organization. Repairs, adjustments and calibrations will be recorded. Records will be available for inspection by the U.S. Army Corps of Engineers (ACE) on request.

**TABLE 6-1
ANALYTICAL METHODS**

PARAMETERS	METHODS
LABORATORY ANALYSIS	
TPH Heavy/Light	Modified EPA Method 8015
TAL Metals	SW-846, Method 6010
TAL Cyanide	SW-846, Method 9010
TCL Volatiles	SW-846, Method 8240
TCL Semivolatiles	SW-846, Method 8270
ON-SITE GC ANALYSIS	
TPH and Non-halogenated Compounds	Modified EPA Method 8020
Chlorinated Volatiles	Modified EPA Method 8010

**TABLE 6-2
FIELD AND QA/QC SAMPLE SUMMARY**

Sampling Task	Media	Analysis Requirements						
		TAL Metals	TAL Hg	TAL Cyanide	TCL VOCs	TCL SOCs	TPH Heavy	TPH Light
FIREFIGHTER TRAINING AREA								
Groundwater Sampling by DPT:								
Field	Water	6	6	6	18	18	18	18
Duplicates ⁽¹⁾	Water	2	2	2	1	1	1	1
Rinsates ⁽²⁾	Water	1	1	1	4	4	4	4
Trip Blanks ⁽³⁾	Water	0	0	0	4	0	0	0
MS/MSD ⁽⁴⁾	Water	1	1	1	1	1	1	1
ACNED QA Samples ⁽⁵⁾	Water	1	1	1	1	1	1	1
Groundwater Well Sampling:								
Field	Water	4	4	4	8	8	8	8
Duplicates	Water	0	0	0	1	1	1	1
Rinsates	Water	1	1	1	2	2	2	2
Trip Blanks	Water	0	0	0	2	0	0	0
MS/MSD	Water	0	0	0	1	1	1	1
ACNED QA Samples	Water	0	0	0	1	1	1	1
Subsurface Soil Sampling by DPT:								
Field	Soil	9	9	9	44	44	44	44
Duplicates	Soil	1	1	1	4	4	4	4
Rinsates	Water	1	1	1	2	2	2	2
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	1	1	1	2	2	2	2
ACNED QA Samples	Soil	1	1	1	4	4	4	4
Surface Soil Samples:								
Field	Soil	5	5	5	28	28	28	28
Duplicates	Soil	0	0	0	3	3	3	3
Rinsates	Water	0	0	0	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	1	1	1	1
ACNED QA Samples	Soil	1	1	1	3	3	3	3
Sediment Samples:								
Field	Soil	4	4	4	4	4	4	4
Duplicates	Soil	1	1	1	1	1	1	1
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	1	1	1	1
ACNED QA Samples	Soil	1	1	1	1	1	1	1
Surface Water Samples:								
Field	Water	4	4	4	4	4	4	4
Duplicates	Water	1	1	1	1	1	1	1
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Water	0	0	0	0	0	0	0
ACNED QA Samples	Water	1	1	1	1	1	1	1
Decontamination Water:								
Field Blanks - DI & Tap Water	Water	2	2	2	2	2	2	2

Notes:

- (1) Duplicates collected at a rate of 10 percent of samples.
- (2) Rinsates - One every other day for soil samples, one per day for water samples.
- (3) Trip Blanks - One per cooler for water samples collected for VOC analysis.
- (4) MS/MDS - Matrix spike/matrix spike duplicates collected at a rate of 5 percent of samples.
- (5) Split samples submitted to Army Corps of Engineers New England Division at a rate of 10 percent of samples.

**TABLE 6-2
FIELD AND QA/QC SAMPLE SUMMARY**

Sampling Task	Media	Analysis Requirements						
		TAL Metals	TAL Hg	TAL Cyanide	TCL VOCs	TCL SOCs	TPH Heavy	TPH Light
LARC 60 MAINTENANCE AREA								
Groundwater Sampling by DPT:								
Field	Water	8	8	8	19	19	19	19
Duplicates ⁽¹⁾	Water	2	2	2	2	2	2	2
Rinsates ⁽²⁾	Water	1	1	1	4	4	4	4
Trip Blanks ⁽³⁾	Water	0	0	0	4	0	0	0
MS/MSD ⁽⁴⁾	Water	1	1	1	1	1	1	1
ACNED QA Samples ⁽⁵⁾	Water	1	1	1	2	2	2	2
Groundwater Well Sampling:								
Field	Water	2	2	2	4	4	4	4
Duplicates	Water	0	0	0	0	0	0	0
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	1	0	0	0
MS/MSD	Water	0	0	0	1	1	1	1
ACNED QA Samples	Water	0	0	0	1	1	1	1
Subsurface Soil Sampling by DPT:								
Field	Soil	9	9	9	46	46	46	46
Duplicates	Soil	1	1	1	5	5	5	5
Rinsates	Water	1	1	1	2	2	2	2
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	1	1	1	2	2	2	2
ACNED QA Samples	Soil	1	1	1	5	5	5	5
Surface Soil Samples:								
Field	Soil	5	5	5	23	23	23	23
Duplicates	Soil	0	0	0	2	2	2	2
Rinsates	Water	0	0	0	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	2	2	2	2
ACNED QA Samples	Soil	1	1	1	2	2	2	2
Sediment Samples:								
Field	Soil	2	2	2	2	2	2	2
Duplicates	Soil	0	0	0	0	0	0	0
Rinsates	Water	0	0	0	0	0	0	0
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	0	0	0	0
ACNED QA Samples	Soil	0	0	0	0	0	0	0
Surface Water Samples:								
Field	Water	2	2	2	2	2	2	2
Duplicates	Water	0	0	0	0	0	0	0
Rinsates	Water	0	0	0	0	0	0	0
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Water	0	0	0	0	0	0	0
ACNED QA Samples	Water	0	0	0	0	0	0	0

Notes:

- (1) Duplicates collected at a rate of 10 percent of samples.
- (2) Rinsates – One every other day for soil samples, one per day for water samples.
- (3) Trip Blanks – One per cooler for water samples collected for VOC analysis.
- (4) MS/MDS – Matrix spike/matrix spike duplicates collected at a rate of 5 percent of samples.
- (5) Split samples submitted to Army Corps of Engineers New England Division at a rate of 10 percent of samples.

**TABLE 6-2
FIELD AND QA/QC SAMPLE SUMMARY**

Sampling Task	Media	Analysis Requirements						
		TAL Metals	TAL Hg	TAL Cyanide	TCL VOCs	TCL SOCs	TPH Heavy	TPH Light
AUTO CRAFT BUILDING AREA								
Groundwater Sampling by DPT:								
Field	Water	6	6	6	6	6	6	6
Duplicates ⁽¹⁾	Water	2	2	2	1	1	1	1
Rinsates ⁽²⁾	Water	1	1	1	1	1	1	1
Trip Blanks ⁽³⁾	Water	0	0	0	1	0	0	0
MS/MSD ⁽⁴⁾	Water	1	1	1	1	1	1	1
ACNED QA Samples ⁽⁵⁾	Water	1	1	1	1	1	1	1
Groundwater Well Sampling:								
Field	Water	2	2	2	1	1	1	1
Duplicates	Water	0	0	0	0	0	0	0
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	1	0	0	0
MS/MSD	Water	0	0	0	0	0	0	0
ACNED QA Samples	Water	0	0	0	0	0	0	0
Subsurface Soil Sampling by DPT:								
Field	Soil	3	3	3	12	12	12	12
Duplicates	Soil	1	1	1	1	1	1	1
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	1	1	1	1	1	1	1
ACNED QA Samples	Soil	1	1	1	1	1	1	1
Surface Soil Samples:								
Field	Soil	1	1	1	6	6	6	6
Duplicates	Soil	0	0	0	1	1	1	1
Rinsates	Water	0	0	0	0	0	0	0
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	0	0	0	0
ACNED QA Samples	Soil	0	0	0	1	1	1	1

Notes:

- (1) Duplicates collected at a rate of 10 percent of samples.
- (2) Rinsates – One every other day for soil samples, one per day for water samples.
- (3) Trip Blanks – One per cooler for water samples collected for VOC analysis.
- (4) MS/MDS – Matrix spike/matrix spike duplicates collected at a rate of 5 percent of samples.
- (5) Split samples submitted to Army Corps of Engineers New England Division at a rate of 10 percent of samples.

6.2.2 Field Equipment

The three elements of the field equipment maintenance program include normal upkeep of equipment, service and repair (when required), and formalized record-keeping of all work performed on each piece of equipment. This section addresses the normal equipment upkeep element of the maintenance program. For most of the equipment, normal maintenance will consist of cleaning outside surfaces, lubrication of all moving parts, and, if applicable, a battery level check and recharge or replacement as necessary. This program will include the maintenance of all monitoring, measuring, and test equipment returning from use, or any equipment used on a daily basis. The frequency of maintenance checks will be dependent on the individual needs and use of each piece of equipment. Details regarding the required maintenance and procedures for the field equipment are provided in Appendix B. Maintenance procedures will be only those necessary for keeping an instrument in service or in preparation for everyday use. It is beyond the scope of this document to cover repair procedures for each piece of equipment. Repair problems will be referred to the manufacturer or other qualified servicing organization.

The Project QC Officer, or the designated task leader, will be responsible for keeping all maintenance records, making sure all equipment used is maintained properly, informing field team members of any specific maintenance requirements for equipment used at the site and shipping any instrument in need of repair to the correct source.

The field personnel responsibilities include maintaining each piece of equipment located at the site and the maintenance of equipment after use. A record of equipment maintenance and repair will be kept in the field logbook.

6.2.3 Rental Equipment

Rental equipment used on the project will be obtained only from a certified rental supplier. The equipment will require a pre-receipt to verify accuracy, maintenance and up-keep of the equipment. A receipt indicating that the equipment has been checked upon return will be required as well.

6.2.4 Laboratory Equipment

An important factor in maintaining accuracy and precision, achieving required holding times, and addressing contract schedule is preventive maintenance. As part of the laboratory's standard operating procedures, service contracts are held on critical analytical

instruments. Information on the maintenance of the laboratory equipment is provided in Appendix A.

6.2.5 On-Site GC

For the portable GC, maintenance checks are conducted on a daily basis and all information is recorded in the system maintenance book. Daily checks include:

- Monitoring purge and flow rates
- Checking gas pressure readings to the GC
- Checking the syringe body alignment
- Replacement of the injection septa
- Ensuring a lit flame for the FID
- Conditioning the columns at 200°C
- Checking the injection ports
- Checking the sufficient pressure warning light on the autosampler

The carrier gases are checked twice daily, on arrival in the morning and on departure in the evening. They are replaced with necessary of if there is a problem with the analysis on the GCs. Other maintenance checks include: 1) teflon plunger tips on the syringes are replaced at least once a month; 2) the carousel wheel and its mechanisms are adjusted when necessary, 3) columns are replaced as required based on loss of resolving capability or decrease in retention times (all other parameters constant) of more than 5 minutes; 4) all tubing is replaced when necessary.

6.3 CALIBRATION PROCEDURES AND FREQUENCY

6.3.1 Field Calibration Procedures

Measuring and test equipment shall have an initial calibration and shall be recalibrated at scheduled intervals against certified standards that have known and valid traceability to recognized national standards. Calibration intervals for each item shall be,

at a minimum, in accordance with manufacturer's recommendations as defined in the equipment manual. Test equipment used for calibration of sensors shall themselves be recalibrated at least once a year or when maintenance or damage indicates a need for recalibration.

Calibration standards shall be maintained and used in an environment with temperature, humidity, and cleanliness controls that are compatible with the accuracy and operating characteristics of the standards. An inspection will be made during the equipment calibration to evaluate the physical condition of the equipment. The purpose of the inspection is to detect any abnormal wear or damage that may affect the operation of the equipment before the next calibration. Equipment found to be out of calibration or in need of maintenance or repair will be identified and removed from service.

The Project QC Officer shall be notified if the test equipment is found to be out of tolerance during inspection and calibration. The corrective actions to be taken include evaluating the validity of previous inspection or test results; evaluating the acceptability of the items inspected or tested since the last calibration check; and repeating the original inspections or tests using calibrated equipment when it is necessary to establish the acceptability of previous inspections or tests.

Each item of measuring and test equipment in the calibration program shall be identified in such a way as to show its calibration status and calibration expiration date. Equipment history records for measurement and test equipment shall be used to indicate calibration status and conditions, corrections to be applied, results of in-service checks, and repair history. This will provide a basis for establishing calibration frequencies and for remedial action if the instrument is found out of calibration.

Calibration frequency and procedures are detailed in Appendix B.

6.3.2 Laboratory Calibration Procedures

Laboratory instrumentation calibration procedures, frequency, and standards will be consistent with the requirements of the applicable analytical method.

6.3.3 On-Site GC Calibration Procedures

Both FID and ECD analyses are conducted at Range 1. Three-point least squares linear regression calibration curves are generated for each detector as needed and the correlation coefficients are examined for each standardized analyte. Correlation coefficients

must be greater than 0.99. The calibration curve is then used to quantify the concentration of the analytes in samples. Following the initial three-point calibration, check standards are analyzed at the beginning and end of each day to ensure retention time and response stability. windows for retention times will be set using the narrowest time band possible (usually 0.05 - 0.1 minutes) without including non-standardized peaks.

6.4 INTERNAL QUALITY CONTROL CHECKS

6.4.1 Field Quality Control

The QC checks employed for field instruments include the following:

<u>QC Method</u>	<u>Purpose</u>	<u>Frequency</u>
Calibration Check	Insures proper working order of field instrument. Measures accuracy and sensitivity.	Daily
Field Duplicate Sample	Measures instrument precision.	10%
Field Rinsate Blanks	Measures cross-contamination	Daily

6.4.2 Laboratory Quality Control

All analyses shall include the following QC procedures, when applicable:

<u>Procedure</u>	<u>Frequency</u>
Calibration	As required
Standards	Daily
Method Blanks	Daily
Duplicates	5%
Matrix Spikes	5%
Surrogates	Each sample
QC Check Samples	Daily

Additional information regarding QC checks (control parameters) is presented in Section 6.6.2.

6.4.3 On-Site GC Quality Control

The on-site GC checks for the GC will include:

<u>GC Method</u>	<u>Frequency</u>
Lab blanks	10%
Replicate analysis	10%
Check standards	Every 40 Samples
Equipment rinsates	At the beginning and end of each day

6.5 NONCONFORMANCE REPORTING

A nonconformance is defined as an identified or suspected deficiency in an approved document (e.g., technical report, analysis, calculation, computer program); an item where the quality of the end item itself or subsequent activities using the document or item would be affected by the deficiency; or an activity that is not conducted in accordance with the established plans or procedures.

Any staff member engaged in project work who discovers or suspects a nonconformance is responsible for initiating a nonconformance report. The Project QC Officer shall evaluate each nonconformance report and shall provide a disposition which describes the actions to be taken.

The Project Manager shall ensure that no further project work dependent on the nonconforming item or activity is performed until approval is obtained and the nonconformance report is closed out. If the nonconformance is related to material, the Project Manager shall be responsible for marking or identifying, with the nonconformance report number, the nonconforming item (if practical) and indicating that it is nonconforming and is not to be used.

A copy of each closed nonconformance report shall be included in the quality assurance file. Copies of all nonconformances shall be maintained by the Project QC Officer.

6.6 DATA ANALYSIS AND REPORTING

6.6.1 Reporting

Data packages generated from analyses shall include the following:

1. Pertinent physical data presented in concise, easy to follow formats (i.e., sample number, client, date of sample preparation, date analyzed, percent moisture, etc.).
2. Data from each discrete sample reported using cross-referencing between normal samples and quality control samples.
3. Reported data to include associated quality control samples such as blanks, spikes and spike duplicates, laboratory duplicates, laboratory control standard (LCS) run with each sample batch, field duplicates and appropriate check standards.
4. Copies of chain-of-custody sheets.

6.6.2 Control Parameters

Duplicate samples, rinsate blanks, and trip blanks will be collected at the rate specified in Sections 4.2 or 6.4 of the CDAP. Lab blanks, spikes and spike duplicates will be run at the rate of one per 20 samples or one per day, whichever is more frequent. Performance Evaluation samples will be run at a rate of once per calendar quarter or at a frequency determined by the ACE. Internal performance evaluation samples will be run at a frequency determined by the internal laboratory QC staff.

The analytical method performance will be determined by an examination of precision, accuracy, and completeness.

Precision is the ability to replicate a value. Precision is determined by measuring the agreement among individual measurements of the same property, under similar conditions. The degree of agreement, expressed as the relative percent difference (RPD), is calculated using the formula below.

Precision:

$$RPD = \frac{(V_1 - V_2) \times 100}{\frac{V_1 + V_2}{2}}$$

where: $V_1 = \text{value 1}$
 $V_2 = \text{value 2}$

Accuracy is a measure of the closeness of an individual measurement to the true or expected value. To determine accuracy, a reference material of known concentration is analyzed or a sample which has been spiked with a known concentration is reanalyzed. Accuracy is expressed as a percent recovery and is calculated using the following formula:

Accuracy:

$$\% \text{ recovery} = 100 \times \frac{\text{measured value}}{\text{truevalue}}$$

Completeness is a measure of the quantity of valid data acquired from a measurement process compared to the amount that was expected to be acquired under the measurement conditions. Completeness is usually expressed as a percentage.

6.6.3 Data Reduction

Data reduction is the process by which raw analytical data generated from off-site laboratory and on-site portable laboratory instrument systems is converted into usable concentrations. The raw data, which may take the form of area counts, instrument responses or observations, is processed by the lab and converted into concentrations expressed in the part-per-million or part-per-billion range. Raw data from these systems include compound identifications, concentrations, retention times and data system print-outs. Raw data is usually reported in graphic form, bar-graph form or tabular form.

6.6.4. Validation

Laboratory

The laboratory shall review data prior to its release. Objectives for review are in accordance with the QA/QC objectives stated earlier in this document. The laboratory is required to evaluate their ability to meet these objectives. Outlying data shall be flagged

in accordance with laboratory SOPs and corrective action shall take place to rectify the problem. Validated data packages received from the laboratory will be assessed for quality. Data will be subject to a data assessment consisting of a review of the following quality controls:

1. Method Blanks: Measure of laboratory contamination. Control limits - detected results should be less than method detection limits.
2. Field Rinstate Blanks: Measure of field contamination. Control limits - detected results should be less than method detection limits.
3. Trip Blanks: Measure of field/transport contamination. Control limits - detected results should be less than method detection limits.
4. Laboratory Duplicates: Measure of laboratory precision. Control limits - the Relative Percent Difference (RPD) should be less than 35%.
5. Field Duplicates: Measure of field sampling and laboratory precision. Control limits - the RPD should be less than 35%.
6. Matrix Spikes: Measure of laboratory accuracy and any sample matrix effects. Control limits - Percent recovery should be within 75-125%.
7. Surrogate Spike Recoveries: Measure of laboratory accuracy. Control limits - Percent recovery should be within 75-125%.
8. Laboratory Control Samples: Measure of laboratory accuracy. Control limits - Percent recovery should be within 75-125%.

On-Site GC Analysis

The data is reviewed to ensure proper identification and quantification of standardized analytes, to ensure that daily check standards results are within 20 percent of the second level standard, to ensure that sample replicate analysis results are within 20 percent of each other, and to ensure that matrix spike percent recovery results are within 50 to 150 percent.

The data and chromatograms are then submitted to the Interpretation and Reporting Group, where each chromatogram is reviewed to confirm the identification and quantification of each standardized analyte. The Total FID Volatiles are calculated and data tables are prepared.

6.6.5 Corrective Action

If a particular analysis is deemed "out-of control," corrective action will be taken to ensure continued data quality. Actions which may be taken include, but are not limited to:

- Rechecking calculations
- Checking QC data on other samples
- Auditing laboratory procedures
- Reanalyzing the sample if the holding time requirements have not been exceeded
- Accepting data with the acknowledged level of uncertainty
- Discarding data

The coordinator of the laboratory's analytical section will be responsible for initiating laboratory corrective action when necessary. Recommendations for corrective actions outside the laboratory will be made by the lab QA/QC Manager to the Project Manager.

7.0 CHEMICAL DATA QUALITY MANAGEMENT DELIVERABLES

7.1 DAILY QUALITY CONTROL REPORT

A Daily Quality Control Report (DQCR) will be completed for each day of field activities. The report includes the weather during sampling, samples taken, instrument maintenance and calibration, and any field changes, problems or corrective actions. A sample report is presented as Figure 7-1.

7.2 DATA REPORT TO THE QUALITY ASSURANCE LABORATORY

The raw data will be submitted to the quality assurance (QA) laboratory, when available, for data assessment/evaluation and comparison purposes. The data will include all blank, sample, and internal quality control results such as spike and surrogate recoveries, and replicate analyses.

7.3 QUALITY CONTROL SUMMARY REPORT

A Quality Control Summary Report (QCSR) will be submitted as part of the Remedial Investigation Report. The QCSR will address:

- Project Scope
- Project Description
- Sampling Procedures (planned vs. implemented)
- Analytical Procedures
- Significant Problems with Analytical Procedures
- Data Presentation
- Quality Control Activities including Discussion of Data Reliability
- Conclusions

The report will also discuss any corrective actions implemented in response to problems encountered during the project. Data packages and data assessment reports will be summarized.

APPENDIX A
LABORATORY PROCEDURES

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SAVANNAH DIVISION USACE-MRD CERTIFICATION



DEPARTMENT OF THE ARMY
MISSOURI RIVER DIVISION, CORPS OF ENGINEERS
P.O. BOX 103, DOWNTOWN STATION
OMAHA, NEBRASKA 68101-0103



REPLY TO
ATTENTION OF

June 16, 1993

Environmental, Hazardous, Toxic
and Radioactive Waste Division

Savannah Laboratories
ATTN: James Andrews
5102 LaRoche Avenue
Savannah, GA 31404

Gentlemen:

This correspondence addresses the recent revalidation of Savannah Laboratories, Savannah, Georgia, by the U.S. Army Corps of Engineers (USACE) Hazardous, Toxic and Radioactive Waste (HTRW) Mandatory Center of Expertise (MCX) for HTRW analysis.

The laboratory has successfully analyzed audit samples as listed below:

<u>METHOD</u>	<u>PARAMETERS</u>	<u>MATRIX</u>
8240	Volatile Organics	water
8010	Halogenated Volatile Organics	water
8020	Aromatic Volatile Organics	water
8270	Semivolatile Organics	water
8270	Semivolatile Organics	sediment
8080	Organochlorine Pesticides	water
8080	Polychlorinated Biphenyls	water
8080	Polychlorinated Biphenyls	sediment
8150	Chlorinated Herbicides	water
8100	PAH	water
8040	Phenol	water
SW-846	TAL Metals	water
SW-846	TAL Metals	sediment
300 Series	Common Anions	water
9060	Total Organic Carbon	water
9010	Cyanide	water
8015M	TPH	water
8015M	TPH	soil
418.1	TRPH	water
9071/418.1	TRPH	soil

Remarks: TAL Metals: 23 EPA Contract Laboratory Program, Target Analyte List (TAL) metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc)

Based on the successful analysis of the performance evaluation samples indicated in the table in paragraph two, your laboratory is revalidated for multimedia sample analysis by the above methods. A full validation of eighteen (18) months was approved by the USACE Contract Laboratory Evaluation Committee on June 14, 1993.

The expiration date of validation is December 21, 1994. The Chemistry Branch of the Hazardous, Toxic and Radioactive Waste Mandatory Center of Expertise may schedule and conduct an on-site audit at any time during the 18 month validation period to evaluate lab performance if deemed necessary. USACE reserves the right to conduct laboratory audits or to suspend validation status for any or all of the listed parameters if deemed necessary. It should be noted that your laboratory may not subcontract USACE analytical work to any other laboratory location without the approval of this office. This lab validation does not guarantee the delivery of any analytical samples from a USACE Contracting Officer Representative.

If you have any questions or comments, please contact Ms. Paulette Lewis at (402) 221-7494.

Sincerely,

Marcia C. Davies
for Marcia C. Davies
Chief, Environmental, HTRW Division
HTRW and Engineering Directorate

SAVANNAH DIVISION KEY PERSONNEL RESUMES

JAMES W. ANDREWS
President
Project Manager, Savannah Division

Academic Background: B.S. Chemistry
 M.S. Nutritional Biochemistry
 Ph.D. Nutritional Biochemistry
 University of Georgia, Athens, GA

Dr. Andrews holds a B.S. degree in chemistry and an M.S. and Ph.D. in nutritional physiology from the University of Georgia. Dr. Andrews' specialty is aquatic chemistry and biochemical and physiological effects of chemicals on animals.

In 1962, Dr. Andrews began his professional career as an environmental chemist with the research division of Continental Forest Industries. During this employment, his duties involved developing techniques for reducing water and air pollution from pulp and paper mills and water quality evaluations of streams.

From 1963 to 1968, he was a research assistant and lecturer at the University of Georgia. As part of this work, he was assigned to special projects at the Hormel Institute in Austin, Minnesota, and at INCAP in Guatemala City, Guatemala.

In 1968, he became one of the initial scientists at the Skidaway Institute of Oceanography in Savannah, Georgia. During his tenure at Skidaway Institute, he was the principal investigator of many biological, physiological and fish cultural studies. Dr. Andrews is the author of more than 70 research papers in the aquatic field. In 1976, he was selected to be a member of a National Academy of Sciences subcommittee on aquatic nutrition.

For several years, Dr. Andrews has worked as a volunteer with the Community Cardiovascular Council of Savannah and Dr. Curtis Hames of the Evans Cardiovascular Project. In this capacity, he has become involved in several multi-national research projects which were designed to relate environmental and dietary exposure to cardiovascular health. This work has led to several scientific publications on the effect of environmental exposure to heavy metals on human health in the high cardiovascular disease area of the southeastern United States.

Dr. Andrews has been a private consultant on environmental and water quality aspects of the coastal southeast since 1969. Since 1975, he has been the President of Savannah Laboratories and Environmental Services, Inc. His primary functions at Savannah Laboratories are the evaluation and interpretation of data and responding to the advisory needs of engineers, environmental specialists, legal experts, and production personnel, as well as supervising bioassay/bioaccumulation and environmental studies.

JANETTE D. LONG

Vice President - Project Manager/Laboratory Director, Savannah Division

Ms. Long has a B.S. degree in chemistry and 16 years experience in the analysis and data review of water, soil, biological and other environmental matrices. Prior to her association with Savannah Laboratories and Environmental Services, Inc., she was a research chemist with the University of Georgia Experiment Station evaluating biological tissues, enzymes and water samples. During her involvement with the Experiment Station, she co-authored several research papers in the aquatic field.

For several years, she assisted the Community Cardiovascular Council of Savannah as a volunteer research chemist. During this time, she assisted in the research effort as well as co-authored several publications concerning the epidemiological aspects of heavy metal exposure on human health in the southeastern United States. Ms. Long has been active in the American Chemical Society activities in the environmental area. She has held several offices in the organization, including President of the Coastal Empire Region.

Ms. Long began her association with Savannah Laboratories in 1975, and as a project manager, has worked closely with clients to review site-specific project plans, generic QA project plans, project regulatory concerns and to ensure that the analyses recommended will provide the desired data and QA/QC requirements requested by the client. She has been responsible for proposal preparation and project management for numerous RCRA, NPDES, environmental impact assessments and other related projects.

BEVERLY HUGHES
Project Manager, Savannah Division

Academic Background: B.S. Biology/Natural Science, 1979
Shorter College, Rome, GA

Beverly Hughes has been an employee of Savannah Laboratories since 1987. Her depth of experience at SL allows her to provide knowledgeable services and support to a variety of clients. At the beginning of a project, Ms. Hughes will serve as the initial contact with clients, identify clients' project goals and data quality objectives, assist with preparation of site-specific QA plans, provide technical support for field work preparation, provide advice on selecting analytical methodology, and coordinate the shipment of sample containers. During the analytical portion of a project, Ms. Hughes will initiate the laboratory work orders, review logins to ensure accuracy with the chain-of-custody record, track project samples through the lab to provide the analytical status to clients, prepare and review all final reports for content and conformance to client format requirements, and ensure the shipment of all required deliverables. Upon project completion, Ms. Hughes is available to answer any questions regarding the analytical results and provide any additional QC data associated with the project and requested by the client.

Ms. Hughes has been a Project Manager since 1992. She has broad experience in projects performed under a variety of regulatory requirements and agency programs including RCRA, SDWA, NPDES, and UST, as well as projects following CLP protocol. In addition, Ms. Hughes has been responsible for the management of a DOE Portsmouth RFI project and for work performed for the U.S. Army Corps of Engineers.

Prior to assuming the position of Project Manager, Ms. Hughes spent five years as Analyst and Department Manager with Savannah Labs. Her laboratory experience includes GC/ECD/FID/NP procedures for the determination of pesticides, PCBs, herbicides, petroleum hydrocarbons, and other semivolatile organic compounds. Her methods experience includes SW-846, 40 CFR, 500-series and CLP methodology. Prior to joining Savannah Labs, Ms. Hughes worked for seven years as an Environmental Specialist with a large chemical company, gaining experience with the requirements and methods associated with NPDES, hazardous wastes and air emissions.

Professional Affiliations: American Defense Preparedness Association since 1994

STEVEN J. WHITE
Project Manager, Savannah Division

Academic Background: B.S. Chemistry, 1981
Armstrong College, Savannah, GA

Steve White has been employed by Savannah Labs since 1982 in a variety of capacities. His extensive experience at SL allows him to provide knowledgeable support for the service of industrial clients, engineering consultants, and governmental agencies. Mr. White assists a client from the beginning of a project in identifying analytical goals and data quality objectives. He also provides technical support during field work preparation, coordinates the dispatch of sample containers, helps to prepare any quality assurance project plans, and assists the client in selecting analytical methodology. During the analytical phase of the project, Mr. White initiates login of sample information and analytical requirements into the LIMS, approves sample delivery group assignments, and reviews logins against client requests on the chain-of-custody record. He also provides the client with the project's status and discusses any analytical problems that may need client input for resolution. Mr. White reviews the final report for completeness and conformance to client format and ensures the shipment of any deliverables. He arranges for any electronic downloading and is available after project completion to answer questions regarding analytical results, quality control data, or data deliverables.

Mr. White has served as Project Manager since 1988. During this time, he managed projects to satisfy requirements of RCRA, SDWA, NPDES, UST, and CLP. He managed projects for the U.S. Army Corps of Engineers and numerous projects to conform to state agency and client-specified requirements.

Prior to assuming the position of Project Manager, Mr. White gained laboratory experience at Savannah Labs as an Inorganic Chemist in the laboratory, performing flame, graphite furnace, and cold vapor AA, as well as spectrofluorometric procedures for the determination of metals. During this time, he also worked with wet chemical techniques for the determination of other inorganic analytes. He later served as a Chemist and Manager in the organic section, becoming experienced with GC/ECD/FID procedures for the determination of pesticides, PCBs, herbicides, phenols, and other semivolatile organic compounds and performed additional work with GC/MS for the determination of semivolatiles. With this experience, Mr. White is directly familiar with SW-846, 40 CFR, 200-series, 300-series, 500-series, and CLP methodologies.

Pesticide Residue Analysis Course (40 hours), EPA Region IV, Athens, GA
HPLC Applications Course from Waters

National Environmental Symposium (1992), S.C. Chamber of Commerce

Professional Affiliations: American Chemical Society since 1981
American Defense Preparedness Association since 1994

LINDA WOLFE
Project Manager, Savannah Division

Academic Background: B.S. Biology, 1978
Shorter College, Rome, GA
B.S. Chemistry, 1987
Armstrong State College, Savannah, GA

Linda Wolfe has been employed by Savannah Labs since 1985, and has served in both laboratory and project management functions during that time. Her extensive experience with high level projects has allowed her to work effectively with a variety of industrial and consulting/engineering clients operating under many environmental protocols. As a Project Manager, in the initial stages of a project, Ms. Wolfe helps a client identify the analytical goals of a project, prepares project-specific QA plans, provides technical advice during preparation for field work, provides assistance choosing analytical methodology, and coordinates the dispatch of sample containers to locations requested by the client. During the analytical phase of a project, Ms. Wolfe initiates sample logins to the LIMS, approves assignment of samples to sample delivery groups, reviews logins against client requests on the chain-of-custody record, and implements any changes to that request by the client. In addition, she tracks the status of a project through the laboratory to provide reports to the client, reviews the final report for content and to ensure client format requirements are met, ensures the shipment of required deliverables and coordinates the downloading of all electronic data. Upon project completion, Ms. Wolfe is available to answer questions regarding the analytical work or data packages and provides additional information to the client as requested.

Ms. Wolfe has been a Project Manager since 1990. During that time, she has gained extensive experience with projects operating under diverse regulatory requirements, agency programs, and client-specific QA plans requiring data package deliverables. Her specific experience includes work performed to requirements of RCRA, SDWA, AFCEE, NEESA, HAZWRAP, NPDES, U.S. Army Corps of Engineers, and CLP-type protocols. Ms. Wolfe is experienced with many electronic downloads including IRPIMS.

Prior to assuming the position of Project Manager, Ms. Wolfe served in the semivolatle GC section and as Manager of the inorganics section of the laboratory. In these roles, she gained experience with GC/ECD methods for the determination of pesticides, PCBs and herbicides; ICP and AA methods for the determination of metals; and various procedures for the determination of inorganics. During this time, she implemented new methods and performed technical writing. Her direct laboratory method experience includes SW-846, 40 CFR, 200-series, 300-series, and CLP methodology. Prior to joining Savannah Labs, Ms. Wolfe had two years experience as a Production and Wastewater Laboratory Specialist with a large chemical company and five years experience as a classroom science instructor.

Waste Testing and Quality Assurance Symposium
AFCEE - Analytical Services Technical Workshop

Professional Affiliations: American Defense Preparedness Association since 1994

KARRI DERR
Project Manager, Savannah Division

Academic Background: B.S. Animal Science, 1988
Iowa State University, Ames, IA

Karri Derr has been employed by Savannah Laboratories since 1988. In her current capacity as Project Manager, Ms. Derr is responsible for all phases of a client's analytical work. At the inception of a project, she serves as initial contact for the client, assists clients in identifying project goals, aids in selecting analytical methodology, provides technical support during preparation for field work, assists with the preparation of site-specific QA plans, and ensures the correct shipment of sample containers to the client. During the analytical phase of a project, Ms. Derr supervises sample logins and ensures logins agree with client chain-of-custody requests. She also provides the status of the project analytical work to clients, prepares and reviews all final reports for content and format, ensures shipment of all deliverables, and coordinates required electronic downloading. Upon project completion, Ms. Derr provides additional QC data requested by the client and answers any questions the client may have.

Ms. Derr has been a Project Manager since 1993 and has gained experience with projects performed under a number of regulatory requirements and agency programs including RCRA, SDWA, NEESA, HAZWRAP, NPDES, UST and UMTRA. In addition, she managed projects for the U.S. Army Corps of Engineers and projects requiring data packages which can be validated to the CLP SOW.

Prior to assuming the position of Project Manager at Savannah Labs, Ms. Derr served in management positions in the metals and the volatiles departments. She is familiar with GC/FID/PID/Hall methods for the analysis of volatile organic compounds, and has experience with GC/MS. Her laboratory experience also includes the determination of metals by ICP and AA. Ms. Derr's method familiarity includes SW-846, 40 CFR, 500-series, 200-series, and CLP methodology. Her laboratory knowledge of both organic and inorganic methods allows her to provide effective service to clients with a variety of needs.

SHEILA B. HOFFMAN
Project Manager, Savannah Division

Academic Background: B.S. Business, 1975
Georgia Southern University, Statesboro, GA

Sheila Hoffman has been employed by Savannah Labs since 1983, serving in a variety of capacities including her current position as Project Manager. In her role as Project Manager, Ms. Hoffman supports all phases of a client's project. Before project initiation, Ms. Hoffman helps the client identify analytical goals and decide on a choice of methodology, provides assistance associated with field activities, and coordinates the shipment of sample containers to the client. Upon sample receipt, Ms. Hoffman is responsible for the login of sample information and analytical requirements to the LIMS. During the analytical process she provides project status information to the client, and reviews the final report for content and format prior to its submission to the client. Upon project completion, Ms. Hoffman answers any questions regarding analytical results or supporting quality control data.

In addition to her functions as Project Manager, Ms. Hoffman serves as Project Coordinator for the laboratory. In this position, she provides support for Project Manager Assistants, reviews all LIMS-printed acknowledgements against client-supplied chain-of-custody records to ensure accuracy, and helps resolve any custody discrepancies or excursions.

Ms. Hoffman has held project management responsibilities since 1988. During this time, she managed projects to meet the requirements of RCRA, SDWA, and NPDES. In addition, she managed numerous projects to satisfy a variety of state agency and client-specified requirements. Ms. Hoffman's specialty is project management support of established and local clients with recurring analytical needs.

Prior to accepting full-time project management duties, Ms. Hoffman served Savannah Labs as Data Manager and Custody Manager. As Data Manager, she had responsibility for overseeing entry of both routine and rush data into the LIMS and transcription review of the entered data. In addition, she coordinated editing of client reports. As Custody Manager, she was responsible for management of all shipping, receiving, and custody functions such as sample login.

ALAN BAILEY
Corporate QA Manager, Savannah Division

Dr. Bailey holds a B.S. degree in chemistry and biology from the University of Georgia and a Ph.D. in analytical chemistry from Clemson University. Between his undergraduate and graduate studies, he worked as a chemist at Union Carbide Agricultural Products Company.

Dr. Bailey's graduate research involved new approaches to the study of chemical exchange across the sediment water interface in both marine and freshwater systems. As a graduate student, he worked two summers in collaborative research in Environmental Research Division at Argonne National Laboratories. Also, while at Clemson, he taught laboratories in freshman chemistry, quantitative analysis, and instrumental analysis, devising and implementing several new experiments for the analytical teaching laboratories.

Dr. Bailey began his association with Savannah Laboratories in 1989. As manager of the General Laboratory section of the Savannah Division, Dr. Bailey is responsible for personnel management, production, and quality control for a wide variety of analyses. The General Laboratory section includes nutrients, cyanide, microbiological parameters, BOD, COD, TOC, TOX, and many other physical and chemical parameters.

Currently, he is QA manager and, among other duties, is responsible for internal systems audits and performance evaluations, certifications, and updates/revisions to Savannah Laboratories' QA plan. Dr. Bailey is a member of the American Chemical Society and the International Association for Great Lakes Research.

VIRGINIA BAISDEN
Field Sampling Manager, Savannah Division

Ms. Baisden has B.S. and M.S. degrees in biology and more than 12 years experience in field sampling and biological and chemical analyses of samples.

Prior to her association with Savannah Laboratories and Environmental Services, Inc. in 1986, Ms. Baisden was employed by the Georgia Department of Natural Resources, Coastal Resources Division, where she was project leader of the Commercial Fisheries Program. While associated with the Coastal Resources Division, she authored several reports and publications of fisheries assessment studies. Ms. Baisden has worked with the Game and Fish Division where she identified zooplankton. She was a research assistant for the Environmental Protection Division on an estuarine water quality monitoring project.

Ms. Baisden's primary duties at Savannah Laboratories include responsibility for all biological and microbiological analyses and coordinating and supervising field sampling.

DERRICK M. SIMONS
Lab Manager, Savannah Division

Derrick M. Simons obtained a B.S. degree from the University of Florida in 1982, with majors in both chemistry and microbiology & cell science. While an undergraduate at the University of Florida, Mr. Simons worked as a research assistant in natural products chemistry.

From 1982 to 1986, Mr. Simons served as a chemist in a commercial environmental testing laboratory, where his duties included the determination of Pesticides, PCBs, Herbicides, Volatile and Semivolatile Organic Compounds by GC and GC/MS methodologies.

Mr. Simons was promoted in 1986 to GC and GC/MS group leader for both Volatile and Semivolatile Organic departments. In 1987, he was promoted to organics lab manager, supervising all GC, GC/MS, and organic extraction personnel where he obtained extensive knowledge of SW-846, 40 CFR, and CLP protocols.

Mr. Simons joined Savannah Laboratories in 1990 as Corporate Organic Manager and Savannah Division Organic Manager. His duties included responsibility for GC, GC/MS, and the organic extraction sections. As well, he was responsible for organic analytical method development, overseeing the training of new personnel, and supervising the maintenance and troubleshooting of GC and GC/MS instrumentation. He was promoted to Lab Manager in the summer of 1992. Additional responsibilities of this position include overall administrative responsibility for all technical lab personnel. As Corporate Organic Manager, he is responsible for preparing SOPs, establishing analytical and QA procedures, evaluating instrumentation, and coordinating production among the organic departments.

WAYNE ROBBINS
Air Department Manager/Project Manager, Savannah Division

Mr. Robbins has a B.S. degree in chemistry and has been trained in analytical and quality control techniques for a wide variety of procedures. He is thoroughly familiar with EPA approved procedures and has attended several EPA training schools on analytical techniques. He is currently in charge of implementing protocols for the analysis of ambient air samples and is responsible for coordinating production, preparing SOPs, and evaluating methodology for this section.

Mr. Robbins has ten years experience in the analysis of environmental samples by EPA procedures.

ANGELA M. WEIMERSKIRK
General Laboratory Manager, Savannah Division

Ms. Weimerskirk has a B.S. degree in chemistry. She began her career with Savannah Laboratories in 1986, at which time she was responsible for the determination of trace metals by ICP and the determination of mercury by cold vapor AAS. She has extensive experience in ion selective electrode determinations of fluoride, ammonia, and TKN, and several years experience with the determination of ions utilizing ion chromatography.

Ms. Weimerskirk is responsible for the organization, coordination, and operation of the Traacs 800 autoanalyzer, the ion chromatograph, and ion selective electrode instrumentation section of the laboratory. She has been involved in method development of cyanide and phenolics by autodistillation/autoanalysis. She is thoroughly familiar with EPA 600/4-79-020, SW-846, and CLP protocols.

THERESA A. HORNSBY
General Lab Supervisor, Savannah Division

Ms. Hornsby received a B.S. in biology from Georgia Southern University in 1987. Prior to joining Savannah Laboratories, she taught physical science at Screven County High School in Sylvania, Georgia and biology lab at Georgia Southern University.

Upon joining Savannah Laboratories, Ms. Hornsby performed automated colorimetric analysis on the Traacs 800 autoanalyzer. She mastered all the Traacs 800 analyses, the ion chromatograph, and manual titration of sulfite, residual chlorine, and THM formation potential.

Ms. Hornsby was promoted to laboratory supervisor in 1992. Her primary responsibilities include troubleshooting, data package colation, problem solving, and status. She is familiar with SW-846, EPA 600 Series, and CLP protocols.

ELIZABETH SICAY
General Lab Supervisor, Savannah Division

Ms. Sicay received a Chemical Technology degree from Savannah Tech in 1988. She joined Savannah Laboratories in 1989 and began work in the bacteriological section performing biochemical oxygen demand and chemical oxygen demand. Eventually, she moved to percent solids, suspended solids, alkalinity, specific conductance, color, odor, residual chlorine and pH.

In 1991, Ms. Sicay transferred to the Traacs 800 autoanalyzer. In 1993, she was promoted to supervisor of the bacteriological studies within the general department. She is familiar with SW-846, CLP protocols, and QA requirements for high level QC projects.

ERNEST WALTON
Corporate Inorganic Manager/Inorganic Manager, Savannah Division

Mr. Walton has a B.S. degree in chemistry from Mercer University and began his association with Savannah Laboratories in 1983. His major area of concentration is the analysis of metals in ground water, biological tissues, sediments and estuarine water. He has been trained in clean room sample preparation techniques and has participated in various training courses of metal analysis utilizing inductively coupled plasma spectroscopy and atomic absorption methodology. He also has experience with various automated, semiautomated, and manual nutrient analysis systems.

Mr. Walton has been trained in quality control procedures for evaluating laboratory data and has attended the Waste Testing and Quality Assurance symposium in Washington, DC. He was responsible for the initial implementation of CLP protocol for the laboratory's inorganic section. Mr. Walton also pioneered the use of software by the laboratory for the production of CLP deliverables. As well as being thoroughly experienced with CLP protocol, Mr. Walton is knowledgeable in all the inorganic methods contained in EPA 600/4-79-020 and SW-846 documents. As Corporate Inorganic Manager, he is responsible for preparing SOPs, establishing analytical and QA procedures, evaluating instrumentation, and coordinating production among the inorganic departments.

MILLICENT WILLIAMS
Volatiles GC Supervisor, Savannah Division

Ms. Williams has a B.S. degree from Hampton University with a major in biology. She joined Savannah Laboratories in 1991.

Prior to her employment with Savannah Laboratories, she was a senior laboratory technician with Ciba-Geigy Chemical Corporation, Greensboro, North Carolina. Her responsibilities included balance isolation and characterization of ¹⁴C metabolites from plants, animals, and soil samples treated with pesticides and fungicides for EPA regulation and re-registration.

Ms. Williams' current responsibilities include the analysis of volatile organic compounds by GC utilizing EPA methods. Her duties include supervision of personnel and production for a volatile GC section.

ANGELA C. STEWART
Semivolatiles GC/MS Manager/Reports Production Manager, Savannah Division

Ms. Stewart has a B.S. degree in chemistry from Armstrong State College. She initially performed the extraction and concentration of samples for semivolatile GC/MS analysis. She was then promoted to GC/MS chemist where she performed analysis utilizing EPA methods.

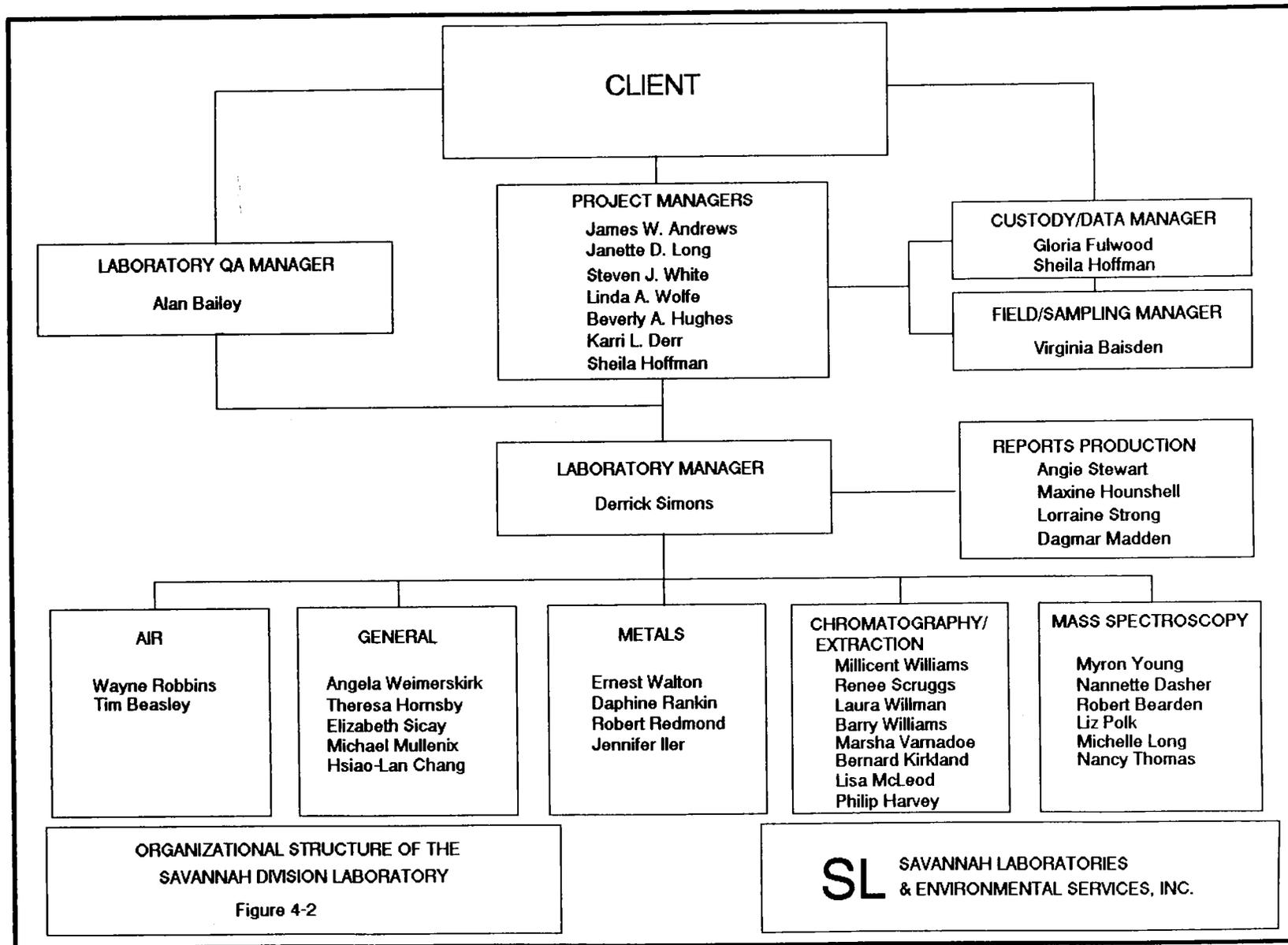
In November of 1992, Ms. Stewart was promoted to department manager where her primary responsibilities include overseeing all semivolatile GC/MS analyses. She is thoroughly familiar with all 40 CFR, SW-846 and CLP methodology. In addition, she is responsible for supervising, maintenance and troubleshooting of semivolatile GC/MS instrumentation, training new personnel, and implementing new analytical procedures for the department.

MYRON J. YOUNG
Volatiles GC/MS Manager, Savannah Division

Mr. Young has a B.S. degree in chemistry and an A.S. degree in electronic engineering. Prior to his employment at Savannah Laboratories and Environmental Services, Inc. in 1987, he was employed as a chemist with Southeast Laboratories of Atlanta, Georgia.

Mr. Young manages the GC/MS volatiles department at Savannah Laboratories and is responsible for coordinating all QA/QC requirements for that department. He is thoroughly familiar with techniques for performing analyses on many different compounds and the operation of the GC and GC/MS instrumentation used to perform such analyses. He is familiar with SW-846, 40 CFR, and CLP protocols for data evaluation.

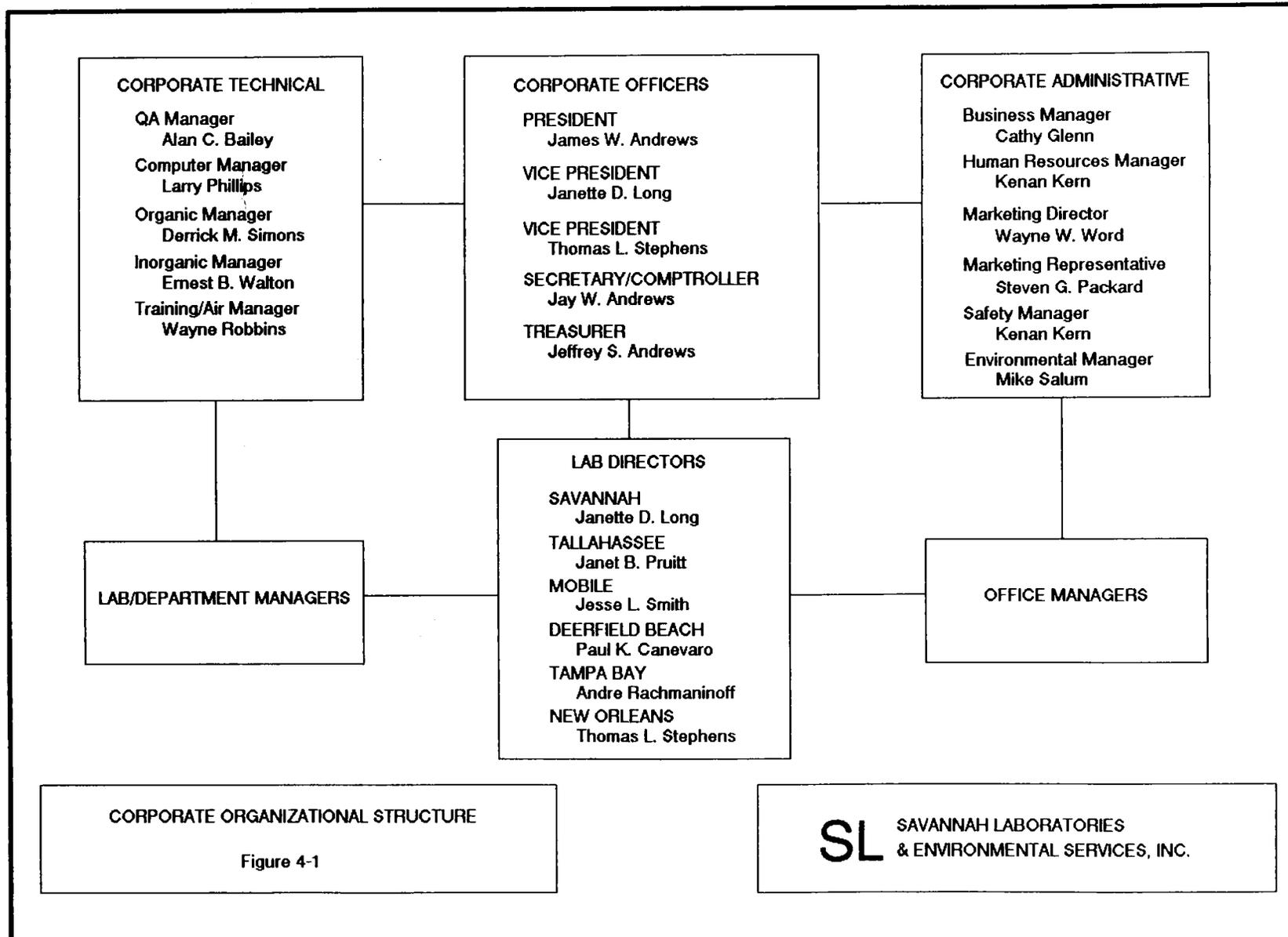
CORPORATE AND SAVANNAH DIVISION ORGANIZATION CHARTS



ORGANIZATIONAL STRUCTURE OF THE
SAVANNAH DIVISION LABORATORY

Figure 4-2

SL SAVANNAH LABORATORIES
& ENVIRONMENTAL SERVICES, INC.



SAVANNAH DIVISION EQUIPMENT SUMMARY

MAJOR LABORATORY INSTRUMENTS - SAVANNAH DIVISION

#	INSTRUMENT	MODEL	DATE ACQUIRED	* MAINTENANCE
3	ICP Units	Jarrell Ash 61E	1/9/93	MA
		Jarrell Ash 61	4/13/87	MA
		Jarrell Ash Enviro 36	10/20/90	MA
1	Mercury Cold Vapor Units	Varian VGA-76/AA20	12/23/89	IM
5	Atomic Absorption Furnace/Flame	Varian 400Z	1/15/90	IM
		Varian 400Z	12/23/89	IM
		Jarrell Ash 22/4000	12/15/92	MA
		Jarrell Ash 22/4000	6/11/92	MA
		Perkin Elmer 2380	1/12/85	IM
7	GC/MS Semivolatiles	HP 5970	1/17/90	MA
		HP 5970	3/5/90	MA
		HP 5970	5/14/90	MA
		HP 5970	12/31/85	MA
		HP 5970	4/20/85	MA
		HP 5971	8/26/92	MA
		HP 5972	4/12/92	MA
7	GC/MS Volatiles	HP 5970	7/6/87	MA
		HP 5970	7/31/91	MA
		HP 5970	9/13/90	MA
		HP 5971	8/30/90	MA
		HP 5971	6/12/92	MA
		HP 5972	3/17/92	MA
		HP 5972	7/2/93	MA
11	Gas Chromatography Semivolatiles	HP 5890 w/dual ECD	12/10/93	MA
		HP 5890 w/dual FID	10/16/90	MA
		Varian 3400 w/dual FID	3/24/92	IM
		Varian 3400 w/dual FID	12/31/87	IM
		Varian 3600 w/dual FID	12/31/87	IM
		Varian 3400 w/dual NPD	12/31/87	IM
		Varian 3400 w/dual ECD	12/31/86	IM
		Varian 3400 w/dual ECD	9/23/85	IM
		Varian 3700 w/dual ECD	2/3/89	IM
		Varian 3700 w/dual ECD	1/14/89	IM
		Varian 3700 w/ECD	7/9/88	IM

#	INSTRUMENT	MODEL	DATE ACQUIRED	* MAINTENANCE
11	Gas Chromatography Volatiles/P&T	Varian 3600 w/PID/FID/TCD Varian 3700 w/Hall/PID Varian 3700 w/Hall/FID Varian 3600 w/Hall/PID/FID Varian 3400 w/PID/FID Varian 3400 w/PID/FID Varian 3300 w/Hall/FID Varian 3300 w/Hall/FID HP 5890 w/dual FID HP 5890 w/dual FID Varian 3400 w/dual FID	6/30/93 7/9/91 5/1/87 3/24/92 1/25/91 2/16/93 7/10/89 12/15/88 8/18/90 11/19/93 2/10/92	IM IM IM IM IM IM IM IM MA MA IM
1	TOC Analyzers	Dohrmann DC80	8/14/89	IM
2	IR Spectrophotometers	Perkin Elmer 710 Buck Scientific HC-404	9/1/91 4/3/89	IM IM
3	UV-VIS Spectrophotometers	Milton Roy 301 Perkin Elmer 35 B&L 88	6/18/91 1/26/88 3/3/89	IM IM IM
3	Nutrient Autoanalyzers	Technicon Traacs 800 Technicon Traacs 800 Technicon Traacs 800	6/16/90 8/14/88 7/19/89	IM IM IM
1	HPLC Units	Waters 486 UV/470 SFL	12/17/93	IM
1	Ion Chromatograph	Dionex DX100	1/28/93	IM
2	TOX Analyzers	Dohrmann MC-3 Dohrmann MC-3	12/9/88 1/15/90	IM IM
3	Sample Concentrator	Zymark TurboVapII Zymark TurboVapII Zymark TurboVapII	9/22/92 1/28/93 1/28/93	IM IM IM

* MA = Maintenance Agreement; IM = Internal Maintenance

SAVANNAH DIVISION CAPACITY SUMMARY

SL CAPACITY SUMMARY
Samples / Week

Parameter Group	SAV
Metals (ICP Scans)	600
Metals (AA)	600
Mercury	400
Wet Chemistry	1000
Coliforms	200
Nutrients	500
COD/BOD/Solids	400
Dithiocarbamates	500
Cyanide	300
Phenolics	300
Sulfide	200
TOX	150
Petroleum Hydrocarbons (IR)	400
Oil & Grease	200
Petroleum Hydrocarbons (GC)	150
Gasoline Range (GRO)	150
Diesel Range (DRO)	150
Volatile Organics (GC)	450
Volatile Organics (GC/MS)	400
Phenols/PAHs (GC)	400
Organochlorine Pesticides/PCBs (GC)	300
Chlorinated Herbicides (GC)	260
Endothal (GC)	100
Nitroaromatics (GC)	150
Phthalate esters	200
EDB	200
Organophosphorus Pesticides	120
Alcohols, Acetates, Glycols	100
Thiocarbamates (GC)	150
Aldicarbs (HPLC)	---
Carbamate & Urea Pesticides (HPLC)	---
Diquat/Paraquat (HPLC)	---
Glyphosate (HPLC)	---

SL CAPACITY SUMMARY
Samples / Week

Parameter Group	SAV
Nitroaromatics/Nitroamines/Explosives (HPLC)	100
Nitroglycerin (HPLC)	100
Formaldehyde (HPLC)	100
PAHs (HPLC)	100
Base Neutral/Acid Extractables(GC/MS)	350
Dioxins & Furans (GC/MS)	200
TCLP (All Parameters)	100
CLP Target Compound/Analyte Lists	200
Air (SUMMA, Absorbents, GC/MS)	125
Air (EPA18 Tedlar, TPH/BTEX)	50
Drinking Water	150
Radiochemistry	
Alpha/Beta	---
Radium 226/228	---
Tritium	---

DOD FACILITIES EXPERIENCE SUMMARY

DOD Facilities for which Savannah Laboratories and Environmental Services, Inc. has served as an analytical contractor or subcontractor.

U.S. Air Force/Air National Guard

Andrews Air Force Base
Battle Creek Air National Guard
Cape Canaveral Air Force Base
Dobbins Air Force Base
Donaldson Air Force Base
Dover Air Force Base
Eglin Air Force Base
Hartsfield/FAA
Homestead Air Force Base
Lockheed Air Force Plant No. 6
McDill Air Force Base
McGhee-Tyson Air National Guard
Minneapolis-St. Paul IAP, AFR
Moody Air Force Base
Myrtle Beach Air Force Base
Norton Air Force Base
Offutt Air Force Base
Patrick Air Force Base
Phelps Collins Air Force Base
Robins Air Force Base
Shaw Air Force Base
Tyndall Air Force Base
Volk Field Air National Guard
Wright Patterson Air Force Base

U.S. Coast Guard/U.S. Marine Corps

Support Center, Elizabeth City
Trumbo Point
Tybee Island
Beaufort Air Station
Logistics Base, Albany
Recruit Depot, Parris Island

U.S. Army

Fort Benning
Camp Butner
Fort Campbell
Camp Davis
Fort Gilliam
Hunter Army Air Field
Fort Jackson
Fort McPherson
Redstone Army Arsenal
Fort Stewart
Tarheel Army Missile Plant

U.S. Navy

Andros Island Naval Station
Annapolis Naval Air Station
Cecil Field
Charleston Naval Air Station
Dallas Naval Air Station
Jacksonville Naval Air Station
Kings Bay Naval Submarine Station
Kingsville Naval Air Station
Mayport Naval Air Station
National Naval Medical Center
Naval Coastal Systems Laboratory
NAVFACENGCOM, Charleston, SC
New Orleans Naval Air Station
North Island Naval Air Station
Waldorf Naval Research Laboratory
Whiting Field Naval Air Station

SAVANNAH DIVISION CERTIFICATION SUMMARY

Savannah Laboratories & Environmental Services, Inc.
Savannah Division Certification List as of 10/03/94

Laboratory approvals and/or certifications from other agencies include:

- A. U.S. Army Corps of Engineers: Missouri River Division (MRD) Approval.
- B. U.S. Air Force: Approved for AFCEE contract analyses.
- C. U.S. Navy: Approved for NEESA/NFESC contract analyses.
- D. U.S. Department of Energy: Approved as a HAZWRAP general order contract laboratory.
- E. U.S. Department of Energy: Approved by Oak Ridge Environmental Restoration Division and EPA Region V for Portsmouth Gaseous Diffusion Plan contract analyses (FR-1).
- F. U.S. Department of Energy: Approved as a UMTRA project laboratory for inorganics.
- G. U.S. DOE Savannah River Plant: Approved for contract analyses (NQA-1).
- H. U.S. Department of Agriculture, Animal and Plant Health Inspection Service: Permit to import foreign soil.
- I. American Association for Laboratory Accreditation (A2LA): Environmental Laboratory Accreditation for potable, non-potable, solid/hazardous waste analyses.
- J. State of Delaware, Health and Social Services: Laboratory certification for drinking water analyses.
- K. State of Florida, Department of Health and Rehabilitative Services: Laboratory certification for drinking water (#87279/87412) and environmental water (#E87052/E87355) analyses.
- L. State of Florida, Department of Environmental Protection: Comprehensive Quality Assurance Plan certification (#890142G).
- M. State of Georgia, Department of Natural Resources: Laboratory certification (#1001) for drinking water analyses.
- N. State of Georgia, Department of Natural Resources: Radioactive Materials License (#GA985-1).
- O. State of Minnesota, Department of Agriculture: Laboratory certification for determination of pesticides and herbicides analyses.
- P. State of New Jersey, Department of Environmental Protection and Energy: Laboratory certification (#50769) for non-potable water analyses.

Savannah Division Certification List as of 10/03/94

Page Two

- Q. State of New York, Department of Health: Laboratory certification (#10842) for environmental analyses.
- R. State of North Carolina, Department of Environment, Health and Natural Resources: Laboratory certification (#269) for wastewater analyses.
- S. State of Oklahoma, Department of Environmental Quality: Laboratory certification (#9316).
- T. Commonwealth of Pennsylvania, Department of Environmental Resources: Laboratory certification (#68-474) for drinking water analyses.
- U. State of South Carolina, Department of Health & Environmental Control: Laboratory certification (#98001) for solid and hazardous wastes, drinking water and environmental water analyses for categories listed under Florida certification.
- V. State of Tennessee, Department of Health and Environment: Laboratory certification (#2961) for drinking water analyses.
- W. State of Tennessee, Department of Environment and Conservation: Listed on the Underground Storage Tank Approved Laboratory List.
- X. Commonwealth of Virginia, Department of General Services: Laboratory certification (#00302) for water analyses.
- Y. State of Wisconsin, Department of Natural Resources: Laboratory certification (#999819810).

STATEMENT OF QUALIFICATIONS

STATEMENT OF QUALIFICATIONS

Prepared by:

**Savannah Laboratories & Environmental Services, Inc.
5102 LaRoche Avenue, Savannah, GA 31404
Phone: (912) 354-7858 Fax: (912) 352-0165**

1.0 INTRODUCTION

Savannah Laboratories & Environmental Services, Inc. (SL) was organized in 1975 as a privately held corporation for the sole purpose of providing quality environmental analytical support to public and private sector clients. Headquartered in Savannah, Georgia, Savannah Laboratories has grown to become one of the largest environmental laboratory networks in the country by focusing on quality performance with responsive service at competitive prices. SL's network strategy, capacity, and experience enable routine handling of both large and small volume projects while maintaining project schedules and quality objectives. A summary of SL's qualifications includes:

- **Dedicated Project Management:** An experienced chemist is assigned directly to each client as a Project Manager, to assist in all phases of project planning, scheduling and data delivery, and to ensure compliance with project goals and requirements. The SL Project Manager works to personalize all aspects of SL service and to provide a consistent and convenient point of client contact.
- **Staff:** SL's staff of over 400 professional and support personnel includes many with advanced degrees as well as extensive environmental and industrial experience. Areas of expertise include analytical chemistry, mass spectrometry, microbiology, environmental chemistry, hazardous waste chemistry, air analysis, and computer science. SL employees undergo rigorous initial training and receive ongoing specialized training for their respective assignments.
- **Facilities & Equipment:** Six state-of-the-art, full service laboratories are available located in Savannah, GA; Tallahassee, Deerfield Beach, and Tampa, FL; Mobile, AL; and New Orleans, LA. Totalling over 110,000 square feet of laboratory and office workspace, each facility is custom designed to maximize efficiency, safety, and the effectiveness of our quality control program. Comprehensive state-of-the-art analytical instrumental techniques are available at each location.
- **Capacity:** SL has the ability to commit sufficient resources of personnel and equipment to meet large project or priority turnaround requirements without sacrificing project quality objectives. Our work group strategy ensures consistent delivery of quality data, personal service, and timely delivery at competitive prices while our network approach provides for backup capacity as required and enhances operating efficiencies.
- **Capabilities:** SL maintains in-house capability to perform all commonly required analyses for EPA Clean Water Act (CWA), Safe Drinking Water Act (SDWA), CERCLA/SARA (Superfund), NPDES, Resource Conservation and Recovery Act (RCRA), and Clean Air Act (CAA) programs including Appendix I, II, IX, TCLP, SPLP, Dioxins, Explosives, Radiochemistry, Delistings, Priority Pollutants, TTO, TCL/TAL (CLP 3/90, 10/91, 10/92), 503 Sludge, Waste Manifests, UST, Stormwater, SWIM and Drinking Water parameters using EPA 500 Series, EPA 600 Series, EPA SW-846 Series methods, EPA Air methods, Radiochemistry, Microbiology, and many state specific methods. Also, method validations may be performed for non-routine target compounds or to achieve non-routine reporting limits to meet specific project goals.
- **Computerized LIMS:** SL has over ten years experience (since 1984) with a computerized Laboratory Information Management System (LIMS) which manages client sample and QA data. This system also provides the capability for *transferring data* by diskette or modem to a client's computer system in a variety of standard or custom formats including: EPA, GIS, IRPIMS, ASCII, Lotus, Excel, dBASE, etc. The SL computer systems staff ensures consistent system operation, develops new programs as required, and is available to design computer downloads to meet client needs.

1.0 INTRODUCTION (cont.)

- **Data Package Deliverables:** SL is able to perform analyses according to specific program requirements such as CLP Statement of Work (3/90, 10/91, 10/92), NEESA/NFESC, HAZWRAP, AFCEE, USACE-MRD, etc. and provide data packages or CLP-type deliverable formats for non-CLP parameters which can be validated by the EPA, state or corporate QA concerns. Data packages may also be provided in other specific report formats as defined by the client.
- **Quality Assurance:** A single comprehensive network-wide quality assurance program is supported by full-time QA staff at each location to monitor and ensure adherence to all required procedures. The program elements include sample custody, method compliance, QC acceptance, data production and validation, document control, performance testing, and internal and external systems audits. The QA program is monitored in the work group, at the lab division and at the corporate level to ensure the consistency and reliability of data produced at all SL facilities.
- **Certifications & Approvals:** The SL network of labs maintains approval or certification by many states (Alabama, Connecticut, Delaware, Florida, Georgia, Louisiana, Minnesota, New Jersey, New York, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Virginia, Washington, and Wisconsin) and government agencies including: on-site inspections by EPA Regions IV and V, project specific approvals by EPA Regions II, III, IV, V and VII, DOE HAZWRAP approval, DOE approval for the Portsmouth Gaseous Diffusion Plant Site, ANSI/ASME NQA-1 approval for the Savannah River Site (WSRC), U.S. Army CE-MRD, U.S. Navy NEESA/NFESC, and U.S. Air Force AFCEE approvals, U.M.T.R.A. for Uranium Mine Tailing Remediation Action Analysis, U.S.G.S. Analytical Evaluation Survey, Board Certified Analysts in Georgia, chemists licensed in Puerto Rico, and A2LA accreditation for potable, non-potable and solid/hazardous waste analyses. Additionally, each lab maintains many local and client specific approvals and participates in the EPA performance studies for the drinking water, environmental, and NPDES programs.
- **Imports/International:** SL is approved by the USDA Animal and Plant Health Inspection Service to import soil from foreign countries to Savannah Laboratories' facilities for analysis and has supported projects from Caribbean, Central American, South American, and Asian countries.
- **Stability:** As the 4th largest network nationally, SL's stability is demonstrated by a reputation for consistent high quality analytical performance; by a regular base of satisfied clients; by consistent, stable and qualified staff; and by continuing expansion of network locations.
- **Experience:** SL has developed extensive corporate and individual experience in providing analytical support services through performing thousands of successful drinking water, groundwater, soil, air, and hazardous waste projects including CERCLA (Superfund), UST, DOD, DOE, and RCRA site assessments, remedial actions, emergency responses, and many routine monitoring programs.
- **References:** SL provides analytical support services to many major consulting firms, government, industry, petroleum and chemical companies nationwide and internationally.

Savannah Laboratories takes great pride in providing *personalized laboratory services*. We commit to each client to become a partner in the process of achieving project goals through customizing our services as required to meet client needs. At Savannah Labs, client satisfaction is our greatest concern.

2.0 PROJECT MANAGEMENT

Savannah Laboratories assigns a designated SL Project Manager to serve as the primary point of contact and coordinate the resources and activities of Savannah Laboratories to meet client needs. As a *senior level chemist* with many years of laboratory experience, the Project Manager is available to assist the client with site specific work plans, QA Project Plans, sampling and preservation techniques, parameter and method selections, final data review, and post-project discussions. Their EPA methods experience enables them to assist clients in planning strategies to minimize the impact of site specific matrix problems, to achieve aggressive detection limit requirements when possible, and when necessary to document for regulatory agencies the limitations of the compliance required methods in relation to specific site requirements.

Specific duties of the Project Manager include:

- (1) Serve as the *primary contact* with the client on a day-to-day basis for scheduling, project planning, budgeting, and result submission.
- (2) *Schedule and track* all analyses and QC data via the Laboratory Information Management System.
- (3) *Review* all sample and QC results and *prepare* the final reports.
- (4) *Coordinate downloading* of data into the specified format for transferring to client's computer.
- (5) *Reconcile* invoices with client format and contract requirements.
- (6) *Evaluate* results with the client's personnel as required to ensure project goals have been met.
- (7) *Address* any technical concerns which may arise and respond with appropriate corrective action.
- (8) *Serve* as an experienced court witness and provide responses to regulatory agencies' inquiries concerning results and QA.

The SL Project Manager will spend the time necessary to understand the special requirements of each client project. *Experience proves* that the closer we work together in project planning, the more successful we can be at executing the plan, achieving the project's goals, and meeting the client's needs.

3.0 STAFF AND OPERATIONAL CAPACITY

The Savannah Laboratories network is uniquely organized to provide consistent quality service throughout our lab divisions while our workgroup strategy ensures timely performance at fair and competitive prices. A key element of this strategy is the selection of the SL Project Manager and primary support facility as the principal supplier of project and contract management services. The other SL network lab divisions are available to provide additional capacity and capabilities should they be required and approved by the client and can be coordinated through the SL Project Manager.

Each location is staffed by dedicated and experienced personnel who have met or exceeded all training requirements for their assignment. Many have advanced degrees in their respective disciplines as well as years of experience with EPA analytical methods. Professional development is also provided for through in-house or external training and periodic cross-training assignments.

Savannah Labs organization charts may be located in the network Comprehensive QA Plan, Section 4, or updates provided upon request.

3.0 STAFF AND OPERATIONAL CAPACITY (cont.)

The number of personnel assigned to each project will be dependent on the volume of analytical requirements. Savannah Laboratories has over 400 full-time managers, chemists, technicians and support staff. SL personnel operate on flexible time schedules as required by project deadlines and turnaround times. Routine analyses are provided on a 2-3 week turnaround basis. Rush analysis can be provided on a one week or 24-72 hour basis. Samples that require rush analysis should be scheduled with the SL Project Manager as early as possible to reserve lab capacity. Samples should be clearly marked as RUSH with the agreed upon delivery schedule noted on the task order or chain of custody.

Each facility operates on a multi-shift basis as necessary to meet project scheduling and holding time requirements up to three eight-hour shifts daily. To facilitate convenient sample receipt, SL sample custodians accept samples Monday through Friday during laboratory hours of operation (8:00 a.m. to 6:00 p.m.) and after business hours by appointment. Sample shipments are also routinely received each Saturday by a sample custodial staff member. Samples can be processed for analysis during non-routine business hours provided prior arrangements are made with the project manager, laboratory manager, or laboratory director.

State-of-the-art automation equipment is utilized, as appropriate per the methods, to operate each instrument at maximum efficiency. Provisions for rush samples, re-runs, and instrument maintenance are made in the scheduling process to ensure sample hold times and project deadlines are met. The laboratory director at each location monitors sample processing and scheduling using our computerized Laboratory Information Management System (LIMS). If capacity problems are identified or should instrument failures occur, sample processing may be rescheduled at another SL Division (with client approval) to ensure that holding times and project objectives are met.

The SL network organizational strategy, capacity and experience enable SL to routinely handle both large and small volume projects on multiple matrices while maintaining project schedules and quality objectives. Laboratory SOPs, and the SL network Comprehensive QA Plan are standardized at all six laboratory divisions and each location is staffed with highly qualified and trained personnel. Intralab QA audits (facility and blind audit samples) are made quarterly to ensure comparable results. Greater than 95% of all project orders are routinely completed within the agreed upon turnaround times; however, should unforeseen problems delay project delivery (such as matrix problems that may require additional sample clean-up procedures or additional dilutions prior to result submittal), the SL project manager will notify the client as soon as possible in order to adjust project scheduling.

Field sampling crews, trained in accordance with EPA and OSHA standards, are available for multi-media groundwater, surface water and shallow soil sampling assistance where this may be required.

Unused samples may be stored, returned or disposed of according to the agreement reached during the pre-project planning discussion with the SL Project Manager and will meet client requirements. Health & Safety, Waste Minimization and Hazardous Waste control procedures comply with OSHA, DOT, and EPA requirements.

SL is in compliance with all federal and many local project EEO requirements and has in place aggressive Affirmative Action, Drug Free Workplace, and employee training programs.

4.0 FACILITIES AND EQUIPMENT

SL's modern facilities in Savannah, GA; Tallahassee, Tampa, and Deerfield Beach, FL; and Mobile, AL provide more than 110,000 square feet of chemical and biological laboratory, data processing, and office space. Savannah division, the SL corporate headquarters and largest lab facility encompasses over 35,000 square feet of custom designed laboratory space and is staffed with over 180 professional and support personnel. The Tallahassee, Florida division facility includes 21,000 square feet of laboratory space staffed with 80 professionals. The 20,000 square-foot Deerfield Beach, Florida facility, serving southern Florida, has a staff of 50 professionals while the Tampa, Florida facility consisting of 12,000 square feet of laboratory space, has a staff numbering 45. The Mobile, Alabama facility comprises 12,000 square feet of laboratory space and is staffed with 45 professional staff members. The newest lab division is New Orleans, LA and will encompass 10,000 square feet and a projected staff of 35. These laboratories are custom designed to accommodate modern instrumentation, to minimize employee exposure, and to reduce the potential of sample contamination. For example, the volatile organics (VOC) analytical areas are completely isolated from the semivolatile extraction areas. This design prevents sample contamination by methylene chloride, acetone, carbon disulfide and other solvent vapors.

Laboratories are equipped with a total of 29 Gas Chromatography/Mass Spectrometry systems, 73 Gas Chromatographs, 21 Atomic Absorption Spectrophotometers, 9 Inductively Coupled Plasma Spectrometers, 6 High Performance Liquid Chromatographs, and 4 Nutrient Autoanalyzer systems (see Table 1). These modern instruments are equipped with autosamplers and computers that allow 24-hour production and data processing. For trace level analyses, a filtered air class 100 clean bench is available. An isolated sample preparation room with a separate air conditioning/heating system has been developed for dioxin and other hazardous substance testing.

SL's operations are highly computerized in order to efficiently collect and archive data and QA results. Over 100 individual computers are used in our data generation and archiving process. Two mainframe computers at Savannah and Tallahassee locations are programmed with a Laboratory Information Management System (LIMS), which links the Savannah, Tallahassee, Tampa, Deerfield Beach, Mobile, and New Orleans facilities via dedicated multiplex telephone modems. The LIMS facilitates sample scheduling and tracking, processing results and quality control data, preparing reports and invoices, and data archiving. This system allows project managers and quality assurance supervisors at the facilities to monitor quality control samples, and to document sample chain of custody and holding time requirements. Procedures and equipment are available for modem or floppy diskette transfer of data to client computer systems.

**TABLE 1
A SUMMARY OF AVAILABLE ANALYTICAL EQUIPMENT**

Type of Analyses	Major Equipment Available*
Purgeables by Gas Chromatography/ Mass Spectrometry (GC/MS)	Fourteen GC/MS systems (Hewlett Packard Model 5970, 5971, 5972) equipped with Tekmar LSC purge and trap concentrator and mass spectral data base libraries.
Purgeables by Gas Chromatography (GC)	Thirty-four gas chromatographs (Varian 3300, 3400, 3600, 3700, HP5890) equipped with ECD, PID, FID and Hall detectors and Tekmar LSC purge & trap sample concentrator.
Acid and Base Neutral Extractables by GC/MS	Fifteen GC/MS systems (Hewlett Packard Model 5970, 5971, 5972, Varian Saturn 3) equipped with autosamplers and mass spectral data base libraries and computers.
Semivolatiles, Pesticides, PCBs and Herbicides by GC	Thirty-nine gas chromatographs (Varian 3400, 3600, 3700 and HP 5790) with ECD, TCD, NPD, and FID detectors.
Metals by Atomic Absorption (AA) Spectroscopy	Twenty-one atomic absorption units (Perkin Elmer Models 2380 and 500, Jarrell Ash 22, and Varian 400 Zeeman) with HGA furnace and auto samplers; five mercury (cold) vapor analyzers; four AA-hydride systems.
Metals by Inductively Coupled Plasma (ICP) Spectroscopy	Nine Inductively Coupled Plasma units (Jarrell Ash Model 61, 61E, and Enviro 36).
High Performance Liquid Chromatograph (HPLC)	Six Waters HPLC systems consisting of Waters 501 pumps with Waters Model 481, 484, 486, and 490E variable UV wavelength detectors, Kratos Model 980 Programmable Fluorescence Detector and two Waters 470 Scanning Fluorescence Detectors.
Toxicity Characteristic Leaching Procedure (TCLP), Synthetic Precipitation Leaching Procedure (SPLP), and Extraction Procedure Toxicity (EP TOX)	Eighteen ZHE extraction devices and three six-place capacity rotary ZHE extractors. Five eight-place capacity rotary extractors for nonvolatile extractions.
Extractions and Sample Preparation Automation	Two ABC and Two Benchmate GPC's, eleven Zymark Turbovap II concentrators, multiport SPE extractors.
General and Wet Chemistry	Dionex Model DX100 Ion Chromatograph, Two OI Total Organic Carbon analyzers, Dorhmann TOC analyzer, Two Dorhmann TOX analyzers, Three TRAACs 800 Automated Nutrient Systems, One Lachat Quickchem AE, Turner Model 430 spectrofluorometer, Bausch and Lomb Model 88 UV-Vis spectrophotometer, Perkin Elmer Model 35 spectrophotometer, Beckman scanning UV spectrophotometer, Fifteen pH and specific ion analyzers, One Perkin Elmer Model 710 IR spectrophotometer, Five Buck Scientific HC-404 analyzers.
Radiochemistry	Tennelec Gross Alpha/Beta Counter and Beckman LS6500 Scintillation Counter with autosamplers, two Ludlam 182 Scalers, two Ludlam 2000 Radon Flask Counters.
Air Analysis	Nutech Volatiles in Air System, SUMMA Canisters, Tedlar Bags, and various absorbents. HP 5970 GC/MS, Varian 3600 GC/TCD, FID, PID and 3400 GC/PID, FID or other as needed.
* In addition to the specific major equipment listed above, the laboratories are equipped with a comprehensive supply of both general and specific equipment and glassware for performing all common EPA approved methods and procedures.	

5.0 AVAILABLE ANALYTICAL METHODS

When available, EPA approved methods are used for all analyses. The primary methods used by SL are described in:

- (1) *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, SW-846, Third Edition*;
- (2) *EPA CLP SOW (3/90, 10/91 and 10/92)*;
- (3) *Guidelines Establishing Test Procedures for Analysis of Pollutants (40 CFR Part 136)*;
- (4) *Methods for Chemical Analysis of Water and Wastes, March 1983 (EPA 600/4-79-020)*;
- (5) *Methods for the Determination of Organic Compounds in Drinking Water, December 1988 (EPA 600/4-88/039)*;
- (6) *Compendium of Methods for the Determination of Organic Compounds in Ambient Air, June 1988 (EPA 600/4-89/017)*.

Written SOPs have been prepared, methods have been validated and Method Detection Limits (MDL) determined for each analytical method as outlined in the SL Comprehensive Quality Assurance Plan. Occasionally client needs may extend beyond the scope of these routine methods. SL offers several levels of method development and validation to fulfill these requirements.

The following sections summarize our operating and QA procedures for specific parameters.

5.1 Purgeables by GC/MS

Purgeables are analyzed utilizing purge and trap and GC/MS instruments according to 500, 600, 8000, and CLP SOW series methods. Method detection limit studies have been performed to ensure the ability to meet method recommended quantitation limits.

Dedicated instrumentation is on line to screen samples requiring purgeables analysis. Screening procedures ensure that samples are analyzed with the appropriate method protocol and reduces the risk of instrument contamination which maximizes sample throughput.

Compound identifications are performed by an experienced mass spectroscopist. Qualitative and quantitative procedures are performed as referenced in the method. GC/MS instruments are calibrated daily by procedures in each method. A laboratory blank, matrix spike, matrix spike or sample duplicate are run daily or with each batch of samples. At least one check standard is analyzed with each batch. Surrogate and internal standard spikes are added to all samples and recovery rates for surrogates reviewed. Field and trip blanks are analyzed as samples (if supplied).

GC/MS systems are equipped with data stations that are capable of acquiring continuous mass scans and storing all data. They are equipped with split/splitless injection and GC to MS interfaces for use with capillary and packed columns. Unknown spectra may be searched against the EPA/NIST mass spectral data base and reviewed by the analyst to provide tentative compound identifications.

5.0 AVAILABLE ANALYTICAL METHODS (cont.)

5.2 Purgeables by GC/Hall-PID-FID

Gas chromatography (GC) Methods in the 500, 600, and 8000 series are used for analysis of purgeables. Purgeables are absorbed onto a purge and trap unit and desorbed into a GC column with a Hall, PID or FID detector. Method detection limit studies have been performed to ensure the ability to meet method recommended quantitation limits. QC procedures are similar to those for purgeables by GC/MS.

5.3 Acid, Base Neutral, and Pesticide Extractables by GC/MS

Extractables are analyzed by GC/MS 500, 600, 8000, or CLP SOW series methods. Water and soil samples are extracted with methylene chloride. The extracts are injected via an autosampler into a GC/MS that is equipped for extractable semivolatile analyses.

Method detection limit studies have been performed to ensure the ability to meet method recommended quantitation limits. Instrument specifications, spectral interpretations, library searches, instrument calibration, and quality control are performed according to the requirements of the methods and, as summarized above, for purgeables (Section 8.1).

5.4 Semivolatile and Pesticide Extractables by GC

All the pesticide, PCB and semivolatile extractables are analyzed by gas chromatography methods in the 500, 600, 8000 and CLP SOW series methods. Samples for pesticide extractables are extracted with methylene chloride, exchanged into hexane, as appropriate, and injected into a gas chromatograph equipped with either an electron capture (ECD), flame ionization (FID), or nitrogen phosphorus (NPD) detector. In addition, many EPA 500/600/8000 series methods have been validated for analysis of nonroutine pesticides by HPLC and specific detector GC methods. GPC and other sample cleanup techniques may be used to reduce sample matrix interferences and for CLP 3/90 SOW protocol projects.

A laboratory blank, matrix spike, and matrix spike or sample duplicate are run daily or with each batch. At least one check standard is analyzed with each group of samples. Surrogate or internal standard spikes are added to all samples and recovery rates for surrogates reviewed. Method detection limit studies have been performed to ensure the ability to meet method recommended quantitation limits.

5.5 Herbicides

As per Method 8151, herbicides are extracted with diethyl ether, methylated, and the resulting methyl esters are analyzed by gas chromatography (electron capture detector). Quality control procedures are described in Method 8151 and are similar to those described above for pesticides by Method 608/8080. In addition to Method 8151, several herbicide methods are performed at SL using HPLC procedures. Method detection limit studies have been performed to ensure the ability to meet method recommended quantitation limits.

5.0 AVAILABLE ANALYTICAL METHODS (cont.)

5.6 Metals

Metals are analyzed by atomic absorption spectroscopy or inductively coupled plasma spectroscopy (ICP), according to methods in EPA 600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*, the 3rd Edition of EPA's SW-846 or EPA CLP SOW 3/90, 10/91.

QC procedures for metal include: daily preparation of a standard curve with five data points for each metal; analysis of a blank and standard after every analytical group; analyses of reagent (sample preparation) blanks; analyses of one spiked sample for every 10 samples (10%); use of automatic background correction on AAS-furnace techniques. Method detection limit studies have been performed to ensure the ability to meet method recommended quantitation limits.

5.7 Air Analysis

Procedures are available for the analysis of air samples from a variety of sources. Ambient air samples can be analyzed for volatile compounds using EPA Compendium Methods TO1 and TO2 techniques. These methods involve the collection of volatile compounds from the air on to a sorbent material from which they are thermally desorbed and analyzed utilizing GC or GC/MS techniques. Whole air samples can also be collected for volatile compounds in Summa-passivated canisters and analyzed by GC/MS using Method TO14. Volatile compounds and other gases collected in Tedlar bags using EPA Method 18 (EPA Stationary Specific Methods-Section 3.16) can be analyzed employing GC or GC/MS techniques. Semi-volatile compounds can be determined in ambient air utilizing the EPA Compendium Methods TO4-TO13. Air samples can be collected on various media including PUF (polyurethane foam) and PUF/XAD-2 resin sampling media. The semi-volatile compounds are extracted from the PUF sampling media using soxhlet extraction methods and are analyzed using GC/MS (BNA) and GC/Electron Capture (Pesticides/PCBs). Air analysis for volatile and semi-volatile compounds is also available utilizing NIOSH and OSHA procedures.

5.8 Additional Services

Additional procedures in EPA 600/4-79-020, 40 CFR Part 136 and SW-846 methods are performed in-house by SL. Methods include Cyanide by Method 9010/9011/9012 or CLP, ion chromatography, automated Technicon nutrient system and specific ion techniques for inorganic anions; wet chemistry techniques; high performance liquid chromatography (HPLC) procedures; conventional gas chromatography methods for phenolics (604/8040), phthalates, PAHs (610/8100), organophosphorus pesticides (622/8141); UV, IR and fluorescence techniques; microbiological procedures and dioxins by GC/MS Methods 613 and 8280, explosives by USATHAMA and SW-846 Method 8330, and Gross α/β , Radium 226/228 and Tritium radiochemistry analysis of waters, soils and waste materials. Method detection limit studies have been performed to ensure the ability to meet method recommended quantitation limits.

5.9 SOPs

Detailed SOPs may be presented for review upon request.

6.0 CERTIFICATIONS, ACCREDITATION AND PROGRAM APPROVALS

As part of our quality assurance program, Savannah Laboratories participates in many governmental and private laboratory certification and approval programs. Many of these require periodic analyses of blind quality assurance samples and on-site inspection of facilities, records and procedures.

One or more of Savannah Laboratories' Divisions has received certification, accreditation, approval or a successful on-site or blind sample audit from the agencies listed below. The certification number or date of initial approval is shown in parenthesis.

A2LA (1993)	Minnesota MDA (1992)
Alabama DEM (40030, 40360)	New Jersey DEPE (50769)
Connecticut DHS (PH-0126)	New York DOH (10842)
Delaware HSS (1993)	North Carolina DEM (269, 12703, 389)
DOE - HAZWRAP (1990)	Oklahoma DEQ (9316)
DOE - Oak Ridge Environmental Restoration Division (1991)	Pennsylvania DER (68-471, 68-474)
DOE Savannah River Plant-WSRS (ANSI/ASME NQA-1 Approval) (1992)	Puerto Rico Licensed Chemists Radioactive Materials Licenses for Florida and Georgia
EPA Region II	South Carolina DHEC (98001, 96005)
EPA Region III	Tennessee DOHE (2961)
EPA Region IV (1984)	Tennessee DOC (UST Approval) (1989)
EPA Region V (1989)	U.M.T.R.A. (Uranium Mine Tailing Remediation Action Analysis)
EPA Region VII (1990)	U.S. Air Force (AFCEE) (1992)
Florida DEP (890142G)	U.S. Army COE (MRD) (1990)
Florida HRS (E87052/87279), (E87355/87412), (E81005/81291), (E87089/87357), (E86221/86371), (E84282/84385)	U.S. Navy (NEESA/NFESC) (1988)
Georgia EPD (1001)	U.S.D.A. (Soil Import Permits)
Georgia Board Certified Analysts	U.S.G.S. Analytical Evaluation Survey
Louisiana DHH (93-10)	Virginia GSA (00302)
	Washington DOE (C146)
	Wisconsin DNR (999819810)

Additionally, each division holds many local and client specific approvals, and is active in states which do not have environmental or hazardous waste approval programs to date.

7.0 COMPUTERIZED LIMS

7.1 SAMPLE TRACKING

The computerized Laboratory Information Management System (LIMS), a key element of the QA/QC program, is outlined in Figure 1. It provides a computerized mechanism for storing field and login information, tracking sample holding times, scheduling and preparing laboratory work sheets, storing results and QC data, reviewing results and relating them to their corresponding QC data, and printing reports (results and QC data) and invoices. Special instructions to communicate program, project, or sample specific QA or processing information is distributed to each chemist or workgroup through LIMS worksheet notes. This automated system ensures laboratory control of client requirements and permits SL to remain flexible in meeting project needs.

7.2 REPORTING OF RESULTS

All reports are prepared by a SL Project Manager highly experienced in evaluating analytical data using both objective and subjective techniques for validation of results. This project management review is facilitated by the computerized Laboratory Information Management System (LIMS) (see Figure 1).

Outliers or other abnormal values are carefully scrutinized, and samples are reanalyzed if the abnormalities cannot be explained. In cases where results from spiked samples suggest interferences, attempts are made to resolve the interference problem, or alternate analytical procedures may be used with client approval. If the interference problem cannot be resolved, it is noted on the report. Reports are customized to meet project requirements. Many standard formats for both hard copy and electronic deliverables are available and may be selected or modified as required during the preproject planning discussion with the SL Project Manager.

7.3 COMPUTERIZED DATA DOWNLOADS

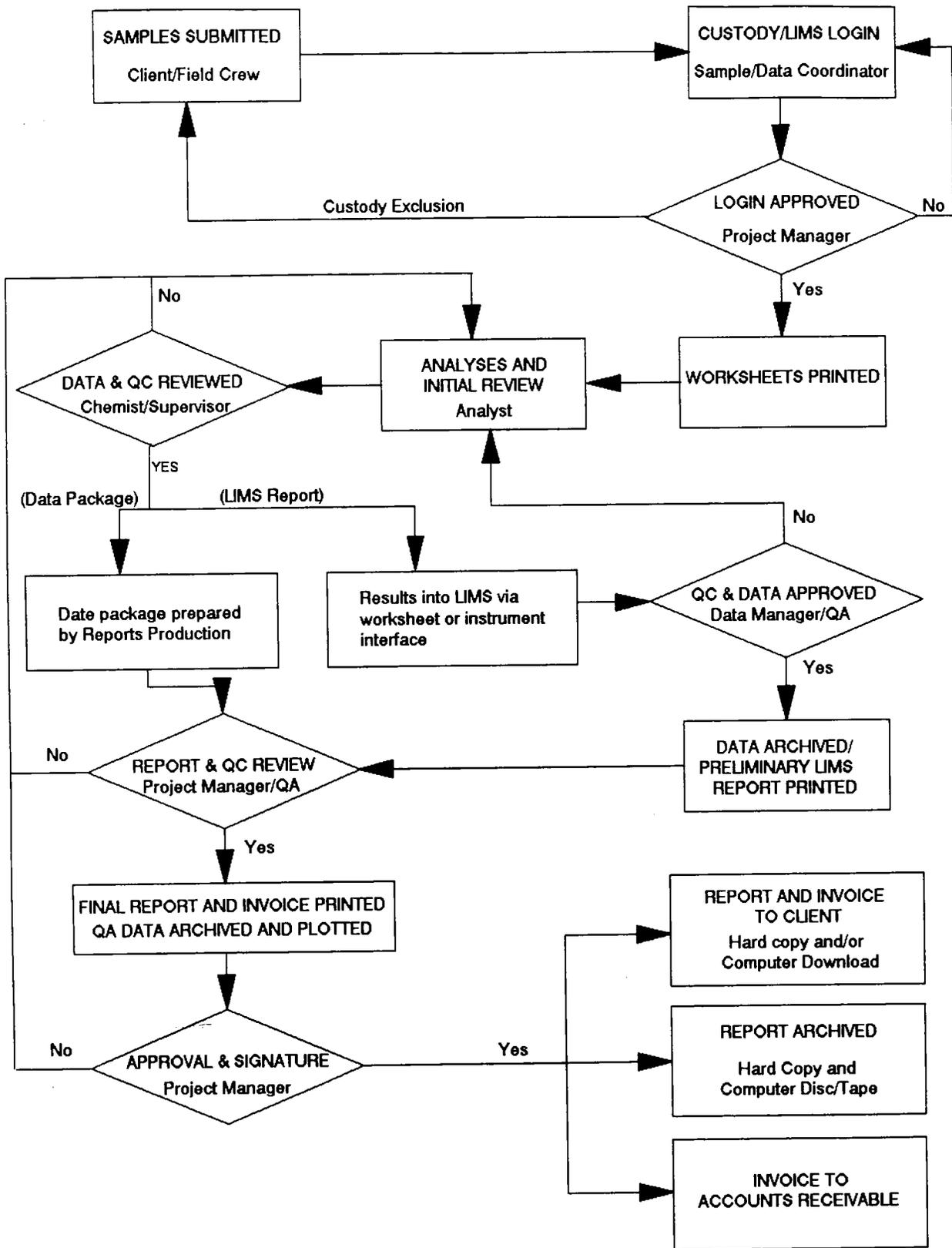
Electronic deliverables may include diskette or modem downloads in formats including: EPA, GIS, IRPIMS, ASCII, Lotus, Excel, or dBASE, etc. Additionally, electronic deliverables may be custom formatted to meet client information or format requirements.

These requirements should be defined and agreed upon prior to the commencement of project work. Laboratory generated data is thoroughly reviewed prior to preparation of electronic or diskette deliverables. The download process includes both electronic and logical error check routines to confirm the data files delivered are consistent with the client's format and data content request. A signed hardcopy report will be provided with all electronic or diskette deliverables and an electronic and documentation audit trail will be maintained of each download event.

In order to ensure data integrity and security, all files selected for data downloads are first transferred from the LIMS to an isolated PC computer system. Access to download files is then controlled via required matches of log on sequences and confidential passwords. The entire download process is regularly reviewed and maintained by our computer department for system performance.

FIGURE 1

FIGURE 1 - FLOW CHART OF SL COMPUTERIZED LIMS



LIMS:10.20.94:1

8.0 QUALITY ASSURANCE

Savannah Laboratories & Environmental Services, Inc.'s QA procedures follow the requirements of EPA *Handbook for Quality Control in Water and Wastewater Laboratories* (EPA 600/4-79-019). Quality Assurance/Quality Control (QA/QC) procedures form the foundation for every phase of sample handling and analysis. Strict adherence to the program is required during all phases of a project, including: presampling discussions, sample collection, preservation, transportation and storage, sample logins and tracking, laboratory analysis, data validation and reporting of results and QA/QC data. The SL Network Comprehensive Quality Assurance Plan provides additional information on the SL QA program including a Statement of Policy (CQAP 3.0), Organizational Strategy (CQAP 4.0), routine QA objectives (CQAP 5.0), internal and external systems audits (CQAP 14), and other operational concerns.

Each division is staffed with full-time dedicated QA Managers who ensure QA standards are being followed and QC coordinators who ensure each project's quality objectives are achieved. All project and QC data are processed by our computerized Laboratory Information Management System (LIMS). The QA Manager, QC Coordinators and the Project Manager have ready access to all project and QC data for each sample logged into the laboratory. Internal QA compliance audits and periodic external systems audits ensure consistent adherence to SL, major programs, and client specific requirements.

9.0 STABILITY

Savannah Laboratories & Environmental Services, Inc. is the largest environmental laboratory in the southeastern United States and the 4th largest network nationally. SL 1993 revenues were in excess of \$30,000,000. The example projects described in Section 12.1 indicate SL's capability to handle numerous large projects. During each of the 19 years of operation, SL has been profitable and has reinvested the profits into equipment and facilities. There are currently no long-term debts nor contingent liabilities pending. All facilities and equipment are fully insured at replacement cost, and \$5,000,000 of general liability and \$5,000,000 of professional liability insurance are maintained by an "A" rated carrier.

In an environment where acquisition and reorganization seem to be the norm, SL has demonstrated the fiscal responsibility of providing consistent high value services to all clients. Sufficient reserves are maintained to allow SL to ensure client satisfaction with all projects and to work to resolve any differences which arise.

10.0 EXPERIENCE AND CAPABILITIES BY PROGRAM

Savannah Laboratories & Environmental Services, Inc.'s 19 years experience in providing environmental analytical services includes:

- RCRA**
- Quarterly groundwater monitoring support for hundreds of RCRA permitted sites including thousands of monitoring well analyses.
 - Primary contract lab for Florida DEP RCRA programs.
 - Laboratories equipped to provide all SW-846 defined tests including:
 - Appendix I, II, IX and Priority Pollutant Lists
 - Toxicity Characteristic Leaching Procedure (TCLP)
 - Synthetic Precipitation Leaching Procedure (SPLP)
 - Groundwater Sampling per TEGD Methodology
 - Dioxins/dibenzofurans by Low Resolution GC/MS Methods
 - Air Analysis for CAA and SARA Occupational and Atmospheric Testing
 - Explosive Residues Analysis using EPA/THAMA Methods
 - Analytical support for hundreds of RCRA remedial investigations/site cleanups.
 - Laboratories approved by Chemical Waste Management for manifest analyses.
 - Analytical support for numerous DELISTING projects for organic and inorganic contaminants.
- CERCLA**
- Analytical support for more than 80 CERCLA PRP investigations and site cleanups.
 - Contract lab for Florida DEP CERCLA program.
 - Routinely provide CLP data packages per 3/90, 10/91, or 10/92 protocols or CLP-type data packages that have been reviewed and accepted by EPA Regions II, III, IV, V, and VII. (Regions IV and V have conducted on-site reviews of SL facilities and procedures.)
- DOD/DOE**
- Approval for hazardous waste analytical support by the following U.S. governmental agencies:
 - U.S. Army Corps of Engineers (MRD)
 - U.S. Navy NEESA/NFESC/NAVY CLEAN Programs
 - DOE Hazardous Waste Remedial Action Program (HAZWRAP)
 - U.S. Air Force AFCEE Program
 - DOE Approval for Portsmouth Gaseous Diffusion Plant Analyses
 - ANSI/ASME NQA-1 Approval for Savannah River Site Analyses
 - Analytical support services on over 60 DOD/DOE facilities.

10.0 EXPERIENCE AND CAPABILITIES BY PROGRAM (cont.)

- UST**
- Contract lab for Florida DEP UST Program.
 - Analytical support for Underground Storage Tank projects for nine major oil companies.
 - Laboratory procedures meet the specific UST analytical and certification requirements of many states.
- NPDES**
- Laboratories equipped to provide all common analyses in 40 CFR, Part 136 and provide NPDES permit compliance analytical testing for numerous clients.
 - Participation in EPA Performance Studies for NPDES Permit Compliance analyses.
- SDWA/
CWA**
- Laboratories having equipment and procedures in place for the recently modified Clean Water Act (CWA) analytical methods (including capillary GC/MS and HPLC) which meet EPA and state requirements for drinking water and groundwater programs.
- CLEAN
AIR ACT**
- Analytical support for hundreds of remedial systems, ambient and source monitoring of air samples by NIOSH, EPA (TO-1 through TO-14), EPA-18, and CLP methods.
 - Capabilities include GC/MS, GC/TCD, GC/FID, GC/PID, SUMMA canisters, Tedlar bags, and various absorbents as per method and target analyte requirements.

10.0 EXPERIENCE AND CAPABILITIES BY PROGRAM (cont.)

10.1 EXAMPLE MAJOR PROJECT REFERENCES

Homestead AFB

U.S. Army Corps of Engineers
through a Major A/E Consultant

Feb. - June, 1993

\$280K

Project Description of Firm's Responsibility

Savannah Laboratories & Environmental Services, Inc. provided laboratory analysis of soil, groundwater and waste materials for TCL organics, TAL inorganics and RCRA hazardous waste characteristics in support of a Remedial Facility Investigation at the Homestead AFB in South Florida. All procedures and methods used were EPA, CE-MRD and State of FL-DEP approved. Hardcopy reports included results and QC for QA review and approval on all landfill and waste samples. CLP forms and supporting documentation were also provided for samples requiring subsequent data validation. Additionally, computerized data files were generated to provide results and QC formatted according to AFCEE-IRPIMS requirements for submittal to the U.S. Air Force's data base GIS program.

Homestead AFB

U.S. Army Corps of Engineers
through a Major A/E Consultant

Feb. - Sept., 1993

\$140K

Project Description of Firm's Responsibility

Savannah Labs provided analytical laboratory testing support for an area Remedial Investigation and Risk Assessment at Homestead AFB, FL. Assistance was provided for site specific work plan and QA project plan development. Analyses performed included the petroleum indicators, volatile organic aromatics, polynuclear aromatic hydrocarbons and total petroleum hydrocarbons; surface water contamination indicator parameters; and TCL/TAL list parameters. Data reports produced included SL-LIMS computer generated reports of results and QC for QA review and approval, and CLP SOW 3/90 reports for subsequent data validation.

Fort Eustis

U.S. Army Corps of Engineers
through a Major A/E Consultant

May, 1993 - Current

\$190K

Project Description of Firm's Responsibility

Savannah Labs has provided laboratory analytical testing services in support of Remedial Investigations of multiple sites, maintenance areas, and landfills located at Fort Eustis, VA. Analyses included TCL volatiles, semivolatiles, and pesticides/PCBs; TAL metals; ordnance related explosive residues; and selected indicated inorganics. EPA and CE-MRD approved procedures were used for all tests including USATHAMA/8330 method for explosive residue analysis. Reports included results and QC for QA review and approval. Computerized data downloads were also delivered in a format compatible with the consultant's data management system. Long term monitoring of the landfill areas is current and continuing.

10.0 EXPERIENCE AND CAPABILITIES BY PROGRAM (cont.)

10.1 EXAMPLE MAJOR PROJECT REFERENCES (cont.)

Portsmouth Gaseous Diffusion Plant

Department of Energy

through a Major A/E Consultant

1990 - Current

\$3,000K

Project Description of Firm's Responsibility

Savannah Labs has provided analytical testing services in support of a major DOE-RFI at the Portsmouth Gaseous Diffusion Plant facility. Thousands of soil and groundwater samples have been analyzed for TCL/TAL and RCRA Appendix IX parameters. Preparation for this project involved the preparation of the project's Quality Assurance and site specific work plans, approval of all proposed methods and procedures, and an onsite audit by DOE, EPA Region V and the DOE O&M and RFI contractors involved in the project. Lab performance is verified through QA review and validation of each report's results and associated QC documentation. Results are downloaded via a computerized data file transfer process into the RFI contractor's mainframe data base for use in data management, report preparation, and graphical presentation GIS programs.

Major Ordnance Manufacturer

1987 - Current

\$220K

Project Description of Firm's Responsibility

Savannah Labs provides ongoing comprehensive analytical support for a major ordnance manufacturing facility. SL has experience with and knowledge of the methods and regulatory requirements associated with explosive residues and other materials common to this facility as a manufacturer of ordnance products. SL uses EPA and state approved methods for the analysis of water, soil, and waste materials.

Water Monitoring Programs

SL provides routine analytical support for the site's NPDES effluent and potable water system permits. Additionally, in the event of product or process discharges, emergency analytical response is supplied for spill monitoring and remedial assessments to assist the manufacturer in minimizing groundwater and surface water impacts.

Hazardous Waste Analysis

TCLP analyses and related RCRA tests are performed on complex waste matrices to ensure proper handling of these materials in transportation and disposal. Additionally, accurate analytical results on complex waste materials is critical to providing a statistical basis for regulatory control, pollution prevention, and waste minimization programs.

RCRA Treatment and Closure

SL has provided analytical monitoring support to an onsite thermal decomposition treatment area and for a RCRA closure of a storage and treatment facility. This included analytical testing of process and ordnance residues and reaction products. Samples included soils, waters, waste residues, sludges, debris, surface wipes and rinsates.

10.0 EXPERIENCE AND CAPABILITIES BY PROGRAM (cont.)

10.1 EXAMPLE MAJOR PROJECT REFERENCES (cont.)

National Naval Medical Center

HAZWRAP

through a Major A/E Consultant

Aug., 1990 - April, 1991

\$90K

Project Description of Firm's Responsibility

Savannah Labs provided analytical laboratory testing support services for a Site Investigation at the National Naval Medical Center. The SL Project Manager assisted with the preparation of the site specific laboratory work plan and Quality Assurance Project Plan. Analyses of waters and sediments for TCL organics and TAL inorganics were performed according to EPA and HAZWRAP requirements. Hardcopy reportables were delivered as a HAZWRAP Level C validatable data package. Additionally, computerized data files were produced and delivered in a client defined spreadsheet format. All methods and procedures were approved by the HAZWRAP/NEESA program quality assurance contractor.

Waldorf Naval Research Laboratory

HAZWRAP

through a Major A/E Consultant

June, 1991 - Feb., 1992

\$110K

Project Description of Firm's Responsibility

Savannah Labs provided analytical laboratory testing support services for the Waldorf Naval Research Laboratory, Site Investigations. SL assisted with the preparation of the site specific laboratory work plan and Quality Assurance Project Plan for approval by the HAZWRAP/NEESA program quality assurance contractor. Analyses included TCL organics, TAL inorganics, total petroleum hydrocarbons, oil and grease, nitrates and gross α/β radiochemistries. Results were presented in a HAZWRAP Level C data package for subsequent data validation and as a computerized download for data base management and report generation.

Charleston Naval Air Station

NEESA/Navy CLEAN

through a Major A/E Consultant

Sept. - Dec., 1993

\$250K

Project Description of Firm's Responsibility

Savannah Labs provided analytical testing in support of an Installation Restoration Program contract for the Charleston Naval Shipyard at NAS Charleston. Assistance with project planning during the preparation of the work plan and QA Project Plan was provided by the SL Project Manager. Laboratory analyses for TCL organic volatiles, semivolatiles, pesticide/PCBs, TAL metals, cyanide and total petroleum hydrocarbons were performed according to EPA method and NEESA program requirements. Reports were delivered in hardcopy to meet NEESA Levels C and D and EPA DQO Levels III and IV requirements for subsequent quality assurance validation and approval. Computerized data downloads in a client defined fixed field ASCII format were also provided.

10.0 EXPERIENCE AND CAPABILITIES BY PROGRAM (cont.)

10.1 EXAMPLE MAJOR PROJECT REFERENCES (cont.)

Dover Air Force Base

HAZWRAP

through a Major A/E Consultant

Aug., 1991 - July, 1992

\$110K

Project Description of Firm's Responsibility

Savannah Labs provided analytical laboratory testing support services for a Remedial Action and Site Investigation Program including assistance with work plan and QA Project Plan preparation. Analyses of water, soil/sediments and wastes included volatile organics, PCBs total petroleum hydrocarbons and RCRA characteristics analysis. The project's requirements for quick responses were satisfied by fax reports of rush results with subsequent delivery of validatable HAZWRAP Level C reports. Additionally, computerized data downloads were delivered in a client specified spreadsheet format. All methods and procedures were reviewed and approved by the HAZWRAP/NEESA programs quality assurance contractor.

Jacksonville Naval Air Station

NEESA/Navy CLEAN

through a Major A/E Consultant

Nov., 1991 - May, 1992

\$90K

Project Description of Firm's Responsibility

Savannah Labs provided analytical laboratory testing support service for a RCRA risk based tank closure of a hazardous waste storage tank. SL assisted with the preparation of the site specific Quality Assurance Project Plan for approval by the Navy, the NEESA QA contractor, and the state environmental agency. A NEESA Level C validatable data package was delivered for the full RCRA Appendix IX list. Low detection limit methods were performed for all parameters to ensure detection, and therefore, inclusion in the risk assessment of the area. GC, GC/MS, HPLC, AA, and ICP methods were employed. A computerized data download in CLP diskette deliverables format was provided to expedite data review and statistical processing.

10.2 REFERENCES

Example References:

Savannah District Corps of Engineers
P.O. Box 889
Savannah, GA 31402-0889
912/652-5300
Ted Hightower

Georgia Pacific Corporation
133 Peachtree Street
Atlanta, GA 30303
404/521-5084
Gerald Tice

Ashland Chemical
P.O. Box 2219
Columbus, OH 43216
614/889-3482
Cliff Glowacki

Monsanto Co.
800 N. Lindbergh Blvd.
St. Louis, MO 63167
314/694-6127
Jo Hanson

Additional references may be provided upon request.

SEPARATE ENCLOSURES:

COMPREHENSIVE QUALITY ASSURANCE PLAN

STANDARD FORMS 254/255

COMPREHENSIVE QUALITY ASSURANCE PLAN

Prepared by and for:

Savannah Laboratories and Environmental Services, Inc.

Savannah Division
5102 LaRoche Avenue
Savannah, GA 31404
912-354-7858

Deerfield Beach Division
414 SW 12th Avenue
Deerfield Beach, FL 33442
305-421-7400

Tallahassee Division
2846 Industrial Plaza Drive
Tallahassee, FL 32301
904-878-3994

Tampa Bay Division
6712 Benjamin Road, Suite 100
Tampa, FL 33634
813-885-7427

Mobile Division
900 Lakeside Drive
Mobile, AL 36609
205-666-6633

New Orleans Division
110 Alpha Drive
Destrehan, LA 70047
504-764-1100

May, 1994

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3.0 STATEMENT OF POLICY

Savannah Laboratories is committed to providing quality data and will endeavor to use good quality control and quality assurance practices for all field sampling and laboratory analytical procedures in order to ensure the best possible precision, accuracy, and representativeness of results from testing of environmental samples.

The objectives of the QA program are to:

- (1) Properly collect, preserve, and store all samples;
- (2) Maintain adequate custody records from sample collection through reporting and archiving of results;
- (3) Use properly trained analysts to analyze all samples by approved methods and within holding times;
- (4) Produce defensible data with associated documentation to show that each system was calibrated and operating within precision and accuracy control limits;
- (5) Accurately calculate, check, and report all data using the Laboratory Information Management System; and
- (6) Document all the above activities in order that all data can be independently validated.

Savannah Laboratories intends to follow all procedures referenced in this plan and to conform to EPA and state regulatory agency guidelines for each project reported. Any changes in EPA or other regulatory procedures will be incorporated during periodic revisions of this plan.

Adherence to the procedures of this plan is assured by the assignment of an experienced project manager to each project. The project manager coordinates and is responsible for all phases of Savannah Laboratories' involvement in the project, including pre-project planning, sample bottle preparation, field sampling, computer entry of work, approving analytical and quality control data, final review of report, and discussion of results with client. The project managers are assisted by QA managers and QC staff at each laboratory.

The QA Plan will be utilized by all six Savannah Laboratories facilities. Additionally, all labs use identical standard operating procedures (SOPs), and all data are incorporated into a single Laboratory Information Management System (LIMS) network which generates common QC limits, etc., and is accessible to all employees. Each project is directed by a single project manager who directs all employees involved on the project, and also reviews, approves, and signs all data reports.

The following sections of this QA plan detail the organizational structures and procedures through which all laboratory results are generated.

4.0 ORGANIZATION AND RESPONSIBILITY

Savannah Laboratories and Environmental Services, Inc. has laboratory facilities in, and conducts field operations from, Savannah, Georgia; Tallahassee, Florida; Mobile, Alabama; Deerfield Beach, Florida; Tampa, Florida; and New Orleans, Louisiana. All six facilities are structured under a common administrative, data management, and quality assurance (QA) system as outlined in Figures 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, and 4.7.

Duties of the key personnel are as follows:

A) Company President

- 1) Establish corporate policy;
- 2) Plan and oversee laboratory infrastructure construction/acquisition;
- 3) Negotiate contractual agreements; and
- 4) Other administrative and budgetary functions.

B) Company Vice President

- 1) Provide guidance to lab directors;
- 2) Establish and maintain company-client relationships; and
- 3) Assist president in establishing and carrying out corporate policy.

C) Secretary/Comptroller

- 1) Coordinate risk management and insurance program;
- 2) Prepare financial reports;
- 3) Coordinate Human Resources payroll section;
- 4) Keep corporate minutes and records; and
- 5) Review contracts and subcontracts.

D) Treasurer

- 1) Prepare financial reports and cost accounting reports;
- 2) Coordinate purchasing, accounts payable and accounting sections;
- 3) Assist corporate officers with budgetary problems;
- 4) Maintain equipment and facilities inventory; and

- 5) Coordinate maintenance program.
- E) Corporate Technical Staff
- 1) Provide technical support for all divisions;
 - 2) Coordinate QA/QC and technical activities affecting all divisions;
 - 3) Write SOPs and other technical documents; and
 - 4) Inform all divisions about method changes.
- F) Marketing Director
- 1) Coordinate corporate marketing efforts with laboratory director, project managers, and marketing department;
 - 2) Assist executive officer in defining corporate marketing policy;
 - 3) Coordinate proposal process; and
 - 4) Schedule trade shows.
- G) Corporate Administrative Staff
- 1) Manage Accounting, Human Resources, and other corporate departments;
 - 2) Coordinate business managers;
 - 3) Manage corporate-wide environmental and safety programs; and
 - 4) Assist corporate officers on all administrative, safety and environmental issues.
- H) Laboratory Director
- 1) Responsible for day-to-day operation of lab;
 - 2) Provide project manager guidance;
 - 3) Establish production priorities; and
 - 4) Approve hiring decisions.
- I) Project Manager
- 1) Initial contact with client on individual job tasks;
 - 2) Prepare all work plans, schedules and manpower allocations;
 - 3) Initiate all procurement for the projects;

- 4) Day-to-day direction of the project team including analytical department managers/supervisors/QA personnel, field sampling crews and data management personnel;
- 5) Coordinate financial and contractual aspects of the projects;
- 6) Provide formatting and technical review of all reports;
- 7) Provide day-to-day communication with the client;
- 8) Exercise final review and approval on all reports and invoices for the project; and
- 9) Respond to post project inquiries.

J) QA Manager

- 1) Coordinate with the project manager, and laboratory managers in order to ensure that project QA is maintained;
- 2) Be available to discuss QA activities and results with project managers;
- 3) Prepare QA reports to management;
- 4) Perform periodic system audits;
- 5) Review not-in-compliance reports and approve corrective actions;
- 6) Coordinate the preparation and approval of all QA plans, method SOPs and QA audit responses; and
- 7) Coordinate and be present during all external QA Audits.

K) Laboratory Manager

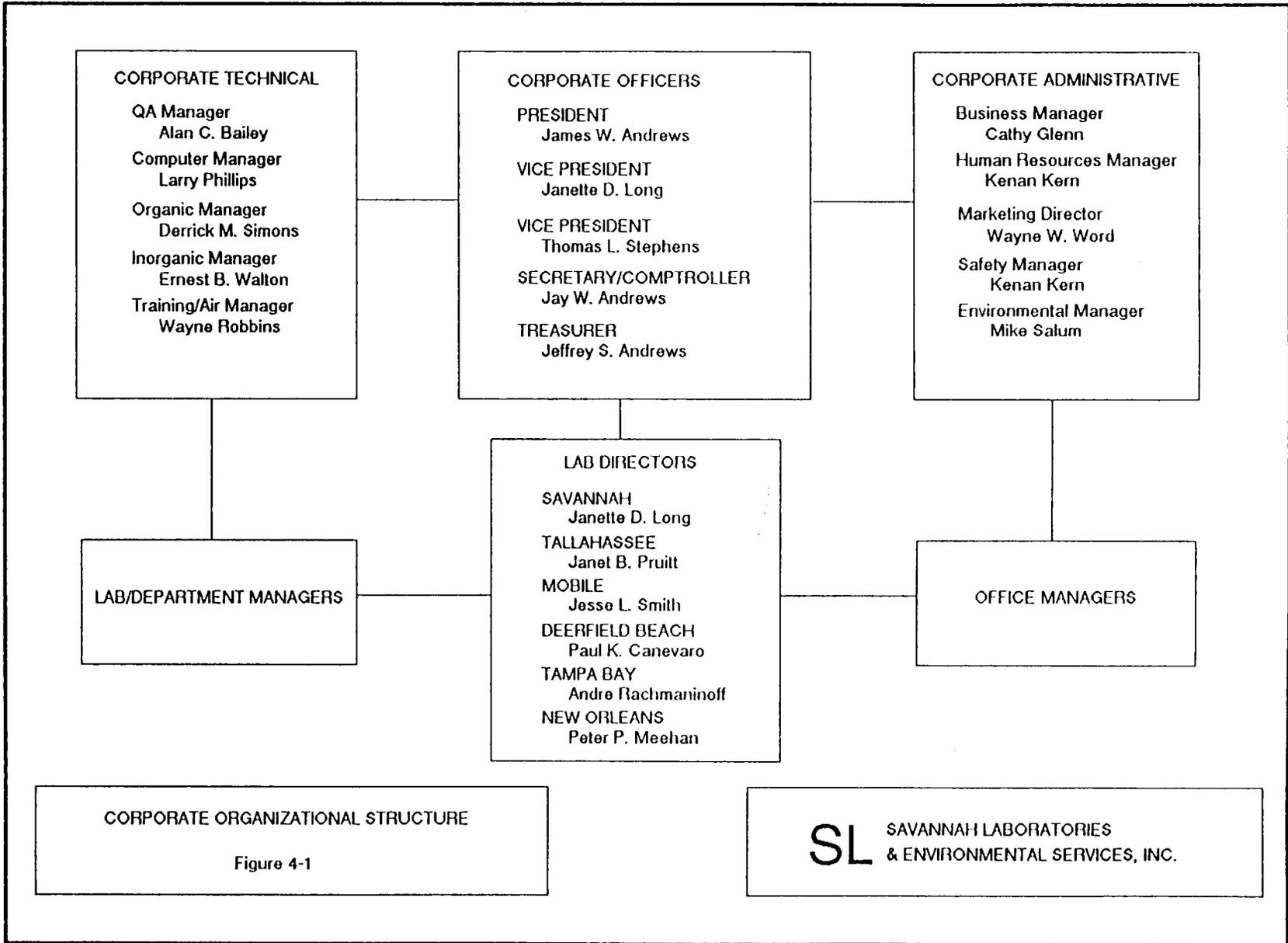
- 1) Coordinate all production activities;
- 2) Work with project managers to ensure project objectives are met;
- 3) Provide guidance to department managers; and
- 4) Interview and hire technical personnel.

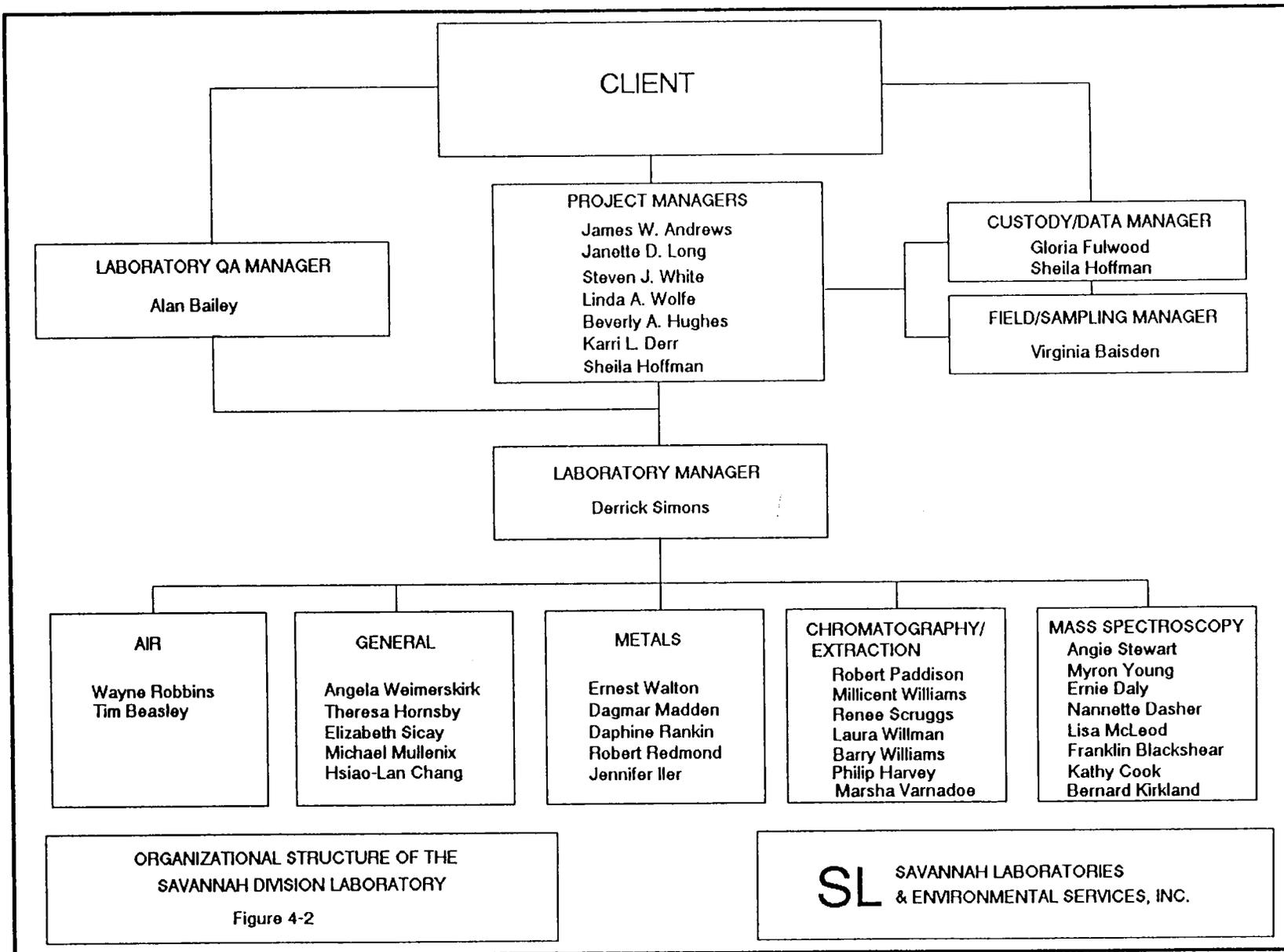
L) Sample/Data Manager

- 1) Schedule bottle orders and supervise bottle prep staff;
- 2) Supervise custody staff;
- 3) Coordinate with project manager and field/sampling manager on scheduling field sampling efforts;

- 4) Identify and document custody discrepancies and communicate with client on custody problems; and
 - 5) Supervise data management staff including computer login, data entry, report preparation, and data archiving personnel.
- M) Field/Sampling Manager
- 1) Coordinate and schedule sampling crews;
 - 2) Prepare sampling reports; and
 - 3) Ensure sampling protocols are followed.
- N) Department Manager
- 1) Organize work flow in department;
 - 2) Assure adequate inventory of reagents and equipment;
 - 3) Ensure effective maintenance and repair of instrumentation;
 - 4) Investigate and evaluate new methodology and equipment; and
 - 5) Train new employees.
- O) Office Manager
- 1) Assist laboratory director with all administrative and financial activities;
 - 2) Coordinate all procurement/receiving with corporate procurement department;
 - 3) Coordinate posting of all invoices with corporate accounts receivable department;
 - 4) Assist comptroller and laboratory directors with collection of receivables;
 - 5) Maintain inventory of all facilities and equipment;
 - 6) Coordinate all human resources and payroll activities; and
 - 7) Maintain petty cash and coordinates laboratory expenditures with corporate accounting department.

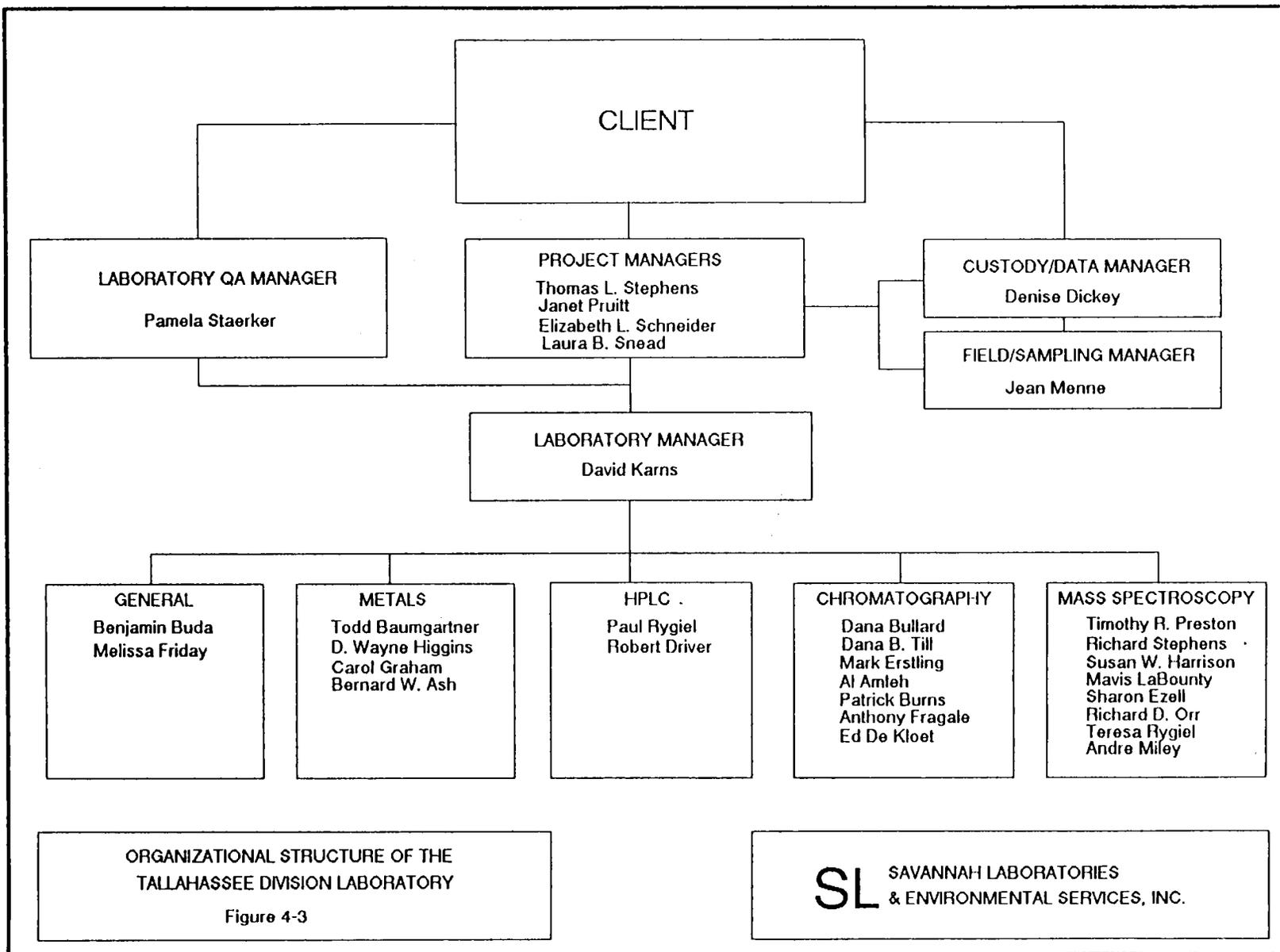
In case of instrument failure, high sample volume, or rapid turnaround requirements, samples are interchanged among the six facilities. In these situations, samples or preserved extracts are transported under EPA recommended chain-of-custody, handling and storage procedures. This exchange of work is possible because of single administrative structure, the use of identical analytical and QA protocols, and the fact that all six facilities are tied into (via telephone modem) a central computerized Laboratory Information Management System (LIMS).





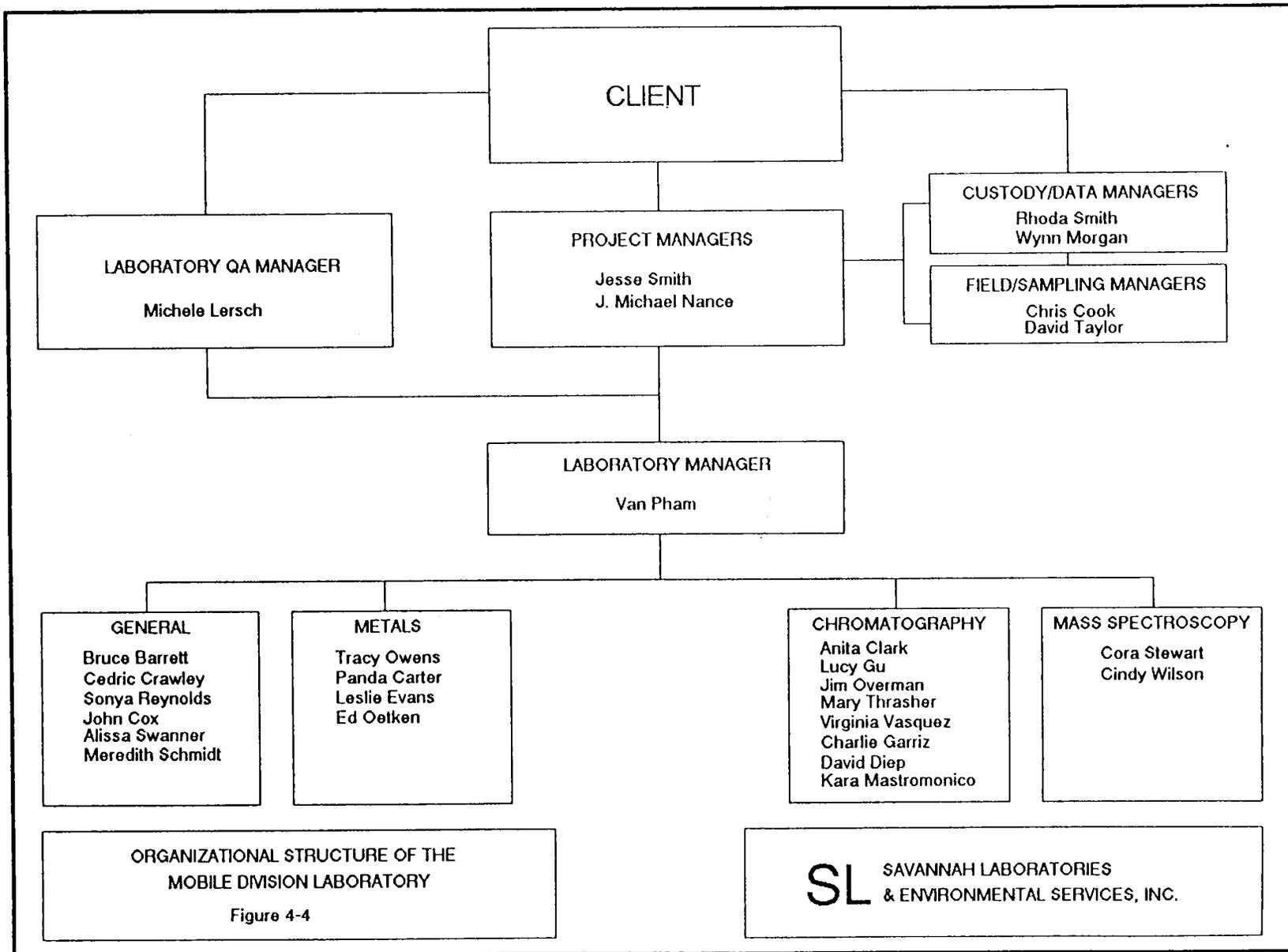
ORGANIZATIONAL STRUCTURE OF THE SAVANNAH DIVISION LABORATORY
Figure 4-2

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.



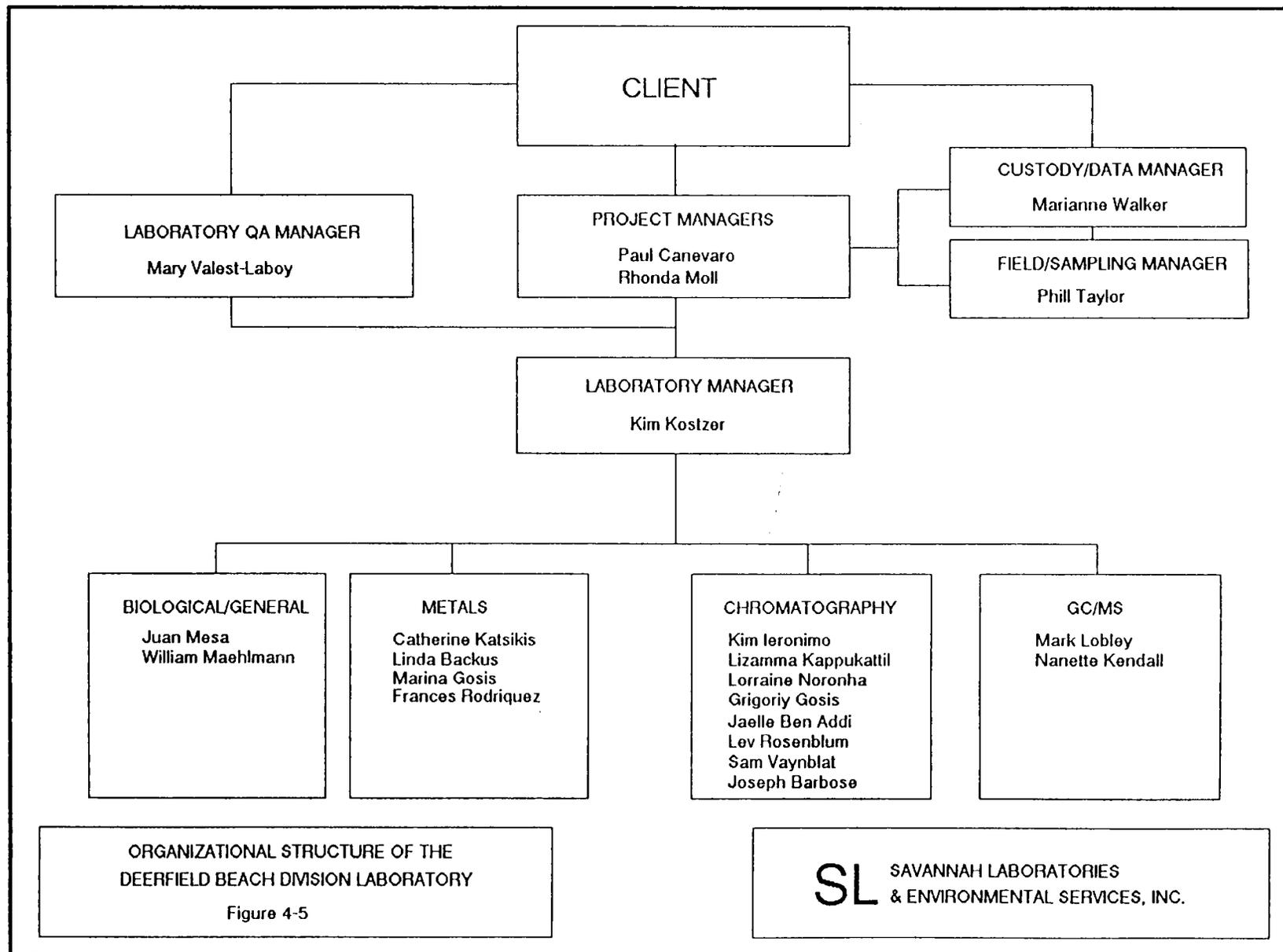
ORGANIZATIONAL STRUCTURE OF THE
TALLAHASSEE DIVISION LABORATORY
Figure 4-3

SL SAVANNAH LABORATORIES
& ENVIRONMENTAL SERVICES, INC.



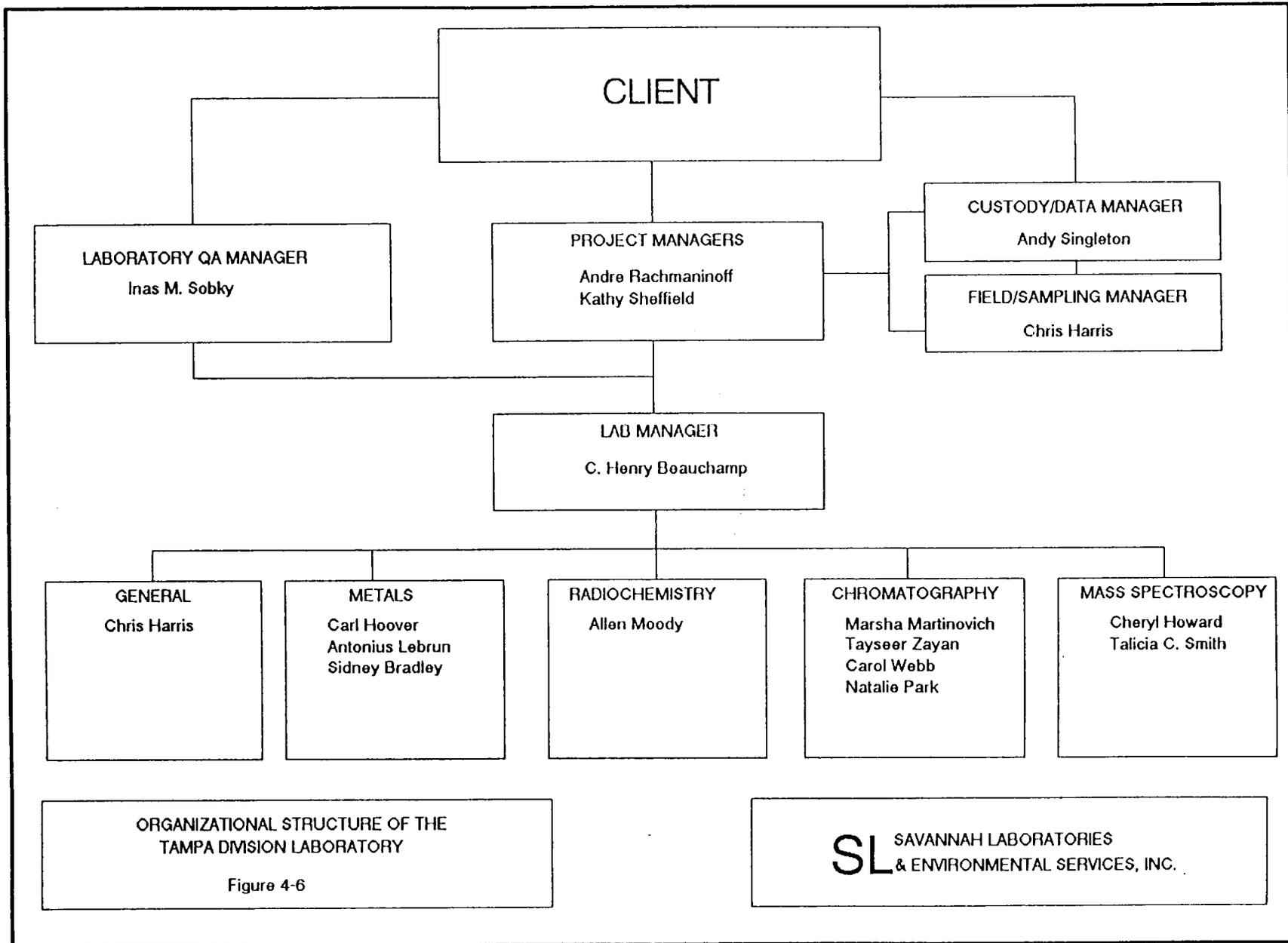
ORGANIZATIONAL STRUCTURE OF THE
MOBILE DIVISION LABORATORY
Figure 4-4

SL SAVANNAH LABORATORIES
& ENVIRONMENTAL SERVICES, INC.



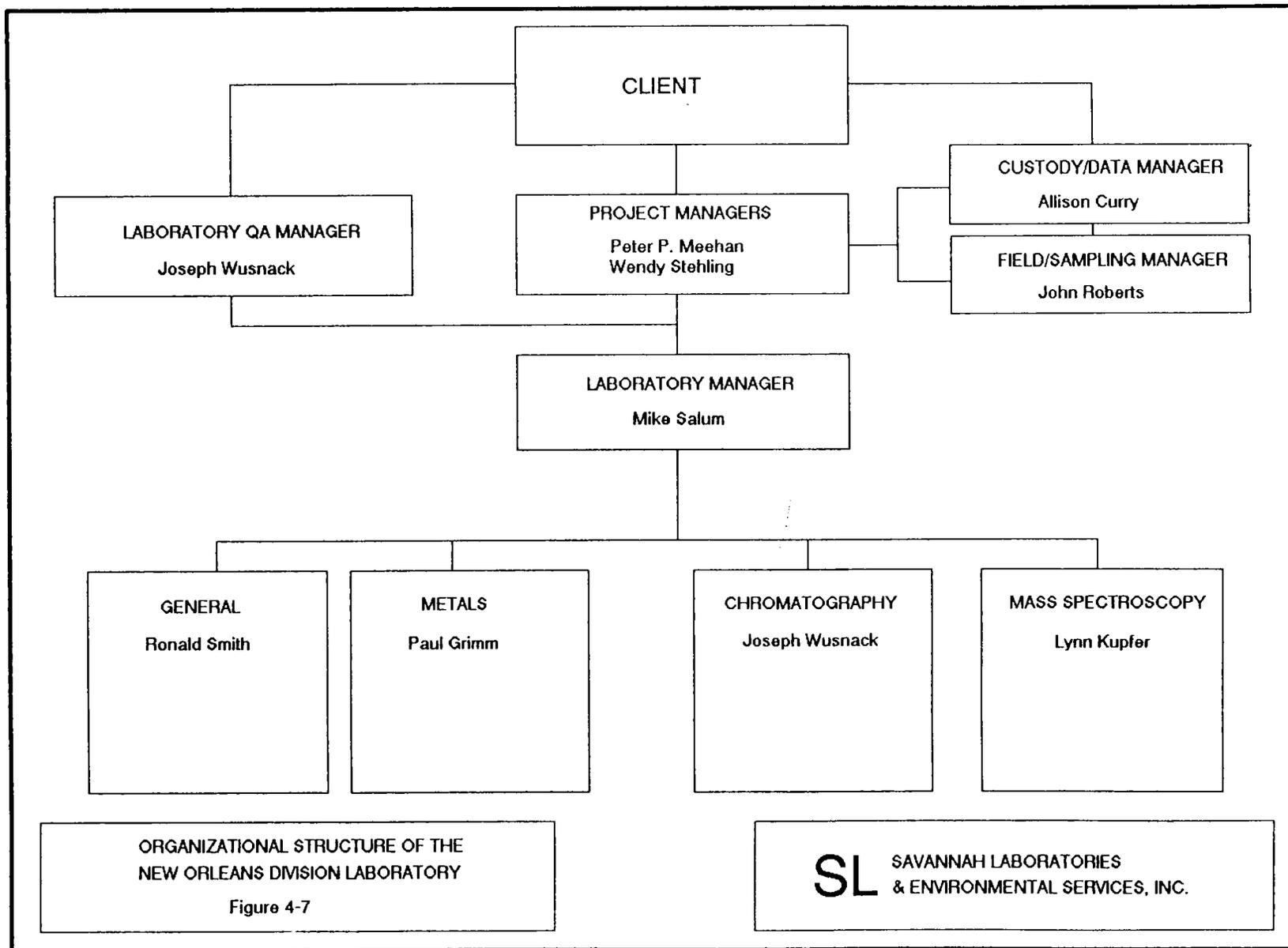
ORGANIZATIONAL STRUCTURE OF THE
DEERFIELD BEACH DIVISION LABORATORY
Figure 4-5

SL SAVANNAH LABORATORIES
& ENVIRONMENTAL SERVICES, INC.



ORGANIZATIONAL STRUCTURE OF THE TAMPA DIVISION LABORATORY
Figure 4-6

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.



ORGANIZATIONAL STRUCTURE OF THE
NEW ORLEANS DIVISION LABORATORY
Figure 4-7

SL SAVANNAH LABORATORIES
& ENVIRONMENTAL SERVICES, INC.

5.0 QUALITY ASSURANCE OBJECTIVES (PRECISION, ACCURACY, AND DETECTION LIMITS)

Savannah Laboratories has a comprehensive quality assurance program which is based on the program outlined in EPA's *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAMS-005/80)*, in the *Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA, 1979), Chapter 1, Final Update 1, (July 1992) of *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)*, and in the Association of Official Analytical Chemists' *Quality Assurance Principles for Analytical Laboratories*.

The key to Savannah Laboratories QA/QC program is strict adherence to the program during all phases of the project including: presampling discussions; sample collection, preservation, transportation and storage; sample login and tracking; laboratory analyses; and validation and reporting of results.

Project and QC data from all facilities are entered into a single Laboratory Information Management System (LIMS). The LIMS provides a computerized mechanism for storing field and login information, tracking sample holding times, scheduling and preparing laboratory work sheets, storing results and QC data, reviewing results and relating them to their corresponding QC data, and printing reports and invoices. The project manager, QA manager, and data management and reporting personnel have direct access via a CRT terminal to all project and QA data from all six facilities.

Tables 5.1 and 5.2 list the laboratory parameters determined by Savannah Laboratories, the methodology, the QA objectives for precision, accuracy and the normal method detection limits (MDLs) for relatively clean environmental samples. Table 5.3 gives the same information for field parameters.

PRECISION

Relative percent difference is used to express precision between two replicate values. In routine analyses, the values for most parameters are usually below quantitation limits; therefore, precision data are derived from duplicate matrix spike or lab control standard results.

The relative percent difference (RPD) is calculated as:

$$RPD = \frac{V1 - V2}{(V1 + V2)/2} \times 100$$

V1, V2 = The two values obtained by analyzing the duplicate samples.

ACCURACY

Accuracy control limits are produced from spike data. Percent recovery is used to express accuracy.

The percent recovery (%R) is calculated as below:

$$\%R = \frac{SPV - SAV}{SA} \times 100$$

SAV - The background value, value obtained by analyzing the sample

SA - Concentration of the spike added to the sample

SPV - Value obtained by analyzing the sample with the spike added

COMPARABILITY

Savannah Laboratories strives for comparability of results through evaluation of data against established precision and accuracy limits. Strict adherence to QA/QC procedures promotes the comparability of one set of reference data to another or comparability of data among all facilities.

REPRESENTATIVENESS

The Savannah Laboratories objective for representativeness of field samples is to ensure that a set of data accurately depicts the chemical or biological characteristics of a sample source. Representativeness is enhanced by an attempt to mix samples prior to aliquot removal. Results are considered reliable and representative if the sample results distribution is within statistically defined bounds of the population mean and variance.

CLP PROTOCOL

For CLP protocol, accuracy and precision limits for matrix spikes, as well as detection limits (CRDLs), are specified by the Statement of Work. These specified limits are given with the CLP methods listed in Tables 5.1 and 5.2.

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMIT (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Aluminum	6010(3010)	2	75-125	0-20	27	200
	200.7	3	85-115	0-20	20	200
	Saltwater	5	50-140	0-40	2.5	10
	CLP	45	80-120	0-20	200	200
Antimony	6010(3010***)	2	75-125	0-20	15	50
	200.7	3	85-115	0-20	15	50
	7041(3005)	2	75-125	0-20	0.65	10
	CLP	45	80-120	0-20	60	60
	204.2	3	80-120	0-20	5.0	5.0
Arsenic	200.7 (4X)	3	85-115	0-20	4.2	10
	6010(3010)	3	75-125	0-20	26	100
	200.7	3	85-115	0-20	23	100
	7060(3020***)	2	75-125	0-20	1.7	10
	206.2	3	80-120	0-20	3.6	10
	206.3/7061	3/2	60-140	0-40	1.4	2.0
CLP	45	80-120	0-20	10	10	
Barium	6010(3010)	2	75-125	0-20	1.2	10
	200.7	3	85-115	0-20	0.68	10
	CLP	45	80-120	0-20	200	200
Beryllium	6010(3010)	2	75-125	0-20	2.3	5.0
	200.7	3	85-115	0-20	0.95	5.0
	7091(3020)	2	75-125	0-20	1.2	5.0
	CLP	45	80-120	0-20	5.0	5.0
	210.2	3	80-120	0-20	1.3	5.0
Boron	6010(3010***)	2	75-125	0-20	13	50
	200.7	3	85-115	0-20	13	50
Cadmium	6010(3010)	2	75-125	0-20	3.3	5.0
	200.7	3	85-115	0-20	2.8	5.0
	7131(3020)	2	75-125	0-20	0.065	1.0
	Saltwater	5	60-140	0-40	0.050	0.050
	CLP	45	80-120	0-20	5.0	5.0
	213.2	3	80-102	0-20	0.25	1.0
Calcium	6010(3010)	2	75-125	0-20	26	500
	200.7	3	85-115	0-20	48	500
	CLP	45	80-120	0-20	5000	5000
Chromium	6010(3010)	2	75-125	0-20	7.6	10
	200.7	3	85-115	0-20	4.6	10
	7191(3020)	2	75-125	0-20	0.34	10
	CLP	45	80-120	0-20	10	10
	218.2	3	80-120	0-20	2.5	10
Chromium, hexavalent	7196	2	75-125	0-20	2.2	10
Cobalt	6010(3010)	2	75-125	0-20	3.6	10
	200.7	3	85-115	0-20	2.2	10
	CLP	45	80-120	0-20	50	50
Copper	200.7 (4X)	3	85-115	0-20	1.7	2.5
	6010(3010)	2	75-125	0-20	18	25
	200.7	3	85-115	0-20	19	25
	220.1/220.2(3020)	3	80-120	0-20	0.57	10
	Saltwater	5	60-140	0-40	0.50	0.50
	CLP	45	80-120	0-20	25	25
Iron	6010(3010)	2	75-125	0-20	15	50
	200.7	3	85-115	0-20	7.8	50
	236.2(3020)	3	75-125	0-20	2.5	10
	Saltwater	5	60-140	0-40	2.0	2.0
	CLP	45	80-120	0-20	100	100

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMIT (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Lead	6010(3010)	2	75-125	0-20	11	50
	200.7	3	85-115	0-20	11	50
	239.2	3	80-120	0-20	2.0	5.0
	Saltwater	5	60-140	0-40	0.50	0.50
	CLP	45	80-120	0-20	3.0	3.0
	7421(3020)	2	75-125	0-20	0.33	5.0
Lithium	3500-Li B	4	80-120	0-20	28	100
Magnesium	6010(3010)	2	75-125	0-20	36	500
	200.7	3	85-115	0-20	25	500
	CLP	45	80-120	0-20	5000	5000
Manganese	6010(3010)	2	75-125	0-20	2.1	10
	200.7	3	85-115	0-20	0.73	10
	CLP	45	80-120	0-20	15	15
Mercury	7470	2	75-125	0-20	0.087	0.20
	Saltwater	5	60-140	0-40	0.025	0.10
	CLP	45	80-120	0-20	0.20	0.20
	245.1	3	80-120	0-20	0.20	0.20
Molybdenum	6010(3010)	2	75-125	0-20	6.4	10
	200.7	3	85-115	0-20	4.5	10
Nickel	200.7 (4X)	3	85-115	0-20	3.6	4.0
	6010(3010)	2	75-125	0-20	6.5	40
	200.7	3	85-115	0-20	5.0	40
	249.2	3	75-125	0-20	0.25	10
	Saltwater	5	60-140	0-40	1.4	2.0
	CLP	45	80-120	0-20	40	40
Phosphorus	200.7***	3	85-115	0-20	50	50
	6010***(3010***)	2	75-125	0-20	50	50
Potassium	6010(3010)	2	75-125	0-20	670	1000
	200.7	3	85-115	0-20	85	1000
	7610(3010)	2	75-125	0-20	25	100
	CLP	45	80-120	0-20	5000	5000
	258.1	3	80-120	0-20	25	100
Selenium	6010(3010)	2	75-125	0-20	91	500
	200.7	3	85-115	0-20	20	500
	270.2	2	80-120	0-20	3.9	5.0
	270.3/7741	3/2	60-140	0-40	0.25	2.0
	CLP	45	80-120	0-20	5.0	5.0
	7740(3020***)	3	75-125	0-20	1.7	10
Silica	6010(3010***)	2	75-125	0-30	120	500
	200.7	3	85-115	0-20	120	500
Silver	6010(3010***)	2	75-125	0-20	6.0	10
	200.7	3	85-115	0-20	2.9	10
	272.1	3	80-120	0-20	2.5	10
	7761	2	75-125	0-20	0.25	1.0
	Saltwater	5	60-140	0-40	0.050	0.050
	CLP	45	80-120	0-20	10	10
	272.2	3	80-120	0-20	0.25	1.0
Sodium	6010(3010)	2	75-125	0-20	14	500
	200.7	3	85-115	0-20	19	500
	273.1	3	75-125	0-20	125	500
	CLP	45	80-120	0-20	5000	5000
Strontium	200.7***	3	85-115	0-20	0.54	10
	6010***(3010***)	2	75-125	0-20	1.1	10

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMIT (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Thallium	6010(3010)	2	75-125	0-20	64	500
	200.7	3	85-115	0-20	92	500
	279.2	3	80-120	0-20	3.5	10
	CLP	45	80-120	0-20	10	10
	7841(3020)	2	75-125	0-20	0.53	10
Tin	200.7***	3	85-115	0-20	15	50
	282.2	3	75-125	0-20	10	50
	6010***V(3010***V)	2	75-125	0-20	10	50
Titanium	200.7***	3	85-115	0-20	2.2	10
	6010***(3010***)	2	75-125	0-20	2.2	10
Tributyl tin	Atomic absorption	40	60-140	0-40	0.0010	0.0010
Vanadium	6010(3010)	2	75-125	0-20	2.5	10
	200.7	3	85-115	0-20	2.2	10
	CLP	45	80-120	0-20	50	50
Zinc	6010(3010)	2	75-125	0-20	7.5	20
	200.7	3	85-115	0-20	5.9	20
	Saltwater	5	60-140	0-40	0.25	1.0
	CLP	45	80-120	0-20	20	20
Zinc Phosphide	FDER Special Method	31	10-210	0-80	0.50	0.50
Zirconium	6010***V(3010***V)	2	75-125	0-20	1100	5000

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (mg/L)	Reporting Limit (mg/L)
Acetate	300.0	3	75-125	0-30	0.25	1.0
Acidity	305.1/2310	3/4	75-125	0-30	2.5	10
Alkalinity	310.1/2320	3/4	75-125	0-30	0.12	1.0
Ammonia (as N)	350.1 350.3	3 3	90-110 75-125	0-30 0-30	0.0099 0.028	0.030 0.050
Ammonia, un-ionized	FL-DER	60	NA	NA	NA	0.010
Bicarbonate	4500-CO ₂ D	4	NA	NA	NA	1.0
BOD	405.1/5210	3/4	60-140	0-30	0.41	2.0
Bromate	300.0	3	75-125	0-30	0.25	1.0
Bromide	9056/300.0 320.1	2/3 3	75-125 75-125	0-30 0-30	0.10 0.50	1.0 2.0
Carbon, total organic	415.1/9060	3/2	60-140	0-40	0.46	1.0
Carbonate	4500-CO ₂ D	4	NA	NA	NA	1.0
CBOD	5210	4	NA	0-30	NA	2.0
Chloride	325.2 325.3/9252 4500-cl ⁻ C 9056/300.0	3 3/2 4 2/3	85-115 75-125 75-125 75-125	0-30 0-30 0-30 0-30	0.24 0.54 0.25 0.19	1.0 1.0 1.0 1.0
Chlorine, residual	4500-cl B 330.2/330.3/330.4/ 330.5	4 3	NA NA	0-30 0-30	NA NA	1.0 1.0
Chlorate	300.0	3	75-125	0-30	0.025	0.10
Chlorite	300.0	3	75-125	0-30	0.025	0.10
Chlorophyll	10200H	4	NA	0-30	NA	0.00010
COD	5220C 410.1 410.2 410.4	4 3 3 3	60-140 60-140 60-140 60-140	0-30 0-30 0-30 0-30	11 5.0 5.0 5.0	20 20 20 20
Coliform, fecal, MPN	9221C	4	NA	0-200	NA	2 MPN/100 mL
Coliform, fecal, MF	9222D	4	NA	0-200	NA	1 col/100 mL
Coliform, total, MPN	9221B	4	NA	0-200	NA	2 MPN/100 mL
Coliform, total, MF	9222B	4	NA	0-200	NA	1 col/100 mL
Color	110.2/2120B	3/4	NA	0-40	NA	5 PCU
Corrosivity	2330B	4	NA	NA	NA	NA
Cyanate	4500-CN L	4	60-140	0-40	0.025	0.10
Cyanide, amenable to chlorination	9012 335.1/9010	2 3/2	NA NA	0-50 0-40	NA NA	0.010 0.010
Cyanide, reactive	7.3.3.2	2	NA	0-50	NA	0.010
Cyanide, total	335.3/9012 335.2/9010 CLP	3/2 3/2 45	85-115 75-125 85-115	0-30 0-30 0-30	0.0016 0.0056 0.010	0.010 0.010 0.010

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (mg/L)	Reporting Limit (mg/L)
Cyanide, weak and dissociable	4500-CN I	4	NA	0-30	NA	0.010
Fluoride	340.2	3	75-125	0-30	0.023	0.20
Formate	300.0	3	75-125	0-30	0.25	1.0
Halogens, total organic	450.1/9020	3/2	60-140	0-40	0.0053	0.010
Hardness, total	2340B	4	NA	NA	NA	3.3
	130.2	3	75-125	0-30	2.5	10
Hydrogen ion (pH)	150.1/9040	3/2	90-110	0-10	NA	NA
Iodide	300.0	3	75-125	0-30	1.2	5.0
Nitrate (as N)	353.2	3	85-115	0-30	NA	0.050
	9056/300.0	2/3	75-125	0-30	0.066	0.10
	352.1	3	75-125	0-30	0.025	0.10
	353.3	3	75-125	0-30	NA	0.050
Nitrate-Nitrite (as N)	353.2	3	85-115	0-30	0.0098	0.050
	353.3	3	75-125	0-30	0.015	0.050
Nitrite (as N)	353.2 (w/o Cd redn)	3	85-115	0-30	0.0068	0.050
	354.1	3	75-125	0-30	0.015	0.050
	9056/300.0	2/3	75-125	0-30	0.044	0.050
	353.3 (w/o Cd redn)	3	75-125	0-30	0.013	0.050
Nitrogen, total Kjeldahl (TKN)	351.2	3	65-135	0-40	0.068	0.10
	351.3	3	75-125	0-30	0.050	0.10
Nitrogen, organic	EPA-CE: 3-305	46	NA	NA	NA	0.10
Nitrogen, total	TKN + NO ₂ /NO ₃	2/3	NA	NA	NA	0.15
Odor	140.1/2150	3/4	NA	NA	NA	1 TON
Oil & Grease	413.1/5520B	3/4	60-140	0-30	2.3	5.0
	413.2/5520C	3/4	60-140	0-30	0.14	1.0
Orthophosphate (as P)	365.1	3	80-120	0-30	0.0059	0.050
	365.2	3	75-125	0-30	0.0072	0.050
	365.3	3	75-125	0-30	0.013	0.050
	9056/300.0	2/3	75-125	0-30	0.071	0.10
Oxalate	300.0	3	75-125	0-30	0.25	1.0
Oxygen, dissolved	360.1/4500-OC	3/4	NA	0-30	NA	0.10
Petroleum hydrocarbons	418.1/5520F	3/4	60-140	0-30	0.34	1.0
Phenolics, total recoverable	420.2/9066	3/2	75-125	0-30	0.0031	0.010
	420.1/9065	3/2	75-125	0-30	0.0076	0.010
Phosphorus, organic (as P)	365.4	3	NA	NA	NA	0.10
Phosphorus, total (as P)	365.4	3	60-140	0-40	0.098	0.10
	365.3	3	60-140	0-40	0.025	0.050
	365.2	3	60-140	0-40	0.0034	0.010
Plate count, heterotrophic	9215	4	NA	NA	NA	1000 CFU/L
Radionuclides, alpha	900.0/9310/7110	54/2/4	64-145	0-31	1.9 pCi/L	2.0 pCi/L

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (mg/L)	Reporting Limit (mg/L)
Radionuclides, beta	900.0/9310/7110	54/2/4	67-140	0-28	1.4 pCi/L	2.0 pCi/L
Radium 226	903.1	54	48-145	0-49	0.60 pCi/L	0.60 pCi/L
Radium 228	904.0/9320 Brooks	54/2 66	27-149 45-150	0-86 0-50	1.6 pCi/L 3.4 pCi/L	2.0 pCi/L 3.4 pCi/L
Redox potential	D1498-76	38	NA	NA	NA	NA
Residue, dissolved	160.1/2540C	3/4	75-125	0-30	4.9	5.0
Residue, suspended	160.2/2540D	3/4	75-125	0-30	3.6	5.0
Residue, total	160.3/2540B	3/4	60-140	0-40	NA	5.0
Residue, volatile	160.4/2540E	3/4	NA	0-40	NA	5.0
Salinity	2520B	4	NA	NA	NA	100
Settleable matter	160.5/2540F	3/4	NA	0-40	NA	0.20 mL
Silica, dissolved	370.1	3	75-125	0-30	2.5	10
Specific conductance	120.1/9050	3/2	90-110	0-10	0.26 μ S/cm	1.0 μ S/cm
Specific gravity	2710F	3	NA	NA	NA	NA
Streptococcus, fecal, MPN	9230B	4	NA	NA	NA	2 MPN/100 mL
Streptococcus, fecal, MF	9230C	4	NA	NA	NA	1 col/100 mL
Sulfate	375.2/9036 375.3 375.4 9056/300.0	2 3 3 2/3	80-120 75-125 75-125 75-125	0-30 0-30 0-30 0-30	3.2 1.2 0.61 0.42	5.0 5.0 5.0 5.0
Sulfide	376.2 9030-SL	3 2	60-140 50-150	0-40 0-50	0.14 0.087	0.40 0.40
Sulfide, reactive	7.3.4.2	2	NA	0-50	NA	0.40
Sulfite	4500-SO ₃ ²⁻ 377.1	4 3	75-125 75-125	0-30 0-30	NA NA	1.0 1.0
Surfactants (MBAS)	425.1	3	70-130	0-30	0.049	0.10
Temperature	170.1	3	NA	0-10	NA	NA
Thiocyanate	4500-CN M	4	60-140	0-40	0.021	0.10
THM formation potential	5710B	4	NA	NA	NA	0.010
Turbidity	180.1/2130	3/4	60-140	0-30	0.067 NTU	0.10 NTU
Radium, total (as Ra 226)	903.0	54	48-145	0-49	0.70 pCi/L	2.0 pCi/L

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Bromobenzene	502.1	51	80-120	NA	0.34	0.50
Bromochloromethane	502.1	51	80-120	NA	0.12	0.50
Bromodichloromethane	502.1	51	80-120	NA	0.44	0.50
Bromoform	502.1	51	80-120	NA	0.91	5.0
Bromomethane	502.1	51	60-140	NA	0.87	5.0
Carbon tetrachloride	502.1	51	80-120	NA	0.12	0.50
Chlorobenzene	502.1	51	80-120	NA	0.12	0.50
Chloroethane	502.1	51	60-140	NA	0.91	1.0
Chloroform	502.1	51	80-120	NA	0.12	0.50
Chloromethane	502.1	51	60-140	NA	0.25	1.0
2-Chlorotoluene	502.1	51	60-140	NA	0.37	0.50
4-Chlorotoluene	502.1	51	60-140	NA	0.32	0.50
Dibromochloromethane	502.1	51	80-120	NA	0.12	0.50
1,2-Dibromoethane	502.1	51	80-120	NA	0.50	1.0
Dibromomethane	502.1	51	80-120	NA	0.12	0.50
1,2-Dichlorobenzene	502.1	51	80-120	NA	0.37	0.50
1,3-Dichlorobenzene	502.1	51	80-120	NA	0.32	0.50
1,4-Dichlorobenzene	502.1	51	80-120	NA	0.31	0.50
Dichlorodifluoromethane	502.1	51	60-140	NA	0.62	1.0
1,1-Dichloroethane	502.1	51	80-120	NA	0.50	0.50
1,2-Dichloroethane	502.1	51	80-120	NA	0.38	0.50
1,1-Dichloroethene	502.1	51	80-120	NA	0.42	0.50
cis-1,2-Dichloroethene	502.1	51	80-120	NA	0.12	0.50
trans-1,2-Dichloroethene	502.1	51	80-120	NA	0.12	0.50
1,2-Dichloropropane	502.1	51	80-120	NA	0.50	0.50
1,3-Dichloropropane	502.1	51	80-120	NA	0.12	0.50
2,2-Dichloropropane	502.1	51	80-120	NA	0.12	0.50
1,1-Dichloropropene	502.1	51	80-120	NA	0.12	0.50
cis-1,3-Dichloropropene	502.1	51	80-120	NA	0.12	0.50
trans-1,3-Dichloropropene	502.1	51	80-120	NA	0.43	0.50
Methylene chloride	502.1	51	80-120	NA	0.12	0.50
1,1,1,2-Tetrachloroethane	502.1	51	80-120	NA	0.46	0.50
1,1,2,2-Tetrachloroethane	502.1	51	80-120	NA	0.12	0.50

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Tetrachloroethene	502.1	51	80-120	NA	0.12	0.50
1,1,1-Trichloroethane	502.1	51	80-120	NA	0.12	0.50
1,1,2-Trichloroethane	502.1	51	80-120	NA	0.12	0.50
Trichloroethene	502.1	51	80-120	NA	0.12	0.50
Trichlorofluoromethane	502.1	51	60-140	NA	0.12	0.50
1,2,3-Trichloropropane	502.1	51	80-120	NA	0.89	1.0
Vinyl chloride	502.1	51	60-140	NA	0.25	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Benzene	502.2	51	80-120	NA	0.10	0.50
Bromobenzene	502.2	51	80-120	NA	0.15	0.50
Bromochloromethane	502.2	51	80-120	NA	0.16	0.50
Bromodichloromethane	502.2	51	80-120	NA	0.44	0.50
Bromoform	502.2	51	80-120	NA	0.91	1.0
Bromomethane	502.2	51	60-140	NA	0.87	1.0
n-Butylbenzene	502.2	51	60-140	NA	0.26	0.50
sec-Butylbenzene	502.2	51	60-140	NA	0.14	0.50
tert-Butylbenzene	502.2	51	60-140	NA	0.13	0.50
Carbon tetrachloride	502.2	51	80-120	NA	0.12	0.50
Chlorobenzene	502.2	51	80-120	NA	0.070	0.50
Chloroethane	502.2	51	60-140	NA	0.91	1.0
Chloroform	502.2	51	80-120	NA	0.31	0.50
Chloromethane	502.2	51	60-140	NA	0.50	1.0
2-Chlorotoluene	502.2	51	60-140	NA	0.19	0.50
4-Chlorotoluene	502.2	51	60-140	NA	0.32	0.50
Dibromochloromethane	502.2	51	80-120	NA	0.21	0.50
1,2-Dibromo-3-chloropropane	502.2	51	80-120	NA	0.99	5.0
1,2-Dibromoethane	502.2	51	80-120	NA	0.50	1.0
Dibromomethane	502.2	51	80-120	NA	0.40	0.50
1,2-Dichlorobenzene	502.2	51	80-120	NA	0.25	0.50
1,3-Dichlorobenzene	502.2	51	80-120	NA	0.21	0.50
1,4-Dichlorobenzene	502.2	51	80-120	NA	0.31	0.50
Dichlorodifluoromethane	502.2	51	60-140	NA	0.62	1.0
1,1-Dichloroethane	502.2	51	80-120	NA	0.50	0.50
1,2-Dichloroethane	502.2	51	80-120	NA	0.38	0.50
1,1-Dichloroethene	502.2	51	80-120	NA	0.42	0.50
cis-1,2-Dichloroethene	502.2	51	80-120	NA	0.12	0.50
trans-1,2-Dichloroethene	502.2	51	80-120	NA	0.22	0.50
1,2-Dichloropropane	502.2	51	80-120	NA	0.50	0.50
1,3-Dichloropropane	502.2	51	80-120	NA	0.12	0.50
2,2-Dichloropropane	502.2	51	80-120	NA	0.12	0.50
1,1-Dichloropropene	502.2	51	80-120	NA	0.12	0.50
cis-1,3-Dichloropropene	502.2	51	80-120	NA	0.18	0.50
trans-1,3-Dichloropropene	502.2	51	80-120	NA	0.43	0.50
Ethylbenzene	502.2	51	80-120	NA	0.070	0.50
Hexachlorobutadiene	502.2	51	60-140	NA	0.25	0.50
Isopropylbenzene	502.2	51	60-140	NA	0.080	0.50
4-Isopropyltoluene	502.2	51	60-140	NA	0.39	0.50

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Methylene chloride	502.2	51	80-120	NA	0.69	1.0
Methyl t-butyl ether (MTBE)	502.2***	51	80-120	NA	1.9	2.0
Naphthalene	502.2	51	60-140	NA	0.12	0.50
n-Propylbenzene	502.2	51	60-140	NA	0.12	0.50
Styrene	502.2	51	80-120	NA	0.16	0.50
1,1,1,2-Tetrachloroethane	502.2	51	80-120	NA	0.46	0.50
1,1,2,2-Tetrachloroethane	502.2	51	80-120	NA	0.89	1.0
Tetrachloroethene	502.2	51	80-120	NA	0.12	0.50
Toluene	502.2	51	80-120	NA	0.080	0.50
1,2,3-Trichlorobenzene	502.2	51	60-140	NA	0.12	0.50
1,2,4-Trichlorobenzene	502.2	51	60-140	NA	0.44	0.50
1,1,1-Trichloroethane	502.2	51	80-120	NA	0.42	0.50
1,1,2-Trichloroethane	502.2	51	80-120	NA	0.12	0.50
Trichloroethene	502.2	51	80-120	NA	0.28	0.50
Trichlorofluoromethane	502.2	51	60-140	NA	0.43	0.50
1,2,3-Trichloropropane	502.2	51	80-120	NA	0.89	1.0
1,2,4-Trimethylbenzene	502.2	51	60-140	NA	0.14	0.50
1,3,5-Trimethylbenzene	502.2	51	60-140	NA	0.37	0.50
Vinyl chloride	502.2	51	60-140	NA	0.42	1.0
o-Xylene	502.2	51	80-120	NA	0.16	0.50
m-Xylene	502.2	51	80-120	NA	0.15	0.50
p-Xylene	502.2	51	80-120	NA	0.15	0.50

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Benzene	503.1	51	80-120	NA	0.10	1.0
Bromobenzene	503.1	51	80-120	NA	0.15	1.0
n-Butylbenzene	503.1	51	60-140	NA	0.26	1.0
sec-Butylbenzene	503.1	51	60-140	NA	0.14	1.0
tert-Butylbenzene	503.1	51	60-140	NA	0.13	1.0
Chlorobenzene	503.1	51	80-120	NA	0.070	1.0
2-Chlorotoluene	503.1	51	80-120	NA	0.19	1.0
4-Chlorotoluene	503.1	51	80-120	NA	0.37	1.0
1,4-Dichlorobenzene	503.1	51	80-120	NA	0.39	1.0
1,3-Dichlorobenzene	503.1	51	80-120	NA	0.21	1.0
1,2-Dichlorobenzene	503.1	51	80-120	NA	0.25	1.0
Ethylbenzene	503.1	51	80-120	NA	0.070	1.0
Hexachlorobutadiene	503.1	51	60-140	NA	0.12	1.0
Isopropylbenzene	503.1	51	60-140	NA	0.080	1.0
Naphthalene	503.1	51	60-140	NA	0.12	1.0
n-Propylbenzene	503.1	51	60-140	NA	0.12	1.0
Styrene	503.1	51	80-120	NA	0.16	1.0
Toluene	503.1	51	80-120	NA	0.080	1.0
Trichloroethene	503.1	51	80-120	NA	0.25	1.0
Tetrachloroethene	503.1	51	80-120	NA	0.25	1.0
1,3,5-Trimethylbenzene	503.1	51	60-140	NA	0.37	1.0
1,2,4-Trimethylbenzene	503.1	51	60-140	NA	0.14	1.0
1,2,4-Trichlorobenzene	503.1	51	60-140	NA	0.44	1.0
1,2,3-Trichlorobenzene	503.1	51	60-140	NA	0.12	1.0
p-Xylene	503.1	51	80-120	NA	0.15	1.0
m-Xylene	503.1	51	80-120	NA	0.15	1.0
o-Xylene	503.1	51	80-120	NA	0.16	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Chloropicrin	504***V/8011***V	51	60-140	NA	0.0025	0.010
1,2-Dibromoethane (EDB)	504/8011	51/2	60-140	NA	0.0061	0.020
1,2-Dibromo-3-chloropropane (DBCP)	504/8011	51/2	60-140	NA	0.0041	0.020
1,1-Dichloropropane	504***V/8011***V	51	60-140	NA	0.50	2.0
1,3-Dichloropropene	504***V/8011***V	51	60-140	NA	0.25	1.0
Methyl isothiocyanate	504***V/8011***V	51	60-140	NA	5.0	20

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Alachlor	505	51	62-142	0-30	0.25	1.0
Aldrin	505	51	56-116	0-30	0.0025	0.010
Atrazine	505	51	36-134	0-40	0.25	1.0
gamma BHC (Lindane)	505	51	61-121	0-18	0.0058	0.010
alpha Chlordane	505	51	35-137	0-30	0.0033	0.010
gamma Chlordane	505	51	31-142	0-30	0.0039	0.010
technical Chlordane	505	51	68-142	0-40	0.025	0.10
Dieldrin	505	51	36-138	0-46	0.0060	0.020
Endrin	505	51	30-208	0-23	0.0073	0.020
Heptachlor	505	5	46-108	0-22	0.012	0.010
Heptachlor epoxide	505	51	53-147	0-30	0.0035	0.020
Hexachlorobenzene	505	51	64-145	0-40	0.012	0.050
Hexachlorocyclopentadiene	505	51	38-108	0-40	0.050	0.20
Methoxychlor	505	51	37-163	0-40	0.057	0.50
cis-Nonachlor	505	51	64-156	0-30	0.012	0.050
trans-Nonachlor	505	51	21-151	0-30	0.005	0.020
Simazine	505	51	69-129	0-40	0.25	1.0
Toxaphene	505	51	74-155	0-40	0.25	1.0
PCB 1016	505	51	7-127	0-40	0.12	0.50
PCB 1221	505	51	62-122	NA	0.12	0.50
PCB 1232	505	51	56-116	NA	0.12	0.50
PCB 1242	505	51	66-126	NA	0.12	0.50
PCB 1248	505	51	54-114	NA	0.12	0.50
PCB 1254	505	51	55-115	NA	0.12	0.50
PCB 1260	505	51	58-118	NA	0.12	0.50

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Alachlor	507	51	62-128	NA	0.25	1.0
Ametryn	507	51	61-121	NA	0.25	1.0
Atraton	507	51	58-124	NA	1.2	5.0
Atrazine	507	51	62-122	NA	0.25	1.0
Bromacil	507	51	61-121	NA	0.50	2.0
Butachlor	507	51	66-126	NA	0.96	1.0
Butylate	507	51	34-160	NA	0.86	2.0
Carboxin	507	51	72-132	NA	0.58	1.0
Chlorpropham	507	51	60-126	NA	0.25	1.0
Cycloate	507	51	59-119	NA	0.83	2.0
Diazinon	507	51	85-145	NA	0.49	1.0
Dichlorvos	507	51	67-127	NA	0.79	1.0
Diphenamid	507	51	63-123	NA	0.96	2.0
Disulfoton	507	51	59-119	NA	1.3	2.0
EPTC	507	51	55-115	NA	0.68	2.0
Ethoprop	507	51	73-133	NA	0.84	2.5
Fenamiphos	507	51	60-120	NA	0.25	1.0
Fenarimol	507	51	69-129	NA	1.0	1.0
Fluridone	507	51	57-117	NA	1.2	5.0
Hexazinone	507	51	60-120	NA	0.25	1.0
Merphos	507	51	66-126	NA	1.0	2.5
Metalaxyl	507***v	51	40-160	NA	0.56	1.0
Methyl paraoxon	507***	51	68-128	NA	0.62	1.0
Metolachlor	507	51	63-123	NA	0.25	1.0
Metribuzin	507	51	71-131	NA	0.29	1.0
Mevinphos	507	51	62-128	NA	1.1	10
MGK 264	507	51	70-130	NA	3.0	20
Molinate	507	51	44-152	NA	0.84	2.0
Napropamide	507	51	71-131	NA	0.81	1.0
Norflurazon	507	51	64-124	NA	0.44	1.0
Pebulate	507	51	64-124	NA	0.79	2.0
Prometon	507	51	48-108	NA	0.25	1.0
Prometryn	507	51	63-123	NA	0.25	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Pronamide	507	51	61-121	NA	1.2	2.0
Propazine	507	51	62-122	NA	0.25	1.0
Simazine	507	51	70-130	NA	0.74	1.0
Simetryn	507	51	69-129	NA	0.25	1.0
Stirophos	507	51	68-128	NA	0.25	1.0
Tebuthiuron	507	51	54-114	NA	1.8	5.0
Terbacil	507	51	67-127	NA	1.2	10
Terbufos	507	51	67-127	NA	0.16	1.0
Terbutryn	507	51	64-124	NA	0.25	1.0
Triademefon	507	51	63-123	NA	0.25	1.0
Vernolate	507	51	56-116	NA	0.16	2.0
Surrogate - Triphenylphosphate	507	51	70-130	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Aldrin	508	51	56-116	NA	0.0013	0.010
alpha BHC	508	51	62-122	NA	0.0020	0.010
beta BHC	508	51	65-125	NA	0.0031	0.020
delta BHC	508	51	68-136	NA	0.0028	0.010
gamma BHC (Lindane)	508	51	59-119	NA	0.0031	0.010
alpha Chlordane	508	51	63-135	NA	0.0025	0.010
gamma Chlordane	508	51	63-135	NA	0.0014	0.010
Chloroneb	508	51	62-132	NA	0.012	0.50
Chlorobenzilate	508	51	78-138	NA	0.0051	0.20
Chlorothalonil	508	51	61-121	NA	0.0010	0.20
Dacthal (DCPA)	508	51	66-140	NA	0.0010	0.20
4,4'-DDD	508	51	77-137	NA	0.0017	0.020
4,4'-DDE	508	51	63-135	NA	0.0018	0.020
4,4'-DDT	508	51	62-162	NA	0.0022	0.050
Dieldrin	508	51	57-117	NA	0.0024	0.020
Endosulfan I	508	51	57-117	NA	0.0020	0.020
Endosulfan II	508	51	62-122	NA	0.0016	0.050
Endosulfan sulfate	508	51	56-148	NA	0.0046	0.10
Endrin	508	51	58-118	NA	0.0075	0.020
Endrin aldehyde	508	51	58-118	NA	0.0031	0.10
Etridiazole	508	51	73-133	NA	0.0021	0.10
Heptachlor	508	5	63-133	NA	0.0027	0.010
Heptachlor epoxide	508	51	57-117	NA	0.0029	0.020
Hexachlorobenzene	508	51	34-164	NA	0.0016	0.050
Methoxychlor	508	51	64-146	NA	0.0022	0.50
cis-Permethrin	508	51	61-121	NA	0.0061	1.0
trans-Permethrin	508	51	81-141	NA	0.0038	1.0
Propachlor	508	51	73-133	NA	0.016	1.0
Toxaphene	508	51	60-150	NA	0.080	1.0
Trifluralin	508	51	73-133	NA	0.0018	0.050
PCB 1016	508	51	60-150	NA	0.080	0.50
PCB 1221	508	51	60-150	NA	0.077	0.50
PCB 1232	508	51	60-150	NA	0.052	0.50

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
PCB 1242	508	51	60-150	NA	0.063	0.50
PCB 1248	508	51	60-150	NA	0.051	0.50
PCB 1254	508	51	60-150	NA	0.021	0.50
PCB 1260	508	51	60-150	NA	0.078	0.50
Surrogate - 2,4,5,6-Tetrachloro-m-xylene (TCMX)	508	51	70-130	NA	NA	NA
Surrogate - 4,4-Dichlorobiphenyl	508	51	70-130	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acifluorfen	515.1	51	74-168	NA	0.023	1.0
Bentazon	515.1	51	70-170	NA	0.081	1.0
Chloramben	515.1	51	68-154	NA	0.047	1.0
2,4-D	515.1	51	49-214	NA	0.062	0.50
Dalapon	515.1	51	48-126	NA	0.061	10
2,4-DB	515.1	51	48-126	NA	0.34	0.50
Dicamba	515.1	51	38-232	NA	0.028	0.50
3,5-Dichlorobenzoic acid	515.1	51	53-151	NA	0.027	1.0
Dichlorprop	515.1	51	46-168	NA	0.070	0.50
Dinoseb	515.1	51	DL-85	NA	0.048	0.50
5-Hydroxydicamba	515.1	51	54-153	NA	0.25	1.0
4-Nitrophenol	515.1	51	60-202	NA	0.066	1.0
Pentachlorophenol	515.1	51	37-224	NA	0.018	1.0
Picloram	515.1	51	45-138	NA	0.015	0.50
2,4,5-T	515.1	51	68-166	NA	0.027	0.50
2,4,5-TP (Silvex)	515.1	51	42-226	NA	0.029	0.50
Surrogate - 2,4-Dichlorophenylacetic Acid (DCAA)	515.1	51	70-130	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acifluorfen	515.2	51	60-140	NA	0.25	1.0
Bentazon	515.2	51	60-140	NA	0.25	1.0
2,4-D	515.2	51	60-140	NA	0.12	0.50
2,4-DB	515.2	51	60-140	NA	0.12	0.50
Dacthal	515.2	51	60-140	NA	0.12	0.50
Dicamba	515.2	51	60-140	NA	0.12	0.50
3,5-Dichlorobenzoic acid	515.2	51	60-140	NA	0.25	1.0
Dichlorprop	515.2	51	60-140	NA	0.12	0.50
Dinoseb	515.2	51	60-140	NA	0.12	0.50
5-Hydroxydicamba	515.2	51	60-140	NA	0.25	1.0
Pentachlorophenol	515.2	51	60-140	NA	0.25	1.0
Picloram	515.2	51	60-140	NA	0.12	0.50
2,4,5-T	515.2	51	60-140	NA	0.12	0.50
2,4,5-TP (Silvex)	515.2	51	60-140	NA	0.12	0.50
Surrogate - 2,4-Dichlorophenylacetic Acid (DCAA)	515.2	51	60-140	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Benzene	524.2	51	80-120	NA	0.11	1.0
Bromobenzene	524.2	51	80-120	NA	0.14	1.0
Bromochloromethane	524.2	51	80-120	NA	0.63	1.0
Bromodichloromethane	524.2	51	80-120	NA	0.17	1.0
Bromoform	524.2	51	80-120	NA	0.18	1.0
Bromomethane	524.2	51	60-140	NA	0.47	2.0
n-Butylbenzene	524.2	51	60-140	NA	0.39	1.0
sec-Butylbenzene	524.2	51	60-140	NA	0.24	1.0
tert-Butylbenzene	524.2	51	60-140	NA	0.19	1.0
Carbon tetrachloride	524.2	51	80-120	NA	0.16	1.0
Chlorobenzene	524.2	51	80-120	NA	0.18	1.0
Chloroethane	524.2	51	60-140	NA	0.62	2.0
Chloroform	524.2	51	80-120	NA	0.14	1.0
Chloromethane	524.2	51	60-140	NA	0.63	2.0
2-Chlorotoluene	524.2	51	60-140	NA	0.22	1.0
4-Chlorotoluene	524.2	51	60-140	NA	0.26	1.0
Dibromochloromethane	524.2	51	80-120	NA	0.25	1.0
1,2-Dibromo-3-chloropropane	524.2	51	80-120	NA	0.81	2.0
1,2-Dibromoethane	524.2	51	80-120	NA	0.21	1.0
Dibromomethane	524.2	51	80-120	NA	0.23	1.0
1,2-Dichlorobenzene	524.2	51	80-120	NA	0.30	1.0
1,3-Dichlorobenzene	524.2	51	80-120	NA	0.23	1.0
1,4-Dichlorobenzene	524.2	51	80-120	NA	0.26	1.0
Dichlorodifluoromethane	524.2	51	60-140	NA	0.69	1.0
1,1-Dichloroethane	524.2	51	80-120	NA	0.68	1.0
1,2-Dichloroethane	524.2	51	80-120	NA	0.28	1.0
1,1-Dichloroethene	524.2	51	80-120	NA	0.21	1.0
cis-1,2-Dichloroethene	524.2	51	80-120	NA	0.26	1.0
trans-1,2-Dichloroethene	524.2	51	80-120	NA	0.40	1.0
1,2-Dichloropropane	524.2	51	80-120	NA	0.19	1.0
1,3-Dichloropropane	524.2	51	80-120	NA	0.35	1.0
2,2-Dichloropropane	524.2	51	80-120	NA	0.77	1.0
1,1-Dichloropropene	524.2	51	80-120	NA	0.17	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
cis-1,3-Dichloropropene	524.2	51	80-120	NA	0.37	1.0
trans-1,3-Dichloropropene	524.2	51	80-120	NA	0.35	1.0
Ethylbenzene	524.2	51	80-120	NA	0.17	1.0
Hexachlorobutadiene	524.2	51	60-140	NA	0.53	1.0
Isopropylbenzene	524.2	51	60-140	NA	0.26	1.0
4-Isopropyltoluene	524.2	51	60-140	NA	0.30	1.0
Methylene chloride	524.2	51	80-120	NA	0.30	1.0
Methyl t-butyl ether (MTBE)	524.2***	51	80-120	NA	0.22	2.0
Naphthalene	524.2	51	60-140	NA	1.0	1.0
n-Propylbenzene	524.2	51	60-140	NA	0.20	1.0
Styrene	524.2	51	80-120	NA	0.16	1.0
1,1,1,2-Tetrachloroethane	524.2	51	80-120	NA	0.22	1.0
1,1,2,2-Tetrachloroethane	524.2	51	80-120	NA	0.26	1.0
Tetrachloroethene	524.2	51	80-120	NA	0.95	1.0
Toluene	524.2	51	80-120	NA	0.55	1.0
1,2,3-Trichlorobenzene	524.2	51	60-140	NA	0.92	1.0
1,2,4-Trichlorobenzene	524.2	51	60-140	NA	0.86	1.0
1,1,1-Trichloroethane	524.2	51	80-120	NA	0.25	1.0
1,1,2-Trichloroethane	524.2	51	80-120	NA	0.50	1.0
Trichloroethene	524.2	51	80-120	NA	0.24	1.0
Trichlorofluoromethane	524.2	51	60-140	NA	0.56	1.0
1,2,3-Trichloropropane	524.2	51	80-120	NA	0.47	1.0
1,2,4-Trimethylbenzene	524.2	51	60-140	NA	0.25	1.0
1,3,5-Trimethylbenzene	524.2	51	60-140	NA	0.24	1.0
Vinyl chloride	524.2	51	60-140	NA	0.52	1.0
o-Xylene	524.2	51	80-120	NA	0.20	1.0
m-Xylene	524.2	51	80-120	NA	0.25	1.0
p-Xylene	524.2	51	80-120	NA	0.25	1.0
Surrogate - p-Bromofluorobenzene	524.2	51	79-125	NA	NA	NA
Surrogate - 1,2-Dichlorobenzene-d4	524.2	51	77-135	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acenaphthylene	525.1	51	70-130	NA	0.15	0.50
Alachlor	525.1	51	70-130	NA	0.59	1.0
Aldrin	525.1	51	35-130	NA	0.21	1.0
Anthracene	525.1	51	70-130	NA	0.36	0.50
Atrazine	525.1	51	70-130	NA	0.35	2.0
Benz(a)anthracene	525.1	51	70-130	NA	0.23	0.50
Benzo(b)fluoranthene	525.1	51	35-130	NA	0.24	0.50
Benzo(k)fluoranthene	525.1	51	35-130	NA	0.23	0.50
Benzo(a)pyrene	525.1	51	35-130	NA	0.19	0.20
Benzo(g,h,i)perylene	525.1	51	35-130	NA	0.28	0.50
Butyl benzyl phthalate	525.1	51	70-130	NA	0.25	1.0
alpha Chlordane	525.1	51	35-130	NA	0.19	1.0
gamma Chlordane	525.1	51	35-130	NA	0.19	1.0
Chrysene	525.1	51	70-130	NA	0.10	0.50
Dibenz(a,h)anthracene	525.1	51	35-130	NA	0.23	0.50
Di-n-butyl phthalate	525.1	51	70-130	NA	0.22	10
Diethylphthalate	525.1	51	70-130	NA	0.31	2.0
bis(2-ethylhexyl)adipate	525.1	51	35-130	NA	0.37	1.0
bis(2-ethylhexyl)phthalate	525.1	51	35-130	NA	0.17	2.0
Dimethylphthalate	525.1	51	70-130	NA	0.40	1.0
Endrin	525.1	51	35-130	NA	0.20	5.0
Fluorene	525.1	51	70-130	NA	0.060	0.50
Heptachlor	525.1	51	35-130	NA	0.20	1.0
Heptachlor epoxide	525.1	51	35-130	NA	0.21	1.0
Hexachlorobenzene	525.1	51	35-130	NA	0.31	0.50
Hexachlorocyclopentadiene	525.1	51	35-130	NA	0.84	0.50
Indeno(1,2,3-cd)pyrene	525.1	51	35-130	NA	0.25	0.50
Lindane	525.1	51	35-130	NA	0.25	1.0
Methoxychlor	525.1	51	35-130	NA	0.52	1.0
trans-Nonachlor	525.1	51	35-130	NA	0.26	1.0
Pentachlorophenol	525.1	51	35-130	NA	0.75	3.0
Phenanthrene	525.1	51	70-130	NA	0.25	0.50
Pyrene	525.1	51	70-130	NA	0.17	0.50

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Simazine	525.1	51	70-130	NA	0.46	2.0
Toxaphene	525.1	51	35-130	NA	12	50
PCBs:						
2-Chlorobiphenyl	525.1	51	70-130	NA	0.15	5.0
2,3-Dichlorobiphenyl	525.1	51	70-130	NA	0.20	5.0
2,4,5-Trichlorobiphenyl	525.1	51	35-130	NA	0.43	5.0
2,2',4,4'-Tetrachlorobiphenyl (MS)	525.1	51	35-130	NA	0.23	5.0
2,2',3',4,6-Pentachlorobiphenyl	525.1	51	35-130	NA	0.21	5.0
2,2',4,4',5,6'-Hexachlorobiphenyl	525.1	51	35-130	NA	0.21	5.0
2,2',3,3',4,4',6-Heptachlorobiphenyl	525.1	51	35-130	NA	0.27	5.0
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	525.1	51	35-130	NA	0.31	5.0
Surrogate - Perylene-d12	525.1	51	35-130	NA	NA	NA
Surrogate - Pyrene-d10	525.1	51	70-130	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Aldicarb (MS)	531.1	33/51	85-145	NA	0.12	0.50
Aldicarb sulfone	531.1	33/51	71-131	NA	0.17	0.50
Aldicarb sulfoxide	531.1	33/51	67-127	NA	0.21	0.50
Carbaryl	531.1	33/51	67-127	NA	0.51	1.0
Carbofuran (MS)	531.1	33/51	72-132	NA	0.47	1.0
3-Hydroxycarbofuran	531.1	33/51	72-132	NA	0.50	1.0
Methiocarb	531.1	51	64-124	NA	1.7	5.0
Methomyl	531.1	33/51	75-135	NA	0.58	1.0
Oxamyl (MS)	531.1	33/51	70-130	NA	0.37	1.0
Propoxur (Baygon)	531.1	33/51	76-136	NA	0.26	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Glyphosate	547	51	66-126	NA	11	150
Endothall	548/548.1	51	15-122	NA	4.1	25
Diquat	549/549.1	51/56	56-116	NA	0.39	1.0
Paraquat	549/549.1	51/56	58-118	NA	0.25	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Benzyl chloride	8010(5030)	2	50-150	0-30	0.25	5.0
Bromobenzene	8010(5030)	2	70-130	0-30	2.5	10
Bromodichloromethane	601/8010(5030)	1/2	66-128	0-19	0.14	1.0
Bromoform	601/8010(5030)	1/2	50-128	0-17	0.52	5.0
Bromomethane	601/8010(5030)	1/2	55-137	0-48	0.31	1.0
Carbon tetrachloride	601/8010(5030)	1/2	74-128	0-22	0.15	1.0
Chlorobenzene (MS)	601/8010(5030)	1/2	64-123	0-18	0.36	1.0
Chloroethane	601/8010(5030)	1/2	55-132	0-37	0.26	1.0
Chloroform	601/8010(5030)	1/2	68-134	0-22	0.20	1.0
1-Chlorohexane	8010(5030)	2	50-150	0-30	0.040	1.0
2-Chloroethylvinyl ether	601/8010(5030)	1/2	52-132	0-20	0.18	10
Chloromethane	601/8010(5030)	1/2	39-149	0-57	0.25	1.0
2-Chlorotoluene	8010(5030)	2	70-130	0-30	0.20	10
4-Chlorotoluene	8010(5030)	2	70-130	0-30	0.20	10
Dibromochloromethane	601/8010(5030)	1/2	69-124	0-20	0.20	1.0
Dibromomethane	8010(5030)	2	70-130	0-30	0.33	1.0
1,2-Dichlorobenzene	601/8010(5030)	1/2	69-127	0-25	0.35	1.0
1,3-Dichlorobenzene	601/8010(5030)	1/2	64-125	0-19	0.19	1.0
1,4-Dichlorobenzene	601/8010(5030)	1/2	59-142	0-25	0.27	1.0
Dichlorodifluoromethane	601/8010(5030)	1/2	70-130	0-30	0.41	1.0
1,1-Dichloroethane	601/8010(5030)	1/2	65-130	0-21	0.19	1.0
1,2-Dichloroethane	601/8010(5030)	1/2	64-127	0-22	0.25	1.0
1,1-Dichloroethene (MS)	601/8010(5030)	1/2	49-144	0-20	0.10	1.0
cis-1,2-Dichloroethene	601/8010(5030)	1/2	66-126	0-21	0.31	1.0
trans-1,2-Dichloroethene	601/8010(5030)	1/2	66-126	0-21	0.31	1.0
Dichloromethane (methylene chloride)	601/8010(5030)	1/2	57-141	0-33	0.24	1.0
1,2-Dichloropropane	601/8010(5030)	1/2	69-121	0-16	0.11	1.0
cis/trans-1,3-Dichloropropylene	601/8010(5030)	1/2	63-135	0-17	0.16	1.0
1,1,2,2-Tetrachloroethane	601/8010(5030)	1/2	61-148	0-20	0.12	1.0
1,1,1,2-Tetrachloroethane	8010(5030)	2	70-130	0-30	0.15	1.0
Tetrachloroethylene	601/8010(5030)	1/2	61-151	0-21	0.12	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
1,1,1-Trichloroethane	601/8010(5030)	1/2	63-132	0-18	0.14	1.0
1,1,2-Trichloroethane	601/8010(5030)	1/2	66-131	0-17	0.20	1.0
Trichloroethene (MS)	601/8010(5030)	1/2	61-144	0-21	0.70	1.0
Trichlorofluoromethane	601/8010(5030)	1/2	61-126	0-33	0.30	1.0
1,2,3-Trichloropropane	8010(5030)	2	50-150	0-30	0.47	1.0
Vinyl chloride	601/8010(5030)	1/2	49-153	0-38	0.37	1.0
1,2-Dibromoethane (EDB)	8010***(5030)	2	75-125	0-30	0.20	1.0
Surrogate - Bromochloromethane	601/8010(5030)	1/2	50-136	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acetone	8015***V(5030)	2	40-130	0-30	6.8	25
2-Butanone (MEK)	8015(5030)	2	60-130	0-40	8.8	25
Diethyl ether (MS)	8015(5030)	2	10-130	0-50	2.0	25
Ethanol	8015(5030)	2	20-140	0-45	3.9	25
Ethyl methacrylate	8015***(5030)	2	42-125	0-40	2.5	10
2-Hexanone	8015***(5030)	2	50-150	0-50	1.6	25
Isobutanol	8015***(5030)	2	50-125	0-40	100	1000
Isopropanol	8015***(5030)	2	30-140	0-40	140	1000
Methacrylonitrile	8015***(5030)	2	10-140	0-60	25	100
Methanol	8015***(5030)	2	50-150	0-40	110	1000
Methyl methacrylate	8015***(5030)	2	42-132	0-42	2.5	10
4-Methyl-2-pentanone (MIBK) (MS)	8015(5030)	2	65-125	0-40	4.0	10
Methyl t-butyl ether (MTBE)	8015***(5030)	2	50-150	0-30	3.6	25
Propionitrile	8015***(5030)	2	10-130	0-50	25	100
Gasoline	GRO 8015 (modified)	70 12	50-150 40-140	0-20 0-40	7.8 27	36 50
Mineral spirits	8015 (modified)	12	40-140	0-40	12	50
Surrogate - α,α,α -Trifluorotoluene	8015	2	77-140	NA	NA	NA
Acetone	8015 (DAI*)	2	50-150	0-50	510	1000
tert-Amyl alcohol	8015 (DAI*)***V	2	50-150	0-50	130	1000
sec-Butanol	8015 (DAI*)***V	2	50-150	0-50	190	1000
n-Butanol	8015 (DAI*)***V	2	50-150	0-50	220	1000
tert-Butanol	8015 (DAI*)***V	2	50-150	0-50	160	1000
n-Butyl acetate	8015 (DAI*)***V	2	50-150	0-50	2200	5000
sec-Butyl acetate	8015 (DAI*)***V	2	50-150	0-50	1800	5000
Butyl cellosolve	8015 (DAI*)***V	2	50-150	0-50	580	5000
Cellosolve acetate	8015 (DAI*)***V	2	50-150	0-50	270	5000
Cyclohexanone	8015 (DAI*)***V	2	50-150	0-50	200	5000
Diacetone alcohol	8015 (DAI*)***V	2	50-150	0-50	1400	5000
1,4-Dioxane	8015 (DAI*)	2	50-150	0-50	300	1000
Ethanol (MS)	8015 (DAI*)***V	2	50-150	0-50	210	1000

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Ethyl acetate	8015 (DAI*)***V	2	50-150	0-50	1200	5000
Methanol (MS)	8015 (DAI*)***V	2	50-150	0-50	110	1000
n-Propanol	8015 (DAI*)***V	2	50-150	0-50	390	1000
Isopropanol (MS)	8015 (DAI*)***V	2	50-150	0-50	140	1000
Diethylene glycol	8015 (DAI*)***V	2	50-150	0-50	1200	5000
Ethylene glycol (MS)	8015 (DAI*)***V	2	50-150	0-50	890	5000
2-Hexanone	8015 (DAI*)	2	50-150	0-50	2100	5000
Isoamyl acetate	8015 (DAI*)***V	2	50-150	0-50	4000	5000
Isobutanol	8015 (DAI*)***V	2	50-150	0-50	100	1000
Isobutyl acetate	8015 (DAI*)***V	2	50-150	0-50	2400	5000
Isopropyl acetate	8015 (DAI*)***V	2	50-150	0-50	1600	5000
2-Butanone (MEK)	8015 (DAI*)	2	50-150	0-50	960	5000
Mesityl oxide	8015 (DAI*)***V	2	50-150	0-50	650	5000
Methyl acetate	8015 (DAI*)***V	2	50-150	0-50	1100	5000
4-Methyl-2-pentanone (MIBK)	8015 (DAI*)	2	50-150	0-50	1700	5000
2-Nitropropane	8015 (DAI*)***V	2	50-150	0-50	440	5000
n-Propyl acetate (MS)	8015 (DAI*)***V	2	50-150	0-50	1200	5000
Propylene glycol (MS)	8015 (DAI*)***V	2	50-150	0-50	600	5000
Tetraethylene glycol	8015 (DAI*)***V	2	50-150	0-50	1200	5000
Tetrahydrofuran (MS)	8015 (DAI*)***V	2	50-150	0-50	790	5000
Triethylene glycol	8015 (DAI*)***V	2	50-150	0-50	2200	5000
Vinyl acetate	8015 (DAI*)	2	50-150	0-50	4400	5000

* DAI = Direct Aqueous Injection

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Benzene (MS)	602/8020(5030)	1/2	68-134	0-19	0.11	1.0
Chlorobenzene (MS)	602/8020(5030)	1/2	70-133	0-17	0.090	1.0
1,2-Dichlorobenzene	602/8020(5030)	1/2	69-125	0-13	0.16	1.0
1,3-Dichlorobenzene	602/8020(5030)	1/2	67-131	0-12	0.10	1.0
1,4-Dichlorobenzene	602/8020(5030)	1/2	75-127	0-14	0.080	1.0
Ethylbenzene	602/8020(5030)	1/2	78-124	0-13	0.070	1.0
Methyl t-butyl ether	602/8020*** (5030)	1/2	50-150	0-30	3.6	10
Toluene (MS)	602/8020(5030)	1/2	69-131	0-19	0.080	1.0
Xylenes	602***/8020(5030)	2	50-150	0-30	0.28	1.0
Surrogate - a,a,a-Trifluorotoluene	602/8020(5030)	1/2	77-140	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Benzene (MS)	8021	2	61-131	0-31	0.19	1.0
Bromobenzene	8021	2	46-195	0-56	0.50	10
Bromochloromethane	8021	2	34-128	0-52	0.27	1.0
Bromodichloromethane	8021	2	46-143	0-54	0.14	1.0
Bromoform	8021	2	31-131	0-40	0.13	5.0
Bromomethane	8021	2	25-167	0-78	0.39	1.0
n-Butylbenzene	8021	2	50-150	0-22	0.17	1.0
sec-Butylbenzene	8021	2	50-150	0-21	0.14	1.0
tert-Butylbenzene	8021	2	49-188	0-48	0.18	1.0
Carbon tetrachloride	8021	2	42-141	0-50	0.18	1.0
Chlorobenzene (MS)	8021	2	48-143	0-24	0.060	1.0
Chloroethane	8021	2	43-158	0-52	0.40	1.0
Chloroform	8021	2	53-134	0-36	0.24	1.0
Chloromethane	8021	2	40-172	0-53	0.26	1.0
2-Chlorotoluene	8021	2	70-140	0-27	0.30	10
4-Chlorotoluene	8021	2	77-136	0-27	0.28	10
Dibromochloromethane	8021	2	44-150	0-56	0.13	1.0
1,2-Dibromo-3-chloropropane (DBCP)	8021	2	24-145	0-56	1.4	1.0
1,2-Dibromoethane (EDB)	8021	2	34-168	0-77	0.52	1.0
Dibromomethane	8021	2	41-147	0-59	0.53	1.0
1,2-Dichlorobenzene	8021	2	52-141	0-39	0.24	1.0
1,3-Dichlorobenzene	8021	2	68-123	0-28	0.19	1.0
1,4-Dichlorobenzene	8021	2	65-131	0-42	0.090	1.0
Dichlorodifluoromethane	8021	2	49-196	0-50	0.41	1.0
1,1-Dichloroethane	8021	2	61-137	0-36	0.19	1.0
1,2-Dichloroethane	8021	2	38-148	0-58	0.18	1.0
1,1-Dichloroethene (MS)	8021	2	48-155	0-35	0.31	1.0
cis-1,2-Dichloroethene	8021	2	40-138	0-39	0.10	1.0
trans-1,2-Dichloroethene	8021	2	64-139	0-43	0.18	1.0
1,2-Dichloropropane	8021	2	53-129	0-45	0.18	1.0
1,3-Dichloropropane	8021	2	53-150	0-57	1.1	1.0
2,2-Dichloropropane	8021	2	40-138	0-39	0.48	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
1,1-Dichloropropene	8021	2	42-141	0-50	0.62	1.0
cis-1,3-Dichloropropene	8021	2	44-146	0-45	0.23	1.0
trans-1,3-Dichloropropene	8021	2	30-152	0-55	0.080	1.0
Ethylbenzene	8021	2	68-118	0-29	0.21	1.0
Hexachlorobutadiene	8021	2	52-145	0-41	0.35	1.0
Isopropylbenzene	8021	2	50-150	0-27	0.16	1.0
p-Isopropyltoluene	8021	2	50-150	0-24	0.21	1.0
Methylene chloride	8021	2	60-177	0-40	0.40	1.0
Naphthalene	8021	2	67-133	0-42	0.69	1.0
n-Propylbenzene	8021	2	50-150	0-19	0.15	1.0
Styrene	8021	2	81-108	0-18	0.39	1.0
1,1,1,2-Tetrachloroethane	8021	2	62-141	0-41	0.54	1.0
1,1,2,2-Tetrachloroethane	8021	2	61-148	0-48	0.28	1.0
Tetrachloroethene	8021	2	53-150	0-57	0.25	1.0
Toluene (MS)	8021	2	64-144	0-22	0.070	1.0
1,2,3-Trichlorobenzene	8021	2	77-125	0-26	0.26	1.0
1,2,4-Trichlorobenzene	8021	2	44-139	0-53	0.30	1.0
1,1,1-Trichloroethane	8021	2	59-136	0-47	0.37	1.0
1,1,2-Trichloroethane	8021	2	64-160	0-53	0.12	1.0
Trichloroethene (MS)	8021	2	51-140	0-48	0.14	1.0
Trichlorofluoromethane	8021	2	58-152	0-37	0.30	1.0
1,2,3-Trichloropropane	8021	2	61-148	0-48	3.3	1.0
1,2,4-Trimethylbenzene	8021	2	32-132	0-44	0.20	1.0
1,3,5-Trimethylbenzene	8021	2	50-150	0-16	0.33	1.0
Vinyl Chloride	8021	2	44-173	0-61	0.26	1.0
o-Xylene	8021	2	50-150	0-18	0.36	1.0
m&p-Xylene	8021	2	62-138	0-49	0.29	1.0
Surrogate - 2-Bromo-1-chloropropane	8021	2	70-130	NA	NA	NA
Surrogate - Fluorobenzene	8021	2	70-130	NA	NA	NA

**TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND
METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS**

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acrolein	603/8030(5030)	1/2	88-118	0-30	8.3	20
Acrylonitrile	603/8030(5030)	1/2	71-135	0-30	6.3	20

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
2-Chlorophenol (MS)	604/8040(3520)	1/2	64-102	0-31	1.1	10
4-Chloro-3-methylphenol (MS)	604/8040(3520)	1/2	56-116	0-29	1.2	10
2,4-Dichlorophenol	604/8040(3520)	1/2	55-111	0-26	1.7	10
2,4-Dimethylphenol	604/8040(3520)	1/2	53-113	0-39	2.9	10
2,4-Dinitrophenol	604/8040(3520)	1/2	29-127	0-25	12	50
2-Methyl-4,6-dinitrophenol	604/8040(3520)	1/2	58-114	0-34	2.3	50
3 and 4 Methyl phenol (m & p cresol)	***8040(3520)	2	10-150	0-50	3.3	10
2-Methyl phenol (o-cresol)	***8040(3520)	2	10-150	0-50	1.8	10
Cresols (total)	8040(3520)	2	NA	NA	2.5	10
2-Nitrophenol	604/8040(3520)	1/2	57-109	0-29	1.1	10
4-Nitrophenol (MS)	604/8040(3520)	1/2	33-129	0-54	1.7	50
Pentachlorophenol (MS)	604/8040(3520)	1/2	65-122	0-27	2.9	50
Phenol (MS)	604/8040(3520)	1/2	51-110	0-35	1.0	10
Trichlorophenols (2,4,5 and 2,4,6)	8040(3520)	2	NA	NA	5.0	10
2,3,4,5-Tetrachlorophenol	***8040(3520)	2	50-150	0-40	2.9	20
2,3,4,6-Tetrachlorophenol	***8040(3520)	2	50-150	0-40	5.0	20
Tetrachlorophenols (2,3,4,5 and 2,3,4,6)	8040(3520)	2	NA	NA	5.0	20
2,4,5-Trichlorophenol	***8040(3520)	2	53-119	0-40	4.4	10
2,4,6-Trichlorophenol	604/8040(3520)	1/2	69-105	0-16	1.8	10
Surrogate - 2,4,6-Tribromophenol	604/8040(3520)	1/2	32-160	NA	NA	NA
Dichlorophen	604.1	18	22-125	0-30	2.5	10
Hexachlorophene	604.1	18	73-125	0-30	2.5	10

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Bis(2-ethylhexyl) phthalate (MS)	606/8060(3520)	1/2	10-162	0-82	1.2	10
Butyl benzyl phthalate (MS)	606/8060(3520)	1/2	10-137	0-73	1.3	10
Diethyl phthalate (MS)	606/8060(3520)	1/2	10-142	0-47	1.5	10
Dimethyl phthalate (MS)	606/8060(3520)	1/2	10-158	0-63	1.5	10
Di-n-butyl phthalate (MS)	606/8060(3520)	1/2	18-137	0-46	1.1	10
Di-n-octyl phthalate (MS)	606/8060(3520)	1/2	12-145	0-52	1.3	10
Surrogate - 2-Fluorobiphenyl	606/8060(3520)	1/2	27-123	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Aldrin (MS - Except CLP 10/92)	608/8080(3520)	1/2	32-135	0-37	0.012	0.050
	CLP 3/90	62	40-120	0-22	0.050	0.050
	CLP 10/92	6	NA	NA	0.010	0.010
Benfluralin	8080(3520)***v	1/2	40-140	0-40	0.0025	0.010
alpha BHC	608/8080(3520)	1/2	37-182	0-30	0.0022	0.050
	CLP 3/90	62	NA	NA	0.050	0.050
	CLP 10/92	6	NA	NA	0.010	0.010
beta BHC	608/8080(3520)	1/2	64-165	0-17	0.0053	0.050
	CLP 3/90	62	NA	NA	0.050	0.050
	CLP 10/92	6	NA	NA	0.010	0.010
delta BHC	608/8080(3520)	1/2	DL-181	0-21	0.0055	0.050
	CLP 3/90	62	NA	NA	0.050	0.050
	CLP 10/92	6	NA	NA	0.010	0.010
gamma BHC (Lindane) (MS - All methods)	608/8080(3520)	1/2	29-155	0-25	0.0027	0.050
	CLP 3/90	62	56-123	0-15	0.050	0.050
	CLP 10/92	6	56-123	NA	0.010	0.010
alpha Chlordane	8081(3520)	2	14-183	0-22	0.0043	0.050
	CLP 3/90	62	NA	NA	0.050	0.050
	CLP 10/92	6	NA	NA	0.010	0.010
gamma Chlordane (MS - CLP 10/92)	8081(3520)	2	89-117	0-26	0.0061	0.050
	CLP 3/90	62	NA	NA	0.050	0.050
	CLP 10/92	6	33-130	NA	0.010	0.010
technical Chlordane	608/8080(3520)	1/2	63-136	0-73	0.064	0.50
Chlorobenzilate	8081(3520)	2	50-150	0-40	0.092	0.50
Chlorothalonil	8081(3520)	2	55-125	0-30	0.050	0.20
Dacthal	8080***v(3520)/ 8081(3520)	2	77-125	0-23	0.0050	0.020
4,4'-DDD	608/8080(3520)	1/2	62-115	0-25	0.016	0.10
	CLP 3/90	62	NA	NA	0.10	0.10
	CLP 10/92	6	NA	NA	0.020	0.020
4,4'-DDE (MS - CLP 10/92)	608/8080(3520)	1/2	50-182	0-17	0.0078	0.10
	CLP 3/90	62	NA	NA	0.10	0.10
	CLP 10/92	6	50-150	NA	0.020	0.020
4,4'-DDT (MS - Except CLP 10/92)	608/8080(3520)	1/2	40-148	0-22	0.021	0.10
	CLP 3/90	62	38-127	0.27	0.10	0.10
	CLP 10/92	6	NA	NA	0.020	0.020
Dicofol (Kelthane)	8081(3520)	2	55-115	0-40	0.012	0.050
Dieldrin (MS - All methods)	608/8080(3520)	1/2	54-138	0-18	0.0051	0.10
	CLP 3/90	62	52-126	0.18	0.10	0.10
	CLP 10/92	6	33-130	NA	0.020	0.020
Endosulfan I	608/8080(3520)	1/2	79-140	0-24	0.0039	0.050
	CLP 3/90	62	NA	NA	0.050	0.050
	CLP 10/92	6	NA	NA	0.010	0.010

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Endosulfan II	608/8080(3520)	1/2	83-160	0-19	0.0098	0.10
	CLP 3/90	62	NS	NA	0.10	0.10
	CLP 10/92	6	NA	NA	0.020	0.020
Endosulfan sulfate (MS - CLP 10/92)	608/8080(3520)	1/2	10-205	0-42	0.041	0.10
	CLP 3/90	62	NA	NA	0.10	0.10
	CLP 10/92	6	50-120	NA	0.020	0.020
Endrin (MS - All methods)	608/8080(3520)	1/2	17-167	0-87	0.0069	0.10
	CLP 3/90	62	56-121	0-21	0.10	0.10
	CLP 10/92	6	56-121	NA	0.020	0.020
Endrin aldehyde	608/8080(3520)	1/2	59-175	0-81	0.016	0.10
	CLP 3/90	62	NA	NA	0.10	0.10
	CLP 10/92	6	NA	NA	0.020	0.020
Endrin ketone	8081(3520)	2	55-100	0-15	0.026	0.10
	CLP 3/90	62	NA	NA	0.10	0.10
	CLP 10/92	6	NA	NA	0.020	0.020
Heptachlor (MS - Except CLP 10/92)	608/8080(3520)	1/2	34-133	0-24	0.0094	0.050
	CLP 3/90	62	40-131	0-20	0.050	0.050
	CLP 10/92	6	NA	NA	0.010	0.010
Heptachlor epoxide (MS - CLP 10/92)	608/8080(3520)	1/2	10-218	0-21	0.0041	0.050
	CLP 3/90	62	NA	NA	0.050	0.050
	CLP 10/92	6	74-150	NA	0.010	0.010
Isodrin	8081(3520)	2	55-110	0-40	0.0099	0.050
Kepone	8081(3520)	2	10-150	0-50	0.038	0.10
Methoxychlor	8080(3520)	2/26	50-140	0-40	0.051	0.50
	CLP 3/90	62	NA	NA	0.50	0.50
	CLP 10/92	6	NA	NA	0.10	0.10
Mirex	8081(3530)	2	52-112	0-37	0.12	0.50
Pendimethalin	8080***v/3520	2	75-146	0-20	0.0021	0.010
Toxaphene	608/8080(3520)	1/2	73-166	0-28	0.69	5.0
	CLP 3/90	62	NA	NA	5.0	5.0
	CLP 10/92	6	NA	NA	1.0	1.0
Trifluralin	8081(3520)	2	54-124	0-40	0.0025	0.010
PCB 1016	608/8080(3520)	1/2	52-152	0-31	0.13	1.0
	CLP 3/90	62	NA	NA	1.0	1.0
	CLP 10/92	6	NA	NA	0.20	0.20
PCB 1221	608/8080(3520)	1/2	15-178	0-20	0.29	2.0
	CLP 3/90	62	NA	NA	2.0	2.0
	CLP 10/92	6	NA	NA	0.40	0.40
PCB 1232	608/8080(3520)	1/2	10-215	0-20	0.18	1.0
	CLP 3/90	62	NA	NA	1.0	1.0
	CLP 10/92	6	NA	NA	0.20	0.20
PCB 1242	608/8080(3520)	1/2	39-150	0-20	0.068	1.0
	CLP 3/90	62	NA	NA	1.0	1.0
	CLP 10/92	6	NA	NA	0.20	0.20

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
PCB 1248	608/8080(3520)	1/2	38-158	0-20	0.13	1.0
	CLP 3/90	62	NA	NA	1.0	1.0
	CLP 10/92	6	NA	NA	0.20	0.20
PCB 1254	608/8080(3520)	1/2	66-122	0-23	0.14	1.0
	CLP 3/90	62	NA	NA	1.0	1.0
	CLP 10/92	6	NA	NA	0.20	0.20
PCB 1260	608/8080(3520)	1/2	58-122	0-20	0.26	1.0
	CLP 3/90	62	NA	NA	1.0	1.0
	CLP 10/92	6	NA	NA	0.20	0.20
Surrogate - Dibutylchloroendate (DBC)	608/8080(3520)	1/2	28-151	NA	NA	NA
Surrogate - 2,4,5,6-Tetrachloro-m- xylene (TCMX)	608/8080(3520)	1/2	22-126	NA	NA	NA
	CLP 3/90	62	60-150	NA	NA	NA
	CLP 10/92	6	30-150	NA	NA	NA
Surrogate - Decachlorobiphenyl (DCB)	608/8080(3520)	1/2	25-126	NA	NA	NA
	CLP 3/90	62	60-150	NA	NA	NA
	CLP 10/92	6	30-150	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Chloroneb	608.1/8080***V (3520)/8081(3520)	10/2	49-125	0-30	0.10	0.40
Chloropropylate	608.1/8080***V (3520)/8081(3520)	10/2	51-125	0-30	0.12	0.50
Chlorobenzilate (MS)	608.1/8081(3520)	10/2	53-125	0-30	0.12	0.50
Etridiazole	608.1/8080***V (3520)/8081(3520)	10/2	60-125	0-30	0.0025	0.010
PCNB	608.1/8081(3520)	10/2	60-125	0-30	0.15	0.60
Propachlor	608.1/8080***V (3520)/8081(3520)	10/2	51-125	0-30	0.12	0.50
Chlorothalonil	608.2/8081(3520)	57/2	55-125	0-30	0.050	0.20
DCPA (Dacthal)	608.2/8081(3520)	57/2	50-150	0-40	0.12	0.50
Dichloran	608.2	57	56-110	0-40	1.2	5.0
Methoxychlor	608.2/8081(3520)	57/2	50-140	0-40	0.12	0.50
Permethrin	608.2/8081(3520)	57/2	50-130	0-40	0.25	1.0
Surrogate - Dibutylchloendate (DBC)	608.1/608.2	10/57	28-151	NA	NA	NA
Surrogate - 2,4,5,6-Tetrachloro- m-xylene (TCMX)	608.1/608.2	10/57	22-126	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
2,4-Dinitrotoluene (MS)	609/8090(3520)(FID) 609/8090(3520) (ECD)	1,2	10-125 10-125	0-40 0-40	2.5 0.075	10 0.30
2,6-Dinitrotoluene (MS)	609/8090(3520) (FID) 609/8090(3520) (ECD)	1,2	10-126 10-126	0-40 0-40	2.5 0.075	10 0.30
Isophorone (MS)	609/8090(3520)	1,2	10-117	0-40	2.5	10
Nitrobenzene (MS)	609/8090(3520)	1,2	10-118	0-40	2.5	10
Surrogate - 2-Fluorobiphenyl	609/8090(3520) (FID)	1,2	27-123	NA	NA	NA
Surrogate - 2,4,5,6-Tetrachloro-m- xylene (TCMX)	609/8090(3520) (ECD)	1,2	22-126	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acenaphthene (MS)	610/8100(3520)	1/2	35-130	0-21	2.6	10
Acenaphthylene	610/8100(3520)	1/2	57-124	0-30	2.4	10
Benzo(a)pyrene (MS)	610/8100(3520)	1/2	14-165	0-40	3.0	10
Benzo(b+k)fluoranthene	610/8100(3520)	1/2	59-168	0-51	2.5	10
Benzo(g,h,i)perylene	610/8100(3520)	1/2	51-198	0-61	2.3	10
Carbazole	8100*** (3520)	2	16-140	0-40	2.5	10
Chrysene + Benzo(a)anthracene	610/8100(3520)	1/2	62-155	0-38	2.5	10
Fluoranthene	610/8100(3520)	1/2	70-134	0-23	3.0	10
Fluorene (MS)	610/8100(3520)	1/2	32-136	0-19	3.0	10
Indeno(1,2,3-cd) pyrene + Dibenzo(a,h)anthracene	610/8100(3520)	1/2	52-178	0-52	2.5	10
1-Methyl naphthalene	610/8100(3520)	1/2	20-140	0-50	2.7	10
2-Methyl naphthalene	610/8100(3520)	1/2	20-140	0-50	3.0	10
Naphthalene (MS)	610/8100(3520)	1/2	40-116	0-28	3.4	10
Phenanthrene + Anthracene	610/8100(3520)	1/2	67-133	0-28	2.5	10
Pyrene (MS)	610/8100(3520)	1/2	41-137	0-28	5.2	10
Diesel	DRO 8100 (mod)***V	69 12	40-140 30-149	0-40 0-40	75 75	100 300
Surrogate - 2-Fluorobiphenyl	610/8100(3520)	1/2	27-123	NA	NA	NA
Surrogate - o-Terphenyl	DRO 610/8100(3520)	69 1/2	50-150 40-145	NA NA	NA NA	NA NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acephate	614***/8141*** (3520)	52/2	25-140	0-50	1.2	5.0
Azinphos methyl	614/622/8141 (3520)	14/2	16-129	0-50	0.25	1.0
Bolstar	622/8141 (3520)	14/2	58-156	0-40	0.25	1.0
Carbophenothion	8141 (3520)	2	20-150	0-40	0.25	1.0
Chlorpyrifos	614/622/8141 (3520)	52/14/2	55-115	0-40	0.25	1.0
Chlorpyrifos methyl	622/8141 (3520)	14	20-130	0-40	0.25	1.0
Coumaphos	622/8141 (3520)	14/2	51-147	0-40	0.25	1.0
Demeton-o	614/622/8141 (3520)	52/14/2	36-120	0-40	0.62	2.5
Demeton-s	614/622/8141 (3520)	52/14/2	36-120	0-40	0.62	2.5
Diazinon (MS)	614/622/8141 (3520)	52/14/2	36-124	0-40	0.25	1.0
Dichlofenthion	622.1/8141***V (3520)	52/2	62-104	0-40	0.25	1.0
Dichlorvos	622/8141 (3520)	14/2	49-120	0-40	0.50	2.0
Dimethoate	8141 (3520)	2	38-120	0-40	0.32	10
Dioxathion	614.1/8141/ (3520)	52/2	25-140	0-40	2.5	10
Disulfoton	614/622/8141 (3520)	52/14/2	10-178	0-66	0.060	2.0
EPN	614.1/8141 (3520)	58/2	48-124	0-40	0.25	1.0
Ethion	614/614.1/8141 (3520)	52/58/2	40-138	0-40	0.12	0.50
Ethoprop	622/8141 (3520)	52/14/2	58-113	0-40	0.12	0.50
Famphur	622.1/8141 (3520)	2	10-129	0-60	0.072	2.0
Fenamiphos	614***	52	40-160	0-40	0.12	0.50
Fensulfothion	622/8141 (3520)	14/2	43-145	0-40	1.2	5.0
Fenthion	622/8141 (3520)	14/2	10-128	0-60	0.25	1.0
Isofenphos	614***	52	40-160	0-40	0.12	0.50
Malathion	614/8141 (3520)	52	60-140	0-40	0.25	1.0
Merphos	622/8141 (3520)	14/2	50-130	0-40	0.25	1.0
Metalaxyl	614***V	52	38-141	0-72	0.54	1.0
Methamidophos	614***V	52	40-160	0-40	0.50	2.0
Metolachlor	8141*** (3520)	52/2	53-133	0-40	0.25	1.0
Metribuzin	614***V	52	75-177	0-20	0.31	2.0
Mevinphos	622/8141 (3520)	52/14/2	34-125	0-40	0.50	2.0
Monocrotophos	8141 (3520)	52/2	25-140	0-50	2.5	10
Naled	622/8141 (3520)	14/2	54-102	0-40	1.2	5.0
Parathion, ethyl (MS)	614/8141 (3520)	52/2	18-171	0-28	0.083	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Parathion, methyl (MS)	614/622/8141(3520)	52/14/2	40-140	0-40	0.072	0.50
Phorate	622/8141(3520)	14/2	36-125	0-40	0.074	1.0
Ronnel (MS)	622/8141(3520)	14/2	45-135	0-35	0.075	1.0
Stirophos (Tetrachlorvinphos)	622/8141(3520)	14/2	48-125	0-40	0.25	1.0
Sulfotepp	8141(3520)	2	10-241	0-40	0.074	0.50
Terbufos	614.1/8141(3520)	58	40-160	0-40	0.12	0.50
Thionazin (MS)	622.1/8141(3520)	2	25-160	0-60	0.056	1.0
Tokuthion (Prothiofos)	622/8141(3520)	14/2	44-125	0-40	0.25	1.0
Trichloronate	622/8141(3520)	14/2	49-161	0-40	0.25	1.0
Surrogate - Triphenylphosphate	614/622/8141	14/20/2	40-125	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
2,4-D (MS)	615/8150	53/2	10-262	0-77	0.12	0.50
2,4-DB	615/8150	53/2	10-230	0-121	0.12	0.50
2,4,5-T (MS)	615/8150	53/2	10-218	0-90	0.031	0.50
2,4,5-TP (Silvex) (MS)	615/8150	53/2	10-201	0-94	0.030	0.50
Dalapon	615/8150	53/2	10-160	0-80	1.4	120
Dicamba	615/8150	53/2	10-317	0-86	0.059	1.2
Dichlorprop	615/8150	53/2	10-258	0-103	0.33	6.0
Dinoseb	615/8150	53/2	10-143	0-157	0.13	6.0
MCPA	615/8150	53/2	10-231	0-91	2.5	120
MCPP	615/8150	53/2	10-210	0-91	2.5	120
Pentachlorophenol	615***/8150***	53/2	10-150	0-80	0.25	1.0
Picloram	615***/8150***v	53/2	10-150	0-40	0.025	0.50
Surrogate - 2,4-Dichlorophenylacetic acid (DCAA)	615/8150	53/2	10-135	NA	NA	NA
Surrogate - 2,4-Dichlorophenoxy butyric acid (2,4-DB)	615/8150	53/2	40-140	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Captan (MS)	617	26	55-125	0-40	0.025	0.10
Carbophenothion	617	26	50-110	0-40	0.25	1.0
Dichloran	617	26	56-110	0-40	1.2	5.0
Dicofol	617	26	55-115	0-40	0.025	0.10
Isodrin (MS)	617	26	55-110	0-40	0.012	0.050
Mirex	617	26	54-104	0-40	0.12	0.50
PCNB	617	26	54-100	0-40	0.0025	0.010
Pendimethalin	617***v	26	75-146	0-20	0.0021	0.010
Perthane	617	26	55-115	0-40	1.2	5.0
Strobane	617	26	48-127	0-40	0.50	2.0
Trifluralin	617	26	54-124	0-40	0.0025	0.010
Chloropicrin	618	27	62-134	0-40	0.25	1.0
Ethylene dibromide	618	27	48-90	0-40	0.12	0.50
Surrogate - 2,4,5,6-Tetrachloro-m-xylene (TCMX)	617/618	26/27	22-126	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Alachlor	619***	7	45-140	0-30	0.50	2.0
Ametryn	619/8141***V(3520)	7/2	60-120	0-40	0.50	2.0
Atraton	619	7	50-115	0-40	1.2	5.0
Atrazine (MS)	619/8141***V(3520)	7/2	40-125	0-30	1.3	2.0
Bromacil	619***	7	55-127	0-30	0.50	2.0
Hexazinone	619***	7	50-130	0-30	0.50	2.0
Metalaxyl	619***	7	50-130	0-40	0.25	1.0
Metribuzin	619***	7	61-141	0-30	0.50	2.0
Norflurazon	619***	7	54-134	0-30	0.50	2.0
Prometon	619/8141***V(3520)	7/2	55-100	0-40	1.5	2.0
Prometryn	619/8141***V(3520)	7/2	55-120	0-40	1.1	2.0
Propazine (MS)	619/8141***V(3520)	7/2	33-100	0-40	1.3	2.0
Secbumeton	619	7	30-130	0-45	1.2	5.0
Simetryn	619	7	50-200	0-40	0.50	2.0
Simazine	619/8141***V(3520)	7/2	25-174	0-50	0.50	2.0
Terbuthylazine	619/8141***V(3520)	7/2	60-130	0-40	1.1	2.0
Terbutryn	619/8141***V(3520)	7	53-113	0-40	0.50	2.0
Triadimefon	619***	7	61-125	0-30	0.50	2.0
Diphenylamine	620	23	56-125	0-30	0.50	2.0
Surrogate - Triphenylphosphate	619/620	7/23	40-125	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Aspon	622.1	8	62-104	0-40	0.25	1.0
Dichlofenthion	622.1	8	62-104	0-40	0.25	1.0
Famphur	622.1	8	10-129	0-40	0.62	2.5
Fenitrothion	622.1	8	61-103	0-40	0.50	2.0
Fonophos	622.1	8	53-133	0-40	0.25	1.0
Phosmet	622.1	8	50-150	0-40	0.25	1.0
Thionazin	622.1	8	25-160	0-40	0.25	1.0
Surrogate - Triphenylphosphate	622.1	8	40-125	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REF	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acetone	8240(5030)/8260(5030)	2	10-161	0-40	4.4	25
	8240(5030)/8260(5030)(25-mL purge)	2	10-161	0-40	2.7	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Acetonitrile	8240(5030)	2	52-170	0-40	280	1000
Acrolein	8240(5030)/8260(5030)	2	60-132	0-40	34	100
	8240(5030)/8260(5030)(25-mL purge)	2	60-132	0-40	12	20
Acrylonitrile	8240(5030)/8260(5030)	2	77-108	0-40	15	100
	8240(5030)/8260(5030)(25-mL purge)	2	77-108	0-40	12	20
Benzene (MS) (MS - All Methods)	624/8240(5030)/8260(5030)	1/2	69-132	0-35	1.1	5.0
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	69-132	0-35	0.18	1.0
	CLP 3/90	62	76-127	0-11	10	10
	CLP 10/92	6	60-140	NA	1.0	1.0
Benzyl chloride	8240(5030)/8260(5030)	2	10-130	0-70	25	100
	8240(5030)/8260(5030)(25-mL purge)	2	10-130	0-70	12	50
Bromobenzene	8260(5030)	2	50-150	0-40	2.5	10
	8260(5030)(25-mL purge)	2	50-150	0-40	0.18	2.0
Bromochloromethane	8260(5030)	2	50-150	0-40	1.2	5.0
	8260(5030)(25-mL purge)	2	50-150	0-40	0.25	1.0
	CLP 10/92	6	NA	NA	1.0	1.0
Bromodichloromethane	624/8240(5030)/8260(5030)	1/2	91-120	0-16	0.37	5.0
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	91-120	0-16	0.19	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
Bromoform (MS - CLP 10/92)	624/8240(5030)/8260(5030)	1/2	72-137	0-17	0.98	5.0
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	72-137	0-17	0.18	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	60-140	NA	1.0	1.0
Bromomethane	624/8240(5030)/8260(5030)	1/2	45-151	0-32	2.2	10
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	45-151	0-32	0.25	2.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
2-Butanone (MEK)	8240(5030)/8260(5030)	2	79-208	0-40	3.2	25
	8240(5030)/8260(5030)(25-mL purge)	2	79-208	0-40	2.2	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
n-Butylbenzene	8260(5030)	2	50-150	0-40	1.5	5.0
	8260(5030)(25-mL purge)	2	50-150	0-40	0.15	1.0
sec-Butylbenzene	8260(5030)	2	50-150	0-40	1.4	5.0
	8260(5030)(25-mL purge)	2	50-150	0-40	0.18	1.0
tert-Butylbenzene	8260(5030)	2	50-150	0-40	1.0	5.0
	8260(5030)(25-mL purge)	2	50-150	0-40	0.15	1.0
Carbon disulfide	8240(5030)/8260(5030)	2	37-138	0-40	1.1	5.0
	8240(5030)/8260(5030)(25-mL purge)	2	37-138	0-40	0.22	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REF	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Carbon tetrachloride (MS - CLP 10/92)	624/8240(5030)/8260(5030)	1/2	67-129	0-21	0.54	5.0
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	67-129	0-21	0.20	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	60-140	NA	1.0	1.0
Chlorobenzene (MS - except CLP 10/92)	624/8240(5030)/8260(5030)	1/2	52-150	0-16	0.55	5.0
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	52-150	0-16	0.18	1.0
	CLP 3/90	62	75-130	0-13	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
2-Chloro-1,3-butadiene (Chloroprene)	8240(5030) 8260(5030)	2	21-163	0-50	0.83	5.0
	8240(5030)/8260(5030)(25-mL purge)	2	21-163	0-50	0.25	1.0
Chloroethane	624/8240(5030)/8260(5030)	1/2	32-179	0-36	2.6	10
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	32-179	0-36	0.30	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
2-Chloroethyl vinyl ether	624/8240(5030)/8260(5030)	1/2	12-237	0-96	1.7	50
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	12-237	0-96	0.11	10
Chloroform	624/8240(5030)/8260(5030)	1/2	58-140	0-62	0.62	5.0
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	58-140	0-62	0.14	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
Chloromethane	624/8240(5030)/8260(5030)	1/2	10-273	0-65	1.4	10
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	10-273	0-65	0.40	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
3-Chloropropene (Allyl chloride)	8240(5030)/8260(5030)	2	81-112	0-40	1.5	5.0
	8240(5030)/8260(5030)(25-mL purge)	2	81-112	0-40	0.25	1.0
2-Chlorotoluene	8240*** (5030)/8260(5030)	1/2	58-125	0-40	0.87	5.0
	8240*** (5030)/8260(5030)(25-mL purge)	1/2	58-125	0-40	0.17	1.0
4-Chlorotoluene	8260(5030)	2	50-150	0-40	0.87	5.0
	8240(5030)(25-mL purge)	2	50-150	0-40	0.13	1.0
Dibromochloromethane	624/8240/8260(5030)	1/2	65-138	0-15	0.53	5.0
	624(5030)/8260(5030)(25-mL purge)	1/2	65-138	0-15	0.24	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
1,2-Dibromo-3-chloropropane (DBCP)	8240(5030)/8260(5030)	2	37-127	0-40	4.2	10
	8240(5030)/8260(5030)(25-mL purge)	2	37-127	0-40	2.0	2.0
	CLP 10/92	6	NA	NA	1.0	1.0
1,2-Dibromoethane (MS - CLP 10/92)	8240(5030)/8260(5030)	2	70-112	0-40	0.48	5.0
	8240(5030)/8260(5030)(25-mL purge)	2	70-112	0-40	0.18	1.0
	CLP 10/92	6	60-140	NA	1.0	1.0
Dibromomethane	8240(5030)/8260(5030)	2	78-110	0-40	0.36	5.0
	8240(5030)/8260(5030)(25-mL purge)	2	78-110	0-40	0.28	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REF	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
1,2-Dichlorobenzene	624/8240(5030)/8260(5030)	1/2	75-131	0-21	0.60	5.0
	624/8240(5030)/8260(5030) (25-mL purge)	1/2	73-131	0-21	0.21	1.0
	CLP 10/92	6	60-140	NA	NA	1.0
1,3-Dichlorobenzene	624/8240(5030)/8260(5030)	1/2	77-119	0-23	0.63	5.0
	624/8240(5030)/8260(5030) (25-mL purge)	1/2	77-119	0-23	0.17	1.0
	CLP 10/92	6	60-140	NA	NA	1.0
1,4-Dichlorobenzene (MS - CLP 10/92)	624/8240(5030)/8260(5030)	1/2	72-130	0-28	0.83	5.0
	624/8240(5030)/8260(5030) (25-mL purge)	1/2	72-130	0-28	0.21	1.0
	CLP 10/92	6	60-140	NA	1.0	1.0
trans-1,4-Dichloro-2-butene	8240(5030)***V	2	11-129	0-40	5.7	10
	8240(5030)/8260(5030) (25-mL purge)	2	11-129	0-40	0.27	2.0
Dichlorodifluoromethane	8240(5030)/8260(5030)	2	72-146	0-40	0.88	5.0
	8240(5030)/8260(5030) (25-mL purge)	2	72-146	0-40	0.39	1.0
1,1-Dichloroethane	624/8240(5030)/8260(5030)	1/2	64-132	0-40	0.56	5.0
	624/8240(5030)/8260(5030) (25-mL purge)	1/2	64-132	0-40	0.94	1.0
	CLP 3/90	62	NA	NA	10	10
1,2-Dichloroethane (MS - CLP 10/92)	624/8240(5030)/8260(5030)	1/2	21-172	0-26	0.56	5.0
	624/8240(5030)/8260(5030) (25-mL purge)	1/2	21-172	0-26	0.12	1.0
	CLP 3/90	62	NA	NA	10	10
cis/trans-1,2-Dichloroethene	624/8240(5030)/8260(5030)	1/2	54-156	0-40	1.2	5.0
	624/8240(5030)/8260(5030) (25-mL purge)	1/2	54-156	0-40	0.19	1.0
	CLP 3/90	62	NA	NA	10	10
cis-1,2-Dichloroethene	624/8240(5030)/8260	1/2	54-456	0-40	1.2	5.0
	624/8240(5030)/8260(5030) (25-mL purge)	1/2	54-456	0-40	0.25	1.0
	CLP 10/92	6	NA	NA	1.0	1.0
trans-1,2-Dichloroethene	624/8240(5030)/8260	1/2	54-156	0-40	1.2	5.0
	624/8240(5030)/8260(5030) (25-mL purge)	1/2	54-156	0-40	0.25	1.0
	CLP 10/92	6	NA	NA	1.0	1.0
1,1-Dichloroethene (MS) (MS - except CLP 10/92)	624/8240(5030)/8260(5030)	1/2	26-155	0-16	1.7	5.0
	624/8240(5030)/8260(5030) (25-mL purge)	1/2	26-155	0-16	0.13	1.0
	CLP 3/90	62	61-145	0-14	10	10
1,2-Dichloropropane (MS - CLP 10/92)	624/8240(5030)/8260(5030)	1/2	75-130	0-15	0.30	5.0
	624/8240(5030)/8260(5030) (25-mL purge)	1/2	75-130	0-15	0.20	1.0
	CLP 3/90	62	NA	NA	10	10
1,3-Dichloropropane	8260(5030)	2	50-150	0-40	0.72	5.0
	8260(5030) (25-mL purge)	2	50-150	0-40	0.15	1.0
2,2-Dichloropropane	8260(5030)	2	50-150	0-40	1.2	5.0
	8260(5030) (25-mL purge)	2	50-150	0-40	0.11	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REF	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
1,1-Dichloropropene	8260(5030)	2	50-150	0-40	0.90	5.0
	8260(5030)(25-mL purge)	2	50-150	0-40	0.18	1.0
cis-1,3-Dichloropropene (MS - CLP 10/92)	624/8240(5030)/8260(5030)	1/2	71-126	0-19	0.59	5.0
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	71-126	0-19	0.17	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	60-140	NA	1.0	1.0
trans-1,3-Dichloropropene	624/8240(5030)/8260(5030)	1/2	64-134	0-18	0.59	5.0
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	64-134	0-18	0.12	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
Diethyl ether	8240*** (5030)	2	50-150	0-40	2.5	10
	8240*** (5030)(25-mL purge)	2	50-150	0-40	0.50	2.0
Ethanol	8240(5030)(25-mL purge)	2	40-160	0-40	250	1000
Ethylbenzene	624/8240(5030)/8260(5030)	1/2	80-117	0-23	0.65	5.0
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	80-117	11	0.077	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	5	NA	NA	1.0	1.0
Ethyl methacrylate	8240(5030)	2	37-139	0-40	1.6	5.0
	8240(5030)(25-mL purge)	2	37-139	0-40	0.25	1.0
Hexachlorobutadiene	8260(5030)	2	50-150	0-40	0.83	5.0
	8260(5030)(25-mL purge)	2	50-150	0-40	0.23	1.0
2-Hexanone	8240(5030)/8260(5030)	2	10-164	0-40	3.6	25
	8240(5030)/8260(5030)(25-mL purge)	2	10-164	0-40	3.6	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Iodomethane	8240(5030)/8260(5030)	2	37-137	0-40	1.5	5.0
	8240(5030)/8260(5030)(25-mL purge)	2	37-137	0-40	0.28	1.0
Isobutyl alcohol	8240(5030)	2	51-179	0-40	310	1000
Isopropylbenzene	8260(5030)	2	50-150	0-40	1.2	5.0
	8260(5030)(25-mL purge)	2	50-150	0-40	0.13	1.0
p-Isopropyltoluene	8260(5030)	2	50-150	0-40	3.7	5.0
	8260(5030)(25-mL purge)	2	50-150	0-40	0.15	1.0
Methacrylonitrile	8240(5030)	2	76-111	0-40	1.3	100
Methylene chloride	624/8240(5030)/8260(5030)	1/2	63-136	0-37	1.5	5.0
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	63-136	0-37	0.83	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	2.0	2.0
Methylmethacrylate	8240(5030)	2	50-130	0-40	1.9	5.0
	8240(5030)(25-mL purge)	2	50-130	0-40	0.25	1.0
4-Methyl-2-pentanone (MIBK)	8240(5030)/8260(5030)	2	68-111	0-40	1.0	25
	8240(5030)/8260(5030)(25-mL purge)	2	68-111	0-40	2.2	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Methyl t-butyl ether (MTBE)	8240*** (5030)	2	50-150	0-40	2.5	10
	8240*** (5030)(25-mL purge)	2	50-150	0-40	0.50	10

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REF	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Naphthalene	8260(5030)	2	50-150	0-40	2.0	5.0
	8260(5030)(25-ml purge)	2	50-150	0-40	0.19	1.0
Pentachloroethane	8240(5030)	2	10-276	0-65	11	25
Propionitrile (ethylcyanide)	8240(5030)	2	63-112	0-40	23	100
n-Propylbenzene	8260(5030)	2	50-150	0-40	1.0	5.0
	8260(5030)(25-ml purge)	2	50-150	0-40	0.12	1.0
Styrene	8240(5030)/8260(5030)	2	60-109	0-40	1.1	5.0
	8240(5030)/8260(5030)(25-ml purge)	2	60-109	0-40	0.15	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
1,1,1,2-Tetrachloroethane	8240B(5030)/8260(5030)	2	34-138	0-40	1.1	5.0
	8240B(5030)/8260(5030)(25-ml purge)	2	34-138	0-40	0.19	1.0
1,1,2,2-Tetrachloroethane	624/8240(5030)/8260(5030)	1/2	66-157	0-25	1.3	5.0
	624/8240(5030)/8260(5030)(25-ml purge)	1/2	66-157	0-25	0.17	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
Tetrachloroethene (MS - CLP 10/92)	624/8240(5030)/8260(5030)	1/2	70-124	0-19	0.79	5.0
	624/8240(5030)/8260(5030)(25-ml purge)	1/2	70-124	0-19	0.12	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	60-140	NA	1.0	1.0
Toluene (MS - except CLP 10/92)	624/8240(5030)/8260(5030)	1/2	62-141	0-24	0.99	5.0
	624/8240(5030)/8260(5030)(25-ml purge)	1/2	62-141	0-24	0.11	1.0
	CLP 3/90	62	76-125	0-13	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
1,2,3-Trichlorobenzene	8260(5030)	2	50-150	0-40	0.69	5.0
	8260(5030)(25-ml purge)	2	50-150	0-40	0.16	1.0
1,2,4-Trichlorobenzene	8260(5030)	2	50-150	0-40	0.88	5.0
	8260(5030)(25-ml purge)	2	50-150	0-40	0.12	1.0
1,1,1-Trichloroethane	624/8240(5030)/8260(5030)	1/2	72-134	0-11	0.75	5.0
	624/8240(5030)/8260(5030)(25-ml purge)	1/2	72-134	0-11	0.21	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
1,1,2-Trichloroethane (MS - CLP 10/92)	624/8240(5030)/8260(5030)	1/2	61-151	0-16	0.39	5.0
	624/8240(5030)/8260(5030)(25-ml purge)	1/2	61-151	0-16	0.31	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	60-140	NA	1.0	1.0
Trichloroethene (MS - All methods)	624/8240(5030)/8260(5030)	1/2	64-131	0-24	1.1	5.0
	624/8240(5030)/8260(5030)(25-ml purge)	1/2	64-131	0-24	0.14	1.0
	CLP 3/90	62	71-120	0-14	10	10
	CLP 10/92	6	60-140	NA	1.0	1.0
Trichlorofluoromethane	624/8240(5030)/8260(5030)	2	17-181	0-65	0.85	5.0
	624/8240(5030)/8260(5030)(25-ml purge)	2	17-181	0-65	0.47	1.0
1,2,3-Trichloropropane	8240(5030)/8260(5030)	2	44-103	0-40	1.3	5.0
	8240(5030)/8260(5030)(25-ml purge)	2	44-103	0-40	0.79	1.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REF	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
1,1,2-Trichloro-1,2,2-trifluoroethane	8240***(5030)	2	82-130	0-23	3.1	5.0
	8240***(5030)(25-mL purge)	2	82-130	0-23	0.25	1.0
1,2,4-Trimethylbenzene	8260(5030)	2	50-150	0.40	1.2	5.0
	8260(5030)(25-mL purge)	2	50-150	0-40	0.13	1.0
1,3,5-Trimethylbenzene	8260(5030)	2	50-150	0-40	1.2	5.0
	8260(5030)(25-mL purge)	2	50-150	0-40	0.16	1.0
Vinyl acetate	8240(5030)/8260(5030)	2	49-147	0-40	1.6	10
	8240(5030)/8260(5030)(25-mL purge)	2	49-147	0-40	0.78	2.0
Vinyl chloride (MS - CLP 10/92)	624/8240(5030)/8260(5030)	1/2	43-137	0-33	1.9	10
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	43-137	0-33	0.44	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	60-140	NA	1.0	1.0
Xylenes (total)	8240(5030)/8260(5030)	2	66-114	0-40	1.1	5.0
	8240(5030)/8260(5030)(25-mL purge)	2	66-114	0-40	0.31	1.0
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	1.0	1.0
Surrogate - Toluene-d8	8240(5030)/8260(5030)	2	77-120	NA	NA	NA
	8240(5030)/8260(5030)(25-mL purge)	2	77-120	NA	NA	NA
	CLP 3/90	62	88-110	NA	NA	NA
Surrogate - p-Bromofluorobenzene	624/8240(5030)/8260(5030)	1/2	80-125	NA	NA	NA
	624/8240(5030)/8260(5030)(25-mL purge)	1/2	80-125	NA	NA	NA
	CLP 3/90	62	86-115	NA	NA	NA
	CLP 10/92	6	80-120	NA	NA	NA
Surrogate - Dibromofluoromethane	8260(5030)	2	86-118	NA	NA	NA
	8260(5030)(25-mL purge)	2	86-118	NA	NA	NA
Surrogate - 1,2-Dichloroethane-d4	624/8240(5030)	1/2	80-125	NA	NA	NA
	624/8240(5030)(25-mL purge)	1/2	80-125	NA	NA	NA
	CLP 3/90	62	76-114	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acenaphthene (MS - Except CLP 10/92)	625/8270(3520)	1/2	60-122	0-25	0.56	10
	CLP 3/90	62	46-118	0-31	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Acenaphthylene	625/8270(3520)	1/2	79-118	0-19	0.91	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Acetophenone	8270(3520)	2	10-150	0-50	0.57	10
2-Acetylaminofluorene	8270(3520)	2	25-150	0-50	0.77	10
Aldrin	625/8270(3520)	1/2	59-154	0-33	1.1	10
4-Aminobiphenyl	8270(3520)	2	10-150	0-50	0.70	10
Aniline	8270(3520)	2	10-150	0-50	8.1	50
Anthracene	625/8270(3520)	1/2	74-137	0-32	0.62	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Aramite	8270(3520)	2	40-150	0-50	0.33	10
Benzidine	625/8270(3520)	1/2	10-200	0-100	20	80
Benzoic acid	8270(3520)	2	10-150	0-50	12	50
Benzo(a)anthracene	625/8270(3520)	1/2	65-142	0-32	0.56	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Benzo(b)fluoranthene	625/8270(3520)	1/2	72-144	0-34	0.55	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Benzo(k)fluoranthene	625/8270(3520)	1/2	60-165	0-36	0.70	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Benzo(g,h,i)perylene	625/8270(3520)	1/2	60-135	0-33	0.32	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Benzo(a)pyrene (MS - CLP 10/92)	625/8270(3520)	1/2	70-138	0-35	0.59	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	50-120	NA	5.0	5.0
Benzyl alcohol	8270(3520)	2	10-150	0-50	1.3	10
Benzyl chloride	8270(3520)	2	10-150	0-50	2.5	10
alpha-BHC	625/8270(3520)	1/2	10-150	0-50	0.95	10
beta-BHC	625/8270(3520)	1/2	87-139	0-12	1.0	10
delta-BHC	625/8270(3520)	1/2	78-152	0-16	1.0	10
gamma-BHC	625/8270(3520)	1/2	10-150	0-50	1.3	10
Bis(2-chloroethoxy) methane	625/8270(3520)	1/2	59-112	0-27	1.2	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Bis(2-chloroethyl) ether (MS- CLP 10/92)	625/8270(3520)	1/2	56-107	0-31	0.74	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	50-110	NA	5.0	5.0
Bis(2-chloroisopropyl) ether	625/8270(3520)	1/2	4-162	0-29	0.79	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Bis(2-ethylhexyl) phthalate	625/8270(3520)	1/2	7-190	0-39	2.2	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
4-Bromophenyl phenyl ether	625/8270(3520)	1/2	55-133	0-32	0.33	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Butyl benzyl phthalate	625/8270(3520)	1/2	30-168	0-30	0.70	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Carbazole	8270(3520)***	2	10-150	0-50	1.3	10
	CLP 3/90	62	NA	NA	10	10
technical Chlordane	625/8270(3520)	1/2	10-150	0-50	12	50
p-Chloroaniline (MS - CLP 10/92)	8270(3520)	2	10-150	0-50	4.4	20
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	10-120	NA	5.0	5.0
4-Chloro-3-methyl-phenol (MS - Except CLP 10/92))	625/8270(3520)	1/2	56-118	0-20	0.54	10
	CLP 3/90	62	23-97	0-42	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
1-Chloronaphthalene	8270(3520)	2	10-150	0-50	2.5	10
2-Chloronaphthalene	625/8270(3520)	1/2	72-106	0-23	0.43	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
2-Chlorophenol (MS - All methods)	625/8270(3520)	1/2	54-107	0-26	0.70	10
	CLP 3/90	62	27-123	0-40	10	10
	CLP 10/92	6	50-110	NA	5.0	5.0
4-Chlorophenylphenyl ether	625/8270(3520)	1/2	62-127	0-30	0.66	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Chrysene	625/8270(3520)	1/2	53-148	0-33	0.31	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
3-Methyl phenol (m-Cresol)	8270(3520)	2	10-150	0-50	0.57	10
2-Methyl phenol (o-Cresol)	8270(3520)	2	10-150	0-50	0.71	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
4-Methyl phenol (p-Cresol)	8270(3520)	2	10-150	0-50	1.4	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
4,4'-DDD	625/8270(3520)	1/2	25-198	0-27	1.4	10

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
4,4'-DDE	625/8270(3520)	1/2	49-172	0-26	1.1	10
4,4'-DDT	625/8270(3520)	1/2	DL-207	0-50	1.9	10
Diallate	8270(3520)	2	10-150	0-50	1.0	10
Dibenz(a,h)anthracene	625/8270(3520) CLP 3/90 CLP 10/92	1/2 62 6	61-140 NA NA	0-33 NA NA	0.50 10 5.0	10 10 5.0
Dibenzofuran	8270(3520) CLP 3/90 CLP 10/92	2 62 6	10-150 NA NA	0-50 NA NA	0.67 10 5.0	10 10 5.0
Di-n-butyl phthalate	625/8270(3520) CLP 3/90 CLP 10/92	1/2 62 6	55-135 NA NA	0-32 NA NA	0.56 10 5.0	10 10 5.0
1,2-Dichlorobenzene	625/8270(3520) CLP 3/90	1/2 62	38-86 NA	0-31 NA	0.62 10	10 10
1,3-Dichlorobenzene	625/8270(3520) CLP 3/90	1/2 62	30-76 NA	0-35 NA	0.35 10	10 10
1,4-Dichlorobenzene (MS - All methods)	625/8270(3520) CLP 3/90	1/2 62	47-103 36-97	0-45 0-28	0.49 10	10 10
3,3'-Dichlorobenzidine	625/8270(3520) CLP 3/90 CLP 10/92	1/2 62 6	DL-171 NA NA	0-193 NA NA	14 10 5.0	20 10 5.0
2,4-Dichlorophenol	625/8270(3520) CLP 3/90 CLP 10/92	1/2 62 6	42-140 NA NA	0-24 NA NA	0.79 10 5.0	10 10 5.0
2,6-Dichlorophenol	8270(3520)	2	10-150	0-50	0.49	10
Dieldrin	625/8270(3520)	1/2	35-198	0-27	3.0	10
Diethyl phthalate (MS - CLP 10/92)	625/8270(3520) CLP 3/90 CLP 10/92	1/2 62 6	70-125 NA 50-120	0-8 NA NA	0.57 10 5.0	10 10 5.0
p-(Dimethylamino)azobenzene	8270(3520)	2	10-150	0-50	0.99	10
7,12-Dimethylbenz(a)anthracene	8270(3520)	2	10-150	0-50	0.67	10
3,3'-Dimethylbenzidine	8270(3520)	2	10-200	0-100	6.6	200
a,a-Dimethylphenethylamine	8270(3520)	2	10-200	0-50	460	2000
2,4-Dimethylphenol	625/8270(3520) CLP 3/90 CLP 10/92	1/2 62 6	51-117 NA NA	0-47 NA NA	1.5 10 5.0	10 10 5.0
Dimethylphthalate	625/8270(3520) CLP 3/90 CLP 10/92	1/2 62 6	78-119 NA NA	0-9 NA NA	0.48 10 5.0	10 10 5.0
m-Dinitrobenzene	8270(3520)	2	10-150	0-50	0.56	10

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
4,6-Dinitro-2-methylphenol	625/8270(3520) CLP 3/90 CLP 10/92	1/2	DL-231	0-23	0.65	50
		62	NA	NA	25	25
		6	NA	NA	20	20
2,4-Dinitrophenol	625/8270(3520) CLP 3/90 CLP 10/92	1/2	DL-256	0-41	6.6	50
		62	NA	NA	25	25
		6	NA	NA	20	20
2,4-Dinitrotoluene (MS - All methods)	625/8270(3520) CLP 3/90 CLP 10/92	1/2	42-166	0-33	0.44	10
		62	NA	NA	10	10
		6	30-120	NA	5.0	5.0
2,6-Dinitrotoluene	625/8270(3520) CLP 3/90 CLP 10/92	1/2	70-127	0-12	0.64	10
		62	NA	NA	10	10
		6	NA	NA	5.0	5.0
Dinoseb (2-sec-Butyl-4,6-dinitrophenol)	8270(3520)	2	10-150	0-50	0.30	10
Di-n-octyl phthalate	625/8270(3520) CLP 3/90 CLP 10/92	1/2	DL-264	0-38	0.14	10
		62	NA	NA	10	10
		6	NA	NA	5.0	5.0
1,4-Dioxane	8270***v(3520)	2	10-150	0-50	0.76	10
Diphenylamine/ N-nitrosodiphenylamine (MS - CLP 10/92)	625/8270(3520) CLP 3/90 CLP 10/92	1/2	10-150	0-50	1.0	10
		62	NA	NA	10	10
		6	30-110	NA	5.0	5.0
1,2-Diphenyl hydrazine	8270(3520)	2	10-150	0-50	1.2	10
Endosulfan I	625/8270(3520)	1/2	10-150	0-50	1.2	20
Endosulfan II	625/8270(3520)	1/2	10-150	0-50	1.9	20
Endosulfan sulfate	625/8270(3520)	1/2	45-171	0-25	1.5	20
Endrin	625/8270(3520)	1/2	10-150	0-50	2.2	20
Endrin aldehyde	625/8270(3520)	1/2	DL-741	0-59	3.0	50
Endrin ketone	8270/(3520)	2	10-150	0-50	12	50
Ethyl carbamate	8270***v(3520)	2	52-100	0-24	2.5	10
Ethyl methane sulfonate	8270(3520)	2	10-150	0-50	0.39	10
Fluoranthene	625/8270(3520) CLP 3/90 CLP 10/92	1/2	75-135	0-31	0.60	10
		62	NA	NA	10	10
		6	NA	NA	5.0	5.0
Fluorene	625/8270(3520) CLP 3/90 CLP 10/92	1/2	80-131	0-17	0.78	10
		62	NA	NA	10	10
		6	NA	NA	5.0	5.0
Heptachlor	625/8270(3520)	1/2	33-178	0-36	1.5	20
Heptachlor epoxide	625/8270(3520)	1/2	48-184	0-25	1.7	20
Hexachlorobenzene (MS - CLP 10/92)	625/8270(3520) CLP 3/90 CLP 10/92	1/2	61-132	0-14	0.46	10
		62	NA	NA	10	10
		6	40-120	NA	5.0	5.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Hexachlorobutadiene	625/8270(3520)	1/2	25-117	0-43	0.46	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Hexachlorocyclopentadiene	8270(3520)	2	10-150	0-50	1.6	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Hexachloroethane (MS - CLP 10/92)	625/8270(3520)	1/2	19-79	0-33	0.32	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	20-110	NA	5.0	5.0
Hexachlorophene	8270(3520)	2	10-200	0-80	1200	5000
Hexachloropropene	8270(3520)	2	10-150	0-50	0.27	10
Indeno(1,2,3-cd)pyrene	625/8270(3520)	1/2	67-134	0-35	0.52	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Isophorone (MS - CLP 10/92)	625/8270(3520)	1/2	68-134	0-22	0.63	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	50-110	NA	5.0	5.0
Isosafrole	8270(3520)	2	10-150	0-50	0.88	10
Kepone	8270(3520)	2	10-150	0-50	2.5	10
Methapyrilene	8270(3520)	2	10-150	0-50	900	2000
3-Methylcholanthrene	8270(3520)	2	10-150	0-50	0.50	10
Methylmethanesulfonate	8270(3520)	2	10-150	0-50	0.44	10
2-Methylnaphthalene	8270(3520)	2	10-150	0-50	0.48	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
1-Methylnaphthalene	8270(3520)	2	10-150	0-50	2.5	10
Naphthalene (MS - CLP 10/92)	625/8270(3520)	1/2	63-113	0-25	0.54	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	30-110	NA	5.0	5.0
1,4-Napthoquinone	8270(3520)	2	10-150	0-50	0.81	10
1-Napthylamine	8270(3520)	2	10-150	0-50	0.93	10
2-Napthylamine	8270(3520)	2	10-150	0-50	0.82	10
Nicotine	8270(3520)	2	10-150	0-50	25	100
2-Nitroaniline	8270(3520)	2	10-150	0-50	0.53	50
	CLP 3/90	62	NA	NA	25	25
	CLP 10/92	6	NA	NA	20	20
3-Nitroaniline	8270(3520)	2	10-150	0-50	3.6	50
	CLP 3/90	62	NA	NA	25	25
	CLP 10/92	6	NA	NA	20	20
4-Nitroaniline	8270(3520)	2	10-150	0-50	1.9	50
	CLP 3/90	62	NA	NA	25	25
	CLP 10/92	6	NA	NA	20	20

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Nitrobenzene	625/8270(3520)	1/2	57-121	0-25	0.54	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
2-Nitrophenol	625/8270(3520)	1/2	40-142	0-28	0.42	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
4-Nitrophenol (MS - Except CLP 10/92))	625/8270(3520)	1/2	17-153	0-33	0.77	50
	CLP 3/90	62	10-80	0-50	25	25
	CLP 10/92	6	NA	NA	20	20
4-Nitroquinoline-1-oxide	8270(3520)	2	10-150	0-50	36	100
N-Nitrosodi-n-butylamine	8270(3520)	2	10-150	0-50	0.64	10
N-Nitrosodiethylamine	8270(3520)	2	10-150	0-50	0.75	10
N-Nitrosodimethylamine	625/8270(3520)	1/2	10-150	0-50	0.54	10
N-Nitrosodi-n-propylamine (MS - All methods)	625/8270(3520)	1/2	40-145	0-39	1.1	10
	CLP 3/90	62	41-116	0-38	10	10
	CLP 10/92	6	30-110	NA	5.0	5.0
N-Nitrosomethylethylamine	8270(3520)	2	10-150	0-50	0.64	10
N-Nitrosomorpholine	8270(3520)	2	10-150	0-50	0.80	10
N-Nitrosopiperidine	8270(3520)	2	10-150	0-50	0.80	10
N-Nitrosopyrrolidine	8270(3520)	2	10-150	0-50	1.2	10
5-Nitro-o-toluidine	8270(3520)	2	10-150	0-50	0.52	10
PCB-1016	625/8270(3520)	1/2	10-150	0-50	120	500
PCB-1221	625/8270(3520)	1/2	10-150	0-50	120	500
PCB-1232	625/8270(3520)	1/2	10-150	0-50	120	500
PCB-1242	625/8270(3520)	1/2	10-150	0-50	120	500
PCB-1248	625/8270(3520)	1/2	10-150	0-50	120	500
PCB-1254	625/8270(3520)	1/2	10-150	0-50	120	500
PCB-1260	625/8270(3520)	1/2	10-150	0-50	120	500
Pentachlorobenzene	8270(3520)	2	10-150	0-50	0.76	10
Pentachloronitrobenzene	8270(3520)	2	10-150	0-50	0.57	10
Pentachlorophenol (MS - All methods)	625/8270(3520)	1/2	16-138	0-33	1.2	50
	CLP 3/90	62	9-103	0-50	25	25
	CLP 10/92	6	NA	NA	20	20
Phenacetin	8270(3520)	2	10-150	0-50	0.81	10
Phenanthrene	625/8270(3520)	1/2	78-135	0-30	0.35	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	NA	NA	5.0	5.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Phenol (MS - All methods)	625/8270(3520)	1/2	40-113	0-31	0.93	10
	CLP 3/90	62	12-110	0-42	10	10
	CLP 10/92	6	40-120	NA	5.0	5.0
p-Phenylenediamine	8270(3520)	2	10-200	0-50	760	2000
2-Picoline	8270(3520)	2	10-150	0-50	2.2	200
Pronamide	8270(3520)	2	10-150	0-50	0.65	10
Pyrene (MS - Except CLP 10/92)	625/8270(3520)	1/2	46-168	0-36	0.49	10
	CLP 3/90	62	26-127	0-31	10	10
	CLP 10/92	6	NA	NA	5.0	5.0
Pyridine	8270(3520)	2	10-150	0-50	1.9	200
Safrole	8270(3520)	2	10-150	0-50	0.52	10
Strychnine	8270(3520)	2	10-150	0-50	25	100
1,2,4,5-Tetrachlorobenzene	8270(3520)	2	10-150	0-50	0.55	10
Trichlorophenols (2,4,5 and 2,4,6)	8270(3520)	2	NA	NA	0.57	10
2,3,4,5-Tetrachlorophenol	8270*** (3520)	2	10-150	0-50	12	50
2,3,4,6-Tetrachlorophenol	8270(3520)	2	45-129	0-22	0.68	50
o-Toluidine	8270(3520)	2	10-150	0-50	1.1	10
Toxaphene	625/8270(3520)	1/2	10-200	0-80	500	2000
1,2,4-Trichlorobenzene (MS - All methods)	625/8270(3520)	1/2	48-111	0-31	0.38	10
	CLP 3/90	62	39-98	0-28	10	10
	CLP 10/92	6	40-100	NA	5.0	5.0
Tetrachlorophenols (2,3,4,5 and 2,3,4,6)	8270(3520)	2	NA	NA	1.3	50
2,4,5-Trichlorophenol	8270(3520)	2	45-113	0-21	0.59	10
	CLP 3/90	62	NA	NA	25	25
	CLP 10/92	6	NA	NA	20	20
2,4,6-Trichlorophenol (MS - CLP 10/92)	625/8270(3520)	1/2	43-136	0-16	0.57	10
	CLP 3/90	62	NA	NA	10	10
	CLP 10/92	6	40-120	NA	5.0	5.0
o,o,o-Triethyl-phosphorothioate	8270(3520)	2	10-150	0-50	0.48	10
1,3,5-Trinitrobenzene	8270(3520)	2	10-150	0-50	0.33	200
Surrogate - Nitrobenzene-d5	625/8270(3520)	1/2	32-117	NA	NA	NA
	CLP 3/90	62	35-114	NA	NA	NA
	CLP 10/92	6	40-112	NA	NA	NA
Surrogate - 2-Fluorobiphenyl	625/8270(3520)	1/2	31-118	NA	NA	NA
	CLP 3/90	62	43-116	NA	NA	NA
	CLP 10/92	6	42-110	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Surrogate - p-Terphenyl-d14	8270(3520)	2	33-141	NA	NA	NA
	CLP 3/90	62	33-141	NA	NA	NA
	CLP 10/92	6	24-140	NA	NA	NA
Surrogate - Phenol-d5	625/8270(3520)	1/2	10-106	NA	NA	NA
	CLP 3/90	62	10-110	NA	NA	NA
	CLP 10/92	6	17-113	NA	NA	NA
Surrogate - 2-Fluorophenol	8270(3520)	2	10-104	NA	NA	NA
	CLP 3/90	62	21-110	NA	NA	NA
	CLP 10/92	6	16-108	NA	NA	NA
Surrogate - 2,4,6-Tribromophenol	8270(3520)	2	41-143	NA	NA	NA
	CLP 3/90	62	10-123	NA	NA	NA
	CLP 10/92	6	18-126	NA	NA	NA
Surrogate - 2-Chlorophenol-d4	CLP 3/90	62	33-110	NA	NA	NA
Surrogate - 1,2-Dichlorobenzene-d4	CLP 3/90	62	16-110	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) (MS)	613/8280 8270 (Screen)	1/2 2	63-137 NA	0-40 NA	0.0042 10	0.0050 10
Polychlorinated Dibenzo-p-dioxin and Dibenzofuran classes						
tetra-CDD (MS)	8280	2	63-137	0-40	0.0042	0.0050
tetra-CDF (MS)	8280	2	60-142	0-40	0.0037	0.0050
penta-CDD (MS)	8280	2	37-163	0-40	0.0035	0.0050
penta-CDF (MS)	8280	2	52-148	0-40	0.0038	0.0050
hexa-CDD (MS)	8280	2	42-158	0-40	0.0041	0.0050
hexa-CDF (MS)	8280	2	58-142	0-40	0.0029	0.0050
hepta-CDD (MS)	8280	2	20-170	0-50	0.0025	0.010
hepta-CDF (MS)	8280	2	20-170	0-50	0.0056	0.010
octa-CDD (MS)	8280	2	20-170	0-50	0.0095	0.010
octa-CDF (MS)	8280	2	20-170	0-50	0.0072	0.010
Internal Standard - ¹³ C ₁₂ -2,3,7,8-TCDD	613	1	> 50	NA	NA	NA
	8280	2	40-120	NA	NA	NA
Internal Standard - ¹³ C ₁₂ -OCDD	8280	2	40-120	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Benfluralin	627	9	40-140	0-40	0.0025	0.010
Ethalfuralin	627	9	40-140	0-50	0.50	2.0
Isopropalin	627	9	48-140	0-50	0.025	0.10
Profluralin	627	9	55-140	0-50	0.050	0.20
Trifluralin (MS)	627	9	17-140	0-50	0.0025	0.010
Surrogate - 2,4,5,6-Tetrachloro-m-xylene	627	9	22-126	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Amobam	630	63	70-130	0-20	♦	♦
Ferbam	630	63	70-130	0-20	♦	♦
Mancozeb	630	63	70-130	0-20	♦	♦
Maneb	630	63	70-130	0-20	♦	♦
Metham	630	63	70-130	0-20	♦	♦
Nabam	630	63	70-130	0-20	♦	♦
Polyram	630	63	70-130	0-20	♦	♦
Zineb	630	63	70-130	0-20	♦	♦
Ziram	630	63	70-130	0-20	5.0	20
Benomyl (as Carbendazim)	631	55	50-126	0-30	1.2	5.0

♦ All compounds reported as Ziram

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Aminocarb	632	13	60-125	0-30	0.25	1.0
Barban	632	13	55-125	0-30	0.25	1.0
Bromacil	632***V	13	52-125	0-30	0.19	2.0
Carbaryl (MS)	632	13	55-125	0-30	0.31	5.0
Carbofuran	632	13	55-125	0-30	2.5	10
Chlorphropham	632	13	55-125	0-30	0.25	1.0
Diuron (MS)	632	13	55-125	0-30	0.016	1.0
Fenuron	632	13	60-125	0-30	1.2	5.0
Fluomethuron	632	13	59-125	0-40	0.25	1.0
Linuron	632	13	55-125	0-30	0.036	1.0
Methomyl	632	13	52-132	0-30	0.25	1.0
Methiocarb	632	13	51-137	0-30	1.2	5.0
Monuron	632	13	56-132	0-30	0.25	1.0
Neburon	632	13	54-126	0-30	0.25	1.0
Oxamyl	632	13	57-125	0-30	0.25	10
Propham	632	13	50-125	0-30	0.25	1.0
Propoxur	632	13	56-125	0-30	0.53	1.0
Siduron	632	13	55-125	0-30	0.25	1.0
Sweep	632	13	58-125	0-30	0.25	1.0
Surrogate - Propachlor	632	13	45-125	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Bromacil	633	41	52-125	0-30	0.50	2.0
DEET	633	41	52-125	0-30	1.2	5.0
Hexazinone	633	41	52-125	0-30	0.12	0.50
Metribuzin	633	41	50-125	0-30	0.25	1.0
Terbacil	633	41	50-130	0-30	1.2	5.0
Triadimefon	633	41	48-125	0-30	0.25	1.0
Tricyclazole	633	41	53-125	0-30	1.2	5.0
Surrogate - Triphenylphosphate	633	41	40-125	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Butylate (MS)	634	15	38-145	0-76	0.28	2.0
Cycloate	634	15	46-159	0-47	0.24	2.0
EPTC	634	15	46-154	0-55	0.42	2.0
Molinate (MS)	634	15	37-127	0-74	0.21	2.0
Pebulate	634	15	22-172	0-50	0.23	2.0
Vernolate	634	15	39-147	0-45	0.19	2.0
Surrogate - Tokuthion	634	15	44-125	NA	NA	NA
Surrogate - Triphenylphosphate	634	15	40-125	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Rotenone	635	19	59-125	0-30	0.50	2.0
Bensulide	636	16	22-140	0-50	0.50	2.0
Oryzalin	638	21	50-130	0-30	0.076	1.0
Bendiocarb	639	20	10-165	0-50	0.50	2.0
Bentazon	643	59	50-150	0-40	1.2	5.0
Picloram	644	64	44-138	0-40	0.12	0.50

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Alachlor (MS)	645	28	45-140	0-30	0.25	1.0
Butachlor	645	28	50-124	0-40	0.25	1.0
Diphenamid	645	28	57-119	0-40	0.25	1.0
Fluridone	645	28	45-154	0-40	0.25	1.0
Lethane	645	28	33-153	0-50	0.25	1.0
Norflurazon	645	28	48-110	0-40	0.25	1.0
Surrogate - Triphenylphosphate	645	28	40-125	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acenaphthene (MS)	8310	2	44-162	0-52	0.31	1.0
Acenaphthylene	8310	2	10-139	0-40	0.15	1.0
Anthracene	8310	2	10-126	0-40	0.0077	0.20
Benzo(a)anthracene	8310	2	12-135	0-40	0.011	0.20
Benzo(b)fluoranthene	8310	2	6-150	0-40	0.0075	0.20
Benzo(k)fluoranthene	8310	2	10-159	0-40	0.0082	0.50
Benzonitrile	8310***	2	10-200	0-40	2.50	10
Benzo(g,h,i)perylene	8310	2	10-120	0-40	0.031	0.50
Benzo(a)pyrene	8310	2	10-128	0-40	0.0077	0.20
Carbazole	8310***	2	10-150	0-40	0.25	1.0
Chrysene (MS)	8310	2	10-199	0-40	0.0088	0.20
Dibenz(a,h)acridine	8310***	2	NA	NA	NA	NA
Dibenzo(a,h)anthracene	8310	2	10-110	0-40	0.027	1.0
Fluoranthene	8310	2	41-155	0-54	0.017	0.50
Fluorene (MS)	8310	2	10-142	0-40	0.037	0.50
Indene	8310***	2	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	8310	2	10-116	0-40	0.0091	0.50
6-Methyl chrysene	8310***	2	NA	NA	NA	NA
1-Methylnaphthalene	8310***	2	10-125	0-40	0.25	1.0
2-Methylnaphthalene	8310***	2	10-125	0-40	0.25	1.0
Naphthalene (MS)	8310	2	50-135	0-40	0.26	1.0
Phenanthrene	8310	2	10-155	0-40	0.024	0.20
Pyrene (MS)	8310	2	50-158	0-43	0.063	0.50
Thiophenol	8310***	2	NA	NA	NA	NA
Surrogate - 4-Terphenyl-d4	8310	2	25-163	NA	NA	NA

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
Acetaldehyde	8315	2	30-110	0-40	50	200
Formaldehyde	8315	2	50-155	0-30	14	50
Aldicarb (Temik) (MS)	8318	2	34-124	0-40	0.98	10
Aldicarb sulfone	8318	2	54-116	0-40	0.55	5.0
Aldicarb sulfoxide	8318***	2	30-140	0-40	0.25	5.0
Carbaryl (Sevin)	8318	2	55-125	0-40	1.3	5.0
Carbofuran (Furadan) (MS)	8318	2	55-125	0-40	1.5	10
Dioxacarb	8318	2	56-124	0-40	1.1	5.0
3-Hydroxycarbofuran	8318	2	47-123	0-40	1.5	5.0
Methiocarb (Mesurool)	8318	2	51-137	0-40	1.4	5.0
Methomyl (Lannate)	8318	2	57-125	0-40	1.8	5.0
Oxamyl (MS)	8318***	2	50-150	0-40	1.6	5.0
Promecarb	8318	2	48-122	0-40	1.4	5.0
Propoxur (Baygon)	8318	2	47-127	0-40	1.5	5.0

TABLE 5.1. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/L)	Reporting Limit (ug/L)
2-Amino-4,6-dinitrotoluene	8330	2	65-135	0-30	0.053	0.20
4-Amino-2,6-dinitrotoluene	8330	2	37-140	0-30	0.069	0.50
1,3-Dinitrobenzene (MS)	8330	2	54-166	0-30	0.019	0.20
2,4-Dinitrotoluene (MS)	8330	2	60-140	0-30	0.019	0.20
2,6-Dinitrotoluene	8330	2	60-140	0-30	0.018	0.50
Diphenylamine	8330***V	2	65-140	0-30	2.3	10
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	8330	2	54-166	0-30	0.024	1.0
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	8330	2	41-165	0-30	0.041	0.50
Nitrobenzene	8330	2	52-152	0-30	0.037	0.20
Nitroglycerin	8330***V	2	71-121	0-22	11	10
n-Nitrosodiphenylamine	8330***V	2	55-121	0-30	2.2	10
2-Nitrotoluene (MS)	8330	2	50-144	0-30	0.054	0.50
3-Nitrotoluene	8330	2	55-165	0-30	0.048	0.50
4-Nitrotoluene	8330	2	54-166	0-30	0.051	0.50
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	8330	2	54-162	0-30	0.021	1.0
Pentaerythritol tetranitrate (PETN)	8330***V	2	50-150	0-30	13	20
1,3,5-Trinitrobenzene	8330	2	50-150	0-30	0.090	0.20
2,4,6-Trinitrotoluene	8330	2	50-170	0-30	9.3	0.20
Surrogate - 3,4-Dinitrotoluene	8330	2	40-140	NA	NA	NA
Asulam	SL-SOP	68	34-155	0-34	0.50	2.0
Ethylenethiourea	SL-SOP	68	60-111	0-36	1.2	5.0
Thiodiglycol	SL-SOP	68	31-97	0-83	25	100

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (mg/kg)	Reporting Limit (mg/kg)
Aluminum	6010(3050) CLP	2	70-130	0-30	2.0	20
		45	70-130	0-20	40	40
Antimony	6010(3050) CLP 7041(3050)***v	2	70-130	0-30	1.5	5.0
		45	70-130	0-20	12	12
		2	70-130	0-30	0.082	1.0
Arsenic	6010(3050) 7060(3050) 7061(3050) CLP	2	70-130	0-30	1.4	10
		2	70-130	0-30	0.23	1.0
		2	60-140	0-40	0.25	1.0
		45	70-130	0-20	2.0	2.0
Barium	6010(3050) CLP	2	70-130	0-30	0.059	1.0
		45	70-130	0-20	40	40
Beryllium	6010(3050) CLP 7091(3050)	2	70-130	0-30	0.095	0.50
		45	70-130	0-20	1.0	1.0
		2	70-130	0-30	0.25	0.10
Boron	6010(3050)***	2	70-130	0-30	1.2	5.0
Cadmium	6010(3050) CLP 7131(3050)	2	70-130	0-30	0.15	0.50
		45	70-130	0-20	1.0	1.0
		2	70-130	0-30	0.25	0.10
Calcium	6010(3050) CLP	2	70-130	0-30	4.8	50
		45	70-130	0-20	1000	1000
Chromium	6010(3050) CLP 7191(3050)	2	70-130	0-30	0.80	1.0
		45	70-130	0-20	2.0	2.0
		2	70-130	0-30	0.25	1.0
Cobalt	6010(3050) CLP	2	70-130	0-30	0.22	1.0
		45	70-130	0-20	10	10
Copper	6010(3050) CLP	2	70-130	0-30	0.54	2.5
		45	70-130	0-20	5.0	5.0
Iron	6010(3050) CLP	2	70-130	0-30	0.78	5.0
		45	70-130	0-20	20	20
Lead	6010(3050) 7421(3050) CLP	2	70-130	0-30	0.62	5.0
		2	70-130	0-30	0.26	0.50
		45	70-130	0-20	0.60	0.60
Lithium	3500-Li B(3050)***	4/2	70-130	0-20	2.5	10
Magnesium	6010(3050) CLP	2	70-130	0-30	2.5	50
		45	70-130	0-20	1000	1000
Manganese	6010(3050) CLP	2	70-130	0-30	0.073	1.0
		45	70-130	0-20	3.0	3.0
Mercury	7471 CLP	2	70-130	0-30	0.0032	0.030
		45	70-130	0-20	0.10	0.10
Molybdenum	6010(3050)	2	70-130	0-30	0.054	1.0
Nickel	6010(3050) CLP	2	70-130	0-30	0.50	4.0
		45	70-130	0-20	8.0	8.0

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (mg/kg)	Reporting Limit (mg/kg)
Potassium	6010(3050)	2	70-130	0-30	37	100
	CLP	45	70-130	0-20	1000	1000
	7610(3050)	2	70-130	0-30	2.5	10
Selenium	6010(3050)	2	70-130	0-30	1.9	5.0
	7740(3050)	2	70-130	0-30	0.27	1.0
	7741(3050)	2	60-140	0-40	0.25	1.0
	CLP	45	70-130	0-20	1.0	1.0
Silica (acid extractable)	6010(3050***)	2	70-130	0-30	12	50
Silver	6010(3050)	2	70-130	0-30	0.18	1.0
	CLP	45	70-130	0-20	2.0	2.0
	7761(3050)	2	70-130	0-30	0.025	0.10
Sodium	6010(3050)	2	70-130	0-30	12	50
	CLP	45	70-130	0-20	1000	1000
Strontium	6010*** (3050***)	2	70-130	0-30	0.054	1.0
Thallium	6010(3050)	2	70-130	0-30	7.2	50
	7841(3050)	2	70-130	0-30	0.065	1.0
	CLP	45	70-130	0-20	2.0	2.0
Tin	6010***V(3050***V)	2	70-130	0-30	1.5	5.0
Titanium	6010***V(3050***V)	2	70-130	0-30	0.25	1.0
Tributyl tin	Atomic absorption	40	70-130	0-40	0.025	0.025
Vanadium	6010(3050)		70-130	0-30	1.4	1.0
	CLP	45	70-130	0-20	10	10
Zinc	6010(3050)	2	70-130	0-30	0.58	2.0
	CLP	45	70-130	0-20	4.0	4.0
Zinc Phosphide	FDER Special Method	31	NA	NA	NA	NA
Zirconium	6010***V(3050***V)	2	70-130	0-30	125	500

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (mg/kg)	Reporting Limit (mg/kg)
Ammonia (as N)	EPA-CE:3-140 350.3(EPA-CE)	46	75-125	0-30	0.20	0.50
		3/46	75-125	0-30	0.030	0.50
BOD	EPA-CE:3-380	46	60-140	0-40	NA	200
BTU	D240-87	38	70-130	0-30	NA	200 BTU/lb
Carbon, total organic	EPA-CE [Walkley-Black] 9060	46 [43]	60-140	0-40	64	100
		2	60-140	0-40	50	100
Cation exchange capacity	9080/EPA-CE:3-20	2/46	70-130	0-40	NA	0.0033 meq/100 g
	9081	2	70-130	0-40	NA	0.0033 meq/100 g
Chloride (extractable)	9251	2	75-125	0-30	4.0	20
	9252	2	75-125	0-30	17	20
	4500-C1 C	4	75-125	0-30	5.0	20
Chloride, total	9251(5050)	2	70-130	0-40	NA	200
	9056(5050)	2	70-130	0-40	NA	200
COD	EPA-CE:3-373	46	60-140	0-40	NA	100
Coliform, fecal	9221C(EPA/AOAC)	67/36	NA	0-200	NA	3 MPN/g
Coliform, total	9221B(EPA/AOAC)	67/36	NA	0-200	NA	3 MPN/g
Cyanide, amenable to chlorination	9012(9013)	2	NA	0-50	NA	1.0
	9010	2	NA	0-40	NA	1.0
Cyanide, reactive	7.3.3.2	2	NA	0-50	NA	1.0
Cyanide, total	9012(9013)	2	75-125	0-30	0.59	1.0
	9010	2	75-125	0-30	0.14	1.0
	CLP	45	85-115	0-25	0.30	0.30
EP Toxicity	1310	2	NA	NA	NA	NA
Fluoride (extractable)	340.2	3	75-125	0-25	0.40	4.0
Halogens, total	9056(5050)	2	70-130	0-40	NA	200
Halogens, total organic (EOX)	EPA-600/4-84-008	44	60-140	0-50	8.6	10
Hydrogen ion (pH)	9045	2	NA	0-10	NA	NA
Ignitability	1010	2	NA	NA	NA	NA
Nitrate (as N)	EPA-CE:3-183	46	75-125	0-30	NA	5.0
Nitrate-Nitrite (as N)	EPA-CE:3-183	46	75-125	0-30	1.2	5.0
Nitrite (as N)	EPA-CE:3-183	46	75-125	0-30	1.2	5.0
Nitrogen, organic	EPA-CE:3-205	46	NA	NA	NA	25
Nitrogen, total	TKN + NO ₃ /NO ₂	46	NA	NA	NA	30
Nitrogen, total Kjeldahl	EPA-CE:3-202	46	65-135	0-30	17	25

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (mg/kg)	Reporting Limit (mg/kg)
Oil and Grease	9070(9071)	2	60-140	0-50	35	100
	413.2(9071)	3(2)	60-140	0-50	2.3	10
Orthophosphate (extractable)	365.1	3	75-125	0-30	0.31	5.0
Paint filter liquids	9095	2	NA	0-40	NA	NA
Petroleum hydrocarbons	9073 (9071)	2	60-140	0-50	3.5	10
Phenolics, total recoverable	9066(EPA-CE)	2 (46)	60-140	0-40	0.74	1.0
	9065(EPA-CE)	2 (46)	60-140	0-40	0.76	1.0
Phosphorus, total	EPA-CE:3-213 EPA-CE:3-212	46	60-140	0-40	24	25
		46	60-140	0-40	6.3	25
Radionuclides, alpha	9310	2	64-145	0-31	NA	NA
Radionuclides, beta	9310	2	67-140	0-28	NA	NA
Residue, fixed (% ash)	EPA-CE:3-59	46	NA	0-40	NA	0.10%
Solids, total	EPA-CE:3-58	46	NA	0-30	NA	0.10%
Solids, volatile	EPA-CE:3-59	46	75-125	0-30	NA	0.10%
Specific gravity	EPA-CE:3-61	46	NA	0-10	NA	NA
Streptococcus, fecal	9230B (EPA/AOAC)	4 (67/36)	NA	NA	NA	3 MPN/g
Sulfate (extractable)	9036	2	75-125	0-30	32	100
	9038	2	75-125	0-30	12	100
	375.3	3	75-125	0-30	25	100
Sulfide	9030-SL	2	50-150	0-50	2.2	10
Sulfide, acid volatile	SL SOP	68	50-150	0-50	2.8	10
Sulfide, reactive	7.3.4.2	2	NA	0-50	NA	10
Sulfur	D129-64/9056(5050)	38/2	70-130	0-30	NA	170
Toxic compound leaching procedure	1311	48	NA	NA	NA	NA
Water (Karl Fisher)	D1744	38	NA	0-30	NA	50

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Benzyl chloride	8010(5030)	2	50-150	0-30	1.2	25
Bromobenzene	8010(5030)	2	70-130	0-30	12	50
Bromodichloromethane	8010(5030)	2	42-172	0-30	1.2	5.0
Bromoform	8010(5030)	2	13-159	0-30	0.65	25
Bromomethane	8010(5030)	2	10-144	0-30	1.4	5.0
Carbon tetrachloride	8010(5030)	2	43-143	0-30	1.1	5.0
Chlorobenzene (MS)	8010(5030)	2	31-122	0-27	1.1	5.0
Chloroethane	8010(5030)	2	46-137	0-30	1.1	5.0
Chloroform	8010(5030)	2	49-133	0-30	0.99	5.0
1-Chlorohexane	8010(5030)	2	50-150	0-30	1.2	5.0
2-Chloroethylvinyl ether	8010(5030)	2	14-186	0-80	12	50
Chloromethane	8010(5030)	2	10-193	0-30	0.85	5.0
2-Chlorotoluene	8010(5030)	2	70-130	0-30	12	50
3-Chlorotoluene	8010(5030)	2	70-130	0-30	12	50
4-Chlorotoluene	8010(5030)	2	70-130	0-30	12	50
Dibromochloromethane	8010(5030)	2	24-191	0-30	0.95	5.0
Dibromomethane	8010(5030)	2	70-130	0-30	6.2	25
1,2-Dichlorobenzene	8010(5030)	2	10-208	0-30	1.2	5.0
1,3-Dichlorobenzene	8010(5030)	2	10-187	0-30	1.2	5.0
1,4-Dichlorobenzene	8010(5030)	2	42-143	0-30	1.2	5.0
Dichlorodifluoromethane	8010(5030)	2	70-130	0-30	1.2	5.0
1,1-Dichloroethane	8010(5030)	2	47-132	0-30	1.0	5.0
1,2-Dichloroethane	8010(5030)	2	51-147	0-30	1.2	5.0
1,1-Dichloroethene (MS)	8010(5030)	2	51-132	0-28	0.82	5.0
cis/trans 1,2-Dichloroethene	8010(5030)	2	38-155	0-30	1.7	5.0
Dichloromethane (Methylene chloride)	8010(5030)	2	25-162	0-30	0.99	5.0
1,2-Dichloropropane	8010(5030)	2	44-156	0-30	0.92	5.0
cis/trans-1,3-Dichloropropylene	8010(5030)	2	22-178	0-30	1.2	5.0
1,1,2,2-Tetrachloroethane	8010(5030)	2	10-184	0-30	0.47	5.0
1,1,1,2-Tetrachloroethane	8010(5030)	2	70-130	0-30	1.2	5.0
Tetrachloroethene	8010(5030)	2	26-162	0-30	0.47	5.0

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
1,1,1-Trichloroethane	8010(5030)	2	41-138	0-30	1.1	5.0
1,1,2-Trichloroethane	8010(5030)	2	39-136	0-30	0.95	5.0
Trichloroethene (MS)	8010(5030)	2	56-133	0-26	1.3	5.0
Trichlorofluoromethane	8010(5030)	2	21-156	0-30	0.71	5.0
1,2,3-Trichloropropane	8010(5030)	2	50-150	0-30	1.2	5.0
Vinyl chloride	8010(5030)	2	28-163	0-30	1.2	5.0
1,2-Dibromoethane (EDB)	8010***(5030)	2	75-125	0-30	1.2	5.0
Surrogate - Bromochloromethane	8010(5030)	2	43-127	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Acetone	8015***v(5030)	2	40-130	0-30	31	130
2-Butanone (MEK)	8015(5030)	2	60-130	0-40	20	130
Diethyl ether (MS)	8015(5030)	2	10-130	0-50	32	130
Ethanol	8015(5030)	2	20-140	0-45	1200	130
Ethyl methacrylate	8015***v(5030)	2	42-125	0-40	12	50
Isobutanol	8015***v(5030)	2	50-120	0-40	1200	5000
Isopropanol	8015***v(5030)	2	30-140	0-40	1200	5000
Methacrylonitrile	8015***v(5030)	2	10-140	0-60	120	500
Methanol	8015***v(5030)	2	50-150	0-40	1200	5000
Methyl methacrylate	8015***v(5030)	2	45-132	0-42	12	50
4-Methyl-2-pentanone (MIBK) (MS)	8015(5030)	2	65-125	0-40	32	130
Methyl t-butyl ether (MTBE)	8015***v(5030)	2	50-150	0-30	23	50
Propionitrile	8015***v(5030)	2	10-130	0-50	120	500
Gasoline	GRO 8015 (modified)	70 12	50-150 40-140	0-20 0-40	16 62	180 250
Surrogate - Trifluorotoluene	8015	2	67-137	NA	NA	NA
Acetone	8015 (DAI*)***v	2	50-150	0-50	250	1000
tert-Amyl alcohol	8015 (DAI*)***v	2	50-150	0-50	130	1000
sec-Butanol	8015 (DAI*)***v	2	50-150	0-50	160	1000
n-Butanol	8015 (DAI*)***v	2	50-150	0-50	100	1000
tert-Butanol	8015 (DAI*)***v	2	50-150	0-50	160	1000
2-Butanone (MEK)	8015 (DAI*)	2	50-150	0-50	1300	5000
n-Butyl acetate	8015 (DAI*)***v	2	50-150	0-50	2300	5000
sec-Butyl acetate	8015 (DAI*)***v	2	50-150	0-50	2000	5000
Butyl cellosolve	8015 (DAI*)***v	2	50-150	0-50	1700	5000
Cellosolve acetate	8015 (DAI*)***v	2	50-150	0-50	3200	5000
Cyclohexanone	8015 (DAI*)***v	2	50-150	0-50	2400	5000
Diacetone alcohol	8015 (DAI*)***v	2	50-150	0-50	2600	5000
1,4-Dioxane	8015 (DAI*)	2	50-150	0-50	250	1000
Ethanol (MS)	8015 (DAI*)***v	2	50-150	0-50	130	1000
Ethyl acetate	8015 (DAI*)***v	2	50-150	0-50	1400	5000

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
2-Hexanone	8015 (DAI*)	2	50-150	0-50	1300	5000
Methanol (MS)	8015 (DAI*)***v	2	50-150	0-50	1000	1000
n-Propanol	8015 (DAI*)***v	2	50-150	0-50	220	1000
Isopropanol (MS)	8015 (DAI*)***v	2	50-150	0-50	130	1000
Diethylene glycol	8015 (DAI*)***v	2	50-150	0-50	1000	5000
Ethylene glycol (MS)	8015 (DAI*)***v	2	50-150	0-50	1900	5000
Isoamyl acetate	8015 (DAI*)***v	2	50-150	0-50	6400	5000
Isobutanol	8015 (DAI*)***v	2	50-150	0-50	130	1000
Isobutyl acetate	8015 (DAI*)***v	2	50-150	0-50	1600	5000
Isopropyl acetate	8015 (DAI*)***v	2	50-150	0-50	1900	5000
Mesityl oxide	8015 (DAI*)***v	2	50-150	0-50	2300	5000
Methyl acetate	8015 (DAI*)***v	2	50-150	0-50	4100	5000
4-Methyl-2-pentanone (MIBK)	8015 (DAI*)	2	50-150	0-50	1300	5000
2-Nitropropane	8015 (DAI*)***v	2	50-150	0-50	1200	5000
n-Propyl acetate (MS)	8015 (DAI*)***v	2	50-150	0-50	1500	5000
Propylene glycol (MS)	8015 (DAI*)***v	2	50-150	0-50	590	5000
Tetraethylene glycol	8015 (DAI*)***v	2	50-150	0-50	4200	5000
Tetrahydrofuran (MS)	8015 (DAI*)***v	2	50-150	0-50	1100	5000
Triethylene glycol	8015 (DAI*)***v	2	50-150	0-50	3300	5000
Vinyl Acetate	8015 (DAI*)	2	50-150	0-50	1300	5000

* DAI = Direct Extract Injection

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Benzene (MS)	8020(5030)	2	63-133	0-27	0.24	5.0
Chlorobenzene (MS)	8020(5030)	2	69-129	0-25	0.63	5.0
1,2-Dichlorobenzene	8020(5030)	2	37-154	0-30	0.79	5.0
1,3-Dichlorobenzene	8020(5030)	2	50-141	0-30	0.57	5.0
1,4-Dichlorobenzene	8020(5030)	2	42-143	0-30	0.54	5.0
Ethylbenzene	8020(5030)	2	32-160	0-30	0.53	5.0
Methyl tert-butyl ether (MTBE)	8020***(5030)	2	50-150	0-30	23	50
Toluene (MS)	8020(5030)	2	70-138	0-26	0.35	5.0
Xylenes (total)	8020(5030)	2	50-150	0-30	1.1	5.0
m-Xylene	8020(5030)	2	50-150	0-30	0.87	5.0
o+p Xylene	8020(5030)	2	50-150	0-30	0.71	5.0
Surrogate - a,a,a-Trifluorotoluene	8020(5030)	2	67-137	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Benzene (MS)	8021	2	61-131	0-31	0.37	5.0
Bromobenzene	8021	2	46-195	0-56	2.5	5.0
Bromochloromethane	8021	2	34-128	0-52	1.4	5.0
Bromodichloromethane	8021	2	46-143	0-54	0.32	5.0
Bromoform	8021	2	31-131	0-40	0.51	25
Bromomethane	8021	2	25-167	0-78	1.7	5.0
n-Butylbenzene	8021	2	50-150	0-22	0.85	5.0
sec-Butylbenzene	8021	2	50-150	0-21	0.70	5.0
tert-Butylbenzene	8021	2	49-188	0-48	0.90	5.0
Carbon tetrachloride	8021	2	42-141	0-50	0.94	5.0
Chlorobenzene (MS)	8021	2	48-143	0-24	0.38	5.0
Chloroethane	8021	2	43-158	0-52	0.66	5.0
Chloroform	8021	2	53-134	0-36	1.1	5.0
Chloromethane	8021	2	40-172	0-53	0.94	5.0
2-Chlorotoluene	8021	2	70-140	0-27	1.5	50
4-Chlorotoluene	8021	2	77-136	0-27	1.4	50
Dibromochloromethane	8021	2	44-150	0-56	0.55	5.0
1,2-Dibromo-3-chloropropane	8021	2	24-145	0-56	7.0	5.0
1,2-Dibromoethane	8021	2	34-168	0-77	2.6	5.0
Dibromomethane	8021	2	41-147	0-59	2.6	5.0
1,2-Dichlorobenzene	8021	2	52-141	10-39	0.64	5.0
1,3-Dichlorobenzene	8021	2	68-123	0-28	0.63	5.0
1,4-Dichlorobenzene	8021	2	65-131	0-42	0.65	5.0
Dichlorodifluoromethane	8021	2	49-196	0-50	1.0	5.0
1,1-Dichloroethane	8021	2	61-137	0-36	0.72	5.0
1,2-Dichloroethane	8021	2	38-148	0-58	1.3	5.0
1,1-Dichloroethene (MS)	8021	2	48-155	0-35	0.92	5.0
cis-1,2-Dichloroethene	8021	2	40-138	0-39	0.84	5.0
trans-1,2-Dichloroethene	8021	2	64-139	0-43	0.93	5.0
1,2-Dichloropropane	8021	2	53-129	0-45	0.68	5.0
1,3-Dichloropropane	8021	2	53-150	0-57	5.5	5.0
2,2-Dichloropropane	8021	2	40-138	0-39	2.4	5.0
1,1-Dichloropropene	8021	2	42-141	0-50	3.1	5.0

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
cis-1,3-Dichloropropene	8021	2	44-146	0-45	0.72	5.0
trans-1,3-Dichloropropene	8021	2	30-152	0-55	0.78	5.0
Ethylbenzene	8021	2	68-118	0-29	0.40	5.0
Hexachlorobutadiene	8021	2	52-145	0-41	1.8	5.0
Isopropylbenzene	8021	2	50-150	0-27	0.80	5.0
p-Isopropyltoluene	8021	2	50-150	0-24	1.0	5.0
Methylene chloride	8021	2	60-177	0-40	1.4	5.0
Naphthalene	8021	2	67-133	0-42	3.4	5.0
n-Propylbenzene	8021	2	50-150	0-19	0.75	5.0
Styrene	8021	2	81-108	0-18	2.0	5.0
1,1,1,2-Tetrachloroethane	8021	2	62-141	0-41	0.83	5.0
1,1,2,2-Tetrachloroethane	8021	2	61-148	0-48	16	5.0
Tetrachloroethene	8021	2	53-150	0-57	0.21	5.0
Toluene (MS)	8021	2	64-144	0-22	0.34	5.0
1,2,3-Trichlorobenzene	8021	2	77-125	0-26	1.3	5.0
1,2,4-Trichlorobenzene	8021	2	44-139	0-53	1.5	5.0
1,1,1-Trichloroethane	8021	2	59-136	0-47	1.3	5.0
1,1,2-Trichloroethane	8021	2	64-160	0-53	0.59	5.0
Trichloroethene (MS)	8021	2	51-140	0-48	0.52	5.0
Trichlorofluoromethane	8021	2	58-152	0-37	0.50	5.0
1,2,3-Trichloropropane	8021	2	61-148	0-48	16	5.0
1,2,4-Trimethylbenzene	8021	2	32-132	0-44	1.0	5.0
1,3,5-Trimethylbenzene	8021	2	50-150	0-16	1.6	5.0
Vinyl Chloride	8021	2	44-173	0-61	0.94	5.0
o-Xylene	8021	2	50-150	0-18	0.40	5.0
m&p-Xylene	8021	2	62-138	0-49	0.42	5.0
Surrogate - 2-Bromo-1-chloropropane	8021	2	70-130	NA	NA	NA
Surrogate - Fluorobenzene	8021	2	70-130	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND
METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Acrolein	8030(5030)	2	88-118	0-30	25	100
Acrylonitrile	8030(5030)	2	71-135	0-30	25	100

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
2-Chlorophenol (MS)	8040(3550)	2	27-150	0-26	50	330
4-Chloro-3-methylphenol (MS)	8040(3550)	2	20-151	0-39	41	330
2,4-Dichlorophenol	8040(3550)	2	44-119	0-40	63	330
2,4-Dimethylphenol	8040(3550)	2	24-118	0-40	140	330
2,4-Dinitrophenol	8040(3550)	2	12-145	0-65	110	1700
2-Methyl-4,6-dinitrophenol	8040(3550)	2	30-136	0-40	50	1700
3 and 4-Methyl phenol (m & p cresol)	***8040(3550)	2	10-150	0-50	180	330
2-Methyl phenol (o-cresol)	***8040(3550)	2	10-150	0-50	92	330
Cresols (total)	8040(3550)	2	10-150	0-50	82	330
2-Nitrophenol	8040(3550)	2	43-117	0-40	44	330
4-Nitrophenol (MS)	8040(3550)	2	10-130	0-34	60	1700
Pentachlorophenol (MS)	8040(3550)	2	10-162	0-80	48	1700
Phenol (MS)	8040(3550)	2	13-149	0-30	68	330
Trichlorophenols (2,4,5 and 2,4,6)	8040(3550)	2	NA	NA	82	330
2,3,4,6-Tetrachlorophenol	***8040(3550)	2	50-150	0-40	160	660
2,3,4,5-Tetrachlorophenol	***8040(3550)	2	50-150	0-40	120	660
Tetrachlorophenols (2,3,4,5 and 2,3,4,6)	8040(3550)	2	NA	NA	160	660
2,4,6-Trichlorophenol	8040(3550)	2	53-119	0-40	55	330
2,4,5-Trichlorophenol	***8040(3550)	2	53-119	0-40	100	330
Surrogate - 2,4,6-Tribromophenol	8040(3550)	2	10-186	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Butyl benzyl phthalate (MS)	8060(3550)	2	10-137	0-66	32	330
Bis(2-ethylhexyl) phthalate (MS)	8060(3550)	2	10-151	0-54	29	330
Di-n-butyl phthalate (MS)	8060(3550)	2	14-123	0-41	28	330
Diethyl phthalate (MS)	8060(3550)	2	10-145	0-34	31	330
Dimethyl phthalate (MS)	8060(3550)	2	10-147	0-31	29	330
Di-n-octyl phthalate (MS)	8060(3550)	2	10-147	0-86	31	330
Surrogate - 2-Fluorobiphenyl	8060(3550)	2	17-164	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Aldrin (MS)	8080(3550) CLP 3/90	2 62	40-137	0-39	0.58	1.7
			34-132	0-43	1.7	1.7
Benfluralin	8080***V(3550)	2	40-140	0-40	0.33	0.33
alpha-BHC	8080(3550) CLP 3/90	2 62	37-134	0-40	0.19	1.7
			NA	NA	1.7	1.7
beta-BHC	8080(3550) CLP 3/90	2 62	17-147	0-40	0.24	1.7
			NA	NA	1.7	1.7
gamma-BHC (Lindane) (MS)	8080(3550) CLP 3/90	2 62	41-134	0-36	0.26	1.7
			46-127	0-50	1.7	1.7
delta-BHC	8080(3550) CLP 3/90	2 62	19-140	0-40	0.40	1.7
			NA	NA	1.7	1.7
technical Chlordane	8080(3550)	2	45-119	0-40	3.5	17
alpha Chlordane	8081(3550) CLP 3/90	2 62	45-140	0-40	0.44	1.7
			NA	NA	1.7	1.7
gamma Chlordane	8081(3550) CLP 3/90	2 62	45-140	0-40	0.42	1.7
			NA	NA	1.7	1.7
Chlorobenzilate	8081(3550)	2	50-150	0-40	5.2	17
Chloroneb	8081(3550)	2	49-125	0-30	3.2	13
Chloropropylate	8081(3550)	2	51-125	0-30	4.0	16
Chlorothalonil	8081(3550)	2	35-130	0-40	1.7	6.7
Dacthal	8080***V(3550)/ 8081(3550)	2	75-127	0-27	0.057	0.33
4,4'-DDD	8080(3550) CLP 3/90	2 62	31-141	0-50	1.1	3.3
			NA	NA	3.3	3.3
4,4'-DDE	8080(3550) CLP 3/90	2 62	30-145	0-50	0.29	3.3
			NA	NA	3.3	3.3
4,4'-DDT (MS)	8080(3550) CLP 3/90	2 62	48-150	0-34	0.60	3.3
			23-134	0-50	3.3	3.3
Dicofol (Kelthane)	8081(3550)	2	40-125	0-40	1.7	20
Dieldrin (MS)	8080(3550) CLP 3/90	2 62	42-139	0-41	0.35	3.3
			31-134	0-38	3.3	3.3
Endosulfan I	8080(3550) CLP 3/90	2 62	45-153	0-40	0.43	1.7
			NA	NA	1.7	1.7
Endosulfan II	8080(3550) CLP 3/90	2 62	10-202	0-65	2.8	3.3
			NA	NA	3.3	3.3
Endosulfan sulfate	8080(3550) CLP 3/90	2 62	26-144	0-50	0.76	3.3
			NA	NA	3.3	3.3
Endrin (MS)	8080(3550) CLP 3/90	2 62	44-151	0-31	0.30	3.3
			42-139	0-45	3.3	3.3
Endrin aldehyde	8080(3550) CLP 3/90	2 62	10-150	0-50	1.1	3.3
			NA	NA	10	10
Endrin ketone	8080***V(3550)/ 8081(3550) CLP 3/90	2 62	40-100	0-31	0.038	3.3
			NA	NA	3.3	3.3
Etridiazole	8081(3550)	2	50-125	0-30	0.33	0.33
Heptachlor (MS)	8080(3550) CLP 3/90	2 62	40-136	0-34	0.80	1.7
			35-130	0-31	1.7	1.7

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Heptachlor epoxide	8080(3550) CLP 3/90	2	37-142	0-40	0.47	1.7
		62	NA	NA	1.7	1.7
Isodrin	8081(3550)	2	10-150	0-50	0.65	3.3
Kepone	8081(3550)	2	10-150	0-50	4.2	17
Methoxychlor	8080(3550) CLP 3/90	2	34-166	0-40	3.6	17
		62	NA	NA	17	17
Mirex	8081(3550)	2	20-100	0-50	8.2	33
Pendimethalin	8080***v(3550)	2	35-125	0-50	17	67
Permethrin (total)	8080***v(3550)	2	40-140	0-50	8.2	33
Propachlor	8081(3550)	2	51-125	0-30	4.0	16
Toxaphene	8080(3550) CLP 3/90	2	41-126	0-50	34	170
		62	NA	NA	170	170
Trifluralin	8081(3550)	2	40-140	0-40	0.33	0.33
Trithion	8080***v(3550)/ 8081(3550)	2	76-120	0-19	3.3	3.3
PCB-1016	8080(3550) CLP 3/90 EPA-600/4-81-045	2	52-152	0-31	4.6	33
		62	NA	NA	33	33
		61	50-130	0-50	1200	5000
PCB 1221	8080(3550) CLP 3/90 EPA-600/4-81-045	2	15-178	0-20	8.8	67
		62	NA	NA	67	67
		61	50-130	0-50	1200	5000
PCB 1232	8080(3550) CLP 3/90 EPA-600/4-81-045	2	10-215	0-20	13	33
		62	NA	NA	33	33
		61	50-130	0-50	1200	5000
PCB-1242	8080(3550) CLP 3/90 EPA-600/4-81-045	2	39-150	0-20	15	33
		62	NA	NA	33	33
		61	50-130	0-50	1200	5000
PCB-1248	8080(3550) CLP 3/90 EPA-600/4-81-045	2	38-158	0-20	5.0	33
		62	NA	NA	33	33
		61	50-130	0-50	1200	5000
PCB-1254	8080(3550) CLP 3/90 EPA-600/4-81-045	2	66-122	0-23	5.2	33
		62	NA	NA	33	33
		61	50-130	0-50	1200	5000
PCB-1260	8080(3550) CLP 3/90 EPA-600/4-81-045	2	58-122	0-20	13	33
		62	NA	NA	33	33
		61	50-130	0-50	1200	5000
Surrogate - Dibutylchloroendate (DBC)	8080(3550)	2	45-131	NA	NA	NA
Surrogate - 2,4,5,6-Tetrachloro-m- xylene (TCMX)	8080(3550) CLP 3/90	2 62	19-132 60-150	NA NA	NA NA	NA NA
Surrogate - Decachlorobiphenyl (DCB)	8080(3550) CLP 3/90	2 62	47-126 60-150	NA NA	NA NA	NA NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
2,4-Dinitrotoluene (MS)	8090(3550)(FID)	2	10-125	0-40	82	330
	8090(3550)(ECD)	2	10-125	0-40	0.56	10
2,6-Dinitrotoluene (MS)	8090(3550)(FID)	2	10-126	0-40	82	330
	8090(3550)(ECD)	2	10-126	0-40	0.65	10
Isophorone (MS)	8090(3550)	2	10-117	0-40	82	330
Nitrobenzene (MS)	8090(3550)	2	10-118	0-40	82	330
Surrogate - 2-Fluorobiphenyl	8090(3550)(FID)	2	17-164	NA	NA	NA
Surrogate - 2,4,5,6-Tetrachloro-m-xylene (TCMX)	8090(3550)(ECD)	2	19-132	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Acenaphthene (MS)	8100(3550)	2	37-115	0-32	10	330
Acenaphthylene	8100(3550)	2	36-114	0-32	16	330
Benzo(a)pyrene (MS)	8100(3550)	2	21-125	0-45	51	330
Benzo(b+k)fluoranthene	8100(3550)	2	26-128	0-41	82	330
Benzo(g,h,i)perylene	8100(3550)	2	25-126	0-42	70	330
Chrysene+Benzo(a)anthracene	8100(3550)	2	30-127	0-42	82	330
Fluoranthene	8100(3550)	2	28-132	0-33	32	330
Fluorene (MS)	8100(3550)	2	36-117	0-33	89	330
Indeno(1,2,3-cd)Pyrene + Dibenzo(a,h)anthracene	8100(3550)	2	20-131	0-47	13	330
1-Methylnaphthalene	8100(3550)	2	20-140	0-50	12	330
2-Methylnaphthalene	8100(3550)	2	20-140	0-50	12	330
Napthalene (MS)	8100(3550)	2	29-111	0-45	15	330
Phenanthrene + Anthracene	8100(3550)	2	38-118	0-32	82	330
Pyrene (MS)	8100(3550)	2	35-123	0-32	21	330
Diesel (MS)	DRO 8100***v (modified)	69 12	40-140 40-140	0-40 0-40	800 2500	3300 10000
Mineral spirits	8100 (modified)	12	40-140	0-40	2500	10000
Surrogate - 2-Fluorobiphenyl	8100(3550)	2	17-164	NA	NA	NA
Surrogate - o-Terphenyl	DRO 8100 (modified) (3550)	69 12	50-150 33-127	NA NA	NA NA	NA NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Acephate	8141*** (3550)	2	40-140	0-50	42	167
Alachlor	8141*** (3550)	2	40-140	0-30	8.2	33
Ametryn	619/8141***V (3550)	2	40-140	0-50	16	66
Atrazine	619/8141***V (3550)	2	40-125	0-30	16	66
Azinphos methyl	8141 (3550)	2	16-129	0-50	1.9	66
Bolstar	8141 (3550)	2	58-156	0-40	8.2	33
Bromacil	8141*** (3550)	2	40-140	0-50	16	66
Butylate	8141*** (3550)	2	38-145	0-76	16	66
Carbophenothion (Trithion)	8141 (3550)	2	20-150	0-40	16	66
Chlorpyrifos	8141 (3550)	2	7-199	0-40	1.6	33
Cyanazine	8141*** (3550)	2	40-125	0-30	2.2	33
Coumaphos	8141 (3550)	2	51-147	0-40	9.8	330
Cycloate	8141*** (3550)	2	46-159	0-47	16	66
Demeton-O	8141 (3550)	2	36-120	0-40	21	83
Demeton-S	8141 (3550)	2	36-120	0-40	21	83
Diazinon (MS)	8141 (3550)	2	36-124	0-30	2.9	33
Dichlofenthion	8141***V (3550)	2	40-140	0-50	8.2	33
Dichlorvos	8141 (3550)	2	49-120	0-40	6.4	66
Dimethoate	8141 (3550)	2	38-120	0-40	12	330
Disulfoton	8141 (3550)	2	10-134	0-93	5.4	66
Dioxathion	8141***V (3550)	2	40-140	0-50	82	330
EPN	8141 (3550)	2	48-124	0-30	1.3	33
EPTC	8141*** (3550)	2	46-154	0-55	16	66
Ethion	8141 (3550)	2	40-138	0-40	4.2	17
Ethoprop	8141 (3550)	2	58-113	0-40	0.61	17
Famphur	8141 (3550)	2	10-129	0-60	42	66
Fenamiphos	8141*** (3550)	2	40-160	0-40	4.2	17
Fensulfothion	8141 (3550)	2	43-145	0-40	2.8	330
Fenthion	8141 (3550)	2	10-128	0-60	2.8	33
Fonophos	8141 (3550)	2	40-160	0-40	8.2	33
Hexazinone	8141*** (3550)	2	40-140	0-50	8.2	33
Isofenphos	8141*** (3550)	2	40-160	0-40	4.2	17
Malathion	8141 (3550)	2	60-140	0-40	13	33
Merphos	8141 (3550)	2	50-130	0-40	1.5	33
Metalaxyl	8141***V (3550)	2	40-140	0-50	8.2	33
Methamidophos	8141***V (3550)	2	40-140	0-50	16	66
Methyl chlorpyrifos	8141 (3550)	2	40-140	0-50	8.2	33
Metolachlor	8141*** (3550)	2	40-140	0-50	8.2	33
Metribuzin	8141***V (3550)	2	40-140	0-50	8.2	33
Mevinphos	8141 (3550)	2	34-125	0-40	2.1	66
Molinate	8141*** (3550)	2	37-127	0-74	16	66

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Monocrotophos	8141(3550)	2	40-140	0-50	82	330
Naled	8141(3550)	2	54-102	0-40	6.9	330
Norflurazon	8141*** (3550)	2	40-140	0-50	8.2	33
Parathion, ethyl (MS)	8141(3550)	2	15-141	0-79	8.2	33
Parathion, methyl (MS)	8141(3550)	2	40-140	0-40	4.2	17
Pebulate	8141*** (3550)	2	22-172	0-50	8.2	33
Phorate	8141(3550)	2	36-125	0-40	8.2	33
Prometon	619/8141***V(3550)	2	40-140	0-50	16	66
Prometryn	619/8141***V(3550)	2	40-140	0-50	16	66
Propazine	619/8141***V(3550)	2	40-140	0-50	16	66
Ronnel (MS)	8141(3550)	2	22-127	0-35	23	33
Simazine	619/8141***V(3550)	2	20-150	0-50	16	66
Stirophos (Tetrachlorvinphos)	8141(3550)	2	48-125	0-40	8.2	33
Sulfotepp (MS)	8141(3550)	2	13-171	0-65	4.2	17
Terbufos	8141(3550)	2	40-140	0-50	4.2	17
Terbutryn	619/8141***V(3550)	2	40-140	0-50	82	330
Terbutylazine	619/8141***V(3550)	2	40-140	0-50	16	66
Thionazin (MS)	8141(3550)	2	25-160	0-60	16	33
Tokuthion (Prothiofos)	8141(3550)	2	44-125	0-40	8.2	33
Triadimefon	8141*** (3550)	2	40-140	0-50	8.2	33
Trichloronate	8141(3550)	2	49-161	0-40	82	330
Trithion	8141(3550)	2	40-140	0-50	55	200
Vernolate	8141*** (3550)	2	39-147	0-45	16	66
Surrogate - Triphenylphosphate	8141(3550)	2	40-125	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
2,4-D (MS)	8150	2	10-130	0-47	1.3	8.3
Dalapon	8150	2	10-170	0-40	16	2000
2,4-DB	8150	2	20-160	0-40	0.74	8.3
Dicamba	8150	2	20-160	0-40	0.54	20
Dichlorprop	8150	2	30-170	0-40	1.8	100
Dinoseb	8150	2	30-170	0-40	0.92	100
MCPA	8150	2	30-170	0-40	350	2000
MCPP	8150	2	30-170	0-40	280	2000
Pentachlorophenol	8151	2	10-150	0-40	4.3	17
Picloram	8150***v	2	10-150	0-40	1.6	3.3
2,4,5-T (MS)	8150	2	24-115	0-46	0.22	8.3
2,4,5-TP (Silvex) (MS)	8150	2	10-150	0-54	0.18	8.3
Surrogate - 2,4-Dichlorophenoxy butanoic acid (2,4-DB)	8150	2	20-160	NA	NA	NA
Surrogate - 2,4-Dichlorophenyl acetic acid (DCAA)	8150	2	10-148	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Acetone	8240(5030)/8260(5030) CLP 3/90	2 62	29-92 NA	0-40 NA	3.0 10	25 10
Acetonitrile	8240(5030)	2	78-151	0-40	21	1000
Acrolein	8240(5030)/8260(5030)	2	22-164	0-65	21	100
Acrylonitrile	8240(5030)/8260(5030)	2	61-145	0-40	12	100
Benzene (MS)	8240(5030)/8260(5030) CLP 3/90	2 62	48-150 66-142	0-27 0-21	0.34 10	5.0 10
Benzyl Chloride	8240(5030)/8260(5030)	2	50-150	0-40	25	100
Bromobenzene	8260(5030)	2	50-150	0-40	2.5	10
Bromochloromethane	8260(5030)	2	50-150	0-40	1.2	5.0
Bromodichloromethane	8240(5030)/8260(5030) CLP 3/90	2 62	35-155 NA	0-40 NA	0.29 10	5.0 10
Bromoform	8240(5030)/8260(5030) CLP 3/90	2 62	45-169 NA	0-40 NA	0.48 10	5.0 10
Bromomethane (Methyl bromide)	8240(5030)/8260(5030) CLP 3/90	2 62	10-242 NA	0-65 NA	1.3 10	10 10
2-Butanone (MEK)	8240(5030)/8260(5030) CLP 3/90	2 62	10-111 NA	0-40 NA	6.1 10	25 10
n-Butylbenzene	8260(5030)	2	50-150	0-40	1.2	5.0
sec-Butylbenzene	8260(5030)	2	50-150	0-40	1.2	5.0
tert-Butylbenzene	8260(5030)	2	50-150	0-40	1.2	5.0
Carbon disulfide	8240(5030)/8260(5030) CLP 3/90	2 62	35-244 NA	0-65 NA	0.98 10	5.0 10
Carbon tetrachloride	8240(5030)/8260(5030) CLP 3/90	2 62	70-140 NA	0-40 NA	0.85 10	5.0 10
Chlorobenzene (MS)	8240(5030)/8260(5030) CLP 3/90	2 62	54-138 60-133	0-33 0-21	0.32 10	5.0 10
2-Chloro-1,3-butadiene (Chloroprene)	8240(5030)/8260(5030)	2	28-256	0-65	4.0	5.0
Chloroethane	8240(5030)/8260(5030) CLP 3/90	2 62	44-136 NA	0-40 NA	3.5 10	10 10
2-Chloroethyl vinyl ether	8240(5030)/8260(5030)	2	10-305	0-65	1.7	50
Chloroform	8240(5030)/8260(5030) CLP 3/90	2 62	51-138 NA	0-40 NA	0.53 10	5.0 10
Chloromethane	8240(5030)/8260(5030) CLP 3/90	2 62	10-273 NA	0-65 NA	2.1 10	10 10
3-Chloropropene (Allyl chloride)	8240(5030)/8260(5030)	2	88-127	0-40	0.46	5.0
2-Chlorotoluene	8260(5030)	2	48-125	0-40	1.2	5.0
4-Chlorotoluene	8260(5030)	2	50-150	0-40	1.2	5.0
Dibromochloromethane	8240/8260(5030) CLP 3/90	2 62	53-149 NA	0-40 NA	0.80 10	5.0 10
1,2-Dibromo-3- chloropropane (DBCP)	8240(5030)/8260(5030)	2	26-165	0-40	6.5	10
1,2-Dibromoethane (EDB)	8240(5030)/8260(5030)	2	86-153	0-40	2.9	5.0
Dibromomethane	8240(5030)/8260(5030)	2	50-150	0-40	0.36	5.0

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
1,2-Dichlorobenzene	8240(5030)/8260(5030)	2	81-113	0-40	0.37	5.0
1,3-Dichlorobenzene	8240(5030)/8260(5030)	2	63-130	0-40	0.79	5.0
1,4-Dichlorobenzene	8240(5030)/8260(5030)	2	69-126	0-40	0.67	5.0
trans-1,4-Dichloro-2-butene	8240(5030)***v	2	79-178	0-40	1.2	10
Dichlorodifluoromethane	8240(5030)/8260(5030)	2	50-150	0-40	0.41	5.0
1,1-Dichloroethane	8240(5030)/8260(5030) CLP 3/90	2 62	59-155 NA	0-40 NA	0.66 10	5.0 10
1,2-Dichloroethane	8240(5030)/8260(5030) CLP 3/90	2 62	49-155 NA	0-40 NA	0.59 10	5.0 10
cis/trans-1,2-Dichloroethene	8240(5030)/8260(5030) CLP 3/90	2 62	54-156 NA	0-40 NA	0.63 10	5.0 10
1,1-Dichloroethene (MS)	8240(5030)/8260(5030) CLP 3/90	2 62	36-161 59-172	0-50 0-22	0.88 10	5.0 10
1,2-Dichloropropane	8240(5030)/8260(5030) CLP 3/90	2 62	10-210 NA	0-65 NA	0.96 10	5.0 10
1,3-Dichloropropane	8260(5030)	2	50-150	0-40	1.2	5.0
2,2-Dichloropropane	8260(5030)	2	50-150	0-40	1.2	5.0
1,1-Dichloropropene	8260(5030)	2	50-150	0-40	1.2	5.0
cis-1,3-Dichloropropene	8240(5030)/8260(5030) CLP 3/90	2 62	10-227 NA	0-65 NA	0.50 10	5.0 10
trans-1,3-Dichloropropene	8240(5030)/8260(5030) CLP 3/90	2 62	17-183 NA	0-65 NA	0.31 10	5.0 10
Diethyl ether	8240*** (5030)	2	50-150	0-40	2.5	10
Ethanol	8240(5030)	2	40-160	0-40	250	1000
Ethyl Acetate	8240***v(5030)	2	73-137	0-21	1.7	5.0
Ethylbenzene	8240(5030)/8260(5030) CLP 3/90	2 62	37-162 NA	0-40 NA	0.50 10	5.0 10
Ethyl methacrylate	8240(5030)	2	47-87	0-40	1.9	5.0
Hexachlorobutadiene	8260(5030)	2	50-150	0-40	1.2	5.0
2-Hexanone	8240(5030)/8260(5030) CLP 3/90	2 62	22-86 NA	0-40 NA	3.0 10	25 10
Iodomethane	8240(5030)/8260(5030)	2	77-105	0-40	0.33	5.0
Isobutyl alcohol	8240(5030)	2	63-173	0-40	690	1000
Isopropylbenzene	8260(5030)	2	50-150	0-40	1.2	5.0
p-Isopropyltoluene	8260(5030)	2	50-150	0-40	1.2	5.0
Methacrylonitrile	8240(5030)	2	69-145	0-60	25	100
Methylene chloride	8240(5030)/8260(5030) CLP 3/90	2 62	10-221 NA	0-65 NA	0.77 10	5.0 10
Methyl methacrylate	8240(5030)	2	32-118	0-45	4.0	5.0
4-Methyl-2-pentanone (MIBK)	8240(5030)/8260(5030) CLP 3/90	2 62	64-125 NA	0-49 NA	2.9 10	25 10
Methyl t-butyl ether (MTBE)	8240*** (5030)	2	40-150	0-40	9.5	50
Naphthalene	8260(5030)	2	50-150	0-40	1.2	5.0

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
2-Nitropropane	(8240***V(5030)	2	35-128	0-47	2.4	10
Pentachloroethane	8240(5030)	2	41-165	0-50	7.0	25
Propionitrile (ethylcyanide)	8240(5030)	2	73-227	0-65	24	100
n-Propylbenzene	8260(5030)	2	50-150	0-40	1.2	5.0
Styrene	8240(5030)/8260(5030) CLP 3/90	2 62	89-101 NA	0-40 NA	0.14 10	5.0 10
1,1,1,2-Tetrachloroethane	8240(5030)/8260(5030)	2	50-150	0-40	1.4	5.0
1,1,2,2-Tetrachloroethane	8240(5030)/8260(5030) CLP 3/90	2 62	46-157 NA	0-40 NA	1.8 10	5.0 10
Tetrachloroethene	8240(5030)/8260(5030) CLP 3/90	2 62	64-148 NA	0-40 NA	0.39 10	5.0 10
Toluene (MS)	8240(5030)/8260(5030) CLP 3/90	2 62	51-141 59-139	0-27 0-21	0.42 10	5.0 10
1,2,3-Trichlorobenzene	8260(5030)	2	50-150	0-40	1.2	5.0
1,2,4-Trichlorobenzene	8260(5030)	2	50-150	0-40	1.2	5.0
1,1,1-Trichloroethane	8240(5030)/8260(5030) CLP 3/90	2 62	52-162 NA	0-40 NA	0.69 10	5.0 10
1,1,2-Trichloroethane	8240(5030)/8260(5030) CLP 3/90	2 62	52-150 NA	0-40 NA	0.26 10	5.0 10
Trichloroethene (MS)	8240(5030)/8260(5030) CLP 3/90	2 62	43-140 62-137	0-27 0-24	1.5 10	5.0 10
1,1,2-Trichloro-1,2,2-trifluoroethane	8240***V(5030)/8260(5030)	2	17-181	0-65	0.72	5.0
1,2,3-Trichloropropane	8240(5030)/8260(5030)	2	43-105	0-40	2.9	5.0
Trichlorotrifluoroethane	8240***V(5030)	2	60-140	0-40	0.71	5.0
1,2,4-Trimethylbenzene	8260(5030)	2	50-150	0-40	1.2	5.0
1,3,5-Trimethylbenzene	8260(5030)	2	50-150	0-40	1.2	5.0
Vinyl acetate	8240(5030)/8260(5030)	2	50-150	0-40	0.62	10
Vinyl chloride	8240(5030)/8260(5030) CLP 3/90	2 62	10-251 NA	0-65 NA	3.9 10	10 10
Xylenes (total)	8240(5030)/8260(5030) CLP 3/90	2 62	50-150 NA	0-40 NA	0.14 10	5.0 10
Surrogate - Toluene-d8	8240(5030)/8260(5030) CLP 3/90	2 62	68-123 84-138	NA NA	NA NA	NA NA
Surrogate - p-Bromofluorobenzene	8240(5030)/8260(5030) CLP 3/90	2 62	64-126 59-113	NA NA	NA NA	NA NA
Surrogate - Dibromofluoromethane	8260(5030)	2	80-120	NA	NA	NA
Surrogate - 1,2-Dichloroethane-d4	8240(5030) CLP 3/90	2 62	46-143 70-121	NA NA	NA NA	NA NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Acenaphthene (MS)	8270(3550) CLP 3/90	2 62	51-108 31-137	0-26 0-19	28 330	330 330
Acenaphthylene	8270(3550) CLP 3/90	2 62	54-140 NA	0-24 NA	31 330	330 330
Acetophenone	8270(3550)	2	10-150	0-50	14	330
2-Acetylaminofluorene	8270(3550)	2	25-150	0-50	17	330
Aldrin	8270(3550)	2	10-166	0-40	31	330
4-Aminobiphenyl	8270(3550)	2	10-150	0-50	7.8	330
Aniline	8270(3550)	2	10-150	0-50	42	330
Anthracene	8270(3550) CLP 3/90	2 62	48-130 NA	0-30 NA	11 330	330 330
Aramite	8270(3550)	2	40-150	0-50	18	330
Benzidine	8270(3550)	2	10-200	0-100	675	2700
Benzo(a)anthracene	8270(3550) CLP 3/90	2 62	42-143 NA	0-25 NA	8.9 330	330 330
Benzoic acid	8270(3550)	2	10-150	0-50	81	1700
Benzo(b)fluoranthene	8270(3550) CLP 3/90	2 62	49-123 NA	0-25 NA	19 330	330 330
Benzo(k)fluoranthene	8270(3550) CLP 3/90	2 62	24-137 NA	0-38 NA	17 330	330 330
Benzo(g,h,i)perylene	8270(3550) CLP 3/90	2 62	10-219 NA	0-50 NA	14 330	330 330
Benzo(a)pyrene	8270(3550) CLP 3/90	2 62	44-141 NA	0-29 NA	13 330	330 330
Benzyl alcohol	8270(3550)	2/6	10-150	0-50	59	330
Benzyl chloride	8270(3550)	2	10-150	0-50	82	330
alpha-BHC	8270(3550)	2	10-150	0-50	35	330
beta-BHC	8270(3550)	2	24-149	0-40	41	330
delta-BHC	8270(3550)	2	10-110	0-40	6.9	330
gamma-BHC	8270(3550)	2	10-150	0-50	27	330
Bis(2-chloroethoxy) methane	8270(3550) CLP 3/90	2 62	33-184 NA	0-50 NA	38 330	330 330
Bis(2-chloroethyl) ether	8270(3550) CLP 3/90	2 62	12-158 NA	0-50 NA	40 330	330 330
Bis(2-chloroisopropyl) ether	8270(3550) CLP 3/90	2 62	36-166 NA	0-50 NA	54 330	330 330
Bis(2-ethylhexyl) phthalate	8270(3550) CLP 3/90	2 62	10-158 NA	0-40 NA	27 330	330 330

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
4-Bromophenyl phenyl ether	8270(3550) CLP 3/90	2 62	53-127 NA	0-40 NA	16 330	330 330
Butyl benzyl phthalate	8270(3550) CLP 3/90	2 62	10-152 NA	0-40 NA	26 330	330 330
Carbazole	8270*** (3550) CLP 3/90	2 62	10-150 NA	0-50 NA	28 330	330 330
Technical Chlordane	8270(3550)	2	10-150	0-50	420	1700
p-Chloroaniline	8270(3550) CLP 3/90	2 62	10-150 NA	0-50 NA	32 330	660 330
4-Chloro-3-methylphenol (MS) (p-Chloro-m-cresol)	8270(3550) CLP 3/90	2 62	38-112 26-103	0-23 0-33	42 330	330 330
1-Chloronaphthalene	8270(3550)	2	10-150	0-50	82	330
2-Chloronaphthalene	8270(3550) CLP 3/90	2 62	60-118 NA	0-40 NA	26 330	330 330
2-Chlorophenol (MS)	8270(3550) CLP 3/90	2 62	45-105 25-102	0-31 0-50	38 330	330 330
4-Chlorophenylphenyl ether	8270(3550) CLP 3/90	2 62	25-158 NA	0-33 NA	25 330	330 330
Chrysene	8270(3550) CLP 3/90	2 62	40-148 NA	0-27 NA	14 330	330 330
m&p-Cresol	8270(3550)	2	10-150	0-50	20	330
o-Cresol	8270(3550) CLP 3/90	2 62	10-150 NA	0-50 NA	60 330	330 330
p-Cresol	8270(3550) CLP 3/90	2 62	10-150 NA	0-50 NA	67 330	330 330
4,4'-DDD	8270(3550)	2	10-145	0-40	34	330
4,4'-DDE	8270(3550)	2	10-136	0-40	31	330
4,4'-DDT	8270(3550)	2	10-203	0-62	57	330
Diallate	8270(3550)	2	10-150	0-50	15	330
Dibenz(a,h)anthracene	8270(3550) CLP 3/90	2 62	40-147 NA	0-28 NA	12 330	330 330
Dibenzofuran	8270(3550) CLP 3/90	2 62	10-150 NA	0-50 NA	30 330	330 330
Di-n-butylphthalate	8270(3550) CLP 3/90	2 62	10-118 NA	0-50 NA	27 330	330 330
1,2-Dichlorobenzene	8270(3550) CLP 3/90	2 62	32-129 NA	0-40 NA	36 330	330 330
1,3-Dichlorobenzene	8270(3550) CLP 3/90	2 62	10-172 NA	0-42 NA	29 330	330 330

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
1,4-Dichlorobenzene (MS)	8270(3550) CLP 3/90	2 62	46-112 28-104	0-28 0-27	29 330	330 330
3,3'-Dichlorobenzidine	8270(3550) CLP 3/90	2 62	10-262 NA	0-100 NA	480 330	660 330
2,4-Dichlorophenol	8270(3550) CLP 3/90	2 62	39-135 NA	0-40 NA	40 330	330 330
2,6-Dichlorophenol	8270(3550)	2	10-150	0-50	13	330
Dieldrin	8270(3550)	2	29-136	0-40	39	330
Diethylphthalate	8270(3550) CLP 3/90	2 62	10-114 NA	0-40 NA	21 330	330 330
p-(Dimethylamino)azobenzene	8270(3550)	2	10-150	0-50	23	330
7,12-Dimethylbenz(a)anthracene	8270(3550)	2	10-150	0-50	9.9	330
3,3'-Dimethylbenzidine	8270(3550)	2	10-200	0-100	110	1700
a,a-Dimethylphenethylamine	8270(3550)	2	10-150	0-50	600	1700
2,4-Dimethylphenol	8270(3550) CLP 3/90	2 62	15-151 NA	0-22 NA	35 330	330 330
Dimethylphthalate	8270(3550) CLP 3/90	2 62	10-112 NA	0-40 NA	24 330	330 330
m-Dinitrobenzene	8270(3550)	2	10-150	0-50	15	330
4,6-Dinitro-2-methylphenol	8270(3550) CLP 3/90	2 62	10-181 NA	0-93 NA	27 800	1700 800
2,4-Dinitrophenol	8270(3550) CLP 3/90	2 62	10-167 NA	0-87 NA	500 800	1700 800
2,4-Dinitrotoluene (MS)	8270(3550) CLP 3/90	2 62	35-111 28-89	0-29 0-47	20 330	330 330
2,6-Dinitrotoluene	8270(3550) CLP 3/90	2 62	50-158 NA	0-40 NA	22 330	330 330
Dinoseb (2-sec-Butyl-4,6-dinitrophenol)	8270(3550)	2	10-150	0-50	29	330
Di-n-octylphthalate	8270(3550) CLP 3/90	2 62	10-146 NA	0-50 NA	16 330	330 330
1,4-Dioxane	8270***V(3550)	2	10-150	0-50	24	330
Diphenylamine/ N-nitrosodiphenylamine	8270(3550) CLP 3/90	2 62	10-150 NA	0-50 NA	18 330	330 330
1,2-Diphenyl hydrazine	8270(3550)	2	10-150	0-50	24	330
Endosulfan I	8270(3550)	2	10-150	0-50	33	660
Endosulfan II	8270(3550)	2	10-150	0-50	19	660
Endosulfan sulfate	8270(3550)	2	10-107	0-50	40	660

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Endrin	8270(3550)	2	10-150	0-50	75	660
Endrin aldehyde	8270(3550)	2	10-209	0-50	72	1700
Endrin ketone	8270/(3550)	2	10-150	0-50	420	1700
Ethyl carbamate	8270***v(3550)	2	48-100	0-20	34	330
Ethyl methanesulfonate	8270(3550)	2	10-150	0-50	11	330
Fluoranthene	8270(3550) CLP 3/90	2 62	54-135 NA	0-21 NA	9.7 330	330 330
Fluorene	8270(3550) CLP 3/90	2 62	59-121 NA	0-40 NA	19 330	330 330
Heptachlor	8270(3550)	2	10-192	0-40	39	660
Heptachlor epoxide	8270(3550)	2	26-155	0-55	36	660
Hexachlorobenzene	8270(3550) CLP 3/90	2 62	10-152 NA	0-40 NA	20 330	330 330
Hexachlorobutadiene	8270(3550) CLP 3/90	2 62	24-116 NA	0-40 NA	20 330	330 330
Hexachlorocyclopentadiene	8270(3550) CLP 3/90	2 62	10-150 NA	0-50 NA	26 330	330 330
Hexachloroethane	8270(3550) CLP 3/90	2 62	40-113 NA	0-40 NA	27 330	330 330
Hexachlorophene ¹	8270(3550)	2	10-200	0-80	42000	170000
Hexachloropropene	8270(3550)	2	10-150	0-50	28	330
Indeno(1,2,3-cd)pyrene	8270(3550) CLP 3/90	2 62	18-157 NA	0-83 NA	10 330	330 330
Isophorone	8270(3550) CLP 3/90	2 62	21-196 NA	0-60 NA	51 330	330 330
Isosafrole	8270(3550)	2	10-150	0-50	15	330
Kepone	8270(3550)	2	10-150	0-50	80	330
Methapyrilene	8270(3550)	2	10-150	0-50	890	3330
3-Methylcholanthrene	8270(3550)	2	10-150	0-50	7.6	330
Methyl methanesulfonate	8270(3550)	2	10-150	0-50	19	330
1-Methylnaphthalene	8270(3550)	2	10-150	0-50	82	330
2-Methylnaphthalene	8270(3550) CLP 3/90	2 62	10-150 NA	0-50 NA	28 330	330 330
Naphthalene	8270(3550) CLP 3/90	2 62	53-125 NA	0-21 NA	28 330	330 330

¹ Exhibits non-reproducible chromatographic behavior.

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
1,4-Napthoquinone	8270(3550)	2	10-150	0-50	24	330
1-Napthylamine	8270(3550)	2	10-150	0-50	12	330
2-Napthylamine	8270(3550)	2	10-150	0-50	6.9	330
Nicotine	8270(3550)	2	10-150	0-50	820	3300
2-Nitroaniline	8270(3550) CLP 3/90	2 62	10-150 NA	0-50 NA	39 800	1700 800
3-Nitroaniline	8270(3550) CLP 3/90	2 62	10-150 NA	0-50 NA	15 800	1700 800
4-Nitroaniline	8270(3550) CLP 3/90	2 62	10-150 NA	0-50 NA	21 800	1700 800
Nitrobenzene	8270(3550) CLP 3/90	2 62	35-180 NA	0-40 NA	33 330	330 330
2-Nitrophenol	8270(3550) CLP 3/90	2 62	29-182 NA	0-40 NA	18 330	330 330
4-Nitrophenol (MS)	8270(3550) CLP 3/90	2 62	10-130 11-114	0-34 0-50	27 800	1700 800
4-Nitroquinoline-1-oxide	8270(3550)	2	10-150	0-50	1200	3300
N-Nitroso-di-n-butylamine	8270(3550)	2	10-150	0-50	16	330
N-Nitrosodiethylamine	8270(3550)	2	10-150	0-50	13	330
N-Nitrosodimethylamine	8270(3550)	2	10-150	0-50	44	330
N-Nitroso-di-n-propylamine (MS)	8270(3550) CLP 3/90	2 62	27-140 41-126	0-35 0-38	60 330	330 330
N-Nitrosomethylethylamine	8270(3550)	2	10-150	0-50	13	330
N-Nitrosomorpholine	8270(3550)	2	10-150	0-50	17	330
N-Nitrosopiperidine	8270(3550)	2	10-150	0-50	9.3	330
N-Nitrosopyrrolidine	8270(3550)	2	10-150	0-50	40	330
5-Nitro-o-toluidine	8270(3550)	2	10-150	0-50	82	330
PCB 1016	8270(3550)	2	10-150	0-50	4200	17000
PCB 1221	8270(3550)	2	10-150	0-50	4200	17000
PCB 1232	8270(3550)	2	10-150	0-50	4200	17000
PCB 1242	8270(3550)	2	10-150	0-50	4200	17000
PCB 1248	8270(3550)	2	10-150	0-50	4200	17000
PCB 1254	8270(3550)	2	10-150	0-50	4200	17000
PCB 1260	8270(3550)	2	10-150	0-50	4200	17000
Pentachlorobenzene	8270(3550)	2	10-150	0-50	21	330
Pentachloronitrobenzene	8270(3550)	2	10-150	0-50	24	330

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Pentachlorophenol (MS)	8270(3550) CLP 3/90	2 62	10-107 17-109	0-89 0-47	27 800	1700 800
Phenacetin	8270(3550)	2	10-150	0-50	13	330
Phenanthrene	8270(3550) CLP 3/90	2 62	56-129 NA	0-21 NA	12 330	330 330
Phenol (MS)	8270(3550) CLP 3/90	2 62	37-112 26-90	0-36 0-35	38 330	330 330
p-Phenylenediamine	8270(3550)	2	10-150	0-50	140	1700
2-Picoline	8270(3550)	2	10-150	0-50	62	330
Pronamide	8270(3550)	2	10-150	0-50	16	330
Pyrene (MS)	8270(3550) CLP 3/90	2 62	33-139 35-142	0-25 0-36	11 330	330 330
Pyridine	8270(3550)	2	10-150	0-50	34	330
Safrole	8270(3550)	2	10-150	0-50	15	330
Strychnine	8270(3550)	2	10-150	0-50	820	3300
Trichlorophenols (2,4,5 AND 2,4,6)	8270(3550)	2	NA	NA	34	330
1,2,4,5-Tetrachlorobenzene	8270(3550)	2	10-150	0-50	16	330
2,3,4,5-Tetrachlorophenol	8270*** (3550)	2	10-150	0-50	420	1700
2,3,4,6-Tetrachlorophenol	8270(3550)	2	36-121	0-31	21	1700
o-Toluidine	8270(3550)	2	10-150	0-50	11	330
Toxaphene	8270(3550)	2	10-150	0-50	1700	67000
1,2,4-Trichlorobenzene (MS)	8270(3550) CLP 3/90	2 62	48-107 38-107	0-28 0-23	21 330	330 330
Tetrachlorophenols (2,3,4,5 and 2,3,4,6)	8270(3550)	2	NA	NA	21	1700
2,4,5-Trichlorophenol	8270(3550) CLP 3/90	2 62	39-123 NA	0-27 NA	34 800	330 800
2,4,6-Trichlorophenol	8270(3550) CLP 3/90	2 62	37-144 NA	0-40 NA	33 330	330 330
o,o,o'-Triethylphosphorothioate	8270(3550)	2	10-150	0-50	18	330
1,3,5-Trinitrobenzene	8270(3550)	2	10-150	0-50	14	330
Surrogate - Nitrobenzene-d5	8270(3550) CLP 3/90	2 62	22-124 23-120	NA NA	NA NA	NA NA
Surrogate - 2-Fluorobiphenyl	8270(3550) CLP 3/90	2 62	35-116 30-115	NA NA	NA NA	NA NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Surrogate - p-Terphenyl-d14	8270(3550) CLP 3/90	2	29-137	NA	NA	NA
		62	18-137	NA	NA	NA
Surrogate - Phenol-d5	8270(3550) CLP 3/90	2	32-123	NA	NA	NA
		62	24-113	NA	NA	NA
Surrogate - 2-Fluorophenol	8270(3550) CLP 3/90	2	27-120	NA	NA	NA
		62	25-121	NA	NA	NA
Surrogate - 2,4,6-Tribromophenol	8270(3550) CLP 3/90	2	17-123	NA	NA	NA
		62	19-122	NA	NA	NA
Surrogate - 2-Chlorophenol-d4	CLP 3/90	62	20-130	NA	NA	NA
Surrogate - 1,2-Dichlorobenzene-d4	CLP 3/90	62	20-130	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	8280	2	69-145	0-40	0.26	0.50
	8270 (Qual. Screen)	2	NA	NA	330	330
Polychlorinated Dibenzo-p-dioxins and Dibenzofurans classes						
tetra-CDD	8280	2	69-145	0-40	0.26	0.50
tetra-CDF	8280	2	59-142	0-40	0.20	0.50
penta-CDD	8280	2	41-203	0-40	0.21	0.50
penta-CDF	8280	2	55-146	0-40	0.16	0.50
hexa-CDD	8280	2	45-174	0-53	0.31	0.50
hexa-CDF	8280	2	50-154	0-46	0.22	0.50
hepta-CDD	8280	2	20-170	0-50	0.42	1.0
hepta-CDF	8280	2	20-170	0-50	0.24	1.0
octa-CDD	8280	2	20-170	0-50	0.84	1.0
octa-CDF	8280	2	20-170	0-50	0.66	1.0
Internal Standard - ¹³ C ₁₂ -2,3,7,8-TCDD	8280	2	40-120	NA	NA	NA
Internal Standard - ¹³ C ₁₂ -OCDD	8280	2	40-120	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Dithiocarbamates (as Ziram) ²	630***v(3550)	63/2	50-126	0-52	330	1000
Benomyl (as Carbendazim)	631(3550)***v	55/2	18-100	0-35	0.084	1.0
Aminocarb	632(3550)***	13/2	50-150	0-50	5.0	20
Barban	632(3550)***v	13/2	50-150	0-50	5.8	20
Bromacil	632(3550)***	13/2	50-150	0-50	10	40
Carbaryl (MS)	632(3550)***v	13/2	50-150	0-50	6.8	50
Carbofuran	632(3550)***v	13/2	50-150	0-50	7.5	50
Chloroprotham	632(3550)***v	13/2	50-150	0-50	5.8	20
Diuron (MS)	632(3550)***v	13/2	50-150	0-50	0.74	5.0
Fenuron	632(3550)***v	13/2	50-150	0-50	2.4	10
Fluometuron	632(3550)***v	13/2	50-150	0-50	2.1	10
Linuron	632(3550)***v	13/2	50-150	0-50	0.87	5.0
Methomyl	632(3550)***v	13/2	50-150	0-50	44	200
Methiocarb	632(3550)***v	13/2	50-150	0-50	13	50
Monuron	632(3550)***v	13/2	50-150	0-50	0.94	5.0
Neburon	632(3550)***v	13/2	50-150	0-50	0.88	5.0
Oxamyl	632(3550)***v	13/2	50-150	0-50	14	50
Protham	632(3550)***v	13/2	50-150	0-50	14	50
Propoxur	632(3550)***v	13/2	50-150	0-50	12	50
Siduron	632(3550)***v	13/2	50-150	0-50	3.9	20
Sweep	632(3550)***v	13/2	50-150	0-50	5.0	20
Surrogate - Propachlor	632(3550)***	13/2	25-148	NA	NA	NA
Picloram	644(3550)***	64/2	40-150	0-50	4.2	17

² The compounds determined as ziram by Method 630 include amobam, farbam, mancozeb, maneb, metham, nabam, polyram, and zineb.

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Acenaphthene (MS)	8310	2	11-144	0-35	5.4	20
Acenaphthylene	8310	2	10-139	0-40	3.9	20
Anthracene	8310	2	10-126	0-40	0.15	4.0
Benzo(a)anthracene	8310	2	12-135	0-40	0.27	4.0
Benzo(b)fluoranthene	8310	2	10-150	0-40	0.12	4.0
Benzo(k)fluoranthene	8310	2	10-159	0-40	0.10	10
Benzo(g,h,i)perylene	8310	2	10-120	0-40	0.42	10
Benzo(a)pyrene	8310	2	10-128	0-40	0.37	4.0
Carbazole	8310***	2	10-150	0-40	5.0	20
Chrysene (MS)	8310	2	10-199	0-40	0.19	4.0
Dibenz(a,h)acridine	8310***	2	NA	NA	NA	NA
Dibenzo(a,h)anthracene	8310	2	10-110	0-40	0.79	20
Fluoranthene	8310	2	56-136	0-28	0.27	10
Fluorene (MS)	8310	2	10-142	0-40	1.0	10
Indene	8310***	2	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	8310	2	10-116	0-40	0.20	10
6-Methylchrysene	8310***	2	NA	NA	NA	NA
1-Methylnaphthalene	8310***	2	10-125	0-40	5.0	20
2-Methylnaphthalene	8310***	2	10-125	0-40	5.0	20
Naphthalene (MS)	8310	2	31-159	0-34	5.0	20
Phenanthrene	8310	2	10-155	0-40	0.58	4.0
Pyrene (MS)	8310	2	49-156	0-28	0.41	10
Thiophenol	8310***	2	NA	NA	NA	NA
Surrogate - 4-Terphenyl-d4	8310	2	28-106	NA	NA	NA

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
Acetaldehyde	8315	2	30-110	0-40	500	2000
Formaldehyde	8315	2	50-155	0-40	77	250
Aldicarb (Temik) (MS)	8318	2	44-114	0-50	7.4	30
Aldicarb sulfone	8318	2	58-118	0-50	7.9	30
Aldicarb sulfoxide	8318***v	2	33-143	0-50	8.3	30
Carbofuran (Furadan) (MS)	8318	2	53-123	0-50	7.4	30
Carbaryl (Sevin)	8318	2	56-126	0-50	6.6	30
Dioxacarb	8318	2	55-125	0-50	14	50
3-Hydroxycarbofuran	8318	2	60-120	0-50	6.7	30
Methiocarb (Mesurool)	8318	2	52-122	0-50	11	50
Methomyl (Lannate)	8318	2	54-114	0-50	9.5	30
Oxamyl (MS)	8318***v	2	45-161	0-50	8.0	30
Promecarb	8318	2	44-120	0-50	7.7	50
Propoxur (Baygon)	8318	2	46-116	0-50	9.8	30

TABLE 5.2. LABORATORY ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR SOLIDS AND SEMISOLIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (ug/kg)	Reporting Limit (ug/kg)
2-Amino-4,6-dinitrotoluene	8330	2	50-150	0-30	50	250
4-Amino-2,6-dinitrotoluene	8330	2	50-150	0-30	78	500
1,3-Dinitrobenzene (MS)	8330	2	54-166	0-30	22	250
2,4-Dinitrotoluene (MS)	8330	2	60-140	0-30	60	250
2,6-Dinitrotoluene	8330	2	60-140	0-30	82	500
Diphenylamine	8330***v	2	65-140	0-30	16	100
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	8330	2	54-166	0-30	54	500
Methyl-2,4,6-trinitro-phenylnitramine (Tetryl)	8330	2	41-165	0-30	82	500
Nitrobenzene	8330	2	52-152	0-30	12	250
Nitroglycerin	8330***v	2	46-190	0-50	38	1000
n-Nitrosodiphenylamine	8330***v	2	55-121	0-30	32	100
2-Nitrotoluene (MS)	8330	2	50-144	0-30	74	250
3-Nitrotoluene	8330	2	55-165	0-30	25	250
4-Nitrotoluene	8330	2	54-166	0-30	53	250
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	8330	2	54-162	0-30	160	500
Pentaerythritol tetranitrate (PETN)	8330***v	2	50-150	0-30	34	1000
1,3,5-Trinitrobenzene	8330	2	50-150	0-30	27	250
2,4,6-Trinitrotoluene	8330	2	50-170	0-30	60	250
Surrogate - 3,4-Dinitrotoluene	8330	2	40-140	NA	NA	NA
Thiodiglycol	SL-SOP	68	70-140	0-50	400	1500

TABLE 5.3. FIELD ANALYTICAL METHODS, QA OBJECTIVES AND METHOD DETECTION LIMITS (MDL) FOR WATER AND OTHER LIQUIDS

PARAMETER	METHOD (Prep)	REFERENCE	ACCURACY* (% Rec)	PRECISION* (% RPD)	MDL** (mg/L)	Reporting Limit (mg/L)
Chlorine, residual	330.5	3	NA	0-40	NA	1.0
Hydrogen ion (pH)	150.1/9040	3/2	85-115	0-15	NA	NA
Oxygen (dissolved)	360.1	3	NA	0-30	NA	0.20
Salinity	210	4	NA	NA	NA	100
Specific conductance	120.1/9050	3/2	90-110	0-10	0.26 μ S/cm	1.0 μ S/cm
Temperature	170.1	3	NA	0-10	NA	NA
Turbidity	180.1/214A	3/4	60-140	0-30	0.067 NTU	0.10 NTU
Water level	EPA	12	NA	0-5	NA	0.10 ft

REFERENCES AND NOTES FOR TABLES 5.1, 5.2, AND 5.3

- * Accuracy data are presented as recoveries for spikes or surrogates. For routine analysis of organics, percent recoveries are evaluated only on the CLP or lab selected spiking compounds. The routine organic matrix spiking compounds are designated by an (MS) following the parameter name. Not all of the matrix spike or surrogate compounds listed in these tables are used with a given set of samples. Precision data are presented as relative percent difference (%RPD). Since reportable levels (above detection limit) for most of the organic parameters may not be detected in all environmental samples, precision is usually evaluated on duplicate spike data.

Accuracy and precision control limits are primarily derived from in-house laboratory data. Some accuracy and precision control limits have been rounded to the nearest "5". In some cases, published limits may be used in lieu of in-house limits because insufficient in-house data are available to calculate limits. In cases where insufficient data are available to generate in-house limits, and no EPA-approved method limits exist, limits are estimated based on available data.

** Method Detection Limit

*** This compound is not included in EPA's list of compounds for this method. However, Savannah Laboratories has verified (validated) that this compound can be analyzed by this method and will report data for this compound if specifically requested by the client.

***V Method validation data for this compound are included in Appendix A.

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6.0 SAMPLING PROCEDURES

When Savannah Laboratories has field sampling responsibilities, an experienced field sampling crew will be sent to the site for sample collection and delivery of samples to the laboratory. Each crew will be supervised by a highly qualified field sampling manager who is trained according to EPA and DEP protocol for groundwater and other environmental sampling. On past projects, these managers have had their field sampling techniques critiqued by DEP personnel (Bureau of Groundwater Protection), Georgia EPD personnel, and EPA Region IV field coordinators.

The DEP sampling SOPs have been adopted by Savannah Laboratories. The notarized statement of intent is found at the end of this section.

6.1 Sampling Capabilities

Savannah Laboratories has the capability for sampling groundwater, surface water, wastewater, soils, sediments/sludges, drinking water, and tissues for the following analyte classes:

Analyte Class	Sample Source
Volatile Organics (VOCs)	Drinking water, groundwater, surface water, wastewater, soils, sediments, and tissues
Semivolatile Organics	Drinking water, groundwater, surface water, wastewater, soils, sediments, and tissues
Pesticides/Herbicides/PCBs	Drinking water, groundwater, surface water, wastewater, soils, sediments, and tissues
Metals (total and/or dissolved)	Drinking water, groundwater, surface water, wastewater, soils, sediments, and tissues
Radionuclides	Drinking water, groundwater, surface water, wastewater, soils, and sediments
Coliform (total/fecal)	Drinking water, groundwater, surface water, wastewater, soils, sediments and tissues
Cyanide/Sulfide	Drinking water, groundwater, surface water, wastewater, soils and sediments
TRPH, TPH ⁽¹⁾	Drinking water, groundwater, surface water, wastewater, soils and sediments
Nutrients ⁽²⁾	Drinking water, groundwater, surface water, wastewater, soils and sediments
General: pH, specific conductance, temperature, turbidity, TSS, TDS, TOC, DO, COD, BOD	Drinking water, groundwater, surface water, wastewater, soils and sediments
Footnotes: (1) TRPH = Total Recoverable Petroleum Hydrocarbons TPH = Total Petroleum Hydrocarbons (2) Nutrients = Nitrogen, Phosphorus Series; Chloride, Sulfate	

6.2 Sampling Equipment

Sampling equipment conforms to construction and usage conditions detailed in the DEP *General Sampling Procedures* SOP, Section 4, Revised September, 1992. A specific equipment listing is provided at the beginning of each subsection of "Sampling Procedures" (Section 6.4).

Following is a list of other routinely used equipment.

Item	Use
Ice chests, styrofoam or insulated plastic	Sample container and sample transport
Sampling vehicles	Sample container and sample transport
Field thermometer	Field measurement of temperature
Field pH meter	Field measurement of pH
Field conductivity meter	Field measurement of conductivity
Electronic water level indicator	Well volume calculation
Stainless steel tape measure	Well volume calculation
Nylon line	Well volume calculation
Sheet plastic	Contamination control
Aluminum foil	Contamination control
Plastic or metal buckets	Collection of purge water or cleaning wastes
Cleaning brushes	Equipment decontamination
Liquinox detergent	Equipment decontamination
Analyte-free water contained in contaminant-free glass or plastic bottles	Equipment decontamination
Isopropyl alcohol (nanograde) contained in contaminant-free glass or plastic bottles	Equipment decontamination
10% Nitric acid (metals grade) contained in contaminant-free glass bottles	Equipment decontamination (except for stainless steel equipment)
Glass or plastic jugs	Transport of cleaning wastes
Sample preservation reagents contained in dispenser bottles or reagent bottles	Sample preservation
Field carrier (covered, divided tray or box)	Transport of preservation reagents
pH paper	Field-check of sample preservation
Disposable pipettes	Addition of preservation reagents
Standard buffer solutions	Calibration of field pH meter
Standard KCl solution	Calibration check of field conductivity meter
Disposable unpowdered latex gloves	Contamination control

6.3 Decontamination and Cleaning Procedures

Sample containers will be obtained or cleaned in the DEP Sampling Procedures SOP, Section 4.4.1, revised September, 1992.

Sampling equipment will be cleaned and decontaminated according to protocols outlined in the DEP Sampling Procedures SOP, Section 4.1, revised September, 1992.

6.4 Sampling Protocols

6.4.1 General Considerations

All sampling will be performed according to the general protocols outlined in the DEP Sampling Procedures SOP, revised September, 1992.

6.4.2 Wastewater Sampling

Wastewater samples will be collected according to the DEP Sampling Procedures SOP, Section 4.2.4, revised September, 1992.

Below is a list of equipment available for wastewater sampling and the parameters which may be sampled.

Type	Construction Materials	Use	Permissible Parameters
Autosampler ¹	Silicon tubing, plastic collection vessel	Composite samples	Metals, non-metallic inorganics, nutrients, demands, radionuclides
	Teflon tubing, glass collection vessel	Composite samples	Organics, non-metallic inorganics, nutrients, demands, radionuclides
Kemmerer	SS or glass, acrylic stopper	Grab @ specific depth	All inorganics
Bucket, beaker, unpreserved sample bottle, dipper ²	SS, glass or Teflon Plastic	Discrete grab Discrete grab	All All inorganics Radionuclides
¹ Three automatic samplers are available among the six divisions. Refrigeration capability is available. ² Device is lowered into stream via decontaminated lines or rods.			

6.4.3 Surface Water Sampling

Surface water samples will be collected according to the DEP Sampling Procedures SOP, Section 4.3.2, revised September, 1992 and the *EPA Region IV Standard Operating Procedures and Quality Assurance Manual*, Section 4.8.3, revised February 1991. Below is a list of equipment available for surface water sampling and the parameters which may be sampled.

Type	Material	Use	Permissible Parameters
DO Dunker	SS or glass	discrete grab, depth composite	All
Kemmerer	SS or glass acrylic stopper	grab @ specific depth	Inorganics Radionuclides
Beaker	SS or glass	discrete grab ¹	All
Bailer	SS or Teflon	grab @ specific depth ²	All
Peristaltic pump with weighted tubing	SS or Teflon silicon tubing	grab at specific depth	Inorganics Radionuclides
Footnotes: 1 Beaker is inverted, submerged, then turned over to fill. 2 Depth limited by length of bailer.			

6.4.4 Groundwater Sampling

Groundwater samples will be collected according to the DEP Sampling Procedures SOP, Section 4.2.5, revised September, 1992.

Below is a listing of pump types and tubing materials used by Savannah Laboratories. Equipment may be interchanged among the six laboratory locations according to need.

Pump Type	Units	Use	Parameters	Description
Positive displacement				
Submersible	4	Purging	All	1
Bladder	2	Purging, sampling	Inorganics Radionuclides	2
Suction lift				
Centrifugal	4	Purging	All	3
Peristaltic	4	Field filtration, purging	Metals Radionuclides	4

1. Submersible pump housing, internal surfaces, and upper fitting for tubing are stainless steel. A 4' to 8' length of Teflon tubing is attached to the stainless steel fitting. The remainder of the discharge tubing is garden hose. The suspension cable is 3' to 4' of stainless steel or Teflon-coated stainless steel, attached to a nylon rope. A check valve at the upper stainless steel/Teflon junction prevents backflow of purge water into the well.
2. The bladder pump housing is Lexan plastic and the tubing is polyethylene. This pump is used for purging only in the case of 2" diameter deep wells. After bladder pump purging, one well volume is purged with an appropriate bailer prior to sampling.
3. Centrifugal surface pumps utilize 4' joinable sections of PVC pipe with a 3' to 4' Teflon tail piece. Only the Teflon portion contacts the formation water. A foot valve prevents backflow of purge water into the well.
4. Peristaltic pumps are routinely used only for in-line field filtration of metals samples. Tubing may be medical grade silicone, Tygon, or polypropylene flexible tubing. On rare occasions, a small diameter shallow well may be purged using this pump. In this case, a Teflon tailpipe arrangement would be used, with only the Teflon contacting the formation water. To prevent backflow of purge water, the tubing is withdrawn from the well while the pump is running.

Below is a listing of bailer materials available for groundwater sampling.

Bailer Material	Permissible Parameters	Non-permissible Parameters
PVC	Metals; non-metallic inorganics; nutrients, demands; biological	Organics, volatile or extractable
Stainless Steel	All parameters	None
Teflon	All parameters	None
Clear PVC or acrylic	Free product thickness	

6.4.5 Potable Water Sampling

Potable water samples will be collected according to the DEP Sampling Procedures SOP, Section 4.2.7, revised September, 1992, and the *EPA Region IV SOP and QAM*, Section 4.10.2, revised February 1991. Equipment available for potable water sampling is listed under groundwater sampling (6.4.4).

6.4.6 Sampling for Soil and Sediment

Soil samples will be collected according to the DEP Sampling Procedures SOP, Section 4.3.4, revised September, 1992.

Sediments will be collected according to the DEP Sampling Procedures SOP, Section 4.3.5, revised September, 1992 and the *EPA Region IV SOP and QAM*, Section 4.8.3.3, revised February 1991.

Below is a list of soil and sediment sampling devices used by Savannah Laboratories.

Type	Material	Use	Permissible Parameters
Trowel, spoon	SS Teflon-coated SS	sampling	All
Shovel	Aluminum SS	sampling sampling	Demands, nutrients Metals, organics , radionuclides
Corer	SS PVC pipe	sampling sampling	All Inorganics Radionuclides
Hand auger	SS	sampling	All
Ponar grab sampler	SS	sediment sampling	All
Mixing tray	Metal, foil-lined glass Plastic	homogenizing, compositing homogenizing, compositing	Extractable organics Inorganics Radionuclides

6.4.7 Sludge Sampling

Domestic waste residual sludges will be collected according to the *EPA POTW Sludge Sampling and Analysis Guidance Document*, revised August 1989.

Sludges from solid and hazardous waste sites will be collected according to the *EPA Region IV SOP and QAM*, Sections 4.12.3 and 4.12.5, revised February 1991.

The same equipment listed for soil and sediment sampling may also be used for sludge sampling.

6.4.8 Liquid Hazardous Waste

Hazardous wastes, drums, and tanks of unknown origins and concentrations are typically not sampled by Savannah Laboratories because the sample operations are inherently dangerous to the personnel involved. Drums and tanks are occasionally sampled when the primary constituents are known and do not present a toxic, fire, or explosion hazard.

If drum, tank or pit sampling is undertaken, it is performed according to the *EPA Region IV SOP and QAM*, Sections 4.12.3 and 4.12.4, Revised February 1991, and may require the equipment given below.

Type	Material	Use	Permissible Parameters
Drum-plug wrench	Manganese bronze head	Open bungs	
Coliwasa sampler	Glass	Sampling	All
Mixing Tubing (4' lengths)	Glass	Sampling	All
Bucket, beaker, unpreserved sample bottle	SS, glass, Teflon	Grab	All
Dipper	Plastic	Grab	All inorganics

6.4.9 Biological Specimens and Tissues

Fish tissues are collected and prepared for analysis according to DEP Sampling Procedures SOP, Section 4.3.6, revised September, 1992, using properly decontaminated stainless steel implements.

Other biological specimens are obtained and prepared in a manner which will preclude contamination from implements or other specimens.

6.5 Special Sampling Considerations

Details of sampling such as compositing and mixing, duplicate or split samples, filtration, and special procedures for volatiles, oil and grease, and microbiological samples will be observed as outlined in the DEP Sampling Procedures SOP, revised September, 1992.

6.6 Sample Preservation and Holding Times

Sample preservation, holding times, sample volumes, and container types are listed in Table 6.1 for water samples. Table 6.2 lists similar information for soil and sediment samples. Table 6.1 is taken from *40 CFR Part 136*, Table II. Table 6.2 is taken from DEP Sampling Procedures SOP, Table 4.4, revised September, 1992. Table 6.2 lists additional

recommended soil holding times based upon conservative estimates of experienced laboratory chemists and consistent with good laboratory practice. Table 6.3 lists the approved procedures, preservation, and holding times for water for parameters not listed on Table 6.1.

6.7 Sample Preservation Protocols

Sample preservation, checks and adjustments will be accomplished according to the DEP Sampling Procedures SOP revised September, 1992. The efficacy of the preservation is checked in the field, for all preserved samples except volatiles, oil and grease and total petroleum hydrocarbons. Necessary adjustments will be made and recorded in a field logbook.

6.8 Sample Dispatch and Recordkeeping

Samples will be labeled, packed, and shipped according to the DEP Sampling Procedures SOP, Section 4.4, revised September, 1992. Examples of a sample label, a monitoring well sampling log, and a chain-of-custody form are present in Figures 6.1, 6.2, and 6.3.

See Section 7 for sample custody procedures.

6.9 Field Reagent and Standard Storage

All reagents, standards, and solvents used in field activities are stored and transported as listed in Table 6.4 and according to the DEP Sampling Procedures SOP, Section 4.4.4, revised September, 1992.

6.10 Field Waste Disposal

Field-generated wastes will be handled according to the DEP Sampling Procedure SOP, Section 4.4.5. Wastes transported back to the laboratory for disposal will be handled in accordance with Section 8.4 of this document.

TABLE 6.1

CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR WATER SAMPLES

PARAMETER	SAMPLE CONTAINER ¹	SAMPLE PRESERVATION ^{2,3}	RECOMMENDED HOLDING TIMES ⁴
Bacterial Tests:			
Coliform, fecal and total	250-mL P	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵	6 hours
Fecal streptococci	250-mL P	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵	6 hours
Inorganic Tests:			
Acidity	250-mL P	Cool, 4°C	14 days
Alkalinity	250-mL P	Cool, 4°C	14 days
Ammonia	100-mL P	Cool, 4°C, H ₂ SO ₄ to pH < 2	28 days
Biochemical oxygen demand (including carbonaceous)	1-L P	Cool, 4°C	48 hours
Bromide	100-mL P	None required	28 days
Chemical oxygen demand	100-mL P	Cool, 4°C, H ₂ SO ₄ to pH < 2	28 days
Chloride	100-mL P	None required	28 days
Chlorine, total residual	250-mL amber G	None required	Analyze immediately
Color	250-mL P	Cool, 4°C	48 hours
Cyanide, total and amenable to chlorination	1-L P	Cool, 4°C, NaOH to pH > 12, 0.6 g ascorbic acid	14 days ⁴
Fluoride	100-mL P	None required	28 days
Hardness	250-mL P	HNO ₃ to pH < 2, H ₂ SO ₄ to pH < 2	6 months
Hydrogen ion (pH)	100-mL P	None required	Analyze immediately
Kjeldahl and organic nitrogen	250-mL P	Cool, 4°C, H ₂ SO ₄ to pH < 2	28 days
Chromium VI	250-mL P	Cool, 4°C	24 hours
Mercury ⁷	130-mL G	HNO ₃ to pH < 2	28 days
Metals ⁷ , except chromium VI and mercury	250-mL P	HNO ₃ to pH < 2	6 months
Nitrate	100-mL P	Cool, 4°C	48 hours
Nitrate-nitrite	100-mL P	Cool, 4°C, H ₂ SO ₄ to pH < 2	28 days
Nitrite	100-mL P	Cool, 4°C	48 hours
Organic carbon	125-mL amber G	Cool, 4°C, HCl or H ₂ SO ₄ to pH < 2	28 days

TABLE 6.1

CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR WATER SAMPLES

PARAMETER	SAMPLE CONTAINER ¹	SAMPLE PRESERVATION ^{2,3}	RECOMMENDED HOLDING TIMES ⁴
Orthophosphate	100-mL P	Filter immediately, cool, 4°C	48 hours
Oxygen, dissolved (electrode)	G bottle & top	None required	Analyze immediately
Oxygen, dissolved (Winkler)	G bottle & top	Fix on site and store in dark	8 hours
Phosphorus, total	250-mL P	Cool, 4°C, H ₂ SO ₄ to pH < 2	28 days
Residue, total	500-mL P	Cool, 4°C	7 days
Residue, filterable (TDS)	250-mL P	Cool, 4°C	7 days
Residue, nonfilterable (TSS)	500-mL P	Cool, 4°C	7 days
Residue, settleable	500-mL P	Cool, 4°C	48 hours
Residue, volatile (VSS)	500-mL P	Cool, 4°C	7 days
Silica	250-mL P	Cool, 4°C	28 days
Specific Conductance	100-mL P	Cool, 4°C	28 days
Sulfate	100-mL P	Cool, 4°C	28 days
Sulfide	250-mL P	Cool, 4°C, add zinc acetate plus sodium hydroxide to pH > 9	7 days
Sulfite	100-mL P	None required	Analyze immediately
Surfactants	250-mL P	Cool, 4°C	48 hours
Temperature	100-mL P	None required	Analyze immediately
Turbidity	250-mL P	Cool, 4°C	48 hours
Organic Tests:⁶			
Purgeable halocarbons	3 X 40-mL G, Teflon-lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵ or 0.06% ascorbic acid ⁵	14 days
Purgeable aromatic hydrocarbons	3 X 40-mL G, Teflon-lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵ or 0.06% ascorbic acid ⁵ , HCl to pH < 2 ⁹	14 days
Acrolein and acrylonitrile	3 X 40-mL G, Teflon-lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵ , adjust pH to 4-5 ¹⁰ or 0.06% ascorbic acid ⁵	14 days
Phenols ¹¹	2 X 1-L G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵	Extraction-7 days Analysis-40 days
Benzidines ^{11,12}	2 X 1-L G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵	Extraction-7 days ¹³

TABLE 6.1

CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR WATER SAMPLES

PARAMETER	SAMPLE CONTAINER ¹	SAMPLE PRESERVATION ^{2,3}	RECOMMENDED HOLDING TIMES ⁴
Phthalate esters ¹¹	2 X 1-L G, Teflon-lined cap	Cool, 4°C	Extraction-7 days Analysis-40 days
Nitrosamines ^{11,14}	2 X 1-L G, Teflon-lined cap	Cool, 4°C, store in dark, 0.008% Na ₂ S ₂ O ₃ ⁵	Extraction-7 days Analysis-40 days
Pesticides ¹¹	2 X 1-L G, Teflon-lined cap	Cool, 4°C, pH 5-9 ¹⁵	Extraction-7 days Analysis-40 days
PCBs ¹¹	2 X 1-L G, Teflon-lined cap	Cool, 4°C	Extraction-7 days Analysis-40 days
Nitroaromatics and isophorone ¹¹	2 X 1-L G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ ⁵ store in dark	Extraction-7 days Analysis-40 days
Polynuclear aromatic hydrocarbons ¹¹	2 X 1-L G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ ⁵	Extraction-7 days Analysis-40 days
Haloethers ¹¹	2 X 1-L G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ ⁵	Extraction-7 days Analysis-40 days
Chlorinated hydrocarbons ¹¹	2 X 1-L G, Teflon-lined cap	Cool, 4°C	Extraction-7 days Analysis-40 days
TCDD ¹¹ (8280)	2 X 1-L G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ ⁵	Extraction-30 days Analysis-45 days of collection
TCDD ¹¹ (613)	2 X 1-L G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ ⁵	Extraction-7 days Analysis-40 days of collection
Total organic halogens	500-mL amber G, Teflon-lined cap	Cool, 4°C, H ₂ SO ₄ to pH < 2	28 days
Total petroleum hydrocarbons	500-mL G, Teflon-lined cap	Cool, 4°C, HCl to < 2	28 days
Phenols, total recoverable	1-L G	Cool, 4°C, H ₂ SO ₄ to pH < 2	28 days
Oil and grease	2 X 500-mL G	Cool, 4°C, H ₂ SO ₄ to pH < 2	28 days
N-Methylcarbamoyloximes and N-Methylcarbamates	125-mL G, Teflon-lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ ⁵ , monochloroacetic acid to pH < 3	Analysis - 28 days if pH adjusted and frozen at -10° C upon receipt at lab
Glyphosate	125-mL G, Teflon-lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ ⁵ , store in dark	Analysis - 14 days, 18 months if frozen
Diquat and Paraquat	500-mL high density foil wrapped PCB, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ ⁵ , NaOH or H ₂ SO ₄ to pH < 2, store in dark	Extraction - 7 days Analysis - 21 days
Benomyl and Carbendazim	1-L amber G, Teflon-lined cap	Cool, 4°C	Extraction - 7 days Analysis - 40 days

TABLE 6.1

CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR WATER SAMPLES

PARAMETER	SAMPLE CONTAINER ¹	SAMPLE PRESERVATION ^{2,3}	RECOMMENDED HOLDING TIMES ⁴
Carbamate and Urea Pesticides	1-L amber G, Teflon-lined cap	Cool, 4°C	Extraction - 7 days Analysis - 40 days
Oryzalin	1-L amber G, Teflon-lined cap	Cool, 4°C NaOH or H ₂ SO ₄ to pH 6-8	Extraction - 7 days Analysis - 40 days
Carbonyl Compounds	2 X 125-mL amber G, Teflon-lined cap	Cool, 4°C	Derivatization and extraction - 3 days Analysis - 3 days
N-Methylcarbamates	2 X 125-mL amber G, Teflon-lined cap	Cool, 4°C, monochloroacetic acid to pH 4-5, store in dark	Extraction - 7 days Analysis - 40 days
Nitroaromatics and Nitroamines	1-L amber G, Teflon-lined cap	Cool, 4°C, store in dark	Extraction - 7 days Analysis - 40 days
Asulam	125-mL G, Teflon-lined septum	Cool, 4°C	21 days
Ethylenethiourea	125-mL G, Teflon-lined septum	Cool, 4°C, store in dark	Extraction - 7 days Analysis - 21 days
Thiodiglycol	125-mL G, Teflon-lined septum	Cool, 4°C	Extraction - 7 days Analysis - 40 days
Radiological Tests:			
Alpha, beta and radium	1-L P	HNO ₃ to pH < 2	6 Months

1. Polyethylene (P) or Glass (G). In cases where more than one inorganic parameter with the sample preservative is required, a single sample container of sufficient size for all analyses is usually preferred. Such grouping of parameters will be indicated when bottles are provided for client sampling.

2. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting are completed.

3. When any sample is to be shipped by common carrier or sent through the United States mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following: hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); nitric acid (HNO₃) in water solutions at concentrations of 0.15% by

weight or less (pH about 1.62 or greater); sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

4. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.

5. Sodium thiosulfate or ascorbic acid may be used only if residual chlorine is present. The dechlorination agent and hydrochloric acid must not be combined in pre-preserved vials.

6. Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

7. Samples should be filtered immediately on-site before adding preservative for dissolved metals.

8. Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

9. Sample receiving no pH adjustments must be analyzed within seven days of sampling.

10. The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within three days of sampling.

11. When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to $4^{\circ}C$, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in Footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine), and Footnotes 12 and 13 (re: the analysis of benzidine).

12. If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ± 0.2 to prevent rearrangement to benzidine.

13. Extracts may be stored up to seven days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.

14. For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 within 24 hours of sampling.

15. The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $\text{Na}_2\text{S}_2\text{O}_3$.

TABLE 6.2

**CONTAINERS, PRESERVATION TECHNIQUES,
AND HOLDING TIMES FOR SOIL OR SEDIMENT SAMPLES**

PARAMETER	SAMPLE CONTAINER	SAMPLE PRESERVATION	RECOMMENDED HOLDING TIMES
Alpha, beta	100-mL P	None Required	6 Months
Cyanide	250-mL P	Cool to 4°C	14 days
Sulfide	250-mL P	Cool to 4°C	7 days
Oil & grease, Total petroleum hydrocarbons	250-mL G	Cool to 4°C	28 days
Nutrients/TOC	250-mL P	Cool to 4°C	28 days
Metals (except Mercury)	500-mL P	Cool to 4°C	6 months
Semivolatile organics	500-mL G with Teflon-lined lid	Dark, cool to 4°C	Extraction-14 days Analysis-within 40 days of extraction
Volatile organics	125-mL amber G with Teflon-lined lid	Dark, cool to 4°C	14 days
Mercury	250-mL P	Cool to 4°C	28 days
Carbonyl Compounds	100-mL G, Teflon-lined lid	Cool to 4°C	Derivatization and extraction - 3 days Analysis - 3 days

**TABLE 6.3

APPROVED WATER AND WASTEWATER PROCEDURES, CONTAINERS, PRESERVATION AND HOLDING TIMES
FOR PARAMETERS NOT FOUND IN 40 CFR 136

Parameter	Method	Reference ¹	Container ²	Preservation ³	Maximum Holding Times ⁴
Bromate	Ion Chromatography	EPA-SOP (300.0) ⁵	P, G	Cool, 4° C	30 days
Chlorophyll	Spectrophotometric	SM 1002G	P, G ⁶	14 d in dark	30 days ⁷
Corrosivity	Calculated (CaCO ₃ Stability, Langelier Index)	SM 203 ASTM 0513-82	P, G	Cool, 4° C ⁷	7 days ⁸
Odor	Human Panel	SM 207	G only	Cool, 4° C	6 hours
Salinity	Electrometric ⁸ Hydrometric Argentometric	SM 210A	G, wax seal	Analyze immediately or use wax seal	30 days ⁹
Transparency	Irradiometric ⁹	17-3.021 FAC	----	----	Analyze in-situ
Un-ionized Ammonia	Calculated ¹⁰	DER-SOP ¹¹	P, G	Cool, 4° C Na ₂ S ₂ O ₃ ¹¹	8 hours unpreserved 28 days preserved ¹¹
Organic Pesticides ¹²	GC and HPLC	EPA (600- Series) ¹²	13	13	13

** Source: 17-160.700, F.A.C.

1. SM XXX = procedures from "Standard Methods for the Examination of Water and Wastewater", APHA-AWWA-WPCF, 16th Edition, 1985.

2. P = plastic, G = Glass

3. When specified, sample preservation should be performed immediately upon sample collection.

4. The times listed are the maximum times that samples may be held before analysis and still be considered valid.

5. "Determination of Inorganic Disinfection By-Products by Ion Chromatography, Method 300.0" by John D. Pfaff and Carol a. Brockoff, U.S. EPA, Cincinnati, Ohio 45268 (copy available from the DER QA Section).

6. Collect sample in opaque bottles and process under reduced light. Samples on filter taken from water having pH 7 or higher may be placed in airtight plastic bags and stored frozen for up to three weeks. Samples from acidic water must be processed promptly to prevent chlorophyll degradation.

7. Temperature and pH must be measured on site at the time of sample collection. Seven days is the maximum time for laboratory analysis of total alkalinity, calcium ion and total solids.

8. The eletrometric and hydrometric analytical methods are suited for field use. The argentometric method is suited for laboratory use. Samples collected for laboratory analysis, when properly sealed with paraffin waxed stopper, may be held indefinitely. The maximum holding time of 30 days is recommended as a practical regulatory limit.

9. Transparency in surface waters is defined as a compensation point for photosynthetic activity, i.e., the depth at which one percent of the light intensity entering at the water surface remains unabsorbed. The DER rule 17-3 FAC requires that the light intensities at the surface and subsurface be measured simultaneously by irradiance meters such as the Kahlsico Underwater Irradiometer, Model No. 268 WA 310, or an equivalent device having a comparable spectral response.

10. The results of the measurements of pH, temperature, salinity (if applicable) and the ammonium ion concentration in the sample are used to calculate the concentration of ammonia in the unionized state. Temperature, pH and salinity must be measured on site at the time of sample collection. Laboratory analysis

of the ammonium ion concentration should be conducted within eight hours of sample collection. If prompt analysis of ammonia is impossible, preserve samples with H_2SO_4 to pH between 1.5 and 2. Acid-preserved samples, stored at 4° C, may be held up to 28 days for ammonia determination. Sodium thiosulfate should only be used if fresh samples contain residual chlorine.

11. DER Central Analytical Laboratory, Tallahassee, FL, Revision No. 1, October 3, 1983. The 1983 draft is available from the DER QA Section.

12. Other pesticides listed in approved EPA methods (608.1, 608.2, 614, 614.1, 615, 617, 618, 619, 622, 622.1, 627, 629, 631, 632, 632.1, 633, 643, 644 and 645) which are not included in Table 1D of 40 CFR Part 136 (July 1989).

13. Container, preservation and holding time as specified in each individual method shall be followed.

FIGURE 6.1

Bottle	_____
Preservative	_____
Location	_____
Analysis	_____
Sample ID	_____
Date	_____
	By _____
	
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Figure 6.2

MONITORING WELL SAMPLING LOG	
Client/Facility: _____	
Well ID: _____	
Well Locked: <input type="checkbox"/> Yes <input type="checkbox"/> No	Bailer Present: <input type="checkbox"/> Yes <input type="checkbox"/> No
* Water Level: _____ (0.01 ft.)	Well Depth: _____ (ft)
Water Evacuation: _____ (liters)	Yield: _____ (L/H)
Floaters: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sinkers: <input type="checkbox"/> Yes <input type="checkbox"/> No
** pH: _____ (units)	Calibrated: _____/_____ (Date/Time)
** SC: _____ (umhos/cm)	Calibrated: _____/_____ (Date/Time)
** Temp: _____ (°C)	Calibrated: _____ (Date/Time)
Bottles Labeled: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Sampling Completed: _____/_____ (Date/Time)	
Bailer Returned & Well Locked: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Custody Form Completed: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Samples Iced: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Coolers Sealed: <input type="checkbox"/> Yes <input type="checkbox"/> No	Seal No: _____
Carrier: _____	Date/Time: _____
Collector Signature: _____	Date/Time: _____
NOTES:	

* Fisher Electronic WL Meter
** Corning Checkmate 90

TABLE 6.4

FIELD REAGENT STORAGE AND TRANSPORT

CHEMICAL	METHOD OF STORAGE	METHOD OF TRANSPORT
Nitric Acid	Stored in original container or dedicated repipet dispenser in vented acid storage cabinet; segregated from other acids.	Transferred to dedicated reagent bottle or repipet dispenser; transported in divided box containing only acids (each acid in separate compartment).
Hydrochloric acid	See above	See above
Sulfuric acid	See above	See above
Sodium hydroxide	Dry flake or pellet form stored in original container in reagent cabinet. solutions stored in separate cabinet.	Dry forms transported in original or dedicated transfer container. Solutions transferred to dedicated plastic container and transported segregated from acids.
Zinc acetate solution	Stored in dedicated repipet dispenser in reagent storage cabinet.	Transported in compartmentalized box in capped repipet dispenser.
EDTA Solution	Stored in dedicated repipet dispenser in reagent storage cabinet.	Transported in compartmentalized box in capped repipet dispenser.
Isopropanol	Stored in original container in vented solvent storage cabinet in volatile analysis/custody area.	Transported in bottle jacket in original container.
pH and conductivity standards	Stored in reagent storage cabinet in air conditioned laboratory.	Transported in dedicated plastic containers.

6.11 Analyte-Free Water

Analyte-free water used in cleaning and field QC samples is defined as water from any source which exhibits no interferences or analytes of interest above the applicable reporting limits.

Analyte-free water may be obtained from the following sources, but is not limited to these sources.

Laboratory deionized: most inorganics

Laboratory deionized with Milli-Q-type polishing: all analytes

Sterilized laboratory deionized: microbiology

Deep well water: any analysis for which acceptability is demonstrated. This water may be purged with nitrogen for VOA determination.

Purchased distilled: any analysis for which acceptability is demonstrated

Analyte-free water will be used as the final rinse in field or lab cleaning procedures, and for trip blanks, field blanks, equipment blanks, and laboratory blanks.

Documentation of analyte-free water sources is maintained via results of trip blanks, equipment blanks, laboratory blanks, control blanks, and container blanks.

STATEMENT OF INTENT TO COMPLY WITH
THE DEPARTMENT OF ENVIRONMENTAL REGULATION
STANDARD OPERATING PROCEDURES FOR LABORATORY OPERATIONS AND
SAMPLE COLLECTION ACTIVITIES

FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
Quality Assurance Section

Part I: STANDARD OPERATING PROCEDURES TO BE INCORPORATED INTO COMPREHENSIVE QA PLANS

Name of Organization:

Savannah Laboratories and Environmental Services

Address:

5102 LaRoche Ave. Savannah, Georgia 31406

Comprehensive QA Plan Number:

Check the specific protocols that your organization will be using while collecting and/or analyzing environmental samples. NOTE: check only documents and protocols as listed in the "DER Standard Operating Procedures for Laboratory Operations and Sample Collection Activities" (DER-QA-001/92) dated September 30, 1992 for which your organization has current equipment capabilities.

THIS FORM MUST BE ACCOMPANIED BY THE SUPPORTING DOCUMENTATION SPECIFIED IN DER-QA-001/92

ORGANIZATION AND RESPONSIBILITY (Chapter 3)

FIELD ACTIVITIES (Chapter 4):

Field Decontamination and Cleaning Protocols:

- Container Cleaning protocols (4.4.1):
 - Sample containers cleaned by organization
 - Sample containers obtained precleaned from commercial vendor
 - Sample containers obtained precleaned from laboratory with an approved Comprehensive QA Plan
- General Considerations and Reagents (4.1.1 through 4.1.3)
- Sampling Equipment (4.1.4)
 - Pumps used only for Purging (4.1.8.1 and 4.1.8.2)
- Automatic Samplers (4.1.5)
 - Pumps used for Purging and Sampling (4.1.8.1 and 4.1.8.2)
- Field Filtration Equipment (4.1.6)
 - Non-Sampling Equipment (Augers, etc.) (4.1.9)
- Teflon Tubing (4.1.7.1)
 - Analyte-Free Water Containers (4.1.10)
- Non-teflon Tubing (4.1.7.2 through 4.1.7.5)
 - Ice Chests and Shipping Containers (4.1.11)
- Field Meters, Flow Meters and Other Field Instruments including Lanyards, Well Sounders and Tapes (4.1.9)

Sampling Protocols:

- General (4.0)
- Aqueous Matrices:
 - General Concerns and Special Sample Handling Procedures (4.2.1 and 4.2.2)
 - Surface Water (4.2.3)
 - Drinking Water Supply System (4.2.8)
 - Wastewater (4.2.4)
 - Temporary Well Points (4.2.9)
 - Groundwater (4.2.5)
 - Air Stripper and Remedial Treatment Systems (4.2.10)
 - Wells with in-place Plumbing (4.2.6)
 - Bioassay (4.2.11)
 - Potable Well Sampling (4.2.7)

Solid Matrices:

- General Concerns and Special Sample Handling Procedures (4.3.1 through 4.3.3)
- Soil (4.3.4)
 - Domestic Waste Sludges (Residuals) (4.3.8)
- Sediment (4.3.5)
 - Sludges - Solid and Hazardous Wastes (4.3.9)
- Fish Tissue (4.3.6)
 - Liquid Hazardous Wastes (4.3.9)
- Shellfish (4.3.7)
 - Macrobenthic Invertebrates (4.3.10)

Preservation, Holding Times and Containers Types:

- Aqueous samples - 40 CFR Part 136, Table II (4.4.2)
- Aqueous samples - 17-160.700, F.A.C., Table 4 (4.4.2)
- Aqueous samples - 17-160.700, F.A.C., Table 8 (4.4.2)
- Solid samples - 17-160.700, F.A.C., Table 5 (4.4.2)

Part I: STANDARD OPERATING PROCEDURES TO BE INCORPORATED INTO COMPREHENSIVE QA PLANS, cont.

Preservatives are:

- Provided by the laboratory in separate containers
- Provided by the laboratory already premeasured into the containers
- Provided by the field consultant

Field-Related Activities:

- Sample Dispatch (4.4.3)
- Reagent and Standard Storage (4.4.4)
- Field Waste Disposal (4.4.5)

SAMPLE CUSTODY AND DOCUMENTATION (Chapter 5):

- General Requirements (5.1)
- Preparation of Field-Sampling Supplies (5.2)
- Custody and Documentation for Field Operations (5.3)
- Custody and Documentation for Laboratory Operations (5.4)
- Electronic Data Documentation (5.5)
- Legal or Evidentiary Custody (5.6)

ANALYTICAL PROCEDURES (Chapter 6):

- Laboratory Glassware Cleaning and Storage Protocols (6.1)
- Laboratory Reagent Storage (6.2)
- Laboratory Waste Disposal (6.3)

CALIBRATION PROCEDURES AND FREQUENCY (Chapter 7):

- General Requirements and Documentation (7.1, 7.2, 7.8 and 7.9)
- Standard Receipt and Traceability (Sec. 7.3)
- Frequency of Standard Preparation and Standard Storage (Sec. 7.4)

Field:

- General Requirements (7.5.1)
- pH (7.5.2)
- Temperature (7.5.3)
- Dissolved Oxygen (7.5.4)
- Automatic Wastewater-type Samplers (7.5.8)
- Specific Conductance (7.5.5)
- Chlorine Measurements (7.5.6)
- OVAs (7.5.7)

Laboratory:

- Laboratory Instruments (7.6)
- Support Equipment Calibration (7.7)

PREVENTATIVE MAINTENANCE (Chapter 8.0)

QUALITY CONTROL REQUIREMENTS AND ROUTINES TO CALCULATE AND ASSESS PRECISION, ACCURACY AND METHOD DETECTION LIMITS (Chapter 9):

Documentation (9.4)

Field Quality Control Requirements:

- Minimum Field Quality Control Requirements (9.1.1)

Laboratory Quality Control Requirements:

- Chemical Analysis (9.1.2.1)
- Microbiological Analysis (9.1.2.2)
- Formulae for Calculating and Assessing Precision and Accuracy (9.2)
- Formulae for Calculating Method Detection Limits (9.3)
- Toxicity (Bioassay) Tests (9.1.2.3)
- Macrobenthic Species Identification (9.1.2.4)

DATA REDUCTION, VALIDATION AND REPORTING (Chapter 10)

CORRECTIVE ACTION (Chapter 11)

PERFORMANCE AND SYSTEMS AUDITS (Chapter 12)

QUALITY ASSURANCE REPORTS (Chapter 13)

Part II: CERTIFICATION

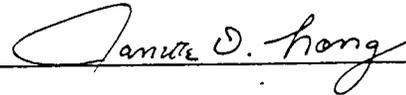
The undersigned, Janette D. Long (name)
Vice President (title) Savannah Laboratories and Environmental
Services (organization), and Alan C. Bailey
Quality Assurance Manager (title)

Savannah Laboratories and Environmental Services (organization), hereby certify that they have obtained copies of all documents pertinent to the protocols that they have identified on the document titled "Standard Operating Procedures to be Incorporated into Comprehensive QA Plans" and that these documents shall be incorporated by reference into the Comprehensive Quality Assurance Plan attached hereto or identified herein. They further certify that the organization of which they are officials or officers as identified herein has the instrumentation and/or equipment and capability to perform the protocols specified by these documents and that they will be responsible for the implementation of said protocols when performing the specified activity. They certify that the officials and employees of the organization identified herein are committed to generating data of a known and verifiable quality. They further certify that they understand that final approval of the Comprehensive Quality Assurance Plan attached hereto or identified herein is contingent upon satisfying the Department's review requirements.

They further certify that the information, statements, facts and representations given and made above are true and correct to the best of their knowledge and belief, and that they are aware that any misrepresentations or falsifications constitute grounds for rejection of approval of the Comprehensive QA Plan attached hereto or identified herein, and that anyone who knowingly makes a false statement in writing with the intent to mislead a public servant in the performance of his official duty shall be guilty of a misdemeanor, of the second degree in violation of Section 837.06, Florida Statutes.

5.27.94

DATE



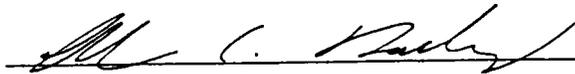
(print name Janette D. Long)

(Title: Vice President)

(Organization Savannah Laboratories)

5-27-94

DATE



(print name(s) Alan C. Bailey)

Quality Assurance Officer(s)

(Organization Savannah Laboratories)

7.0 SAMPLE CUSTODY

7.1 Sample Custody Objectives

The primary objective of sample custody is to provide accurate, verified, and traceable records of sample possession and handling from sample container shipment through laboratory receipt and sample disposition.

Evidence of documentation of sample collection, shipment, laboratory receipt and custody is accomplished utilizing a chain-of-custody record (Figure 7.1). A sample is considered in custody if it is:

- in actual possession of the sampler or transferee
- in view after being in physical possession of the sampler or transferee
- sealed so that sample integrity will be maintained while in possession of the sampler or transferee
- in a secured area, restricted to authorized personnel.

7.1.1 Custody Record Maintenance

Field and laboratory records are maintained in a secure area. All field and laboratory data are recorded in bound notebooks and entries are made in waterproof ink. Field and laboratory data entry errors are deleted with a one-line strike through the error. Correction tape or other substances designed to obliterate documentation are strictly prohibited in the laboratory or custody areas. The correction is initialed and dated by the sampling or analytical staff member making the change. Field and laboratory information is documented on prepared forms. All forms for recording field and laboratory data include spaces for date and initials which must be completed by the data recorder. Field and laboratory documentation not recorded on prepared forms is also dated and initialed.

7.2 Sample and Legal Custody Procedures

All samples are received by the laboratory custodian under either routine or special legal chain-of-custody procedures. Legal custody is a special type of sample custody in which all events associated with a specific sample are documented in writing.

7.3 Laboratory and Field Custody Procedures

The following procedures apply to the custody activities observed by Savannah Laboratories during sample or legal custody procedures.

7.3.1 Selection and Preparation of Sample Containers Supplied to a Client or Sampling Team

Sample containers provided by SL are constructed from EPA designated materials, contain EPA prescribed preservatives and are affixed with an SL identification label (Figure 7.2). In order to monitor container temperature, a 100-mL plastic container labeled "Sample Container

FIGURE 7.2

Bottle	_____
Preservative	_____
Location	_____
Analysis	_____
Sample ID	_____
Date	_____
	By _____
	
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Temperature-Lab Use Only" is prefilled with tap water and supplied with each sample shipment to monitor sample temperature upon receipt.

Projects which require sample containers to be screened for contaminating properties prior to shipment and certified "contaminant-free" can be provided upon the client's request and expense. Containers will be provided with a unique batch assignment number to permit traceability. A sample container preparation logbook (Figure 7.3) is maintained by custody personnel in the event this level of service is requested. All standard custody procedures are maintained for precleaned sample containers.

7.3.2 Chain of Custody Documentation, Traceability, and Sample Integrity

Formal chain-of-custody procedures are initiated by a *custody dispatch technician* who is responsible for organization and relinquishment of sample containers to the client or field personnel.

All field information must be properly recorded on the chain-of-custody form. Proper completion of the form is the responsibility of the *field sampling manager* and is required prior to relinquishment of the samples. If the site location is different from the client address, the site location is recorded in the "Project Name" space on the chain-of-custody form, or on the right hand side of the form if additional space is required. The sample identities assigned in the field are recorded in the "Sample Identification" column. Common carriers may identify themselves by signing the "Relinquished By" space on the chain-of-custody form.

For samples transported from the field to the laboratory by common carrier, chain of custody is maintained. Completed custody forms must accompany each sealed cooler, and are placed in a plastic bag and taped to the inside lid of the cooler. At the client's request, coolers are sealed in the field with the SL Custody Seal (Figure 7.4) or custody tape by the field sampling team to ensure that tampering will be immediately evident. A unique identification number is recorded on the seal and accompanying chain-of-custody form with waterproof ink. A copy of each airbill package tracking form associated with a shipment of samples is maintained in the appropriate client files.

The *sample receipt custodian* is responsible for the inspection of shipping containers upon laboratory receipt for overall integrity and to ensure that the contents have not been altered or tampered with during transit. If tampering is apparent, the sample receipt custodian immediately contacts the assigned *project manager* who is responsible for client notification. A sample custody excursion form (Figure 7.5) is filed by the sample receipt custodian, and any corrective action required by the client is documented on the accompanying project chain-of-custody form which is dated and signed by the sample or project manager.

FIGURE 7.4

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC. OFFICIAL SAMPLE SEAL	SAMPLE ID			SEALED BY	DATE
	SIGNATURE				
	SEAL NO	DATE	TIME		

SAMPLE CUSTODY EXCURSION

SL Project/SDG # _____

Sample Description	Date Sampled	Date Received	Inappropriate Container	Container Breakage	Container Leakage	Container Label Discrepancy	Custody Seal Not Intact	Other (Client-Specified Excursions)	Initials
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									

CLIENT NOTIFICATION

SL Contact	Notification Date	Client Contact	Excursion Resolution
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

FIGURE 7.5

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If shipping containers arrive intact, they are immediately opened by the sample receipt custodian in the receiving area, and the chain-of-custody form and temperature container removed for inspection. Container temperature upon receipt is documented in a bound sample registry (Figure 7.6), or if requested by the client, documented on the chain-of-custody form.

7.3.3 Field Custody

When sample collection is performed by SL, Savannah Laboratories' field sampling manager is responsible for ensuring that chain-of-custody procedures for all sampling events are properly documented. The custody forms and login procedures follow the protocol outlined in Section 7.3.

Prior to field sampling, it is preferable to place waterproof sample labels on each sample container and complete each sample label with as much information as possible in waterproof ink. Field sampling technicians are responsible for ensuring that labels are completed. Each sample is identified in the field by a unique alphanumeric designation on the label.

All information included on each container label must be included on all field-generated records including: permanent field notebook, individual well log, groundwater elevation form, and chain-of-custody form. This field documentation demonstrates traceability of the containers and samples and links all ancillary records to specific sampling events.

Each sample is packed to ensure against leakage or breakage and to maintain individual sample integrity. All glass containers are secured individually with bubble wrap. Each set of sample containers with the same sample identity is placed together in plastic bags and sealed. When more than one set of sample containers (different sample identities) are placed in the sample cooler, each set must be sealed in a separate plastic bag. All VOA sample vials are wrapped twice in bubble wrap and each set is sealed in a separate plastic bag. An attempt should be made by the field sampling team to precool samples to 4° C prior to packing the sample coolers for shipment. Cooler temperature is maintained at 4° C in transit by adding sufficient quantities of ice dispersed throughout the cooler. Additional information regarding sampling can be found in Section 6.0.

Ten percent of samples collected by the SL field sampling team will consist of quality control samples for pH, specific conductivity, temperature, or other client specified parameters per site to satisfy DQOs or project requirements.

When applicable to the site, the following information is documented by the field technicians in the bound field notebook. This field documentation is reviewed, approved and initialed by the field sampling manager prior to client submission.

Site location
Date/time of sampling
Sample identification (including specific location)
Sample sequence number
Site conditions
Weather conditions
Description of QC samples collected
Names of personnel/visitors
Sampling/purging equipment used
Field analysis data
Field decontamination techniques
Well casing composition and diameter
Drilling/boring method
Drilling well type/name
Water table and well depth
Purge volume calculations
Volume of water purged
Date/time of purging
Analytical data to monitor stabilization of well
Use of fuel powered units
Plumbing/tap material construction
Purging flow rate
Purging time
Flow rate at sample collection
Depth samples taken
Beginning/ending time for composite sampling
Depth soil samples taken
Soil sampling technique used
Type/description of drums
Phases sampled in drums

More complete information is provided regarding sampling procedures and documentation in Section 6.

7.3.4 Sample Documentation, Identification, and Login

A sequentially assigned laboratory identification number is assigned by division and recorded on the chain-of-custody form and each sample container submitted with the project and recorded in the bound Sample Registry. Proper and complete sample documentation must be provided on the chain-of-custody form in order to log samples into the sample registry. The sample registry includes all information necessary to maintain chain of custody including laboratory ID, client (field) ID, and initials of the sample receipt custodian. Ancillary information such as sample collection date and requested analyses is transferred directly from the chain-of-custody form into the LIMS, and appears on the client project-specific acknowledgement.

Once the chain of custody is verified, the project identified by this unique number is logged into the computerized LIMS (Figure 12.1) to transfer the desired work order request to the laboratory. The sample receipt custodian checks each sample against the chain-of-custody form for discrepancies between information on the sample label and information

provided on the chain-of-custody form. The sample receipt custodian also inspects all samples for leakage or obvious seal tampering (if provided). All samples are unpacked in a well-ventilated sample receipt area. Personal respirators and face shields are available to each sample receipt staff member for use with any hazardous samples. Samples received in plastic containers which appear to be accumulating or evolving gas are treated cautiously and inspected under a chemical hood because they may contain toxic fumes or be of an explosive nature.

A space labeled "custody intact" provided on the chain-of-custody form is used to describe the sample condition upon receipt. A "Y" indicates no custody problem was identified and a "N" indicates samples or container integrity was compromised and client notification and corrective action is required. At client request, a "Cooler Receipt Form" (Figure 7.7) can be completed to document custodial concerns at sample login.

Discrepancies noted by the custody staff are transmitted to the project and sample manager and are resolved with the client prior to laboratory work assignment. Discrepancies are documented on the sample custody excursion form. The project manager and the sample manager attempt to resolve custody discrepancies expeditiously to avoid holding time compromises. After a decision concerning a sample has been made, the project manager or sample manager makes an initialed note on the original custody form which states person notified, time, date, and resolution, if applicable. This information is also documented on the sample custody excursion form. A faxed or hard copy of custodial resolutions or project order alterations is secured from the client prior to work initiation. Copies of this documentation are mailed to the client and maintained in the client file.

7.3.5 Sample Preservation

After addition of the project sequential identification number, the samples are dispersed to the appropriate laboratory section sample storage areas. Color-code dots and unique sample bottle types correspond to specific analysis and are stored at designated sample storage areas throughout the laboratory sections. Bound sample storage temperature logs are maintained for all sample storage refrigerators to assure proper temperature maintenance throughout the analytical process.

The color code scheme for the various preservatives used in SL's sample containers is in the Sample Container Request Form which is submitted to a client requesting sample containers. This two-sided form is shown in Figures 7.8 and 7.9.

All sample containers used by the SL field sampling team contain premeasured portions of preservatives. Additional preservatives are obtained prior to each sampling event from parent stocks assayed and maintained by the laboratory. Documentation is kept for all additional preservatives used in the field. The effectiveness of pH adjustment by addition of acid or base to the samples is checked after sampling by pouring a small amount of the preserved samples into a small specimen cup.

COOLER RECEIPT FORM	
Client:	Project:
SL Log #:	Date Received:
SL Cooler Receipt Custodian (Signature):	

Use other side of this form to note details concerning custodial discrepancies

		YES	NO
1	Did a shipping slip (air bill, etc.) accompany the cooler shipment?		
2	Were custody seals affixed to the outside of cooler? If YES, enter the following: Seal Identification (if provided):		
3	Were custody seals unbroken and intact at the date and time of arrival?		
4	Were custody papers completed properly (ink, signed, etc.)?		
5	Was wet ice/blue ice used? (Circle which media)		
6	Cooler temperature upon receipt:		
7	Describe type of packing in cooler (vermiculite, bubble pack, etc.).		
8	Were sampling containers supplied by SL or client? (Circle which one)		
9	Did all bottles arrive intact and were labels in good condition?		
10	Did all bottle labels agree with custody papers?		
11	Were bubbles present in VOA samples?		
12	Was the project manager notified of any custody discrepancies or excursions?		
13	Was a custody excursion form completed and a copy provided to the project manager? If so, complete No. 14.		
14	Who was contacted? By whom: Date:		

SL SAVANNAH LABORATORIES
& ENVIRONMENTAL SERVICES, INC.

5102 LaRoche Avenue • Savannah, GA 31404 • (912) 354-7858 • Fax (912) 352-0165

Shipping Address: _____

Date of Shipment: 05/19/94

Method of Shipment:

Phone No:

Project Reference:

Account No:

Project Site Location:

SAMPLE CONTAINER REQUEST FORM

AQUEOUS										NONAQUEOUS										
																				PRESERVATIVES
																				Lab Pk Prep. by: _____
																				Lab Pk Checked by: _____
																				Quantity of Lab Pks. Shipped: _____
																				Proj Mgr: _____
																				Coordinator: _____
																				Comments: _____

																				NO. OF CONTAINERS SHIPPED
																				NO. OF CONTAINERS/SAMPLE
																				SET(S) OF TRIP BLANKS
																				SET(S) OF FIELD BLANKS
																				SET(S) OF EQUIPMENT BLANKS
																				ANALYSIS

It is the shipper's responsibility to ensure samples are maintained at the appropriate temperature during transit.

PRESERVATION COLOR CODE KEY

- RED(R) CAUTION! STRONG OXIDIZER! CONTAINS NITRIC ACID. Avoid skin and eye contact. If contact is made, FLUSH IMMEDIATELY with water.
- GREEN(G) CAUTION! CONTAINS SULFURIC ACID. Avoid skin and eye contact. If contact is made, FLUSH IMMEDIATELY with water.
- BLUE(B) CAUTION! STRONG CAUSTIC! CONTAINS SODIUM HYDROXIDE. Avoid skin and eye contact. If contact is made, FLUSH IMMEDIATELY with water.
- ORANGE(O) No preservatives added.
- TAN(T) Contains Zinc Acetate. Avoid skin and eye contact. If contact is made, FLUSH IMMEDIATELY with water.
- YELLOW(Y) Contains Sodium Thiosulfate. Sterilized container.
- LT.BLUE(LB) CAUTION! CONTAINS HYDROCHLORIC ACID. Avoid skin and eye contact. If contact is made, FLUSH IMMEDIATELY with water.

DO NOT inhale vapors that may be caused from a chemical reaction between the preservative and sample. Collect sample in a well-ventilated area or use appropriate breathing apparatus. NEVER RINSE sample containers. If skin contact with preservatives occurs, flush exposed areas IMMEDIATELY.

Laboratory locations in Savannah, GA • Tallahassee, FL • Mobile, AL • Deerfield Beach, FL • Tampa, FL

GENERAL SAMPLING INSTRUCTIONS

DO NOT PRE-RINSE CONTAINERS. These containers have been specially prepared for specific analyses (See Preservative Color Code Key). Fill container to within 1" of capacity unless otherwise indicated, cap tightly, label and ice. Some requests require multiple containers to perform all analyses. (See Sample Request Form on reverse side.)

LITER PLASTIC

Orange n/m: Physical Properties, Miscellaneous General (BOD)
Red n/m: Radiological (Rad 226, Rad 228, alpha and beta)
Orange w/m: Metals and Miscellaneous Inorganics, General, Physical Properties
(Nonaqueous)

LITER AMBER GLASS

Orange n/m: Extractable Organics (BNAs, Pesticides/PCBs, Herbicides), Dioxins/Dibenzofurans
Orange w/m: All Organics (excluding Volatiles), Inorganics, Physical Properties, General
(Nonaqueous)

500 ML PLASTIC

Blue n/m: Cyanide
Orange m/m: Physical Properties, Miscellaneous General
Red m/m: Metals with Mercury
Orange w/m: Inorganics, Physical Properties
(Nonaqueous)

500 ML GLASS W/TFE

Lt. Blue m/m: Petroleum Hydrocarbons
Green m/m: Oil and Grease
Green m/m (amber): TOX. Fill to capacity.
Orange w/m: All Organics (excluding Volatiles), Inorganics, Physical Properties, General
(Nonaqueous)

250 ML PLASTIC

Orange w/m: Inorganics, Physical Properties, General (single parameter)
(Nonaqueous)
Orange m/m: Physical Properties, Inorganics (nutrients), Hexavalent Chromium
Red m/m: Metals without Mercury
Green m/m: Nitrogen series, Phosphorus
Tan m/m: Sulfide

250 ML NALGENE

Yellow m/m: Bacteriological (Coliform, Standard Plate Count) Sterile container - do not touch cap or container interior. Remove faucet strainer and flush line prior to sample collection.

125 ML AMBER GLASS W/TFE

Green m/m: TOC. Fill to capacity.
Green n/m: Total Recoverable Phenolics
Orange m/m: Volatiles. Fill to capacity - no headspace.
(Nonaqueous)

100 ML PLASTIC

Orange m/m: Physical Properties, Inorganics (single parameter)
Green m/m: Nutrients, COD (single parameter)

100 ML GLASS

Orange w/m: Organics, Inorganics, Physical Properties, General (single parameter)
(nonaqueous):

40 ML GLASS VIAL W/TFE

Lt. Blue n/m: Volatiles (Aromatics and/or Halogenated constituents). Fill vials until slightly overflowing with minimum aeration. Place septa W/TFE liner facing sample and seal with NO headspace.
Orange n/m: EDB, Volatile Halocarbons. Fill as referenced above.
Yellow n/m: Trihalomethanes (THM). Fill as referenced above.

250 ML GLASS

Orange w/m: Physical Properties, Inorganics (single parameter)
(nonaqueous):

Container Closure Key (n/m = narrow mouth, m/m = medium mouth, w/m = widemouth)

CONTAINER SHIPPING INSTRUCTIONS

After sample collection, please check all custody forms and sample containers for discrepancies. Sign the custody form and seal in the enclosed plastic bag. To avoid container leakage during transit, additional plastic bags have been included in the shipment to contain ice for sample preservation. Please place these ice bags between the samples and secure the lab pack for shipment. Return lab packs to Savannah Laboratories & Environmental Services, Inc., 5102 LaRoche Avenue, Savannah, GA 31404. If you have any questions concerning containers shipped or acceptable field substitution, please contact your project manager or sample coordinator for assistance at (912) 354-7858 or FAX (912) 352-0165.

Thank you for your patronage.

and testing with narrow range pH paper. Because of the risk of compromising sample integrity, VOA samples cannot be checked in the field.

All samples received by Savannah Laboratories are checked for proper pH adjustment by the appropriate preparation or analytical department as soon after receipt as possible. The pH of each sample is checked, documented, and adjusted, if necessary. To avoid compromising sample integrity, volatile samples are checked for proper pH adjustment only at the time of analysis. The pH of volatile samples is not adjusted.

7.3.6 Sample Security, Accessibility, Distribution, and Tracking

Only authorized personnel are permitted within the laboratory areas where sample access is possible. Sample storage areas are designed to segregate volatile and nonvolatile samples. Standards and extracts are also departmentally controlled and stored in segregated facilities.

The set of analyses required for a group of samples is project-dependent. After sample registry login and verification, samples are relinquished from the receiving area to the appropriate sample preparation area. Those samples not requiring preparation are relinquished immediately to the sample analysis storage area. Using LIMS-generated sample preparation worksheets for guidance, samples are extracted, digested, or distilled as appropriate. An example sample preparation log (Fluoride Extraction Log) is shown in Figure 7.10. The extracts, digestates, or distillates are then transferred and relinquished to the appropriate analysis section, where analysis is performed. An example analysis log (Fluoride Analysis) is shown in Figure 7.11.

For projects where in-laboratory custody records are required by the client, the SL project manager should inform the custodian and sample manager to coordinate custody activities prior to sample receipt. For those samples, department-specific in-laboratory sample tracking forms are executed by department staff. An example of a form of this type (Semivolatile Extract Custody Log) is shown in Figure 7.12. Samples and sample preparations are stored in a secure (locked) sample storage area. When samples or sample preparations are removed from or returned to designated storage areas, the form is signed and dated by the analyst.

Sample holding times are tracked via the LIMS. Sample collection dates are routinely entered into the LIMS with all sample logins. This information allows holding times specific to each departmental analysis to be tracked by department managers, supervisors, chemists, and analysts through the use of daily status sheets, reference sheets, and preparation worksheets. Date analyzed is recorded via instrument outputs or analysis forms when applicable as an integral part of the raw data. Upon the analysis of each parameter, the date of analysis is entered into the LIMS and can be compared to the date sampled to validate that holding times have not been compromised.

7.3.7 Sample Disposition

After analysis completion, custody of unused sample portions, extracts, or digests is relinquished to the central secured storage area. Unless a client requests the project manager to save unused samples, digests, or extracts, disposal from the central storage occurs as soon as holding times have expired or three weeks after results submission.

Requests for extended sample, digest or extract storage must be provided by the client to the SL project manager in writing (or contract form) prior to sample receipt and extended storage may result in additional fees to be negotiated by the SL project manager prior to sample receipt. SL is not responsible for evaporation or other deterioration of samples, extracts, or digests during extended storage periods.

Samples which are requested to be returned to the client may be picked up at the laboratory by the client, shipped by Federal Express (at the client's expense for packaged shipping) or returned by any other legal means that is arranged by the client. Clients requesting the return of samples should provide detailed shipping instructions.

If a client by contract requires that samples be disposed of by a hazardous waste contractor, the client's name and EPA ID number are used on the manifest and the client is billed for all disposal related costs.

Other excess sample portions will be composited according to matrix (solids, oils or aqueous) by the laboratory. The composited soils, sediments and other solid samples are subsampled and analyzed for hazardous waste characterization: ignitability, reactivity, (releasable cyanide and sulfide), corrosivity (pH), toxicity (TCLP by SW-846 Method 1311) and PCBs. If the pooled subsample is hazardous by any of the hazardous waste characteristics or contains greater than 50 ppm PCBs, the composited excess sample is disposed of by a hazardous waste contractor. If the pooled subsample is not deemed hazardous per these tests, the composited excess material is disposed of in an industrial/municipal landfill.

Since previous analyses by Savannah Laboratories have indicated that composite excess aqueous sample meets the public sewer system discharge criteria in 40 CFR Part 261.3(a)(2)(iv)(E), composited aqueous samples are neutralized to pH 6-8 and discharged into the public sewer system which receives the laboratory's wastewater provided the results from the tests performed on the sample do not indicate that the sample exceeds hazardous characteristics as stated in 40 CFR Part 262, Subpart C.

The laboratory tracks sample disposal via the LIMS. The LIMS keeps track of clients' specific disposal instructions, compiles results from the analyses of composited samples, prepares sample disposal lists, invoices for disposal and sample return costs, and provides a disposal record for all excess samples.

7.3.8 Interdivisional Custody

The laboratory director at each location monitors the sample load and turnaround time through LIMS-generated reports. If it appears that analysis demand will exceed capacity, or if instrument failure occurs, samples may be transferred (provided client contracts or arrangements, project QA plans or certification limitations do not prohibit sample transfer) to another SL division to ensure that holding times and turnaround commitments are met.

If samples are transferred to another division laboratory, full custody is maintained. Special determination codes specific to each laboratory location are entered into the LIMS to enable the project manager and laboratory director to track sample progress and maintain chain of custody. Copies of the original chain-of-custody form (executed for interdivisional sample submittal), computerized LIMS work order acknowledgements, and extract or digest preparation logs pertinent to the project order accompany the samples or sample preparations. The accompanying documentation also includes dates of sample preparation and requested analyses. Upon sample receipt at the receiving division laboratory, standard custody procedures are followed.

7.4 Electronic Data Records

By careful assignment of user passwords and file access/lock codes, Savannah Laboratories maintains a high level of data security for the LIMS. Thus, only authorized SL personnel can access client files to view data. In addition, data entry and editing is restricted to highly trained data management personnel.

Data may be downloaded in a variety of standard formats including ASCII, Spreadsheet, Database, or Text files such as *.ASC, *.WK1, *.DBF, *.TXT, etc. Additionally, lab data may be formatted to match client-specific requirements. These requirements should be defined and agreed upon prior to project commencement. Laboratory-generated data are thoroughly reviewed prior to preparation of electronic or diskette deliverables. The download process includes both electronic and logical error check routines to confirm the data files delivered are consistent with the client's format and data content request. A signed hardcopy report will be provided with all electronic or diskette deliverables and an electronic and documentation audit trail of each download event will be maintained.

In order to ensure data integrity and security, all files selected for data downloads are transferred from the LIMS to an isolated PC computer system. Access to download files is then controlled via required matches of log-on sequences and confidential passwords. The entire download process is regularly reviewed and maintained by the computer department for system performance.

Internal documentation is maintained by the LIMS manager for all LIMS programs. This documentation includes descriptions of any program additions, deletions, or modifications, the date of revision, and the initials of the responsible programmer. To verify proper program

functioning of the hardware and software, a simulation account is maintained. When hardware or software is modified, the LIMS uses actual data in the simulation account in order to verify the modifications are functioning as anticipated. Antivirus software serves the LIMS as a protective measure.

At present, laboratory instrumentation is not interfaced directly to the LIMS and thus, no instrument-LIMS data transfer step requires verification. All instrument data is verified by chemists or analysts as described in Section 12.5.2.

Entry of data into the LIMS from chemists' worksheets is routinely performed by data entry technicians. Immediately following data entry, approval sheets are printed with the entered data as it appears in the LIMS. Assistant project managers compare all data on the approval sheets against the chemists' worksheets for data transcription errors.

7.5 Verification of Hard Copy Records

Data worksheets, data approval forms, and final reports are routinely printed for verification and signatures. Hard copies of final reports, field data, chain-of-custody forms, and any ancillary documentation pertinent to the project will be stored in a secured storage area and placed chronologically within alphabetically arranged client files.

8.0 ANALYTICAL PROCEDURES

The ultimate responsibility for analytical method selection lies with the client or regulatory agencies. Whenever possible, laboratory and field analysis of all samples are conducted by EPA-approved methodology. When EPA approved methods do not exist or project protocols require alternative methods, these methods must be approved by the client and the appropriate regulatory agency.

Tables 5.1 and 5.2 list Savannah Laboratories' routine laboratory parameters with their respective method numbers. Table 5.3 lists field parameters with their respective method numbers.

A detailed SOP has been prepared for each routine analytical method. Copies of SOPs are issued under document control procedures to each staff member involved with the procedure. A master copy of each SOP is maintained by the QA manager.

In cases where GC, LC, or GC/MS methods are used to determine compounds not included in the actual method list, these unlisted parameters are flagged in the tables with a triple asterisk (***) and method validation data are included in Appendix A.

For those cases where no specific soil or sediment method exists, water methods are adapted. These adaptations are described in Section 8.2, and validation data are presented in Appendix A. Unless indicated in the appropriate SOP, all parameters listed in Tables 5.1 through 5.3 are analyzed by the methods referenced, without modifications. Interpretation of ambiguous or conflicting method requirements is accomplished by consulting with regulatory agencies and EPA laboratory/QA personnel.

8.1 Glassware Cleaning Procedures

Laboratory glassware washing procedures are adapted from SW-846, 40 CFR Part 136, *Standard Methods*, and EPA 600/4-79-019, and are as follows:

Extractable Organics

Prerinse each item with the solvent to be used in it. As soon as possible after use, rinse with lab-grade acetone. Wash with hot water and a nonphosphate detergent such as Alconox, scrubbing thoroughly with a brush. Rinse thoroughly with tap water at least three times. Rinse inside surface with Nochromix solution, catching rinsate for re-use. Rinse again with tap water, followed by pesticide-grade acetone. Rinsing with hexane is avoided to minimize the possibility of contamination of glassware used for total petroleum hydrocarbon determination. Air dry when possible, and do not bake Class A volumetric glassware. Store glassware inverted or cap openings with foil to exclude dust and other contaminants. Because of possible damage, caps, septa, and plastic items are not rinsed with Nochromix.

Volatile Organics

Wash with tap water and Alconox or Liquinox, then rinse thoroughly with organic free water. Oven dry at 110°- 120°C for at least two hours. Do not bake Class A volumetric glassware. Glassware is usually stored in the oven until use. Caps and septa are washed in the same manner, but caps are not oven-dried. Highly contaminated glassware is allowed to soak in Nochromix solution overnight, then washed as above.

General Chemistry, Microbiology, Nutrients, Demands

Wash with hot tap water and Liquinox, rinse thoroughly with tap and deionized water, and air dry. Store glassware inverted or cap openings with foil. Autoclave bacteriological laboratory glassware and collection bottles as described in analytical procedures. COD digestion tubes and caps are cleaned with brushing and tap water (no soap) and rinsed thoroughly with deionized water. Tubes for TKN and total phosphorus sample digestions are washed with hot water and Liquinox, and rinsed with tap water, Nochromix, and deionized water.

Metals/Radionuclides

Wash glass, plastic, and Teflon items in hot tap water and Alconox. Rinse with tap water, 1:1 nitric acid, tap water, and deionized water. Teflon beakers used for sample digestion are further decontaminated by adding 20 mL nitric acid and 12 mL hydrochloric acid, covering with a watch glass, and digesting on a hot plate for two hours. Following this treatment, they are rinsed with 10% nitric acid and deionized water and allowed to air dry.

8.2 Soil Sample Preparation Notes

In the absence of an approved soil method, water methods are adapted for soil matrices. The following soil preparation procedures are applied to parameters in Table 5.2.

1. Fluoride (extractable): Method 340.2

Approximately 5 g of sample is weighed out exactly and placed in a screw-cap plastic bottle. One hundred mL of DI water is added to the sample, the bottle is capped, placed in a rotating extractor, and rotated for 2 hours. Upon removal, the sample is allowed to settle, the supernatant decanted, and the extract is analyzed as a liquid sample.

2. Gross Alpha and Gross Beta Particle Activity: Method 9310

Soil is ground to a fine powder with mortar and pestle, and 50 to 100 mg soil is weighed onto a tared planchet. Sample is distributed evenly over planchet surface, fixed with clear acrylic solution, dried, and counted.

3. Chloride (extractable): Method 9251/9252/4500-Cl⁻C

Approximately 5 g of sample is weighed out exactly and placed in a screw-cap plastic bottle. One hundred mL of DI water is added to the sample,

the bottle is capped, placed in a rotating extractor, and rotated for 2 hours. Upon removal, the sample is allowed to settle and the supernatant is decanted. The extract is analyzed as a liquid sample.

4. Sulfate (extractable): Method 9036/9038/375.3

Approximately 5 g of sample is weighed out exactly and placed in a 100-mL screw-cap plastic bottle. One hundred mL of DI water is added to the sample, the bottle is capped, placed in a rotating extractor, and rotated for 2 hours. Upon removal, the extract is filtered using a syringe filter with a 0.20-um pore size filter and analyzed as a liquid sample.

5. Orthophosphate (extractable): Method 365.1

Approximately 5 g of sample is weighed out exactly and placed in a screw-cap plastic bottle. One hundred mL of DI water is added to the sample, the bottle is capped and placed in a rotating extractor, and rotated for 2 hours. Upon removal, the sample is allowed to settle and the supernatant is decanted. The extract is analyzed as a liquid sample.

8.3 Validated Compounds and Modifications of Referenced Analytical Methods

Except for the instances described below, parameters in Tables 5.1 and 5.2 have been determined by the methods referenced with no significant modification to those methods, other than the use of additional standards for parameters not included in the referenced method lists.

Extractable Petroleum Products

Extractable petroleum products are determined by the modified 8100 method. In this procedure, the semivolatile products are extracted from the samples with methylene chloride. The extract is injected into a GC equipped with an FID detector and the oven is programmed to effect separation of the component compounds on the column. The identification of a petroleum product is made by comparison of the standard chromatogram against the sample chromatogram, using pattern recognition techniques.

Purgeable Petroleum Products

Purgeable petroleum products are determined by the modified 8015 method. In this procedure, the volatile products are purged from the sample by helium gas. The VOCs are then collected on a sorbent trap. When the adsorption is complete, the sorbent trap is heated and then backflushed with helium to desorb the collected analytes onto the GC column. The oven is temperature programmed to effect separation of the component compounds on the column and the detector is an FID. The identification of a petroleum product is made by comparison of the standard chromatogram against the sample chromatogram, utilizing pattern recognition techniques.

Method 8015 - DAI

Method 8015 allows for the determination of compounds by direct aqueous injection (DAI). In this procedure, compounds are determined on a GC

using a flame ionization detector. Soils and other solid matrixes are first extracted into an equal part of reagent water prior to analysis.

The identification of a compound is based upon comparison of the retention time of the suspect peak with that of the standard. Confirmations may be done upon request by client and involve analysis of the sample utilizing a dissimilar column or gas chromatography/mass spectroscopy (GC/MS).

Sulfide

In the determination of sulfide in liquid samples containing turbidity or color and in all soil or sediment samples, samples are distilled as per SW-846 method 9030. Upon distillation of the sample, the trapping solution is analyzed colorimetrically as a clear liquid sample as per EPA method 376.2.

Asulam

Water samples are analyzed by passing them through a solid phase cartridge and then acidifying with concentrated H_3PO_4 . The sample is then injected directly into the HPLC system. The HPLC system consists of an isocratic pump and a UV detector.

Thiodiglycol

Water samples are analyzed by passing them through a solid phase cartridge. Soil samples are extracted by sonication with calcium chloride solution and then processed through the same cleanup as the water sample. The samples are injected into the HPLC system which consists of an isocratic pump and a UV detector.

Ethylenethiourea

Water samples are extracted 1:1 with methylene chloride to remove nonpolar interferences. The extracted water layer is then forced through a solid phase extraction column to remove polar interferences. Ethylenethiourea is determined in the prepared sample by HPLC, using a five-point calibration curve and the external standard technique.

8.4 Reagent Storage and Documentation

Reagents are stored with consideration for safety and maximum shelf life. Storage conditions for various classes of reagents are given in Table 8.1, as well as discussed below. Documentation maintenance status for the reagent classes is also given in Table 8.1.

All acids, except those poured up in small marked containers which are for immediate use, are stored in the original containers in acid storage cabinets.

All bases, except those poured up in small containers for immediate use and those that are standardized for specific purposes, are stored in the original containers in designated areas or storage cabinets.

TABLE 8.1

REAGENT STORAGE

Chemical	Method of Storage	Documentation
Acids	Original containers in acid storage cabinets	Yes
Bases	Original containers in designated storage cabinets	Yes
Nonflammable Organic Solvents	Original containers in designated storage cabinets	Yes
Flammable Solvents	Original containers in vented flammable storage cabinets	Yes
Dry Reagents	Original containers in designated cool, dry storage cabinets	Yes
Reactive Chemicals	Original containers in isolated cool, dry storage cabinets	Yes

All flammable solvents, except those poured up for immediate use are stored in original containers in approved vented flammable storage cabinets which are located in air conditioned areas.

Dry reagents are stored in designated cabinets in cool, dry areas. Reactive chemicals, cyanides and sulfides are labeled and isolated from other chemicals.

All acids used for metal sample digestions and all solvents used for semivolatle sample extraction are tested prior to initial use. Specific acceptable chemical lots are reserved and stored by the vendor(s) and are requisitioned and received as needed by the laboratory. Lot numbers used for digestions or extractions are recorded in bound notebooks in the appropriate departments.

Reagent blanks are analyzed with each sample batch for all methods, validating the purity of all reagents. All reagent containers are dated when received, and dated and initialed when opened (except high use items consumed in less than one week). Documentation is maintained to provide traceability of the reagents used with the analysis of any batch to specific reagent lot numbers.

8.5 Waste Disposal

Savannah Laboratories' divisions operate as either conditionally exempt small quantity generators or small quantity generators of hazardous waste.

All waste disposal is carried out in accordance to Savannah Laboratories' Waste Disposal SOP. This document includes procedures for identification, storage, personnel training, tracking forms, report forms, safety, as well as details of the disposal. Hazardous waste disposal procedures are given in Table 8.2 and discussed below.

Hazardous wastes must:

- be stored in non-leaking containers in good condition with close-fitting lids and kept closed when wastes are not being added or removed.
- be accurately labeled with waterproof labels. Labels must specify the words "Hazardous Waste", the composition and physical state of the waste, the hazardous properties of the waste (e.g., flammable, reactive, etc.), and the name and address of the generator.
- be clearly labeled on each container with the date that the period of accumulation began. The date must also be documented on the Hazardous Waste Tracking Log Form.
- be handled in containers and in a way that minimizes the possibility of spills and escape of wastes into the environment.
- be stored in an area which is regularly inspected for deteriorating or leaking containers.

TABLE 8.2

WASTE DISPOSAL PROCEDURES

Waste Type	Associated Analytical and Sample Prep Methods	Storage Procedures	Disposal Procedures
Halogenated Solvents Methylene Chloride	Pesticides, Herbicides, BNA, GPC, etc.	Store in glass bottles, then in drums.**	Reclaimed by HW contractor
Freon	Oil & Grease, Petroleum Hydrocarbons	Store in glass bottles, then in drums	Reclaimed by laboratory
Mixed Solvents (Flammable & nonhalogenated)	VOC Standards, Herbicides, Pesticides	Store in glass bottles, then in drums	Disposal by HW contractor
All neat standards	All analyses	Store in original bottles of glass/plastic bottles, then lab pak	Disposal by HW contractor (Packed by also)
Heavy Metals Solutions	Metals, COD, Chloride	Store in glass bottles, then in drums	Disposal by HW contractor
Acid Solutions	Metals, General Inorganics, Extractions	Store in glass bottles or add to neutralizing chambers	Neutralize; sanitary sewer
Alkaline Solutions	General Inorganics, Extractions	Store in glass bottles	Neutralize, sanitary sewer
All samples containing Organics or Inorganics exceeding hazardous waste standards*	All analytical groups	Store in original bottles or jars in sample custody storage area	Return to client, or disposal by HW contractor

* Hazardous Waste Characteristics (D001 - D017) (40 CFR Part 261), HCN > 250 mg/kg, H₂S > 500 mg/kg, TCLP Toxicity Characteristics (Federal Register, 55FR 11798), March 29, 1990, or contains greater than 50 ppm PCBs.

** Bottles are kept in each lab and are periodically moved by the Waste Coordinator to hazardous waste storage area.

All waste must be segregated for temporary accumulation and storage as well as for disposal. Care must be taken to combine waste materials into categories or waste streams based upon their compatibility.

The following three types of waste are stored in 55-gallon drums.

1. Halogenated solvents such as methylene chloride (closed cap metal drum)
2. Nonhalogenated flammable solvents (closed cap metal drum)
3. Heavy metals or other aqueous wastes except cyanide (poly drum)

All other wastes should be stored in the original container or 4-liter glass bottles and disposed of via lab pak. (Packed by disposal company in 55-gallon open top drums.)

9.0 CALIBRATION PROCEDURES AND FREQUENCY

9.1 Laboratory Equipment

Savannah Laboratories is equipped with state-of-the-art instrumentation to provide quality analytical data to clients. A list of the instrumentation maintained by Savannah Laboratories for the determination of the parameters contained in Tables 5.1 and 5.2 is found in Table 9.1. A list of all field instrumentation maintained by the laboratory is contained in Table 9.2.

9.2 Standard Receipt and Traceability

Standards are purchased from commercial sources in mixes designed for the specific methods or as neat compounds. Certificates of analysis are shipped with each ampule by the vendor. When possible, standards are certified to meet or exceed the criteria established by the U.S. EPA or are traceable to NIST standards.

Upon receipt, dates are placed on all standard materials. Standard logbooks are maintained by all sections of the laboratory to document the traceability of working standards back to neat materials or prepared stock mixes. All standards are assigned a lot number that provides a unique identification as well as identifying the type of standard. This unique lot number is documented in a laboratory notebook along with date of preparation, initials of preparer, concentration, expiration date (if applicable), and solvent (if applicable). If required, a standard preparation narrative is also provided in this notebook to detail the preparation steps for each stock standard.

9.3 Standard Sources and Preparation

Savannah Laboratories maintains an inventory of materials to produce stock standards or purchases stock standards from commercial vendors. Laboratory preparation of all lab-prepared stock, intermediate, and working standards is documented by the responsible analysts. Table 9.3 presents standard sources and preparation protocols for various sections of the laboratory. Field instruments requiring calibration standards (conductivity meters and pH meters) use the same sources as laboratory instrumentation.

Table 9.4 lists titrants used by the laboratory and information regarding their standardization.

9.4 Laboratory Instrument Calibration

The calibration procedures given below meet or exceed EPA method requirements.

Calibration requirements specified by the method which are more stringent than these procedures will be used.

TABLE 9.1

MAJOR LABORATORY INSTRUMENTS AT EACH SAVANNAH LABORATORIES LOCATION

#	Instrument	Deerfield Beach	Tallahassee	Savannah	Mobile	Tempa Bay	New Orleans
9	ICP Units	1-Jarrell Ash 61	1-Jarrell Ash 61	1-Jarrell Ash 61 1-Jarrell Ash Enviro 36 1-Jarrell Ash 61E Trace	1-Jarrell Ash 61E 1-Perkin Elmer 6000	1-Jarrell Ash 61E	1-Jarrell Ash 61E
6	Mercury Cold Vapor Units	1-Varian VGA/AA20	1-Varian VGA-76/AA20	1-Varian VGA-76/AA20	1-Perkin Elmer MAS/6000	1-Coleman 50B	1-Coleman 50B
15	Atomic Absorption Furnace/Flame	2-Varian 400Z	2-Varian 400Z 1-Varian AA 20	1-Varian 400Z 2-Jarrell Ash 4000 1-Jarrell Ash 22 1-Perkin Elmer 2380	1-Varian 400Z 1-Perkin Elmer 5000	1-Varian 400Z 1-Varian AA 20	1-Varian 600Z
14	GC/MS Semivolatiles	1-HP 5970	3-HP 5970	4-HP 5970 1-HP 5971 1-HP 5972	1-Varian Saturn 3 1-HP 5970	1-HP 5971	1-HP 5972
15	GC/MS Volatiles	1-HP 5970	3-HP 5970	3-HP 5970 2-HP 5971 2-HP 5972	1-HP 5970 1-HP 5972	1-HP 5971	1-HP 5970
39	Gas Chromatography Semivolatiles	3-Varian 3400 with dual ECD 3-Varian 3400 with dual FID 1-Varian 3700 with FID	1-Varian 3400 with dual NPD 2-Varian 3400 with dual FID 4-Varian 3400 with dual ECD 1-Shimadzu 9AM with dual ECD 1-HP 5880 with FID	1-Varian 3400 with dual FID 1-Varian 3400 with dual NPD 2-Varian 3400 with dual ECD 2-Varian 3700 with dual ECD 1-Varian 3700 with ECD 2-HP 5890 with dual ECD 1-HP 5890 with dual FID 1-Varian 3600 with dual FID	4-Varian 3400 with dual ECD 1-Varian 3400 with FID 1-Varian 3300 with dual NPD	2-Varian 3400 with dual ECD 2-Varian 3400 with dual FID 1-Varian 3600 with dual ECD	1-HP 5890 with dual ECD 1-Varian 3400 with dual FID

TABLE 9.1

MAJOR LABORATORY INSTRUMENTS AT EACH SAVANNAH LABORATORIES LOCATION

#	Instrument	Deerfield Beach	Tallahassee	Savannah	Mobile	Tampa Bay	New Orleans
9	ICP Units	1-Jarrell Ash 61	1-Jarrell Ash 61	1-Jarrell Ash 61 1-Jarrell Ash Enviro 36 1-Jarrell Ash 61E Trace	1-Jarrell Ash 61E 1-Perkin Elmer 6000	1-Jarrell Ash 61E	1-Jarrell Ash 61E
6	Mercury Cold Vapor Units	1-Varian VGA/AA20	1-Varian VGA-76/AA20	1-Varian VGA-76/AA20	1-Perkin Elmer MAS/6000	1-Coleman 50B	1-Coleman 50B
15	Atomic Absorption Furnace/Flame	2-Varian 400Z	2-Varian 400Z 1-Varian AA 20	1-Varian 400Z 2-Jarrell Ash 4000 1-Jarrell Ash 22 1-Perkin Elmer 2380	1-Varian 400Z 1-Perkin Elmer 5000	1-Varian 400Z 1-Varian AA 20	1-Varian 600Z
14	GC/MS Semivolatiles	1-HP 5970	3-HP 5970	4-HP 5970 1-HP 5971 1-HP 5972	1-Varian Saturn 3 1-HP 5970	1-HP 5971	1-HP 5972
15	GC/MS Volatiles	1-HP 5970	3-HP 5970	3-HP 5970 2-HP 5971 2-HP 5972	1-HP 5970 1-HP 5972	1-HP 5971	1-HP 5970
41	Gas Chromatography Semivolatiles	3-Varian 3400 with dual ECD 3-Varian 3400 with dual FID 1-Varian 3700 with FID	1-Varian 3400 with dual NPD 2-Varian 3400 with dual FID 4-Varian 3400 with dual ECD 1-Shimadzu 9AM with dual ECD 1-HP 5880 with FID	1-Varian 3400 with dual FID 1-Varian 3400 with quad FID 1-Varian 3400 with dual NPD 2-Varian 3400 with dual ECD 2-Varian 3700 with dual ECD 1-Varian 3700 with ECD 2-HP 5890 with dual ECD 1-HP 5890 with dual FID 1-Varian 3300 with dual ECD	4-Varian 3400 with dual ECD 1-Varian 3400 with FID 1-Varian 3300 with dual NPD	2-Varian 3400 with dual ECD 2-Varian 3400 with dual FID 1-Varian 3600 with dual ECD	1-HP 5890 with dual ECD 1-Varian 3400 with dual FID

TABLE 9.1

MAJOR LABORATORY INSTRUMENTS AT EACH SAVANNAH LABORATORIES LOCATION

#	Instrument	Deerfield Beach	Tallahassee	Savannah	Mobile	Tampa Bay	New Orleans
34	Gas Chromatography Volatiles/P&T	1-Varian 3600 with PID/Hall 2-Varian 3300 with PID/Hall 1-Varian 3300 with PID/FID 1-Varian 3300 with FID/Hall 1-Varian 3400 with PID/Hall	1-Varian 3400 with PID/FID 1-Varian 3700 with Hall/FID 1-Varian 3300 with Hall/FID 1-Varian 3300 with PID/Hall 1-Varian 3300 with PID/FID 1-Varian 3400 with PID/Hall 1-Varian 3600 with PID/Hall	1-Varian 3600 with PID/FID/TCID 1-Varian 3700 with Hall/FID 1-Varian 3600 with Hall/PID/FID 2-Varian 3400 with PID/FID 2-Varian 3300 with Hall/FID 1-Varian 3700 with Hall/FID 1-HP 5890 with dual FID 1-Varian 3400 with dual FID 1-HP 5890 with FID and Tekmer 7000	1-Varian 3300 with Hall/FID 1-Varian 3300 with Hall/FID 1-Varian 3400 with PID/FID	1-Varian 3300 with FID/Hall 1-Tracor 540 with PID/Hall 1-Varian 3600 with PID/Hall 1-Varian 3400 with FID/FID 1-Varian 3400 with PID/Hall	1-Varian 3400 with PID/Hall 1-Varian 3400 with PID/FID
2	TOC Analyzers			1-Dohrmann DC80	1-OI 524C		
6	IR Spectrophotometers	1-Buck Scientific HC-404	1-Buck Scientific HC-404	1-Buck Scientific HC-404	1-Buck Scientific HC-404	1-Buck Scientific HC-404	1-Buck Scientific HC-404
8	UV-VIS Spectrophotometers	1-Milton Roy 21	1-Milton Roy 301 1-B&L 21	1-Milton Roy 301 1-Perkin Elmer 35	1-Sequoia Turner 340	1-Milton Roy 301	1-Milton Roy 301
4	Nutrient Autoanalyzers			3-Technicon Traacs 800	1-Lachat Quickchem AE		
5	HPLC Units		1-Waters 486 1-Waters 484 1-Kratos 980 1-Waters 490E 1-Waters 470		1-Waters 712 1-Waters 470		
1	Alpha/Beta Counter					1-Tennelec LB 5100	
2	Radon Flask Counter/Scaler					2-Ludlum Measurements 182/2000	

TABLE 9.1

MAJOR LABORATORY INSTRUMENTS AT EACH SAVANNAH LABORATORIES LOCATION

#	Instrument	Deerfield Beach	Tallahassee	Savannah	Mobile	Tampa Bay	New Orleans
10	BOD Incubator	2-Westinghouse 16.8	1-Precision 815	1-Lab Line 2-Precision Lo-Temp	1-Fisher Isotemp 1-Precision Lo-Temp	1-Fisher 307	1-Fisher 307
31	Drying Oven	4-Fisher Isotemp 500 1-Tempcon	2-VWR 1305 U 1-Fisher Isotemp 500 3-Blue M 1-Fisher Isotemp 655G 2-Tempcon	4-Fisher Isotemp 500 1-Tempcon N8620-1	3-Blue M 1-Precision Scientific 2-Fisher Isotemp	3-VWR 1305U	3-VWR 1305U
10	Block Digestor	2-Hach	1-Thermolyne Dri-Bath	2-Technicon BD-40 1-Thermolyne Dri-Bath 1-Lab Line Multiblank 2093	1-Techni: Dri-Block DB-3H 1-Lachat BD-46	1-Thermolyne	
6	TCLP (nonvolatile)	Custom	Custom	2-Custom	Custom	Custom	Custom
3	TCLP (ZHE)		1-ATCS ZHE	2-ATCS ZHE	1-ATCS ZHE		
3	Ignitability Apparatus (Pensky-Martens)	1-Kochler	1-Koehler K-16200	1-Koehler K-162	1-Koehler K-162		
3	Gel Permeation Chromatograph		2-ABC SP 1000	1-Benchmate GPC			
13	Sample Concentrator	2-Zymark TurboVapII	2-Zymark TurboVapII	4-Zymark TurboVapII	2-Zymark TurboVapII	2-Zymark TurboVapII	1-Zymark TurboVapII

TABLE 9.2

MAJOR FIELD INSTRUMENTS AT EACH SAVANNAH LABORATORIES LOCATION

#	Instrument	Deerfield Beach	Tallahassee	Savannah	Mobile	Tampa Bay	New Orleans
5	pH/SC/DO/T ⁺ Meters	1-Corning Checkmate 90	1-Corning Checkmate 90	1-Corning Checkmate 90		1-Corning Checkmate 90	1-Corning Checkmate 90
5	pH/Temp Meters		1-Orion 23A	1-Orion SA-230	1-Orion 23A	1-Orion 23A	1-Orion 23A
4	Conductivity/Salinity Meters	1 YSI 33	1-YSI 33	1-YSI 33	1-YSI 33		
3	DO Meters		1-YSI 51B	1-YSI 51B	1-YSI 50B		
2	Turbidimeters		1-Hach 16800	1-DRI 15C			
2	Water Level Meters		1-Slope 51453	1-Fisher			

TABLE 9.3

STANDARD SOURCE AND PREPARATION FOR LABORATORY INSTRUMENTATION

Instrument Group	Standard Source	How Received	Source Storage	Preparation From Source	Lab Stock Storage	Prep Frequency
ICP	Baker/Spex	Stock 1,000 or 10,000 ppm solutions	Room temp	Working std prepped directly from stock	Room temp	Monthly or as needed
AA	Baker/Spex	Stock 1,000 ppm solutions	Room temp	Intermediate stds prepped from stocks. Working stds prepped from intermediates.	Room temp Room temp	Daily Daily
Autoanalyzer	Fisher Baker	Neat material	Room temp	Stock stds prepped from solids. Intermediate stds from stocks. Working stds from intermediates.	Refrigerator Used immediately Used immediately	Monthly Daily or as needed Daily or as needed
Ion Chromatograph	Fisher Baker Mallinckrodt	Neat material	Room temp	Stock stds prepped from solids. Intermediate stds from stocks. Working stds from intermediates.	Refrigerator Used immediately Used immediately	Monthly Daily or as needed Daily or as needed
UV-VIS Spectrophotometer	Fisher Baker EM	Neat Material	Room temp	Stock stds prepped from solids. Intermediate stds from stocks. Working stds from intermediates.	Refrigerator Used immediately Used immediately	Monthly Daily or as needed Daily or as needed
IR Spectrophotometer	Fisher	Neat liquids	Room temp	Stock std prepped from neat liquid. Working stds from stock.	Refrigerator Refrigerator	Monthly Monthly
Turbidimeter	Hach	Standard 4000 ppm formazin solution	Refrigerator	Working stds prepped from stock.	Used immediately	As needed to check Gelex stds

TABLE 9.3

STANDARD SOURCE AND PREPARATION FOR LABORATORY INSTRUMENTATION

Instrument Group	Standard Source	How Received	Source Storage	Preparation From Source	Lab Stock Storage	Prep Frequency
Conductivity Meter	YSI or Fisher	Standard solution or neat KCl	Room temp	Used as is or prepare from neat.	Room temperature	As needed
TOC	Mallinckrodt	Neat KHP	Room temp	Stock std from solid Working std from stock.	Refrigerator Refrigerator	Monthly Monthly
pH Meter	Fisher	Calibration buffer solutions	Room temp	Used as is.	----	----
ISE	Baker	Neat material	Room temp	Stock std from source. Intermediate std from stock. Working std from intermediate.	Refrigerator Refrigerator Used immediately	Monthly Monthly or as needed As needed
TOX	Fisher	Neat material	Room temp	Std from source.	Room temp	Monthly
Bomb Calorimeter	Parr	Neat tablets	Room temp	Used as is.	----	----
Gas Chromatographs and GC/MS (Volatiles)	Supelco, Ultra, Accustandard, ChemService, Baxter, Aldrich, Restek	Neat Solutions (50-5000 ppm)	Freezer	Stock stds. from neat sources. Intermediate stds from stocks. Working standards from intermediates and/or purchased solutions.	Freezer Freezer Freezer	Annually or as noted by manufacturer expiration date. Semiannually -- (2 months or sooner for gases, styrene, 2-chloroethylvinyl ether) Weekly
Gas Chromatographs and GC/MS (Semivolatiles)	Supelco, Restek, ChemService, Crescent Chemical, Aldrich, Ultra	Neat Solutions (50-10000 ppm)	Refrigerator	Stock stds from neat sources. Intermediate stds from stocks. Working standards from intermediates.	Refrigerator or freezer Refrigerator or freezer Refrigerator or freezer	Semi-annually or annually as required Semi-annually or annually as required Semiannually or as needed

TABLE 9.3

STANDARD SOURCE AND PREPARATION FOR LABORATORY INSTRUMENTATION

Instrument Group	Standard Source	How Received	Source Storage	Preparation From Source	Lab Stock Storage	Prep Frequency
High Performance Liquid Chromatographs	ChemService, Crescent Chemical, Supelco	Neat Solutions > 1000 ppm	Refrigerator	Stock stds from neat sources.	Refrigerator	Semi-annually
				Intermediate stds from stocks and/or purchased solutions.	Refrigerator	Monthly
				Working standards from intermediates.	Refrigerator	Weekly
Gas Proportional Counter (alpha/beta)	EPA NIST	Sealed Source Stock Soln.	Room temp Metal case Room temp Foil-lined cabinet	Used as is. Working std, prepped from stock.	-- Room temp Foil-lined cabinet	-- As needed
Radon Flask Counter	EPA NIST	Sealed Source Stock Soln.	Room temp Foil-lined cabinet Room temp Foil-lined cabinet	Used as is. Working std, prepped from stock.	-- Room temp Foil-lined cabinet	-- As needed

TABLE 9.4

STANDARDIZATION OF TITRATING SOLUTIONS

Analysis	Solution Requiring Standardization	Standard Identity	Standard Source	Frequency of Standardization
Acidity	Sodium Hydroxide (0.02 N)	KHP	Mallinckrodt	With each batch
Alkalinity	Sulfuric acid	Na ₂ CO ₃	Mallinckrodt	With each batch (or purchased certified)
COD	Ferrous ammonium sulfate	K ₂ Cr ₂ O ₇	Mallinckrodt	With each batch
Chloride	Silver nitrate	NaCl	Baker	With each batch (or purchased certified)
Sulfide	Sulfide working standard	I ₂ /Na ₂ S ₂ O ₃	VWR/Baker	Weekly
TOC (Soil)	Ferrous sulfate	K ₂ Cr ₂ O ₇	VWR/Baker	With each batch

9.4.1 Metals

ICP

The inductively coupled plasma atomic emission spectrophotometer is standardized daily with single concentration standard solution containing metals of interest and a blank. Multipoint calibrations are performed at least annually with a minimum of three standards and a blank encompassing the concentration range of interest. The calibration curve is maintained to verify the linearity of each metal over the standardization range. After standardization, the standardization standards are reanalyzed and must agree with $\pm 5\%$ of the true value. Initial calibration verification (ICV) standards are analyzed and must agree within $\pm 10\%$ of true value. To verify low-level linearity, a standard at the quantitation limit is analyzed and must meet established control limits. This is followed by interference check standards A and AB which must be within $\pm 20\%$ of true values. Continuing calibration verification (CCV) standards are run after every 10 samples and sample data must be bracketed by calibration verification standards that are $\pm 10\%$ of true values in order for data to be acceptable. For method 200.7, ICV/CCV standards must be within $\pm 5\%$ of true values in order for bracketed data to be acceptable. Duplicate lab control standards are digested and analyzed with each batch of samples to determine accuracy and precision, and must be recovered within established control limits for batch data to be acceptable.

AA

Atomic absorption spectrophotometers are calibrated daily with a minimum of three standards and a blank. An ICV standard is analyzed immediately upon calibration, and must meet accuracy criteria of 90-110%. CCV standards are analyzed after every 10 samples and must be recovered within 80-120% for bracketed data to be acceptable. Lab control standards (digested standards) are analyzed in duplicate for every batch of 20 samples and must be recovered established control limits for batch data to be acceptable.

9.4.2 General Chemistry

Autoanalyzer

The autoanalyzer is calibrated daily with a minimum of five standards. The calibration curve is established by linear regression and the correlation coefficient must be ≥ 0.995 . Independent calibration verification standards are analyzed immediately following the calibration standards, after every 10 samples, and at the end of each run. Data must be bracketed by calibration verification standards that meet control criteria to be acceptable.

Ion Chromatograph

For initial validation of the method and to determine linearity of the calibration curve, three to five standards are analyzed. Either linear regression or quadratic curve fitting is used, depending on analyte. The linear regression correlation coefficient must be ≥ 0.995 for any analyte

to be considered as giving a linear response. After initial validation, for linear analytes, the instrument is standardized daily with a single point standard. Calibration verification standards are analyzed immediately upon calibration, after every 10 samples, and at the end of each run. Data must be bracketed by calibration verification standards that meet control criteria to be acceptable.

UV-VIS Spectrophotometer

The spectrophotometer is calibrated daily with a minimum of five standards. The calibration curve is established by linear regression and the correlation coefficient must be ≥ 0.995 . Calibration verification standards are analyzed immediately following the calibration standards, after every 10 samples, and at the end of each run. Data must be bracketed by calibration verification standards that meet control criteria to be acceptable.

IR Spectrophotometer

The infrared spectrophotometer is calibrated daily with a minimum of five standards. The calibration curve is established by linear regression, and the correlation coefficient must be > 0.995 . A calibration verification standard is analyzed immediately upon calibration, after every 10 samples, and at the end of each run. Data must be bracketed by calibration verification standards that meet control criteria to be acceptable.

Turbidimeter

Gelex solid standards are calibrated against formazin standards initially and then quarterly. The instrument is calibrated daily with one Gelex standard for each range of interest. A mid-range calibration verification standard is analyzed for every 10 samples and must meet control criteria in order for bracketed data to be acceptable.

Conductivity Meter

The cell constant of each meter is determined at a minimum annually by the analysis of five KCl standards. To verify the cell constant, a verification standard is analyzed at the beginning of each working day, using a KCl standard in the expected range of the samples. For meters not having automatic temperature compensation, all samples are analyzed at $25^{\circ} \text{C} \pm 2^{\circ} \text{C}$.

pH Meter

The pH meter is calibrated daily with two standard buffers at pH 7.0 and either 4.0 or 10.0, and checked with a third buffer at 10.0 or 4.0 which must indicate ± 0.10 pH units of its given value. A calibration verification standard is analyzed immediately upon calibration and after every 10 samples. The calibration verification standard must meet control criteria in order for bracketed data to be acceptable. Manual or automatic temperature compensation is performed, depending on the meter. Additional checks of the pH meter may be performed with buffers other than 4 or 10 if samples are outside the pH range of 4-10.

TOC

A single point standard is used to calibrate the instrument daily. A calibration verification standard is analyzed immediately upon calibration, after 10 samples, and at the end of each run. Data must be bracketed by calibration verification standards that meet control criteria to be acceptable.

ISE

Ion selective electrodes are calibrated daily with a minimum of five standards. The calibration curve is established by linear regression applied to the log of the standard concentrations versus potential and must result in a correlation coefficient ≥ 0.995 . Calibration verification standards are analyzed immediately upon calibration, after every 10 samples, and at the end of each run. Data must be bracketed by calibration standards that meet control criteria to be acceptable.

TOX

Although the TOX instrument provides an "absolute" measurement, and is not subject to calibration, a check standard is analyzed daily immediately after the blank, and must meet control criteria in order for data to be acceptable.

Bomb Calorimeter

The energy equivalent of the bomb calorimeter is determined quarterly by bombing six standard benzoic acid tablets. A control standard is analyzed in duplicate for every batch of samples, and must meet control criteria in order for data to be acceptable.

DO Meter

DO meters are calibrated prior to use either by Winkler titration or the air calibration technique, and annually by Winkler titration.

Temperature

All laboratory and field thermometers are calibrated annually by comparison with a NIST-certified thermometer. Field meters with automated temperature compensation are checked before use with a calibrated thermometer.

9.4.3 Gas Chromatographs

Volatiles

Initial calibration is performed upon instrument startup and whenever continuing calibration fails the acceptance criteria. A five-point standard curve is prepared using all target compounds. The low standard concentration is near the PQL, and the high standard defines the usable linear range of the detector. After the five standards are purged and analyzed, a calibration curve is generated using internal standard

methodology. If the internal standard exhibits matrix interference in sample, external standard methodology may be used; however, an internal standard is preferred for purge-and-trap methods. Ideally, all volatile compounds should exhibit enough linearity to use a straight line fit forced through the origin. However, some compounds may exhibit true non-linearity but consistent performance using a quadratic fit. A quadratic fit curve may be used. The analyst should visually inspect the curves before proceeding with sample analysis.

An alternative to quantitation from a calibration curve is quantitation from an average response factor (RF). This is an acceptable technique for all SW-846 8000-series methods, all 40 CFR 136 600-series methods, and all 500-series drinking water methods. For the 8000-series methods, if the % RSD is < 20%, the average RF may be used. For the 500- and 600-series methods, if the % RSD is < 10%, the average RF may be used. Quantitation from the curve is preferred.

Continuing calibration check (CCC) standards are analyzed at the intervals specified in the methods. The CCC standard concentration is normally the mid-point of the five-point calibration curve, and must be at the level specified in the method "Q-tables" for the 600- and 8000-series methods. The 500- and 600-series methods specify a mid-level CCC at the beginning of each working day. The 8000-series methods specify a mid-level standard at the beginning of each working day and after every ten samples thereafter if needed for further sample analyses. The acceptance criteria for the 600- and 8000-series methods for volatiles are listed in each method's "Q-table." The analyzed value of each standard component must fall within the range of values given in the table. For compounds not present on the Q-table, the analyzed value must fall within 15% of the true value, or the laboratory may generate internal acceptance ranges based on a minimum of thirty data points. The acceptance limits for the 500-series methods are $\pm 20\%$ of the true value.

If the CCC standard fails acceptance criteria, another CCC standard may be analyzed. If the second standard also fails, the initial calibration must be repeated.

2-Chloroethyl vinyl ether exhibits erratic chromatographic behavior. The Supelco, Inc. Purgeable A Mixture footnotes 2-chloroethyl vinyl ether with the following: "Due to instability of 2-chloroethyl vinyl ether, we cannot guarantee the concentration of this component." These problems with 2-chloroethyl vinyl ether impact the ability of SL to consistently analyze for this compound within the method requirements or PQL. If the requirements or PQL cannot be met for 2-chloroethyl vinyl ether, the appropriate flag should accompany the data for this compound in the report.

Single-point calibrations are used for method 504 as specified in the method.

Semivolatiles/Pesticides/Herbicides

Initial calibration is performed upon instrument startup and whenever a CCC standard fails the acceptance criteria. A five-point standard curve

is prepared using all target compounds. The low standard concentration is near but above the MDL and the high standard defines the usable linear range of the detector.

After the five standards are injected, the computer software generates a calibration curve using either internal standard or external standard methodology. The analyst chooses the best fit type for each compound, either linear or quadratic. The analyst should inspect the curves before proceeding with sample analysis. An alternative to quantitation from a calibration curve is quantitation from an average response factor as long as the minimum %RSD criterion is met. The %RSD criteria are as follows:

1. < 10% for 600-series methods.
2. < 20% for 8000-series methods.
3. ≤ 20% for 500-series methods, except Method 504 must be < 20%.

CCC standards are analyzed at the intervals specified in the methods. The 8000-series methods specify a CCC standard at the beginning of each working day and after every 10 samples thereafter if needed for further sample analyses. The 600-series methods specify a CCC standard at the beginning of each working day. The 8000- and 600-series methods CCC standard acceptance criteria are ± 15% difference from the true value. The 500-series methods specify a CCC standard at the beginning of each work day. An additional CCC standard, different in concentration from the initial standard, must be run at the end of the work day when using the external standard calibration technique for methods 507, 508, and 515.1. The acceptance criteria for these CCC standards is ± 20% difference from the true value. The 500-series methods allow a single point calibration as an alternative as long as the response produced by an unknown in the sample extract is ± 20% of the standard response.

If the CCC standard fails acceptance criteria, another CCC standard may be analyzed. If the second standard also fails, the initial calibration must be repeated.

The above calibration procedures meet or exceed EPA method requirements.

The CLP protocol differs from the other EPA methodologies. Calibration curves with a minimum of three points are kept on record at the lab. The CLP statements of work are followed as written.

9.4.4 GC/Mass Spectrometer

Hardware tuning is performed on each GC/MS prior to calibration as specified in the applicable EPA methods. Ion abundance acceptance criteria for semivolatile GC/MS tuning with DFTPP and volatile tuning with BFB are given below. Mass calibration is performed as an integral part of tuning. Tuning is performed at the beginning of each 12-hour clock for each GC/MS in accordance with EPA methods.

SEMIVOLATILE ORGANIC GC/MS TUNING AND MASS CALIBRATION (DFTPP)	
m/e	Ion Abundance Criteria
51	30-60% of mass 198
68	< 2% of mass 69
70	< 2% of mass 69
127	40-60% of mass 198
197	< 1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	> 1% of mass 198
441	Present but less than mass 443
442	> 40% of mass 198
443	17-23% of mass 442

VOLATILE ORGANIC GC/MS TUNING AND MASS CALIBRATION BROMOFLUOROBENZENE (BFB)	
m/e	Ion Abundance Criteria
50	15.0 - 40.0% of mass 95
75	30.0 - 60.0% of mass 95
95	Base peak, 100% relative abundance
96	5.0 - 9.0% of mass 95
173	Less than 2.0% of mass 174
174	Greater than 50.0% of mass 95
175	5.0 - 9.0% of mass 174
176	Greater than 95.0 %, but less than 101.0% of mass 174
177	5.0 - 9.0% of mass 176

Initial calibration is performed at instrument startup and whenever a CCC standard fails acceptance criteria. A five-point standard curve is prepared containing all target compounds. Concentrations are those defined by CLP, which are also appropriate for other EPA methodology.

Response factors are generated for each compound. The acceptance criteria used to assess the calibration are those specified in SW-846 for the 600- and 8000-series methods and in the various CLP SOWs for CLP analyses. These are as follows:

Semivolatiles		
	Initial Calibration	Continuing Calibration Check
625 and 8270	< 30% RSD for CCCs	≤ 30% difference for CCCs
Semivolatile CLP 2/88 SOW	< 30% RSD for CCCs	≤ 25% difference for CCCs
625, 8270, CLP 2/88 SOW	≥ 0.050 SPCCs	≥ 0.050 for SPCCs
CLP 3/90 SOW	As specified in 6/91 Revision of Method (OLM01.6)	
525	≤ 30% RSD or alternatively generate linear, 2nd order, or 3rd order calibration curve	≤ 30% difference or alternatively (using analyst discretion), all analytes fall on the curve from the initial calibration

Volatiles		
	Initial Calibration	Continuing Calibration Check
624	< 30% RSD for CCCs	20 ug/L standard meets limits specified in Q Table
8240 + CLP 2/88 SOW	< 30% RSD for CCCs	≤ 25% difference for CCCs
624, 8240, CLP 2/88 SOW	≥ 0.300 for SPCCs (except Bromoform ≥ 0.250)	≥ 0.300 for SPCCs (except Bromoform ≥ 0.250)
CLP 3/90 SOW	As specified in 6/91 Revision of Method (OLM01.6)	
524.2	≤ 20% RSD or alternatively generate linear, 2nd or 3rd order curve	± 30% difference or alternatively) using analyst discretion), all analytes must fall on the curve from the initial calibration

CCC standards are analyzed at the intervals specified in the methods. These intervals are as follows:

1. 500-series -- every 8 hours
2. 600-series -- every working day
3. CLP & 8000-series -- every 12 hours.

If the CCC standard fails acceptance criteria, another CCC standard may be analyzed. If the second standard also fails, the initial calibration must be repeated.

Sample quantitation is based on the average RF or curve (when RTE data systems are not available) from the initial calibration for 500-, 600-, and 8000-series methods and the single point RF from the continuing calibration standard for CLP.

Hexachlorophene exhibits very poor chromatographic behavior within the limits of the working calibration range. If this compound is not detected, ND (not detected) will be reported rather than a detection limit.

2-Chloroethyl vinyl ether exhibits erratic chromatographic behavior. The Supelco, Inc. Purgeable A Mixture footnotes 2-chloroethyl vinyl ether with the following: "Due to instability of 2-chloroethyl vinyl ether, we cannot guarantee the concentration of this component." These problems with 2-chloroethyl vinyl ether impact the ability of SL to consistently

analyze for this compound within the method requirements or PQL. If the requirements or PQL cannot be met for 2-chloroethyl vinyl ether, the appropriate flag should accompany the data for this compound in the report.

9.4.5 High Performance Liquid Chromatographs

Initial calibration is performed at instrument startup, following instrument maintenance or change in conditions, and whenever CCC fails acceptance criteria.

A three-point curve is prepared for 500- and 600-series methods. Five points are used for 8000-series methods. The low standard is near the PQL and the high standard defines the usable linear range of the detector.

After the three or five calibration standards are analyzed, a calibration curve is generated by the instrument computer, using external standard methodology. Where data system capabilities are limited, response factors are generated. RSD criteria of 10% for the 600-series methods and 20% for the 500- and 8000-series methods are applied. If the maximum RSD criteria are met, the average RF is used for quantitation.

A CCC using a mid-level standard is performed at the beginning of each working day and after every ten samples or as required by the method. Acceptance criteria are $\leq 10\%$ difference from the true value or average RF for the 600-series methods, $\leq 20\%$ D for the 500-series methods, and $\leq 15\%$ D for the 8000-series methods.

If the CCC standard fails acceptance criteria, another CCC standard may be analyzed. If the second standard also fails, the initial calibration must be repeated.

9.4.6 Gas Flow Proportional Counter

Initial calibration is performed at instrument start up, following instrument maintenance or a change in quench gas. Counting voltage is set utilizing a sealed beta source by increasing the voltage through the detector until the beta plateau region is determined. The amount of cross-talk into the alpha channel is then minimized and the beta count maximized utilizing the discriminator. Counting efficiencies are then established utilizing the (relatively) pure beta and alpha source standards. These standards are analyzed daily, and recalibration is required if their activity count varies 5% or more.

Self-absorption curves are generated at a frequency of once every three months, and the results are plotted on a cumulative scatter plot curve. Values for self-absorption are then taken from the best fit curve generated from this plot and applied to all sample result calculations. Duplicate laboratory control samples are analyzed with each batch of 20 samples to determine accuracy and precision. Additionally, a matrix spike and matrix spike duplicate or sample duplicate are analyzed with each batch of samples. Instrument background counts are also performed daily for use in all sample result calculations for that day.

Radon Flask Counter

Initial calibration is performed at instrument start up or following instrument maintenance. The alpha plateau region is initially determined utilizing a sealed source alpha emitter. Each radon flask is then evacuated, filled with helium at atmospheric pressure, and background counted. Their individual efficiencies are then determined utilizing a standard of known activity. The sealed source alpha emitter is counted daily, and recalibration is required if its activity varies by 10% or more.

Duplicate laboratory control samples are analyzed with each batch of 20 samples to determine accuracy and precision. Additionally, a matrix spike and matrix spike duplicate or sample duplicate are analyzed with each batch of samples.

9.5 Low Level Calibration Check for Florida Samples

For all projects which require Florida DEP QAS criteria, an additional continuing calibration check standard at a level near the PQL (usually lowest level standard) is analyzed. This check standard is used to ascertain that the PQL can be reached.

9.6 Field Instrument Calibration

Calibration of field instrumentation (conductivity/salinity meters, pH meters, DO meters, and turbidimeters) is performed in the field prior to use, in accordance with the DEP *Calibration Procedures and Frequency SOP*, Section 7.5, revised September, 1992. All calibration data are documented in a bound field notebook.

9.7 Calibration Documentation

All calibration records including raw data, response factors, standard concentrations, curves, reduced data, and instrument settings or conditions are stored and archived according to laboratory standard operating procedures. Current chromatograms, curves, and results transcribed onto forms are kept at the analysts' workstations and periodically archived into a data storage area. Initial and continuing calibrations are stored by date for ease of location. All standard ID numbers appear on graphs, plots, chromatograms, or curves for traceability purposes.

10.0 PREVENTIVE MAINTENANCE

10.1 Maintenance Schedule

All Savannah Laboratories facilities are equipped with up-to-date computerized instrumentation. In order to gain maximum performance and minimize downtime, regular inspection, maintenance, cleaning, and servicing of all laboratory and field equipment is performed according to the manufacturers' recommendations. A maintenance log is kept for each piece of laboratory and field instrumentation, detailing any malfunction and the steps taken to correct the problem. Routine repairs and maintenance are performed and documented by the analyst responsible for the particular instrument. Non-routine maintenance is signed and dated by the analyst or repair technician. Routine maintenance procedures for laboratory instrumentation are given in Table 10.1. The frequencies of routine maintenance procedures for Savannah Laboratories' field instrumentation are given in Table 10.2.

Maintenance contracts are carried for most instrumentation, and close contact is maintained with service personnel to provide optimum instrument functioning.

An extensive spare parts inventory is maintained for routine repairs at the facilities, consisting of GC detectors, AA lamps, fuses, printer heads, flow cells, tubing, certain circuit boards and other common instrumentation components. Since instrumentation is standardized throughout the laboratory network, spare parts and components can be exchanged among the labs.

Equipment such as refrigerators, ovens, and incubators are periodically checked with calibrated thermometers. Refrigerators and incubators are checked at least daily and the temperatures documented in a notebook. Sample storage refrigerators must be $4 \pm 2^{\circ}$ C. All thermometers are calibrated annually against an NIST-certified thermometer.

Electronic analytical balances are calibrated daily with internal mechanisms if available. Calibration checks are performed and documented on all balances at least weekly with Class S weights and must meet the criteria given in Table 10.3. The HAZWRAP program requires checking each balance daily with at least one weight.

10.2 Contingency Plan

In general, each facility has at least one backup unit for each critical unit. In the event of instrument failure, portions of the sample load may be diverted to duplicate instrumentation within each facility, the analytical technique switched to an alternate approved technique (such as manual colorimetric determination as opposed to automated colorimetric determination), or samples shipped to another properly certified or approved Savannah Laboratories location (where identical SOPs, QA procedures and instruments are utilized). When shipping samples to another facility, interdivisional chain-of-custody procedures are followed as given in Section 7.

TABLE 10.1

LABORATORY EQUIPMENT PREVENTIVE MAINTENANCE SCHEDULE

EQUIPMENT ITEM	Service Interval					SERVICE LEVEL
	D	W	M	Q	A	
ICAP						
Profile	X					Profile on a daily basis.
Nebulizer	X					Inspect and clean. Replace tubing daily. Check flow rate.
Filters		X				Inspect and clean.
Spray Chamber			X			Inspect and clean.
Quartz Torch			X			Clean and realign.
D-Shaped Mirrors				X		Inspect mirror surface and replace if necessary.
SMITH-BIEFTJE FURNACE AA SPECTROPHOTOMETER						
Sapphire Window	X					Remove and clean with n-propanol.
Flow Rate	X					Place 10 mL DI water in a 10-mL cylinder. Push Neb. Air button and run one minute. Flow should be 2.0 to 2.5 mL.
Graphite Tube	X					Replace if necessary and condition before use.
Quartz Windows	X					Clean window with lint-free cloth and distilled water.
Contact Rings and Plates				X		Replace contact rings if they are worn.
Filters		X				Remove filter from instrument, clean with water and mild soap.
ZEEMAN FURNACE AA SPECTROPHOTOMETER						
Check sampler syringe for air	X					Flush syringe if necessary.
Graphite Tubes	X					Replace if necessary and condition before use.
Graphite Electrodes				X		Replace contact rings if they are worn.
Quartz Windows	X					Remove and clean with lint-free cloth and DI water and/or alcohol.
CONTINUUM FURNACE AA SPECTROPHOTOMETER						
Quartz Windows	X					Remove and clean with lint-free cloth and DI water.
Graphite Tubes	X					Replace if necessary and condition before use.
Contact Rings and Plates				X		Replace contact rings if they are worn.
Filters		X				Remove filter from instrument, clean with water and mild soap.
D2 Arc Lamp				X		Check lamp. Adjust or replace as necessary.
TURBIDIMETER						
			X			Focus optics.
CONDUCTIVITY METER						
				X		Inspect and replatinize cell as necessary.

TABLE 10.1

LABORATORY EQUIPMENT PREVENTIVE MAINTENANCE SCHEDULE

EQUIPMENT ITEM	Service Interval					SERVICE LEVEL
	D	W	M	Q	A	
pH METER	X					Inspect probe membrane, filling solution level.
DRYING OVEN	X					Verify correct temperature with calibrated thermometer.
ANALYTICAL BALANCE		X				Check calibration with class S standard metric weights. Annual inspection.
TOP LOADER BALANCE		X				Check calibration with class S standard metric weights. Annual inspection.
ION CHROMATOGRAPH						
AS3 Column				X		Inspect quarterly or as required.
AS3 Guard Column				X		Inspect quarterly or as required.
Pump Pistons					X	Inspect annually.
AUTOANALYZER						
Pump Platen		X				Inspect weekly and replace as required.
Pump Tubes	X					Inspect and replace as needed.
Flow Cell		X				Inspect and clean.
BLOCK DIGESTOR				X		Check calibration against thermometer.
UV/VIS SPECTROPHOTOMETER					X	Semiannual check for wavelength verification.
IR SPECTROPHOTOMETER		X				Inspect and clean exposed optics weekly, if necessary.
ION SELECTIVE ELECTRODE			X			Inspect and polish electrode.
BOMB CALORIMETER		X				Inspect seals, replace if necessary.
DISSOLVED OXYGEN METER	X					Check probe membrane for deterioration. Replace as necessary.
BOD INCUBATOR	X					Temperature checked twice daily.
BACTERIOLOGICAL INCUBATOR	X					Temperature checked twice daily.
AUTOCLAVE		X				Seals inspected and replaced as necessary.
WATERBATH	X					Temperature checked twice daily.
TCLP EQUIPMENT				X		Check rotation rate quarterly.
GAS CHROMATOGRAPH - SEMIVOLATILES						
Autosampler System	X					Check daily for correct operation. Syringe and tubing solvent cleaned daily. Needles and tubing replaced as needed.
Septa	X					Replace autosampler septa daily and injector as needed.
GC Columns (Packed)		X				Change glass wool plugs at front of column.
GC Capillary Columns	X					Inspect daily. Change glass sleeve insert as needed and cut front of column if necessary.

TABLE 10.1

LABORATORY EQUIPMENT PREVENTIVE MAINTENANCE SCHEDULE

EQUIPMENT ITEM	Service Interval					SERVICE LEVEL
	D	W	M	Q	A	
ECD					X	Semiannually cleaned and leak tested by service technician.
FID					X	In-house cleaning as needed.
Carrier Gases		X				Tanks are changed when pressure reads 500 to ensure purity.
Oxygen Trap				X		Inspect and replace as necessary.
GAS CHROMATOGRAPH - VOC						
Column	X					Checked daily. Repack glass wool and replace column as needed.
Septum	X					Checked daily. Replace as necessary.
Gas Tank	X					Levels checked daily. Replace when pressure < 500 psi.
Oxygen/Moisture Trap				X		Inspect and replace as necessary.
Particulate Trap					X	Checked and replaced if problem in GC flow rate.
Hall Detector	X					Checked daily for proper operation and response.
FID	X					Checked daily for proper operation and response.
PID	X					Checked daily for proper operation and response.
GC/MS						
Column	X					Front portion of column checked/maintained daily for contamination; replace every 1 month or as needed.
Septum	X					Changed daily.
Injection Port Liner	X					Changed daily.
Splitless Disc	X					Changed daily.
Autosampler	X					Checked daily for proper function.
Rough Pump				X		Oil changed to ensure proper operation.
Turbo Pump				X		Turbo molecular pump oiled as needed by instrument service representative.
Mass Spectrometer				X		Cleaning of source every 1 month or as needed.
Tape Head					X	Cleaned after each tape.
Tape Drive					X	Cleaned annually.
PURGE AND TRAP						
Sorbent Trap	X					Checked daily. Replace and condition as necessary.
Purge Flow	X					Checked daily, adjust as needed.
Gas Tank	X					Check daily.

TABLE 10.1

LABORATORY EQUIPMENT PREVENTIVE MAINTENANCE SCHEDULE

EQUIPMENT ITEM	Service Interval					SERVICE LEVEL
	D	W	M	Q	A	
TOC ANALYZER						
Pump Tubes		X				Inspect and replace if necessary.
Flow rate			X			Check and adjust if necessary.
Detector Windows					X	Check and clean if necessary.
TOX ANALYZER						
Pyrolysis Tube		X				Inspect and clean or replace if necessary.
Electrodes		X				Inspect and clean if necessary.
Electrolyte	X					Replace as necessary.
HPLC SYSTEMS						
Pumps	X					Filter all solvents, water, and extracts if pressure buildup occurs. Visual leak check. Prime pumps at startup.
Pumps				X		Inspect seals, replace as needed.
Columns	X					Check for pressure buildup; store with ends capped in appropriate mobile phase. Visual leak check.
Detector Fittings	X					Visual leak check.
Detector Optics	X					Inspect removable filters for dust, fingerprints. Clean as needed.
Detector Optics					X	Replace lamps as needed.
Autosampler	X					Checked daily for proper operation. Clean, lubricate moving parts as needed.
Gases for sparging and autosampler operation		X				Change tanks when pressure reads 500 psi.
TENNELEC LB5100						
Sample Changer				X		Inspect moving parts, lubricate as needed.
Detector	X					Checked daily for proper operation and response. Serviced by manufacturer only.
Detector gas			X			Change tank when pressure reads 500 psi. Allow new tanks to dissipate radon for two weeks before use.
Flow Meter	X					Checked daily for proper operation.
LUDDLUM MEASUREMENTS 2000	X					Checked daily for proper operation. Serviced by manufacturer only.
LUDDLUM MEASUREMENTS 182	X					Check push rod for high voltage engagement daily. Check instrument noise level without flask daily.

TABLE 10.2

FIELD EQUIPMENT PREVENTIVE MAINTENANCE SCHEDULE

EQUIPMENT ITEM	Service Interval					SERVICE LEVEL
	D	W	M	Q	A	
TURBIDIMETER HACH 16800/DRT-15C	X					Inspect and replace cell as needed.
CONDUCTANCE METER YSI 33				X		Inspect and replatinize cell as necessary.
FISHER AND ORION pH METERS	X					Inspect probe membrane, filling solution level.
YSI MODEL 50B/51B DISSOLVED OXYGEN METER	X					Check probe membrane for deterioration. Replace as necessary.
CORNING CHECKMATE 90 pH/SC/DO/T° METER	X					Check probe, cell, membrane.
FISHER/SLOPE WATER LEVEL METERS	X					Check probe cord for integrity/cleanliness, meter for response.

TABLE 10.3

BALANCE CALIBRATION CHECKS

Analytical Balance

Class S Weight	Tolerance
0.01 g	± 0.0002 g
0.1 g	± 0.0002 g
0.5 g	± 0.0004 g
1 g	± 0.0004 g
10 g	± 0.0005 g
50 g	± 0.0010 g

Top-Loading Balance

Class S Weight	Tolerance
0.1 g	± 0.02 g
0.5 g	± 0.02 g
1 g	± 0.04 g
5 g	± 0.04 g
10 g	± 0.05 g
50 g	± 0.10 g

11.0 QUALITY CONTROL CHECKS AND ROUTINES TO ASSESS PRECISION AND ACCURACY AND CALCULATIONS OF METHOD DETECTION LIMITS

The key to a successful QA/QC program is strict adherence to the program during all phases of the project, including: presampling discussions; sample collection, preservation, storage and analyses; and validation and reporting of results. Field and laboratory quality control checks are part of each sampling trip and laboratory analysis and meet or exceed all FL DEP requirements. Without the proper quality control procedures, analyst and method performance cannot be measured.

11.1 Field QC Checks

Savannah Laboratories recommends to their clients that proper control procedures meet or exceed the appropriate regulatory agency field QC requirements. If particular field method or project-specific quality assurance plan (QAPjP) QC requirements are more stringent than the general procedures given below, the method QC or QAPjP requirements are followed.

Blanks which are collected in the field are an important link in the quality control data chain for a set of samples. The analytical data derived from these blanks are necessary to assess field sampling operations. These blanks are used to verify that sample containers, preserving reagents and equipment are contaminant-free. Blanks are also used as a check for potential on-site environmental contamination, to evaluate personnel expertise in sample collection and to reveal problems that may occur in sample storage and transport.

The field quality control blanks should not be isolated from actual samples. They must be considered as samples and treated identically (preserved with the same reagents, stored and transported in the same containers as the samples, etc.).

The types and frequency of blanks must be included in all quality assurance plans. In cases where data quality objectives dictate more stringent controls, additional field quality control blanks may be required. The following protocol outlines the minimum field blank requirements necessary to assure the validity and integrity of any sampling episode.

If the client requires or submits field QC check samples, these will be analyzed per client's instructions and invoiced as samples. Since field QC check samples are usually liquids, they are prepared and analyzed by liquid procedures and reported as liquids. Unless requested by clients or required by a project specific QA plan, lab QC deliverables are not provided for field QC check samples.

11.1.1 Trip Blanks

PURPOSE: The trip blank is to be used when sampling for volatile organics and other sensitive parameters. The purpose is to determine if contamination has occurred as a result of improper sample container

cleaning, contaminated blank source water, sample contamination during storage and transportation due to exposure to volatile organics (e.g., gasoline fumes) and other environmental conditions during the sampling event.

PREPARATION: Trip blanks are prepared prior to the sampling event either by the laboratory providing sample containers, or by field team personnel who are responsible for the initial preparation of sample containers and field equipment. The water must be free of volatile organic contaminants. Any appropriate preservatives must be added at the time that the blanks are prepared. The sample containers are sealed, labeled appropriately, and transported to the field in the same sampling kits as the sample vials. These blanks are not to be opened in the field. They are to be transferred to the sample container designated for volatile sample storage and transport and accompany the samples to the laboratory. Subsequent blanks (field and equipment) for volatile organics should use the same source water as the trip blanks, unless the water used for field and equipment blanks can be proven equivalent.

FREQUENCY: One trip blank for each volatile organic analysis (601, 602, 624, etc.) shall be provided per cooler used for storing and transporting volatile sample vials. If a laboratory requires submission of multiple vials for a method, the same number of vials must be submitted for the trip blank.

11.1.2 Field Blanks

PURPOSE: Field blanks are used to evaluate the effects of on-site environmental contaminants, the purity of reagents used as preservatives or additives and the general sample container filling/collection techniques. Field blanks are recommended for all parameters.

PREPARATION: Field blanks are prepared on-site by filling the sample container(s) with analyte-free water, adding preservatives, sealing the containers and completing the appropriate documentation. The field blanks must be handled in the same manner as the sample group for which it was intended (i.e., blanks must be stored and transported with the sample group).

NOTE: The water for VOA field blanks should be equivalent to the trip blank water (see Trip Blank Preparation).

FREQUENCY: One field blank per parameter group per day or at a frequency of 5% of the samples in the parameter group per day, whichever is greater.

11.1.3 Equipment Blanks

PURPOSE: Equipment blanks are required if sampling equipment is precleaned or field-cleaned. These blanks are used to determine the effectiveness of field cleaning procedures as well as to reveal those sources of contamination that may be found in a trip blank. Equipment

blanks are recommended for all parameter groups and matrices to be collected and analyzed.

PROCEDURE: The final rinse water (analyte-free) shall be rinsed on or through the sampling equipment, whether precleaned or field cleaned, collected, and placed in appropriate preserved containers. These blanks must be stored and transported with the samples.

NOTE: The water used for volatile equipment blanks should be from the same or equivalent source as the trip blank water.

FREQUENCY: When less than five samples of a similar matrix are taken, one equipment blank prepared on-site for precleaned or field-cleaned equipment should be collected and analyzed for each parameter.

When five to ten samples of a similar matrix are taken, one equipment blank should be collected on field-cleaned equipment or one on-site blank should be collected in precleaned equipment if no equipment is cleaned in the field.

For sampling events involving ten or more samples, a minimum of one blank should be taken on precleaned equipment or at the rate of 5% (whichever is greater) of the samples in each analyte group for all matrices. One blank should be taken on field-cleaned equipment or at the rate of 5% (whichever is greater) of the samples in each analyte group for all matrices.

11.1.4 Field Duplicates

Field duplicates are taken, analyzed, reported and invoiced when requested by the client or specified by a project specific QA plan. Savannah Laboratories recommends that a minimum of one duplicate for 10% of samples be taken for all parameter groups and matrices to be collected and analyzed.

11.1.5 Field QC Summary

The recommended frequency of field blanks and duplicates is summarized below:

No. Samples	Precleaned Equipment Blanks	Field-Cleaned Equipment Blanks	Trip Blank (VOCs)	Duplicates
10+	Minimum of one, then 5%	Minimum of one, then 5%	One per cooler	Minimum of one, then 10%
5-9	One*	One*	Not required	One
< 5	One*	One*	Not required	Not required

* Note: For nine or fewer samples, one equipment blank is required from either precleaned or field-cleaned equipment.

If any equipment is cleaned in the field, the blank is to be taken from the field-cleaned equipment.

11.2 Laboratory QC Checks

The laboratories employ control samples to assess the validity of the analytical results. Determination of the validity of sample results is based on the acceptance criteria being met by the control samples. The acceptance criteria for each type of control sample are defined in the appropriate SOP. These acceptance criteria are per method requirements or calculated annually from historical data.

For projects which require Florida DEP QAS criteria, matrix spike results will be utilized for laboratory control. If matrix spikes are out of control, laboratory control standard (LCS) results and method control criteria will be utilized for the ultimate determination of control of the analytical batch. For all other projects, LCSs will be utilized primarily to determine if a batch is in control.

Clients are requested to provide sufficient sample for matrix spikes. If the client does not provide sufficient sample replicates for matrix spikes/duplicates, laboratory generated samples will be provided. In cases where laboratory-generated matrices are used, the sample registry in the department logbook will be stamped "Insufficient sample volume was available to perform a batch matrix spike analysis."

For CLP protocols or other cases (i.e., client or QAPjP mandated) where "sample specific" (non-batch) QC is required, matrix spike/duplicate analysis will be conducted on replicate samples provided by the client. In this case, matrix spikes/duplicates will be invoiced as samples. In all other cases, matrix spikes will be on a batch- (not client-, project- or sample-) specific basis.

When possible, aliquots for matrix spikes are taken from the same container as the field sample. In some cases with liquid samples, this is not possible, i.e., semivolatile extractables, oil and grease, TPH, etc.

The control samples are analyzed in the same manner as the field samples. QC check samples are analyzed on an analytical batch frequency unless otherwise stated. An analytical batch is defined as a group of samples which are processed as a unit. If the number of samples in the group is greater than 20, each group of 20 samples or less is handled as a separate batch.

Other QC check samples are analyzed for performance evaluations or as part of internal or external audits as given in Section 14. Unacceptable QC check sample results associated with reported data during project analysis are noted in the project report.

If particular laboratory method or QAPjP QC requirements are more stringent than the general procedures given below, the method QC requirements are followed.

11.2.1 Organics

Method Blanks: A method blank will be analyzed for each batch of samples.

Lab Control Standards: Blank spikes or lab control standards will be processed and analyzed per method requirements with each batch of samples. For drinking water samples, analyte spike concentrations will be at or near reporting limits as specified for lab-fortified blanks in the 500 series methods.

Surrogates: Appropriate surrogates (see Tables 5.1 and 5.2) will be added to all samples, standards and blanks.

Matrix Spikes: Matrix spikes will be analyzed with each batch at a frequency of 5% of samples if sufficient sample is available. If a method does not specify matrix spiking compounds, the SW-846 or CLP matrix spiking compounds will be used. Appropriate matrix spikes will be used for other chromatographic methods. Matrix spikes containing all compounds will be analyzed periodically to generate accuracy and precision limits.

Matrix Spike Duplicates/Sample Duplicates: Duplicate samples or matrix spikes will be analyzed with each batch or at a frequency of 5% of samples if sufficient sample is available. In cases where duplicate matrix spikes are used, precision data are obtained on only the matrix spiking compounds.

11.2.2 Inorganic and General Chemistry

Calibration Blanks: Calibration blanks are nondigested blanks which are analyzed at a frequency of 10% of samples.

Method Blanks: Method blanks should be processed and analyzed with each batch at a frequency of 5% of samples of the same matrix.

Lab Control Standards: A blank spike or lab control standard will be processed and analyzed with each batch of samples.

Matrix Spikes: Matrix spikes will be analyzed at a frequency of 5% of samples if sufficient sample is available.

Matrix Spike Duplicates/Sample Duplicates: Duplicate samples or duplicate matrix spikes will be analyzed at a frequency of 5% of samples if sufficient sample is available.

11.2.3 Microbiology

Quality control checks are routinely performed for all microbiological analyses. Strict requirements for the house deionized water must be met before it can be used in any testing. Each monitored parameter, its monitoring frequency, and its acceptance limits is as follows: residual

chlorine, monthly, < 0.1 mg/L; trace metals (total Cd, Cr, Cu, Ni, Pb, Zn), annually, < 1.0 mg/L; conductivity, daily < 1.0 umho/cm; heterotrophic plate count, monthly, < 1000 CFU/mL; inhibitory residue, annually or for each new lot of detergent, less than 15% difference between groups; suitability, annually, ratio between 0.8 and 3.0.

Other laboratory QC practices are utilized to provide accurate microbiological results. These include the use of autoclave tape to insure proper sterilization of sample containers, media, etc. Incubators are maintained at $35 \pm 0.5^\circ \text{C}$ and water baths at $44.5 \pm 0.2^\circ \text{C}$. Thermometers used for these monitoring purposes are calibrated annually against an NIST-certified thermometer. Other equipment, such as the dissecting microscope and colony counter are maintained in clean operating condition at all times.

Microbiological samples are analyzed in duplicate at a rate of 10% of positive samples. A positive control sample is analyzed in duplicate with each batch of coliform samples.

Blanks are routinely analyzed with microbiological samples. For membrane filter analyses, a sterile dilution water blank is run initially, after every 10 samples, and at the end of each analytical run. For MPN analysis, sterile dilution water is added to a lauryl tryptose broth tube for a blank for each analytical run.

11.2.4 Radiochemistry

Background Count: Background counts are obtained at a frequency of once per day for gross alpha, gross beta and radium 228; and determined for each flask prior to sample introduction for radium 226.

Method Blanks: Method blanks are analyzed at a frequency of 5% of samples of the same matrix.

Lab Control Standards: Lab control standards are analyzed with each batch of 20 samples of the same matrix.

Matrix Spike/Matrix Spike Duplicate or Sample Duplicates: These are analyzed with each batch of 20 samples of the same matrix.

11.3 Routine Methods Used to Assess Precision and Accuracy

Control charts (Figures 11.1 and 11.2) for precision and accuracy are initiated for each parameter upon method validation. Control charts are based on procedures in *The Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA, 1979) and contain both "warning limits" (± 2 standard deviations) and "control limits" (± 3 standard deviations). Control limits are updated annually for all parameters. A minimum of ten data points is used to update these limits. Formulas used for calculations of precision and accuracy are provided in Section 5.0.

In order to assess precision and accuracy, sample concentrations can be divided into three ranges: low, mid, and high. Low level is defined as concentrations from the minimum detection limit to a level five times the MDL. Mid level is defined as the mean level between the minimum detection level and the upper end of the linear range. High level is defined as the concentration at the upper end of the linear range. The accuracy and precision limits in Tables 5.1, 5.2, and 5.3 were calculated from spikes in the mid-concentration range (Table 11.1) and are used to assess precision and accuracy.

11.4 Method Detection Limits and Reporting Limits

Method detection limits (MDLs) are determined biannually in accordance with the procedures in SW-846 and Appendix B of 40 CFR Part 136. This procedure includes analyzing seven or more prepared spikes or standards in reagent water at levels 3-5 times the estimated detection limit. The standard deviation of the replicate measurements is calculated, and the MDL is computed by multiplying by the appropriate Student's t value for the appropriate 99% confidence level (for seven replicates, $t = 3.14$).

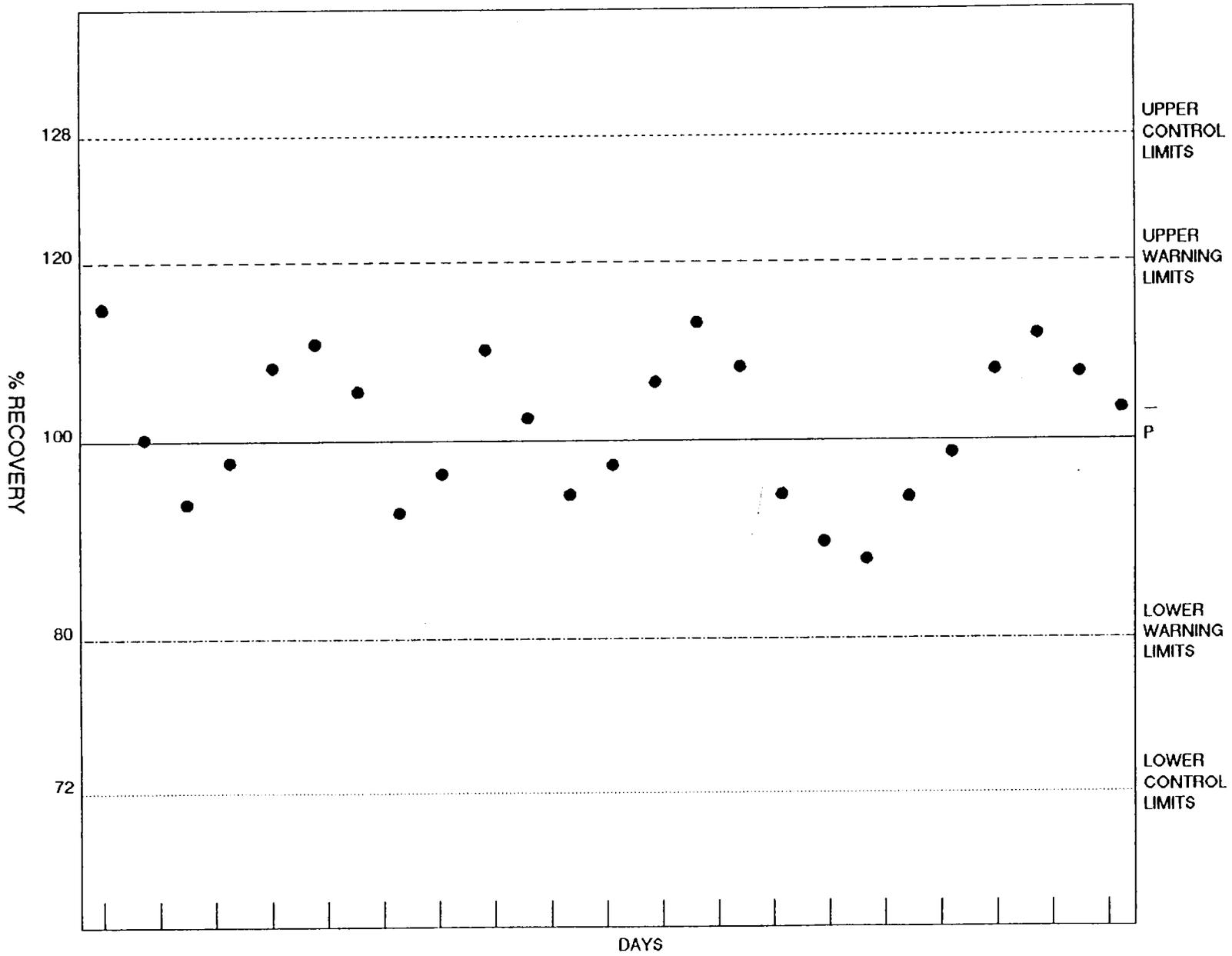
The MDL calculated by the procedure described above is defined as the minimum concentration of a substance that can be measured in reagent water and reported with a given confidence that the analyte concentration is greater than zero.

For other protocols (i.e., Contract Laboratory), other procedures are used to estimate detection limits.

Since MDLs are based on the analyses of standards in reagent water, they may not be useful in reporting data for environmental samples. Thus, practical quantitation limits (PQLs) may be used for reporting a non-detected parameter. PQLs are defined as the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

For data requiring Florida DEP QAS criteria, the PQL can be calculated by multiplying the reported MDL by a factor of four and any required dilution factor.

The term from SW-846, Estimated Quantitation Limit (EQL) is used interchangeably with PQL. In all cases, PQLs are greater than MDLs. When PQLs are defined in SW-846 or the CLP protocols (CRDLs), these defined PQLs are generally used in data reporting provided they are achievable.



EXAMPLE OF CONTROL CHART FOR % RECOVERY

FIGURE 11.1

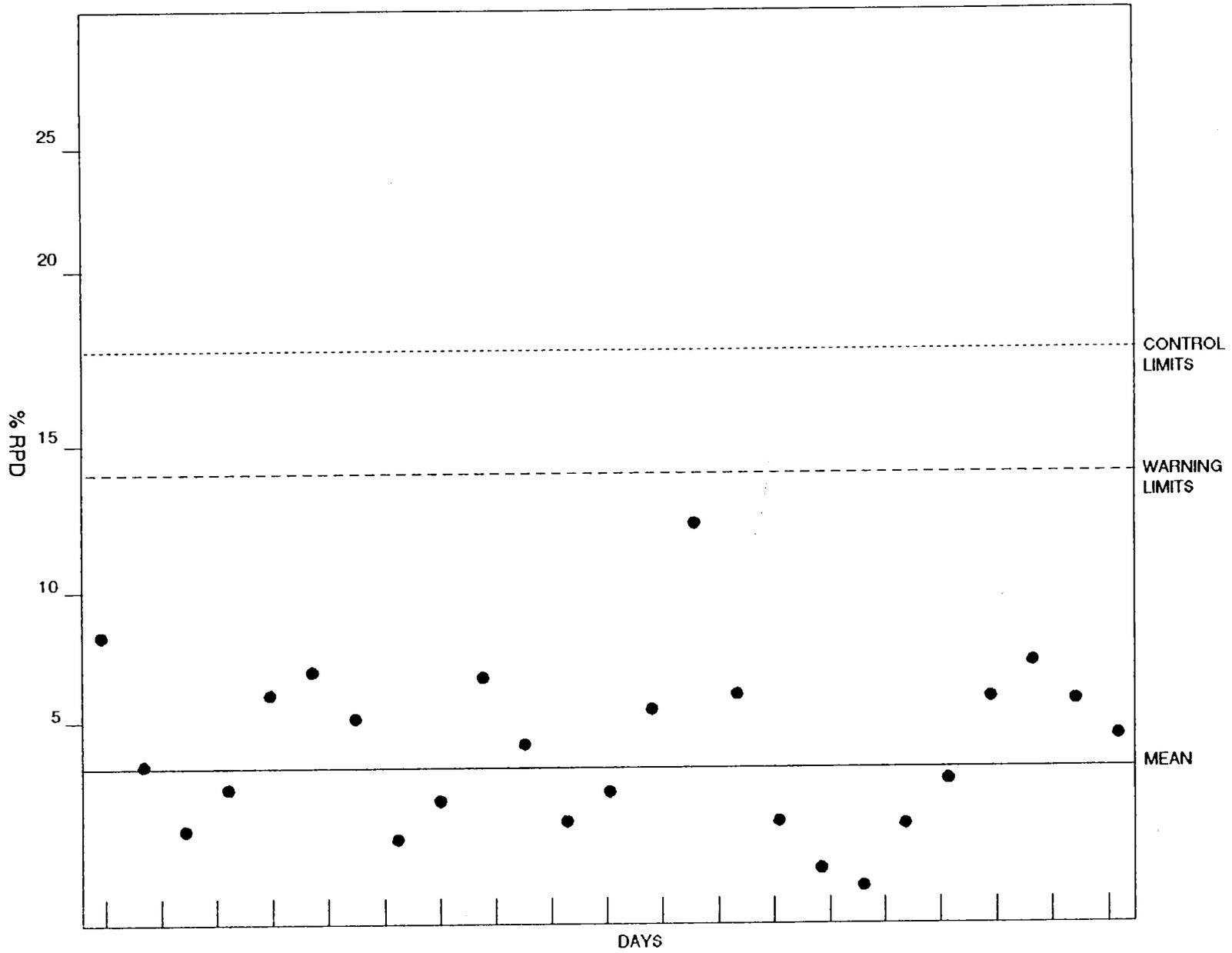


FIGURE 11.2
EXAMPLE OF CONTROL CHART FOR % RPD

TABLE 11.1

Methods Used to Generate Accuracy and Precision Targets			
Method	Purpose	Concentration Level	Method References
Quality Control Check Standards (QCCS) or LCS	Accuracy	Mid Level	All metal, general, and organic methods for which a QCCS or LCS is required.
Quality Control Check Standards (QCCS) or LCS	Precision	Mid Level	All metal, general, and organic methods for which a QCCS or LCS duplicate is required.
Duplicate Samples (DS)	Precision	Mid Level	All methods for which duplicate sample precision is required or a QCCS or LCS is not available.
Matrix Spikes (MS)	Accuracy	Mid Level	All metal, general, and organic methods for which an MS is required.
Matrix Spike Duplicates (MSD)	Precision	Mid Level	All metal, general, and organic methods for which an MSD is required.

12.0 DATA REDUCTION, REVIEW, AND REPORTING

12.1 Introduction

In order to provide the highest quality data possible, an extensive system for sample custody, data reduction, review, and reporting has been implemented.

12.2 Sample Custody

Upon receipt of the samples, the custody forms are checked against the sample identifications listed on the containers by the sample custodians, and a unique SL log number is assigned to each sample group. Any discrepancies are noted, including cooler temperatures, broken bottles and/or misidentified samples. Clients are immediately notified if discrepancies exist.

After receipt, the samples are delivered to the appropriate laboratory sections where the samples are checked for proper preservation and this information is recorded in bound notebooks when applicable. When necessary, the samples are then stored in refrigerators that are monitored at least daily for temperature.

12.3 Organization and Initiation of Sample Analyses

The key to Savannah Laboratories' sample flow, analysis, data/QA review, archiving, and reporting system is the single LIMS network which controls the day to day production of the laboratories. This system, which is summarized in Figure 12.1, provides project managers, QA personnel, and all analysts immediate information on the status of any sample in all six facilities. This system schedules and prioritizes all work, provides a mechanism for sample tracking, review of reportables and QC data, generation of reports and invoices, and archiving of all reports and associated QC data.

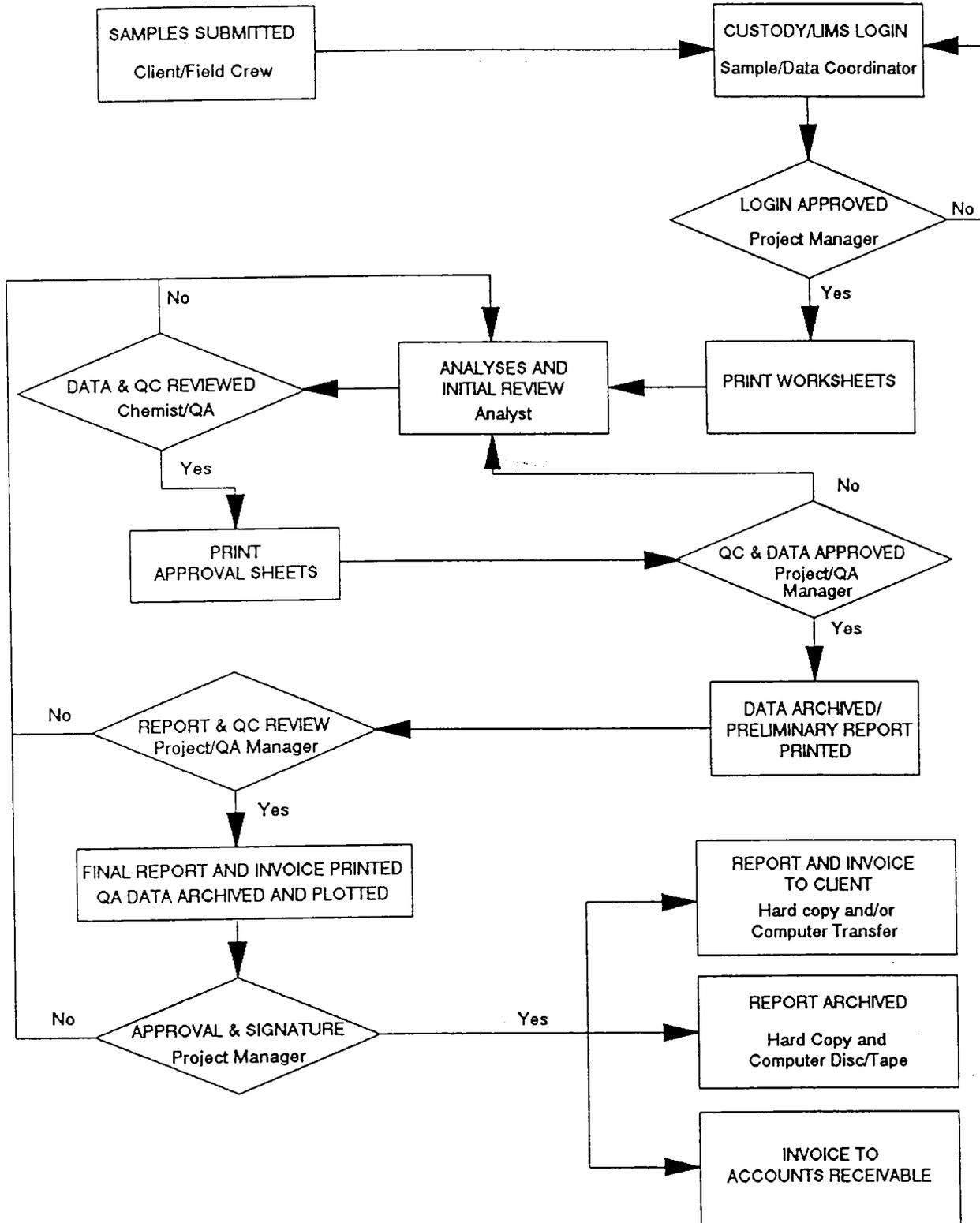
Upon receipt of custody forms, the project manager instructs data management personnel to log the sample analysis request and identification into the LIMS. The LIMS is based on an ADDS Mentor 7000 computer (NCR) which links the laboratories via telephone multiplex. This enables any project manager, section manager, QA manager, laboratory director, or chemist with authority to access and check the status of all projects.

If special handling or data packaging is required, the QA department receives copies of the custody forms and computer acknowledgements, initiates a QA project file and determines the sample batching. A sample delivery group (SDG) sheet is established and distributed to all affected departments including the various laboratory chemists, project managers, and section managers.

After the sample analysis request is logged into the LIMS and approved, the LIMS generates worksheets which are printed and distributed.

FIGURE 12.1

FLOW CHART OF SL COMPUTERIZED LABORATORY INFORMATION MANAGEMENT SYSTEM (LIMS)



12.4 Sample Analysis and Data Reduction

Through the use of the worksheets and/or SDG sheets, the samples are prepared following the procedures given in each of EPA's approved methods. The preparation information is recorded in bound notebooks throughout the laboratory.

12.4.1 Data Reduction

Most sample concentration results are read directly from instrumentation without further reduction or calculations. Dilution factors are applied upon the dilution of samples having concentrations above the calibration range. In many cases, these are input into the instrument computer and correct results are calculated automatically. In other cases, a manual calculation may be made. Soil/solid waste concentration results for all laboratory sections are calculated on a dry weight basis prior to reporting by dividing the instrument result by the dry weight fraction.

Other than the cases discussed above, data obtained by the following method/instrument are directly reportable: GC, GC/MS, metals, general chemistry automated colorimetry, TOC, DO, turbidity, and pH.

Methods data requiring reduction prior to reporting include titrimetric methods, BOD, COD, conductivity, manual UV/VIS/IR, residue, TOX, and radiochemical parameters.

Table 12.1 gives equations used in computer-controlled instrumentation for data reduction as well as equations used for the manual calculation of reportable concentration results.

All laboratory pH meters are temperature compensated. Laboratory conductivity is always measured at 25°C.

The laboratory raw data containing the instrument-generated reports, manually calculated results, and all supporting preparation, calibration, and analytical data are retained at the individual work stations until reports are issued unless additional handling or data packaging is required.

All field pH and conductivity meters are temperature compensated. Cell constants for field conductivity meters are determined by laboratory personnel annually as given in Section 9.4.2. Field conductivity is calculated as given in Table 12.1. All other field data are read directly from instrumentation.

Bound field notebooks are used for documentation of required data reduction. Calculations are recorded in waterproof ink.

TABLE 12.1

SUMMARY OF EQUATIONS USED IN CALCULATIONS

Equations	Reporting Units	
BN/A Extractables by GC/MS [Internal Standard Method (625 and 8270)]	Water	Solid*
<p>Response Factor = $\frac{As \times Cis}{Ais \times Cs}$ (RF)</p> <p>As = area of the characteristic ion of standard Ais = area of the characteristic ion of internal standard Cs = concentration of standard (ug/L) Cis = concentration of the internal standard (ug/L)</p> <p>Water Conc., ug/L = $\frac{As \times Cis}{Ais \times RF}$</p> <p>As = area of the characteristic ion (sample) Ais = area of the characteristic ion (internal standard) Cis = concentration of the standard (ug/L) RF = response factor</p> <p>Sediment Conc., ug/kg = $\frac{\text{ug of internal standard} \times As \times 1}{(\text{kg of sample})(\% \text{ solids} \times .01) \times Ais \times RF}$</p> <p>As = area of the characteristic ion (sample) Ais = area of the characteristic ion (internal standard) RF = response factor</p>	ug/L (or mg/L)	ug/kg (or mg/kg)
VOC by GC/MS [Internal Standard Method - See section on BN/A]		
VOCs by GC		
<p>Response Factor = $\frac{\text{ug/L of compound to be measured}}{\text{peak height}}$ (RF)</p> <p>Water Conc., ug/L = RF x peak height x dilution factor</p> <p>Sediment Conc., ug/L = $\frac{\text{RF} \times \text{peak height} \times \text{liter equivalent of std. volume}}{(\text{kg of sample})(\% \text{ solids} \times .01)}$</p>	ug/L (or mg/L)	ug/kg (or mg/kg)
Pesticides/PCBs and Other GC Procedures		
<p>Response Factor = $\frac{\text{ug of analyte}}{\text{peak area}}$ (RF) (Standard)</p> <p>Water Conc., ug/L = $\frac{\text{RF} \times \text{peak area} \times \text{extract volume in uL}}{(\text{liters of sample extracted})(\text{injection volume in uL})}$</p> <p>Sediment Conc., ug/kg = $\frac{\text{RF} \times \text{peak area} \times \text{extract volume in uL}}{(\text{kg of sample extracted})(\% \text{ solids} \times .01)(\text{injection volume in uL})}$</p>	ug/L (or mg/L)	ug/kg (or mg/kg)

TABLE 12.1

SUMMARY OF EQUATIONS USED IN CALCULATIONS

Equations	Reporting Units	
	Water	Solid*
Metals		
<p>Calibration curve construction</p> $y = mx + b$ <p> $y = \text{absorbance}$ $m = \text{slope} = \frac{\text{absorbance}}{\text{concentration}}$ </p> <p> $x = \text{concentration (mg/L)}$ $b = y \text{ intercept}$ </p> <p>Calculation of water sample concentration</p> <p>Water Conc., $\text{ug/L} = \frac{y - b}{m} \times \text{dilution factor}$</p> <p>Sediment Conc., $\text{mg/kg} = \text{mg/L} \times \text{dilution factor} \times \frac{\text{final volume (liters) of digest}}{(\text{kg of sample})(\% \text{ solids} \times .01)}$</p>	<p>ug/L (or mg/L)</p>	<p>ug/kg (or mg/kg)</p>
UV/VIS and IR Procedures		
<p>Calibration curve construction (see metals)</p> <p>Water Conc., $\text{mg/L} = \frac{y - b}{m} \times \text{dilution factor}$</p> <p>Sediment = $\text{mg/L} \times \frac{\text{liters of leachate (or digest)}}{(\text{kg of sample})(\% \text{ solids} \times .01)}$ Conc.</p>	<p>mg/L</p>	<p>mg/kg</p>
General Titrimetric Procedures		
<p>Analyte, $\text{mg/L} = \frac{N_{\text{titrant}} \times \text{Titer}}{\text{Vol. of sample titrated}} \times \text{eq. wt.} \times 1000$</p>	<p>mg/L</p>	
BOD		
<p>BOD, $\text{mg/L} = \frac{(\text{Int. DO} - \text{Final DO}) - \text{Seed Correction Factor}}{\text{Vol. fraction of sample}}$</p>	<p>mg/L</p>	
COD		
<p>COD, $\text{mg/L} = \frac{(\text{Blk titer} - \text{sample titer}) \times N_{\text{fac}} \times 8000}{\text{Vol. of sample, mL}}$</p>	<p>mg/L</p>	

TABLE 12.1

SUMMARY OF EQUATIONS USED IN CALCULATIONS

Equations	Reporting Units	
	Water	Solid*
Conductivity		
Cell constant = $\frac{1000}{\text{Observed conductivity of 1000} - \mu\text{S/cm std.}}$	$\mu\text{S/cm}$	
Residue		
Residue, mg/L = $\frac{\text{Total wt.} - \text{Wt. of dish or filter}}{\text{Vol. of sample, L}}$	mg/L	
TOX		
TOX, $\mu\text{g/L} = (C_1 + C_2 - 2C_3) \times \frac{1000 \text{ mL}}{\text{Vol. of sample}}$ C_1 = instrument reading of 1 ^o column C_2 = instrument reading of 2 ^o column C_3 = instrument reading of blank column TOX, mg/kg = $\frac{\text{instrument reading}}{\mu\text{L injected}} \times \frac{5}{\text{dry wt. fraction}}$	mg/L	mg/kg
Gross Alpha, Gross Beta		
Gross α or β = $\frac{(\text{cpm sample} - \text{cpm background}) (1000)}{(2.22) E_1 (E_2) (\text{sample volume in mL or sample mass in mg})}$ E_1 = counting efficiency E_2 = self absorption Counting error = $\frac{(A + B)^{1/2} (1.96) (1000)}{(2.22) (E_1) (E_2) (\text{sample volume in mL or sample mass in mg})}$ A = gross counts/(count time in min) ² B = background counts/(count time in min) ²	pCi/L	pCi/g
Radium 226		
Ra-226 = $\frac{C}{(2.22)(E)(V)} \times \frac{1}{1-e^{-zt_1}} \times \frac{1}{e^{-zt_2}} \times \frac{1}{1-e^{-zt_3}}$ C = net count rate E = calibration constant for system and scintillation cell V = sample volume in liters t_1 = elapsed time (days) between first and second de-emanations, and $z = 0.181 \text{ days}^{-1}$ t_2 = elapsed time (h) between second de-emanation and counting, and $z = 0.00755 \text{ h}^{-1}$ t_3 = counting time (min), and $z = 1.26 \times 10^{-4} \text{ h}^{-1}$ z = decay constant for Radon 222	pCi/L	

TABLE 12.1

SUMMARY OF EQUATIONS USED IN CALCULATIONS

Equations	Reporting Units	
	Water	Solid*
<p>Radium 228</p> $Ra-228 = \frac{C}{(2.22)(E)(V)(R)} \times \frac{1}{1-e^{-zt_1}} \times \frac{1}{e^{-zt_2}} \times \frac{zt_3}{1-e^{-zt_3}}$ <p>C = net count rate E = counter efficiency for Actinium 228 V = sample volume in liters R = (fractional chemical yield of yttrium carrier (fractional chemical yield of barium carrier) z = decay constant for Actinium 228 (0.001884 min⁻¹) t₁ = ingrowth time (min) t₂ = time interval between first yttrium hydroxide precipitation and start of counting time t₃ = counting time interval (min)</p>	pCi/L	
<p>* Data for solid or semisolid samples are reported on a dry weight basis.</p>		

12.4.2 Chromatographic and Data File Identification

Chromatograms and data files are given a unique alphanumeric identification by the chemists initiating the analyses in each section where appropriate. These file identification numbers reflect either the date the sequence was initiated (GC sections), the order in which the samples were analyzed (GC/MS sections), and/or the sample identification and log numbers given by the client and listed on the LIMS.

12.5 Data Transfer and Review

12.5.1 Data Transfer to LIMS

The analytical results are entered on the sectional worksheets after review. The worksheet data are entered into the LIMS by the data entry technicians. For many parameters, data are directly transferred to the LIMS by instrument interface.

After the data are entered into the LIMS, approval sheets are printed and checked against the information entered into the LIMS for transfer errors and anomalies.

12.5.2 Data Review

Laboratory analytical results are reviewed by the chemist responsible for the analysis and/or a peer chemist or a section supervisor. Prior to entering the reportable data into the LIMS, laboratory raw data have been reviewed, stamped, and signed to ensure that all of the method specifications have been met. This includes checking the extraction, digestion, distillation, and other preparation logs, as well as ensuring that all precision and accuracy requirements are addressed, and all steps of the analyses have been completed. If any problems arise during the analysis of the sample batch, it is the responsibility of the chemist and the section supervisor to bring this to the attention of the project manager, section manager, and QA manager through a written corrective action report.

The field/sampling manager is responsible for data review of all field-generated data. This includes verifying that all field descriptive data is recorded as per Section 6, that all field calibration requirements have been met as per Section 9, that all field QC data have met criteria given in Table 5.3, and that field data are entered accurately on worksheets.

For reports on which QA deliverables are required, data flags are used to inform the project manager and the client of any additional information that might aid in the interpretation of the data. The data flagging system incorporates data qualifiers which are similar to flags specified in the Contract Laboratory Program protocols, as well as additional flags used to help explain batch specific events.

When data acquisition and reporting have been completed, the project manager reviews and prepares the final report. Because the project managers have extensive experience in evaluating analytical data, they

have developed both objective and subjective techniques for data review. Each value reported is reviewed in the context of the respective environmental matrix and all available QC/QA data. Outliers or other abnormal values are carefully scrutinized, and samples are reanalyzed if the abnormalities cannot be explained. Where there are cases in which the results from spiked samples suggest interferences, attempts are made to remove the interferences, or alternate analytical procedures are used. If the interference problem cannot be resolved, the data are flagged and/or a narrative is included with the report.

12.5.3 Special Project or Data Package Review

If special handling and/or data packages are requested by the client, QA personnel also review the project report and the raw data. This includes checking that holding time requirements are met, checking calibrations, reviewing all quality control data and/or control charts, and initiating any corrective action or reanalyses that might be appropriate.

12.6 Reporting

The final report is printed and signed by the project manager after all review has been completed.

Figures 12.2 - 12.4 are examples of SL Level 0, SL Level 1 and SL Level 2 typical reports for liquid samples. SL Level 3 reports are CLP-type data packages for non-CLP parameters. These are either generated on the LIMS or with specified software (or a combination of both). For CLP reports (SL Level 4), the CLP forms from the CLP SOW are generated by instrument software and are submitted to the client. If requested by the client or a project specific QA Plan, hybrid/custom reports or CLP data packages with diskette deliverables can be provided. All LIMS reports can be downloaded onto diskettes or to most clients' computers.

The data flags that may appear in a project report for Levels 0-3 are defined on the signature page, and any additional comments are also footnoted on this page.

If data packaging is requested, a paginated data package is provided in addition to the project report. The format of the project report and/or data package can be adjusted to meet the needs of the client.

12.7 Data Storage

The raw data are stored in metal filing cabinets at each work station until the cabinets are filled to capacity. The data are then transferred to a secured area and filed chronologically by laboratory section in banker's boxes and maintained for three years. If the data are to be purged to the client or need to be separated from the general raw data files, the data can be boxed, labeled and stored in a separate secured area.

Hard copies of all LIMS reports are maintained for five years in client files. All LIMS reports and associated QC data are kept for a minimum of

three years on the LIMS hard diskettes and/or magnetic tape. All data on the LIMS are backed up daily on magnetic tape.

All in-lab data generated by computer systems are stored to tape when the capability exists. The tapes are labeled and stored at the individual work stations.

Keys to the data storage areas are retained by the QA staff and the section/department managers.

FIGURE 12.2

EXAMPLE OF RESULTS ONLY REPORT

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LOG NO: SE-FLQAP0

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 Savannah, Georgia 31406

Project: Level 0 (Results Only) Example
 Sampled By: Client

REPORT OF RESULTS

Page 1

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE SAMPLED
FLQAP0-1	Water Sample	05-12-94
PARAMETER	FLQAP0-1	
Volatiles by GC/MS (8240)		
Chloromethane, ug/l		<10
Bromomethane, ug/l		<10
Vinyl Chloride, ug/l		<10
Chloroethane, ug/l		<10
Methylene Chloride (Dichloromethane), ug/l		<5.0
Acetone, ug/l		<50
Carbon Disulfide, ug/l		<5.0
1,1-Dichloroethene, ug/l		<5.0
1,1-Dichloroethane, ug/l		<5.0
Trans-1,2-Dichloroethylene, ug/l		<5.0
cis-1,2-Dichloroethylene, ug/l		<5.0
Chloroform, ug/l		<5.0
1,2-Dichloroethane, ug/l		<5.0
2-Butanone (MEK), ug/l		<50
1,1,1-Trichloroethane, ug/l		<5.0
Carbon Tetrachloride, ug/l		<5.0
Vinyl Acetate, ug/l		<10
Bromodichloromethane, ug/l		<5.0
1,1,1,2-Tetrachloroethane, ug/l		<5.0
1,2-Dichloropropane, ug/l		<5.0
trans-1,3-Dichloropropene, ug/l		<5.0
Trichloroethene, ug/l		<5.0
Dibromochloromethane, ug/l		<5.0

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REPORT OF RESULTS

Page 2

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE SAMPLED
FLQAP0-1	Water Sample	05-12-94
PARAMETER	FLQAP0-1	
1,1,2-Trichloroethane, ug/l	<5.0	
Benzene, ug/l	<5.0	
cis-1,3-Dichloropropene, ug/l	<5.0	
2-Chloroethylvinyl Ether, ug/l	<50	
Bromoform, ug/l	<5.0	
2-Hexanone, ug/l	<50	
4-Methyl-2-pentanone (MIBK), ug/l	<5.0	
Tetrachloroethene, ug/l	<5.0	
Toluene, ug/l	<5.0	
Chlorobenzene, ug/l	<5.0	
Ethylbenzene, ug/l	<5.0	
Styrene, ug/l	<5.0	
Xylenes, ug/l	<5.0	

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REPORT OF RESULTS

Page 3

LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

FLQAP0-2 Method Detection Limit (MDL)

PARAMETER FLQAP0-2

PARAMETER	FLQAP0-2
Volatiles by GC/MS (8240)	
Chloromethane, ug/l	4.5
Bromomethane, ug/l	2.2
Vinyl Chloride, ug/l	2.8
Chloroethane, ug/l	3.5
Methylene Chloride (Dichloromethane), ug/l	1.9
Acetone, ug/l	7.1
Carbon Disulfide, ug/l	1.1
1,1-Dichloroethene, ug/l	1.7
1,1-Dichloroethane, ug/l	0.56
Trans-1,2-Dichloroethylene, ug/l	1.3
cis-1,2-Dichloroethylene, ug/l	1.1
Chloroform, ug/l	0.62
1,2-Dichloroethane, ug/l	0.56
2-Butanone (MEK), ug/l	3.2
1,1,1-Trichloroethane, ug/l	0.75
Carbon Tetrachloride, ug/l	0.54
Vinyl Acetate, ug/l	1.8
Bromodichloromethane, ug/l	0.37
1,1,2,2-Tetrachloroethane, ug/l	1.4
1,2-Dichloropropane, ug/l	2.4
trans-1,3-Dichloropropene, ug/l	0.59
Trichloroethene, ug/l	1.6
Dibromochloromethane, ug/l	0.53

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REPORT OF RESULTS

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LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

 FLQAP0-2 Method Detection Limit (MDL)

PARAMETER	FLQAP0-2
1,1,2-Trichloroethane, ug/l	0.70
Benzene, ug/l	1.1
cis-1,3-Dichloropropene, ug/l	0.59
2-Chloroethylvinyl Ether, ug/l	1.7
Bromoform, ug/l	0.98
2-Hexanone, ug/l	3.6
4-Methyl-2-pentanone (MIBK), ug/l	2.7
Tetrachloroethene, ug/l	0.79
Toluene, ug/l	1.4
Chlorobenzene, ug/l	0.55
Ethylbenzene, ug/l	0.65
Styrene, ug/l	4.8
Xylenes, ug/l	1.3

 Methods: EPA SW-846

 J. W. Andrews, Ph. D.

Final Page Of Report

FIGURE 12.3

EXAMPLE OF SL LEVEL I REPORT

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Project: Level I Example Report
 Sampled By: Client

REPORT OF RESULTS

Page 1

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE SAMPLED
FLQAP1-1	Water Sample	05-12-94
PARAMETER	FLQAP1-1	
Volatiles by GC/MS (8240)		
Chloromethane, ug/l		<10
Bromomethane, ug/l		<10
Vinyl Chloride, ug/l		<10
Chloroethane, ug/l		<10
Methylene Chloride (Dichloromethane), ug/l		<5.0
Acetone, ug/l		<50
Carbon Disulfide, ug/l		<5.0
1,1-Dichloroethene, ug/l		<5.0
1,1-Dichloroethane, ug/l		<5.0
Trans-1,2-Dichloroethylene, ug/l		<5.0
cis-1,2-Dichloroethylene, ug/l		<5.0
Chloroform, ug/l		<5.0
1,2-Dichloroethane, ug/l		<5.0
2-Butanone (MEK), ug/l		<50
1,1,1-Trichloroethane, ug/l		<5.0
Carbon Tetrachloride, ug/l		<5.0
Vinyl Acetate, ug/l		<10
Bromodichloromethane, ug/l		<5.0
1,1,2,2-Tetrachloroethane, ug/l		<5.0
1,2-Dichloropropane, ug/l		<5.0
trans-1,3-Dichloropropene, ug/l		<5.0
Trichloroethene, ug/l		<5.0
Dibromochloromethane, ug/l		<5.0

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Project: Level I Example Report
Sampled By: Client

REPORT OF RESULTS

Page 2

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE SAMPLED
FLQAP1-1	Water Sample	05-12-94
PARAMETER	FLQAP1-1	
1,1,2-Trichloroethane, ug/l	<5.0	
Benzene, ug/l	<5.0	
cis-1,3-Dichloropropene, ug/l	<5.0	
2-Chloroethylvinyl Ether, ug/l	<50	
Bromoform, ug/l	<5.0	
2-Hexanone, ug/l	<50	
4-Methyl-2-pentanone (MIBK), ug/l	<50	
Tetrachloroethene, ug/l	<5.0	
Toluene, ug/l	<5.0	
Chlorobenzene, ug/l	<5.0	
Ethylbenzene, ug/l	<5.0	
Styrene, ug/l	<5.0	
Xylenes, ug/l	<5.0	

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REPORT OF RESULTS

Page 3

LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

 FLQAP1-2 Method Detection Limit (MDL)

PARAMETER FLQAP1-2

Volatiles by GC/MS (8240)	
Chloromethane, ug/l	4.5
Bromomethane, ug/l	2.2
Vinyl Chloride, ug/l	2.8
Chloroethane, ug/l	3.5
Methylene Chloride (Dichloromethane), ug/l	1.9
Acetone, ug/l	7.1
Carbon Disulfide, ug/l	1.1
1,1-Dichloroethene, ug/l	1.7
1,1-Dichloroethane, ug/l	0.56
Trans-1,2-Dichloroethylene, ug/l	1.3
cis-1,2-Dichloroethylene, ug/l	1.1
Chloroform, ug/l	0.62
1,2-Dichloroethane, ug/l	0.56
2-Butanone (MEK), ug/l	3.2
1,1,1-Trichloroethane, ug/l	0.75
Carbon Tetrachloride, ug/l	0.54
Vinyl Acetate, ug/l	1.8
Bromodichloromethane, ug/l	0.37
1,1,2,2-Tetrachloroethane, ug/l	1.4
1,2-Dichloropropane, ug/l	2.4
trans-1,3-Dichloropropene, ug/l	0.59
Trichloroethene, ug/l	1.6
Dibromochloromethane, ug/l	0.53

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Sampled By: Client

REPORT OF RESULTS

Page 4

LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

FLQAP1-2 Method Detection Limit (MDL)

PARAMETER	FLQAP1-2
1,1,2-Trichloroethane, ug/l	0.70
Benzene, ug/l	1.1
cis-1,3-Dichloropropene, ug/l	0.59
2-Chloroethylvinyl Ether, ug/l	1.7
Bromoform, ug/l	0.98
2-Hexanone, ug/l	3.6
4-Methyl-2-pentanone (MIBK), ug/l	2.7
Tetrachloroethene, ug/l	0.79
Toluene, ug/l	1.4
Chlorobenzene, ug/l	0.55
Ethylbenzene, ug/l	0.65
Styrene, ug/l	4.8
Xylenes, ug/l	1.3

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LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

FLQAP1-3 Method Blank
 FLQAP1-4 Lab Control Standard (LCS) % Recovery

PARAMETER	FLQAP1-3	FLQAP1-4
Volatiles by GC/MS (8240)		
Chloromethane, ug/l	<10	---
Bromomethane, ug/l	<10	---
Vinyl Chloride, ug/l	<10	---
Chloroethane, ug/l	<10	---
Methylene Chloride (Dichloromethane), ug/l	<5.0	---
Acetone, ug/l	<50	---
Carbon Disulfide, ug/l	<5.0	---
1,1-Dichloroethene, ug/l	<5.0	98 %
1,1-Dichloroethane, ug/l	<5.0	---
Trans-1,2-Dichloroethylene, ug/l	<5.0	---
cis-1,2-Dichloroethylene, ug/l	<5.0	---
Chloroform, ug/l	<5.0	---
1,2-Dichloroethane, ug/l	<5.0	---
2-Butanone (MEK), ug/l	<50	---
1,1,1-Trichloroethane, ug/l	<5.0	---
Carbon Tetrachloride, ug/l	<5.0	---
Vinyl Acetate, ug/l	<10	---
Bromodichloromethane, ug/l	<5.0	---
1,1,2,2-Tetrachloroethane, ug/l	<5.0	---
1,2-Dichloropropane, ug/l	<5.0	---
trans-1,3-Dichloropropene, ug/l	<5.0	---
Trichloroethene, ug/l	<5.0	104 %

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LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

FLQAP1-3 Method Blank
 FLQAP1-4 Lab Control Standard (LCS) % Recovery

PARAMETER	FLQAP1-3	FLQAP1-4
Dibromochloromethane, ug/l	<5.0	---
1,1,2-Trichloroethane, ug/l	<5.0	---
Benzene, ug/l	<5.0	100 %
cis-1,3-Dichloropropene, ug/l	<5.0	---
2-Chloroethylvinyl Ether, ug/l	<50	---
Bromoform, ug/l	<5.0	---
2-Hexanone, ug/l	<50	---
4-Methyl-2-pentanone (MIBK), ug/l	<50	---
Tetrachloroethene, ug/l	<5.0	---
Toluene, ug/l	<5.0	97 %
Chlorobenzene, ug/l	<5.0	110 %
Ethylbenzene, ug/l	<5.0	---
Styrene, ug/l	<5.0	---
Xylenes, ug/l	<5.0	---

Methods: EPA SW-846

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FIGURE 12.4

EXAMPLE OF SL LEVEL II REPORT

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REPORT OF RESULTS

Page 1

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE SAMPLED
FLQAP2-1	Water Sample	05-12-94
PARAMETER	FLQAP2-1	
Volatiles by GC/MS (8240)		
	Chloromethane, ug/l	<10
	Bromomethane, ug/l	<10
	Vinyl Chloride, ug/l	<10
	Chloroethane, ug/l	<10
	Methylene Chloride (Dichloromethane), ug/l	<5.0
	Acetone, ug/l	<50
	Carbon Disulfide, ug/l	<5.0
	1,1-Dichloroethene, ug/l	<5.0
	1,1-Dichloroethane, ug/l	<5.0
	Trans-1,2-Dichloroethylene, ug/l	<5.0
	cis-1,2-Dichloroethylene, ug/l	<5.0
	Chloroform, ug/l	<5.0
	1,2-Dichloroethane, ug/l	<5.0
	2-Butanone (MEK), ug/l	<50
	1,1,1-Trichloroethane, ug/l	<5.0
	Carbon Tetrachloride, ug/l	<5.0
	Vinyl Acetate, ug/l	<10
	Bromodichloromethane, ug/l	<5.0
	1,1,2,2-Tetrachloroethane, ug/l	<5.0
	1,2-Dichloropropane, ug/l	<5.0
	trans-1,3-Dichloropropene, ug/l	<5.0
	Trichloroethene, ug/l	<5.0
	Dibromochloromethane, ug/l	<5.0

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Page 2

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE SAMPLED
FLQAP2-1	Water Sample	05-12-94
PARAMETER	FLQAP2-1	
1,1,2-Trichloroethane, ug/l	<5.0	
Benzene, ug/l	<5.0	
cis-1,3-Dichloropropene, ug/l	<5.0	
2-Chloroethylvinyl Ether, ug/l	<50	
Bromoform, ug/l	<5.0	
2-Hexanone, ug/l	<50	
4-Methyl-2-pentanone (MIBK), ug/l	<50	
Tetrachloroethene, ug/l	<5.0	
Toluene, ug/l	<5.0	
Chlorobenzene, ug/l	<5.0	
Ethylbenzene, ug/l	<5.0	
Styrene, ug/l	<5.0	
Xylenes, ug/l	<5.0	
Surrogate - Toluene-d8	94 %	
Surrogate - 4-Bromofluorobenzene	100 %	
Surrogate - 1,2-Dichloroethane-d4	92 %	
Date Analyzed	05.13.94	
Prep or Extraction Date	05.13.94	

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LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

FLQAP2-2 Method Detection Limit (MDL)

PARAMETER	FLQAP2-2
Volatiles by GC/MS (8240)	
Chloromethane, ug/l	4.5
Bromomethane, ug/l	2.2
Vinyl Chloride, ug/l	2.8
Chloroethane, ug/l	3.5
Methylene Chloride (Dichloromethane), ug/l	1.9
Acetone, ug/l	7.1
Carbon Disulfide, ug/l	1.1
1,1-Dichloroethene, ug/l	1.7
1,1-Dichloroethane, ug/l	0.56
Trans-1,2-Dichloroethylene, ug/l	1.3
cis-1,2-Dichloroethylene, ug/l	1.1
Chloroform, ug/l	0.62
1,2-Dichloroethane, ug/l	0.56
2-Butanone (MEK), ug/l	3.2
1,1,1-Trichloroethane, ug/l	0.75
Carbon Tetrachloride, ug/l	0.54
Vinyl Acetate, ug/l	1.8
Bromodichloromethane, ug/l	0.37
1,1,2,2-Tetrachloroethane, ug/l	1.4
1,2-Dichloropropane, ug/l	2.4
trans-1,3-Dichloropropene, ug/l	0.59
Trichloroethene, ug/l	1.6
Dibromochloromethane, ug/l	0.53

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LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

FLQAP2-2 Method Detection Limit (MDL)

PARAMETER	FLQAP2-2
1,1,2-Trichloroethane, ug/l	0.70
Benzene, ug/l	1.1
cis-1,3-Dichloropropene, ug/l	0.59
2-Chloroethylvinyl Ether, ug/l	1.7
Bromoform, ug/l	0.98
2-Hexanone, ug/l	3.6
4-Methyl-2-pentanone (MIBK), ug/l	2.7
Tetrachloroethene, ug/l	0.79
Toluene, ug/l	1.4
Chlorobenzene, ug/l	0.55
Ethylbenzene, ug/l	0.65
Styrene, ug/l	4.8
Xylenes, ug/l	1.3

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LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

 FLQAP2-3 Method Blank
 FLQAP2-4 Lab Control Standard (LCS) % Recovery
 FLQAP2-5 Matrix Spike (MS) % Recovery
 FLQAP2-6 Matrix Spike Duplicate (MSD) % Recovery
 FLQAP2-7 Precision (% RPD for MS/MSD)

PARAMETER	FLQAP2-3	FLQAP2-4	FLQAP2-5	FLQAP2-6	FLQAP2-7
Volatiles by GC/MS (8240)					
Chloromethane, ug/l	<10	---	---	---	---
Bromomethane, ug/l	<10	---	---	---	---
Vinyl Chloride, ug/l	<10	---	---	---	---
Chloroethane, ug/l	<10	---	---	---	---
Methylene Chloride (Dichloromethane), ug/l	<5.0	---	---	---	---
Acetone, ug/l	<50	---	---	---	---
Carbon Disulfide, ug/l	<5.0	---	---	---	---
1,1-Dichloroethene, ug/l	<5.0	98 %	100 %	98 %	2.0 %
1,1-Dichloroethane, ug/l	<5.0	---	---	---	---
Trans-1,2-Dichloroethylene, ug/l	<5.0	---	---	---	---
cis-1,2-Dichloroethylene, ug/l	<5.0	---	---	---	---
Chloroform, ug/l	<5.0	---	---	---	---
1,2-Dichloroethane, ug/l	<5.0	---	---	---	---
2-Butanone (MEK), ug/l	<50	---	---	---	---
1,1,1-Trichloroethane, ug/l	<5.0	---	---	---	---
Carbon Tetrachloride, ug/l	<5.0	---	---	---	---
Vinyl Acetate, ug/l	<10	---	---	---	---
Bromodichloromethane, ug/l	<5.0	---	---	---	---

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LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

FLQAP2-3 Method Blank
 FLQAP2-4 Lab Control Standard (LCS) % Recovery
 FLQAP2-5 Matrix Spike (MS) % Recovery
 FLQAP2-6 Matrix Spike Duplicate (MSD) % Recovery
 FLQAP2-7 Precision (% RPD for MS/MSD)

PARAMETER	FLQAP2-3	FLQAP2-4	FLQAP2-5	FLQAP2-6	FLQAP2-7
1,1,2,2-Tetrachloroethane, ug/l	<5.0	---	---	---	---
1,2-Dichloropropane, ug/l	<5.0	---	---	---	---
trans-1,3-Dichloropropene, ug/l	<5.0	---	---	---	---
Trichloroethene, ug/l	<5.0	92 %	98 %	103 %	2.5 %
Dibromochloromethane, ug/l	<5.0	---	---	---	---
1,1,2-Trichloroethane, ug/l	<5.0	---	---	---	---
Benzene, ug/l	<5.0	100 %	102 %	97 %	5.0 %
cis-1,3-Dichloropropene, ug/l	<5.0	---	---	---	---
2-Chloroethylvinyl Ether, ug/l	<50	---	---	---	---
Bromoform, ug/l	<5.0	---	---	---	---
2-Hexanone, ug/l	<50	---	---	---	---
4-Methyl-2-pentanone (MIBK), ug/l	<50	---	---	---	---
Tetrachloroethene, ug/l	<5.0	---	---	---	---
Toluene, ug/l	<5.0	99 %	89 %	98 %	9.5 %
Chlorobenzene, ug/l	<5.0	104 %	94 %	94 %	6.2 %
Ethylbenzene, ug/l	<5.0	---	---	---	---
Styrene, ug/l	<5.0	---	---	---	---
Xylenes, ug/l	<5.0	---	---	---	---
Surrogate - Toluene-d8	98 %	---	---	---	---
Surrogate - 4-Bromofluorobenzene	94 %	---	---	---	---
Surrogate -	100 %	---	---	---	---
1,2-Dichloroethane-d4					
Date Analyzed	05.13.94	---	---	---	---
Prep or Extraction Date	05.13.94	---	---	---	---

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LOG NO SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES

FLQAP2-3 Method Blank
FLQAP2-4 Lab Control Standard (LCS) % Recovery
FLQAP2-5 Matrix Spike (MS) % Recovery
FLQAP2-6 Matrix Spike Duplicate (MSD) % Recovery
FLQAP2-7 Precision (% RPD for MS/MSD)

PARAMETER FLQAP2-3 FLQAP2-4 FLQAP2-5 FLQAP2-6 FLQAP2-7

Methods: EPA SW-846

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CLP EQUIVALENT SUPPLEMENTAL DATA PACKAGE INCLUDES

1. Run sequence log
2. Five-point curves or data with chromatograms or instrument printouts
3. Daily check standard/continuing calibration form and standard chromatograms or instrument printouts
4. Sample spike, (LCS and matrix), method blank chromatograms, quant reports, and/or instrument printouts
5. Project narrative

13.0 CORRECTIVE ACTION

Corrective action will be initiated when data are determined to be questionable or QC criteria are out of control. For routine operational problems, the analysts correct the problem and note the problem/corrective action on the run log or bench data sheet.

When formal corrective action is required, a nonconformance report (NCR) is prepared on the NCR form (Figure 13.1). NCRs are required for:

1. Chronic problems which could affect data quality or production and are due to equipment or facility disrepair or inadequacy, improper training, employee attitude or ineptness, supply, reagent or standard quality, SOP inadequacy or error, or any other problems which could be corrected by management. NCRs for this type of problem should be prepared by the analyst and channelled through the department manager/lab manager to the laboratory director. The box by "Request Lab Director's Attention" should be checked and final action should be taken by the lab director.
2. For uncorrectable nonconformance problems which are noted by an asterisk (*) in Table 13.1 which could affect the quality of report data, corrective action is initiated by the analyst or department manager. Before an NCR is prepared, the analyst/department manager will review raw data, calculations, and operating conditions of the instrument. If this does not resolve the problem, analysis of the batch (samples plus QC samples) is repeated provided sufficient sample is available. If data are submitted in cases where QC is not in compliance, this is documented in a case narrative which is part of the data report. The action must be approved by the project manager who submits the report.
3. When QA problems are discovered during internal data review, internal system audits, client inquiries, or external data review or validation, an NCR is prepared by the QA, project, or department manager, as appropriate, and is filed in the QA department.

The status of all NCRs is tracked through an NCR registry which lists the NCR number, date initiated, originator initials, department, SL log number, nonconformance and corrective action codes, and closeout date.

Copies of completed, closed-out NCRs are filed in departmental notebooks. The original NCRs are filed in the QA department.

Control charts are periodically reviewed and evaluated by department managers or departmental staff. All quality control data at Savannah Laboratories are evaluated on a "real-time" basis by laboratory staff against annually updated limits. This evaluation is done prior to control charting. Thus, control charts are used only to track trends and satisfy certain agency requirements. Corrective action is taken as required if control chart trends do not meet specified agency protocols.

Corrective action responses to agencies addressing any parameters found to be outside the acceptance limits in WP, WS or similar performance audits are made in a formal corrective action response letter. This letter details the results of data review and investigation, describes causative factors if found, and the corrective action taken to address any problems uncovered in the review or investigation. Copies of the corrective action letters are appended to the performance audit results and submitted when results are requested. Blind performance audit samples are generally analyzed as corrective action to unacceptable results.

Savannah Laboratories will abide by any corrective action deemed necessary by all pertinent agencies.

FIGURE 13.1

NONCONFORMANCE REPORT (NCR)

NCR # _____

Date Initiated: _____ Client ID: _____ Client _____

SL Log No. _____ Analysis: _____ Date of Analysis: _____

Analyst: _____ Department Manager: _____ Project Manager: _____

Nonconformance Code: _____ Description: _____

Project Manager's Initials: _____ Date: _____

QA Manager's Initials: _____ Date: _____

Request Lab Director's attention LD Initials: _____ Date: _____

Corrective Action Code: _____ Description: _____

Corrective Action Completed: Department Manager's Initials: _____ Date: _____

QA Manager's Initials: _____ Date: _____

Copies of this report should be filed in the departmental Corrective Action Notebook and in the report file. The original is retained by the QA department.

TABLE 13.1

CORRECTIVE ACTION

QC Activity	Acceptance Criteria	Recommended Corrective Action
* GC/MS tuning or ICP/AA	Per SOPs or Chapter 9.0	Do not analyze samples unless criteria are met.
* Initial calibration standards	Per SOPs or Chapter 9.0	Reanalyze standards. If still unacceptable, remake standards or instrument corrections.
* QC check/continuing calibration standard	Per SOPs, See Chapter 9.0	Reanalyze standard. If still unacceptable, remake standards, or recalibrate.
* Method blank	< PQL (for CLP procedures, use SOW guidelines)	Reanalyze blank. If problem, determine source of contamination. If necessary or possible, redigest/extract batch and reanalyze.
* Surrogate recovery (GC/MS semivolatiles)	Tables 5.1 and 5.2. One acid and one base may be out of criteria.	Follow method guidelines.
* Surrogate recovery (GC/MS volatiles)	0 outside criteria in Tables 5.1 and 5.2	Follow SW-846 method or CLP guidelines.
* Surrogate recovery GC or LC	Tables 5.1 and 5.2	Check for possible matrix interferences or other causes and follow method guidelines.
Matrix spike recoveries	Tables 5.1 and 5.2**	Check for possible matrix interferences or other causes. If still out, evaluate LCS.
* Lab control standard (LCS) recoveries	In-house or protocol-required limits.**	Check calculations, reanalyze standards, and if necessary or possible, redigest or extract batch and reanalyze.
* Internal standards (organics)	Method or protocol-required limits***	Follow method or protocol guidelines

* If criteria cannot be met, an NCR must be prepared and approved by QA manager and project manager.

** For projects subject to Florida DEP QAS criteria, matrix spikes are utilized for control criteria. If matrix spikes are out, LCSs are evaluated.

*** Not usually required for 500, 600 and 8000 series methods.

14.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits are performed in each laboratory throughout the year.

14.1 Internal System Audits

14.1.1 Corporate Audits

Periodically, as directed by the president or corporate QA manager, an on-site systems audit is conducted on all or selected aspects of the laboratory and field operations at each facility. This audit is coordinated by the president and the corporate QA manager and is conducted by a multiperson audit team which may be comprised of individuals with expertise in the organic, inorganic, QA, project custody, data management, and field sampling areas, the corporate safety director, and a representative from the business office. This on-site audit may be supplemented by review of reports and QA data in the LIMS network and review of selected data packages. An audit report is issued by the team, to the president within two weeks of completion of the audit and a copy is provided by the QA manager to the lab director.

The corporate system audits consist of an examination of laboratory procedures and documentation to ensure that the entire laboratory is being operated according to established protocol. The auditors will audit that the proper frequency of quality control standards, spikes, duplicates, etc., are incorporated with each sample analytical run, and all results are documented, up to date, and accessible for review. Control charts are checked to ensure their proper maintenance. Calculations are spot checked and data procedures are reviewed to ensure SOPs are being followed, and special attention is given to calibration procedures. The systems audit check also ascertains whether proper documentation exists to trace working analytical standards back to stock standards. Finally, analysts' techniques are evaluated against techniques as defined in the SOPs, the SL Training SOP, and recognized good laboratory practices.

The QA manager and laboratory director coordinate the response to the audit and are responsible for documenting required corrective action.

14.1.2 Laboratory Audits

Semiannual internal laboratory systems audits are conducted by QA managers at each division. The scope and depth of the audit are determined by each QA manager according to requirements of the division. Prepared checklists are generally used to assist the auditing process. These checklists are periodically changed to audit various aspects of the operation of the laboratory and to ensure they are current with all quality control procedures. An internal laboratory systems audit may include any of the audit items of the corporate internal systems audit described above. It may also consist of or include tracing an SL log number through the laboratory and auditing all associated quality control documentation. The audit may check that corrective actions for past external on-site inspections have been fully implemented. A report of the audit is prepared and submitted to the lab director and corporate QA manager. An

example page from an internal laboratory systems audit checklist is given in Figure 14.1. This particular example contains quality assurance questions directed to the custody section of the laboratory.

14.1.3 Field Audits

An internal field systems audit of each divisional field sampling operation is performed annually. These audits are conducted by each field/sampling manager and may include all aspects of field sampling operations. An example page from an internal field systems audit checklist is given in Figure 14.2.

14.2 External System Audits

Each laboratory may be certified by a number of state agencies, governmental agencies or private certification programs. Most of these programs require continuing on-site system audits of the laboratory. The laboratories submit to these on-sites as required by these certifying agencies and organizations and respond to any noted nonconformances with corrective actions.

Field system audits are performed periodically by various federal and state regulatory agencies. Field sampling and documentation procedures are examined to ensure sampling is performed according to the agency protocols.

14.3 Performance Audits

14.3.1 Internal Performance Audits

Internal performance audits or evaluations are routinely performed by Savannah Laboratories. Single blind performance audits are employed for several reasons. One purpose is to provide corrective action for parameters judged to be unacceptable on WP, WS or other major external performance audits. Periodic internal performance audits are also used to test parameters that are not routinely tested by external performance audits. Finally, single blind performance audits are employed to satisfy certain certification requirements, to satisfy auditors' specific requests for performance audit samples, or provide additional evidence of data quality to clients with specific questions regarding laboratory performance.

In addition to internal single blind performance audits, Savannah Laboratories performs double blind performance audits periodically. In this type audit (which are initiated by the corporate QA manager), analysts do not know a sample's identity as an audit sample. This performance audit tests parameters included in most major methods.

FIGURE 14.1

LABORATORY INTERNAL SYSTEMS AUDIT CHECKLIST		
	Yes	No
I. CU (Custody) Section Contacts: _____ _____		
A. Are comprehensive, up-to-date SOPs available for this section? Comments: _____ _____		
B. Are custody logbooks properly maintained? Comments: _____ _____		
C. Is sample preservation checked and documented on arriving samples? Comments: _____ _____		
D. Is the temperature of each lab pack recorded and documented upon arrival? Comments: _____ _____		
E. Are sample custody excursion forms used if required? Comments: _____ _____		
F. Are chain-of-custody forms properly filed? Comments: _____ _____		

FIGURE 14.2

FIELD INTERNAL SYSTEMS AUDIT CHECKLIST		
	Yes	No
I. General Procedures		
Contacts: _____ _____		
A. Were sampling locations identified by map or facility tour by the client? Comments: _____ _____		
B. Were the wells locked? Comments: _____ _____		
C. Were samples collected starting with the least likely contaminated and proceeding to the most likely contaminated? Comments: _____ _____		
D. Were new disposable rubber gloves worn during collection of all samples? Comments: _____ _____		
E. Was sampling equipment wrapped in aluminum foil and protected from possible contamination prior to sample collection? Comments: _____ _____		

14.3.2 External Performance Audits

All facilities participate in each of the following performance evaluation audits semiannually:

1. U. S. EPA Water Supply Study (WS Series).
2. U. S. EPA Water Pollution Study (WP Series).

Additionally, the laboratories participate in several regulatory agency, certifying group, or client requested performance audits. Results from these performance audits are reported to management, agencies, and clients as required.

Results from agency performance audits are supplied to clients upon request.

15.0 QUALITY ASSURANCE REPORTS

15.1 Internal Reports

The QA manager of each division is responsible for providing quality assurance reports to division and/or corporate management. QA managers report all performance evaluation results (such as WP and WS study results) to the laboratory director and corporate QA manager. These submissions include any required corrective action responses and are made upon completion of the responses.

Reports are also made to the laboratory director and corporate QA manager of any external audits or on-site inspections of each laboratory that result in a written report from the auditor or inspector. If the inspection requires corrective actions, the corrective action response will be included in the reports.

Reports of any changes in certification status are reported to the marketing director, corporate QA manager, and all laboratory directors and vice presidents. New or updated certificates of certification and new or revised certified parameter lists are submitted as soon as they are received by the division QA manager.

An annual report addressing any revisions to the QA plan and including data for updating control limits and MDLs is due two months prior to the anniversary date of the QA plan and is submitted to the vice presidents and corporate QA manager. Any suggestions for additions, deletions, or modifications to the text, updated equipment lists and organizational charts, method/parameter additions or deletions, and any required method validation studies are submitted with this report.

Results of semiannual internal systems audits are reported to the laboratory director and the corporate QA manager as completed. These reports are maintained in both the divisional and corporate QA files.

Requests for SOP changes or new SOPs are made to the corporate QA manager as required. Technical changes to the SOPs are approved by the corporate organics or inorganics manager as appropriate.

QA managers from all divisions meet periodically to report on and discuss issues of common concern. These topics may include SL's quality assurance plan, SOPs, chronic nonconformances, training, control charts, document control, and general quality control issues. The president is present during these meetings so that decisions reached may be implemented with full understanding and support of upper management. Each QA manager reports on QA issues that may be specific to their division and resolutions are suggested to any QA problems that manager has identified.

The corporate QA manager reviews all QA reports and summarizes them in a presentation to the president and vice presidents.

15.2 External Reports

Monthly progress reports are made to all required agencies or offices such as HAZWRAP, NEESA and the UMTRA Project Office. The scope and content of these reports is generally defined by the agency or office.

When required, QA reports are submitted to DEP QAS as provided for in Table VI, Appendix D of DER-QA-001/90. Each project-specific report is submitted at the recommended frequency, and includes a title page, a table of contents, specific information for either the performance or systems audits, significant QA/QC problems, and corrective action status as described in Appendix D. If no project audits are performed and no significant QA/QC problems occur for the duration of a project requiring a DEP QA report, a letter stating these facts will be submitted in lieu of the QA report.

APPENDIX B
EQUIPMENT CALIBRATION AND MAINTENANCE

EQUIPMENT CALIBRATION AND MAINTENANCE PROCEDURES

Calibration and maintenance procedures for the equipment identified below are presented in this Appendix.

- Dissolved Oxygen Meter
- Explosimeter
- Glass-Mercury Thermometer
- HNu Photoionization Analyzer
- Photo Vac Micro Tip HL-200
- OVA Flame Ionization Detector
- In-Situ HERMIT Environmental Data Logger
- pH Meter
- Specific Conductance Meter
- TLV Sniffer Combustible Gas Detector Meter
- Turbidimeter
- Water Quality Monitoring System

CALIBRATION AND MAINTENANCE OF DISSOLVED OXYGEN METER

Accuracy

The calibrated accuracy of the dissolved oxygen meter (YSI Model 51B Dissolved Oxygen Meter) will be better than ± 0.2 mg/l when calibrated within $\pm 5^{\circ}\text{C}$ of actual sample temperature. Temperature which can also be measured with this instrument, has an accuracy of $\pm 0.7^{\circ}\text{C}$ over the full scale temperature range of -5°C to $+45^{\circ}\text{C}$.

Calibration

- 1) Switch instrument to OFF and adjust meter mechanical zero.
- 2) Switch to ZERO and adjust to "O" on mg/l scale.
- 3) Switch to FULL SCALE and adjust to "15" on mg/l scale.
- 4) Prepare probe for operation, plug into instrument, wait up to 15 minutes for probe to stabilize. Probe can be located in calibration chamber or ambient air.
- 5) Switch to CALIB O₂ and adjust CALIB control until meter indicates local altitude on short scale in upper right corner of meter.
NOTE: It is desirable to calibrate probe in a high humidity environment. See instruction manual for more detail on calibration and other instrument and probe characteristics.

Maintenance

- 1) When not in use or between measurements, keep the dissolved oxygen probe immersed in or moist with deionized water.
- 2) Replace batteries after 1000 hours of operating or if full scale adjustment cannot be made. Use Eveready 935 "C" size or equal.
- 3) Membranes will last indefinitely depending on use. Average replacement is 2-4 weeks. Probe should be stored in humid environment to prevent drying out.
- 4) Calibrate daily.

Data Validation

All instrument calibrations will be documented, indicating the meter readings before and after the meter has been adjusted. Each preparation of probe and method of calibration will also be documented. This is important, not only for data validation, but also to establish maintenance schedules and component replacement.

CALIBRATION AND MAINTENANCE OF THE EXPLOSIMETER

Accuracy

The calibrated accuracy of the Mine Safety Appliances (MSA) Combustible Gas and Oxygen Alarm, Model 261, is $\pm 0.3\%$ oxygen at constant temperature and pressure; and $\pm \%$ LEL (lower explosive limit) up to 50% of full scale, and $\pm 5\%$ LEL up to 100% of full scale

for combustible gas. Measurement ranges are 0 to 25% oxygen, and 0 to 100% LEL, with operating temperature ranging from 0°F to 104°F. However, below 32°F, response time is longer.

Calibration

Combustible System Calibration Check - Before the calibration of the combustible gas indicator can be checked, the Model 261 must be in operating condition. Calibration check adjustment is made as follows:

- 1) Check and zero the instrument.
- 2) Attach the flow control to the recommended calibration gas tank.
- 3) Connect the adapter-hose to the flow control.
- 4) Open flow control valve.
- 5) Connect the adapter-hose fitting to the inlet of the instrument. After approximately 15 seconds, the LEL meter pointer should be stable and within the range specified on the calibration sheet accompanying the calibration equipment. If the meter pointer is not in the correct range, stop the flow and remove the right hand side (speaker) panel. Turn on the flow and adjust the "S" control with a small screwdriver to obtain the reading specified on the calibration sheet.
- 6) Disconnect the adapter-hose fitting from the instrument.
- 7) Close the flow control valve.
- 8) Remove the adapter-hose from the flow control.
- 9) Remove the flow control from the calibration gas tank.
- 10) Replace the side panel on the Model 261.

Oxygen System Calibration Check - Make an oxygen system calibration check each time a combustible gas check is made.

Note: More detailed instructions are contained in the operating manual.

Maintenance

- 1) Battery Pack Charging - The primary maintenance item of the Model 261 is the rechargeable, 4.0-volt lead-acid battery. Using the appropriate batter charger (120 VAC, Part No. 631664, or 240 VAC, Part No. 631712) insert charger plug into charge jack.

The POWER ON lamp indicates that the charger is receiving power from the 120 or 240 VAC line. The FAST CHARGE lamp indicates that the battery voltage is low and that the charger has automatically switched to the higher charge rate. When the battery is approximately 95% charged, the charger will change to the trickle charge rate and the FAST CHARGE lamp will be extinguished.

Caution: Use only the chargers specified above to charge the instrument; otherwise, damage to the battery pack and/or the instrument circuitry may result.

Recommended charging time is 14 hours. The battery pack may be left on charge for longer periods without damage.

Warning: Do not charge the battery pack in areas that may contain a flammable mixture of combustible gases, vapors, or dust and air; otherwise, an explosion may occur since a source of ignition exists during charging.

- 2) Extended Operation - An external Charging Adapter (Part No. 477153) can be used to charge a depleted battery while it is removed from the instrument. Use of this adapter permits extended operation by enabling the user to install a second, back-up battery into the instrument while externally charging the depleted battery.

The battery pack may not supply full power capacity after repeated partial use between chargings; therefore, it is recommended that the battery pack be "exercised" at least once per month by operating the Model 261 for 8 to 19 hours and then recharging. The battery pack should be charged after each day of use (or prior to use if the instrument has not been operated for 30 days).

- 3) Battery Pack Replacement - When the rechargeable, 4.0-volt lead-acid battery pack no longer responds to recharging or no longer "holds" a charge, the pack should be replaced according to the following procedure:
 - a) Loosen the knurled screws holding the handle and remove the handle.
 - b) Looking at the front panel of the instrument, remove the right (audible alarm side) panel by unscrewing the four side panel screws.
 - c) Gently pull the side panel loose and tilt the instrument to help slide out the battery case. Disconnect the molded nylon plug from the battery case. (NOTE: Do not disconnect the alarm speaker.)
 - d) Install the new battery by reversing steps 1 through 3 above.

- 4) Sample Inlet Filter/Filter Element - The sample inlet filter should be examined each time the Model 261 is recharged. If the filter element appears to be coated with dust or dirt, it should be washed, dried and re-inserted or a new element substituted. If a new element is installed, also install a new filter O-ring. Make sure the inlet seal O-ring in the inlet filter cap is properly seated. If the O-ring is damaged or missing, replace it before using the Model 261 with any sampling accessories.
- 5) Printed Circuit Board Adjustments - The printed circuit board contains five adjustment pots, identified as follows:

Oxygen Sensor Adjustment

- O₂H: The Oxygen High Alarm Point Adjustment (factory-set at 23%).
- O₂L: The Oxygen Low Alarm Point Adjustment (factory-set at 19.5% oxygen).
- O₂ OFFSET: The Oxygen Offset controls the zero reading of the oxygen meter. The leads to the oxygen cell must be disconnected and shorted together, and the front panel CALIBRATE O₂ knob turned fully clockwise. The % oxygen meter should indicate zero; adjust OFFSET if necessary.

Combustible Gas Sensor Adjustment

- CGA: The combustible Gas Alarm Point Adjustment (factory-set at 25% LEL).
- S: After zeroing, the Span is adjusted by sampling calibration check gas and adjusting the readout accordingly.

Data Validation

All instrument calibrations will be documented, indicating the meter readings before and after the meter has been adjusted. The standard used to calibrate the meter will also be documented. This is important, not only for data validation, but also to establish maintenance schedules and component replacement.

CALIBRATION AND MAINTENANCE OF GLASS-MERCURY THERMOMETER

To check the glass-mercury thermometer, both the thermometer and the YSI temperature probe should be immersed into the same beaker of water. Any differences in

temperature should be noted and recorded in the field log. The thermometer should be kept clean and protected from breakage in a hard tube or case.

CALIBRATION AND MAINTENANCE OF HNu PHOTOIONIZATION ANALYZER

Accuracy

The HNu PI-101 is temperature compensated so that a 20 degrees Celsius change in temperature corresponds to a change in reading of less than two percent full-scale at maximum sensitivity. The useful range of the instrument is from 0.2 to 2000 ppm. Response time is less than three seconds to 90 percent of full-scale.

Calibration

Prior to use, the HNu meter will be checked using a pressurized cylinder of isobutylene. The isobutylene will be certified by HNu Systems Inc. to be 100 ppm of isobutylene in air. The HNu meter is calibrated to benzene at the manufacturer. Thus, the 100 ppm of isobutylene check gas should deflect to 63 ppm on the meter scale.

Maintenance

1. If any of the following conditions occur, consult the troubleshooting guide provided in the Instruction Manual:
 - a. No meter response in any switch position (including BATT CHK).
 - b. Meter response in BATT CHK, but reads zero or near zero for all others.
 - c. Instrument reads correctly in BATT CHK and STBY, but not in measuring mode.
 - d. Instrument responds in all positions, but signal is lower than expected.
 - e. Erratic meter movement occurs.
 - f. Instrument response slow or irreproducible.
 - g. Low battery indicator.

Should the troubleshooting techniques fail to resolve the problem, send the instrument to the manufacturer for repair and maintenance.

2. The light source window will be cleaned at a minimum of every two weeks. Cleaning frequency will be based on meter performance when checked against 100 ppm of isobutylene in air.

3. The meter battery will be checked at the beginning and end of each day. If the needle is not within or above the green battery arc on the scale-plate, the battery will be recharged prior to making any measurements.

Data Validation

A daily log will be kept to document equipment and standards utilized. Recorded information for the equipment will include the name, model number, and data of calibration. Standards used in calibration of equipment will be documented by trade name, lot number and expiration date. Any unusual readings and routine maintenance procedures will also be documented.

CALIBRATION AND MAINTENANCE OF MICROTIP HL-200

Accuracy

The Photovac Inc. Microtip HL-200 after calibration with isobutylene, 100 ppm Span Gas, is accurate to within ± 2 ppm or $\pm 10\%$ for 0 to 100 ppm range, $\pm 15\%$ for 100 to 1,000 ppm range, and $\pm 20\%$ for 1,000 to 2,000 ppm range. The useful range of the instrument is from 0.1 to 2,000 ppm isobutylene equivalent. Response time is less than three seconds.

Calibration

Prior to use, the Microtip HL-200 will be checked using a pressurized cylinder of isobutylene. The isobutylene will be certified by Photovac Inc. to be 100 ppm of isobutylene in air. The Microtip meter is calibrated to toluene at the manufacturer. The following procedure will be used to calibrate the Microtip:

1. Set the Microtips zero point with a supply of Zero Gas, which contains no ionizable gases or vapors.
2. Then expose the Microtip to the Span Gas of known concentration, press enter and the Microtip will automatically calibrate itself.

Maintenance

1. If any of the following conditions occur, consult the troubleshooting guide provided in the Instruction Manual:
 - a. Microtip draws liquids
 - b. Instrument displays fault and status codes in the display window

- c. Detector light intensity is low
 - d. Signal from zero gas is too high
 - e. Detector field voltage is low
2. The light source window will be cleaned at a minimum of every 24 hours of operation. Cleaning frequency will be based on meter performance when checked against 100 ppm of isobutylene in air.
 3. The Microtip battery will be checked at the beginning and end of each day. If the Lo Bat status is indicated in the display, the battery will be recharged prior to making any measurements or replaced with a fully-charged battery.

Data Validation

A daily log will be kept to document equipment and standards utilized. Recorded information for the equipment will include the name, model number, and data of calibration. Standards used in calibration of equipment will be documented by trade name, lot number and expiration date. Any unusual readings and routine maintenance procedures will also be documented.

CALIBRATION AND MAINTENANCE OF OVA FLAME IONIZATION DETECTOR

Accuracy

The Foxboro Model 128 OVA is factory calibrated to read methane equivalents. The instrument has a linear scale available in three ranges: 0-10, 0-100, and 0-1000 ppm. The response time is less than three seconds with 90% scale response.

Calibration

The OVA will be field calibrated on a daily basis using a pressurized methane reference gas standard. The reference gas will be certified to be 100 ppm of methane in air. After the instrument is in operation, a sample of reference gas is drawn through the probe. The gas select knob on the panel is then used to shift the readout meter indication to correspond to the concentration of the calibration gas mixture. Calibration on any one range automatically calibrates the other two ranges.

Maintenance

1. If any of the following conditions occur, consult the troubleshooting guide provided in the Instruction Manual:
 - a. Low sample flow rate on flow indicator (normally two units on flow gauge).
 - b. H₂ flame will not light or stay lighted.
 - c. Slow response time.
 - d. Slow recovery time.
 - e. Pump will not run.
 - f. No power on electronics, but pump runs.
 - g. No power to pump or electronics.

Should the troubleshooting techniques fail to resolve the problem, send the instrument to the manufacturer for repair and maintenance.

2. The instrument will be checked for air leaks at a minimum of every 24 hours of operation. After positioning the instrument vertically so the flow gauge can be observed, cover the end of the probe with one finger. If the ball drops to the bottom of the flow gauge, no substantial air leaks are present. Consult the Instruction Manual for leak isolation procedures if air leaks are detected.
3. The OVA battery will be checked at the beginning and end of each day. If the needle is not within the battery arc on the readout assembly, the battery will be recharged prior to making any measurements.

Data Validation

A daily log will be kept to document equipment and standards utilized. Recorded information for the equipment will include the name, model number, serial number, and date of calibration. Standards used in calibration of the equipment will be documented by trade name, lot number, and expiration date. Any unusual readings and routine maintenance procedures will also be documented.

CALIBRATION AND MAINTENANCE OF THE IN-SITU HERMIT ENVIRONMENTAL DATA LOGGER

Description

An In-Situ HERMIT Environmental Data Logger, Model SE1000B or equivalent, will be used on site in conjunction with an In-situ pressure transducer (PXD-260, PTX-160D or PTX-161D), to record water level changes during hydraulic conductivity testing.

The front panel controls of the HERMIT consist of a five digit liquid crystal display and an eight key keypad. The keys are divided into two groups: the white keys for basic

operations and the blue keys for data entry and modification. Basic operations include CLOCK, XD (short for transducer) and DATA; each of which can be accessed with a single keystroke. Data modifying operations such as START, STOP and changing test parameters require a sequence of keystrokes to prevent their accidental use.

Maintenance

There are no customer serviceable parts inside the SE1000B. The unit should require no calibration or periodic maintenance during its service life. It should not be necessary to clean the connectors or cable contacts. The action of installing the cables is normally sufficient to clean contamination from the contacts. The front panel may be wiped clean with a soft, damp cloth.

Battery Replacement

The battery pack used in the SE1000B is of special design, requiring that the unit be returned to In-situ's customer service facility for replacement. Permanent damage to the unit can result from improper replacement packs and procedures. When the low battery indicator appears in the display, the unit has approximately ten hours of "wake" time left. External power may be used to supplement battery power until the unit can be returned for a replacement pack.

Service

The SE1000B may need to be returned for service if any of the following symptoms appear:

1. A display of the form "Err.20" indicates that the unit does not pass its internal self tests. The unit will not permit itself to be used for data collection, and data already stored in the unit are inaccessible (upon wake up, the unit will display the error and immediately go back to sleep).
2. An unusually high number of watchdog counts may indicate an intermittent problem. The unit may be used for data collection but should be returned for a checkup as soon as possible.
3. A low battery indication in the display. The unit can probably finish the current test and dump the data. Long term tests should not be started when the unit is in this condition.

If symptoms other than these are apparent, check the cable interconnections and the programming of the SE1000B before requesting service on the unit. One incorrect scale factor or coefficient setting can cause data to appear way off.

CALIBRATION AND MAINTENANCE OF pH METER

Accuracy

An Orion SA 250 pH meter will be used for on-site pH and temperature measurement. The SA 250 meter will be equipped with a suitable combination pH electrode and automatic temperature compensation (ATC) probe. Temperature differential between the pH buffer standards and samples is automatically compensated for by the meter. The SA 250 meter has resolution capability to 0.1 or 0.01 standard pH units. Department of Transportation and Mil specifications have been met or exceeded for shock, vibration and moisture.

Check Out Procedure and Calibration

Prior to initial daily use, the SA 250 meter will be checked according to the following procedure.

Meter Check Out Procedure

1. Slide power switch to ON position. Attach BNC Shorting Plug to BNC connector on top of meter.
2. If LO BAT indicator on LCD remains on, the battery must be replaced.
3. Slide mode switch to mV. Display should read 0 + 0.3.
4. Slide mode switch to temp. Display should read 25.0. If 25.0 is not displayed, using \leftarrow , \rightarrow , and X10 keys, until 25.0 is displayed and press enter.
5. Slide mode switch to pH .01. Press iso. Display should read the letters ISO then a value of 7.00. If 7.00 is not displayed, scroll until 7.00 is displayed and press enter.
6. Press slope. Display should read the letters SLP then a value of 100.0. If 100.0 is not displayed, scroll until 100.0 is displayed and press enter.

7. Press sample. Observe the letters pH then a steady reading of 7.00 ± 0.02 should be obtained. If not, press cal and scroll until 7.00 is displayed and press enter. Press sample and observe a reading of 7.00.
8. Remove the shorting plug. After a successful completion of steps 1-8 the meter is ready to use with an electrode.

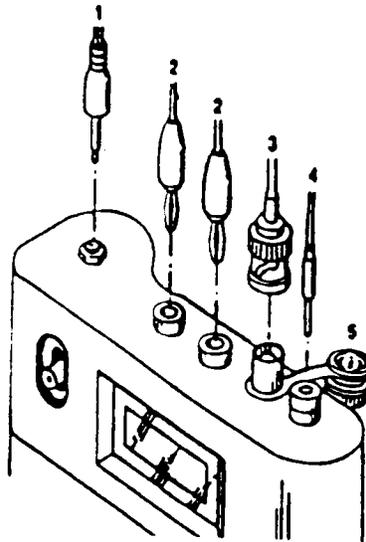


Figure B-1 - Portable pH Meter Electrode Connections

Electrode Connections

Refer to Figure B-1.

1. Attach electrodes with BNC connectors to sensor input by sliding connector onto input, pushing down and turning clockwise to lock into position. Connect reference electrodes with pin tip connectors by pushing connector straight into reference input.

NOTE: If using a combination electrode with a BNC connector, the reference pin-tip jack is not used (4 in Figure B-1).

Calibration

Calibration of the SA 250 meter will be performed using two standard buffer solutions of pH = 7.00 s.u. and pH = 4.01 s.u. Buffer solutions are standardized at 28 degrees Celsius against National Bureau of Standards certified pH = 6.88 and pH = 9.18 reference samples prior to measuring the pH of any sample. The following procedure is used for calibrations:

1. Connect electrode(s) to meter. Slide the mode switch to pH.1 4.01.

2. Place electrode(s) into pH₂, 7.00 buffer.
3. Press cal. The display will alternate between .1. and the pH value of the buffer, indicating this is the first buffer and a value has not been entered. Wait for a stable pH display and press enter. The correct display will freeze for 3 seconds then advance to .2. indicating the meter is ready for the second buffer.
4. Rinse electrode(s) and place into pH = 4.01 buffer. Wait for a stable pH display and press enter .

After the second buffer value has been entered the letters PH will be displayed. The meter is now calibrated and automatically advances to sample mode.

5. Rinse electrode(s), place into sample. Record pH directly from the meter's display.

The use of the ATC probe eliminate the need for temperature calibration.

Maintenance

1. When not in use or between measurements, the pH probe will be kept immersed in or moist with pH = 7.000 buffer solution.
2. The battery will be placed when the "LO BAT" indicator remains on during the instrument check out.
3. The pH electrode will be replaced whenever the probe is cracked or irremovable deposits build up on the junction.
4. If response time or stability problems develop and cannot be corrected the meter will be sent to the manufacturer for maintenance.

Data Validation

All instrument calibrations will be documented, indicating the meter readings before and after the meter has been adjusted. The pH buffers used to calibrate the meter will also be documented. This is important, not only for data validation, but also to establish maintenance schedules and component replacement.

CALIBRATION AND MAINTENANCE OF SPECIFIC CONDUCTANCE METER

Accuracy

The calibrated accuracy of the specific-conductance meter (YSI, Inc. Model 33 S-C-T Meter) ± 4.5 percent; this represents the worst-case error resulting from errors in the instrument and probe combined. Instrument error alone ranges from ± 2.5 to $\pm 3.0\%$.

Calibration

The specific-conductance meter will be calibrated by turning the MODE control to REDLINE and adjusting the REDLINE control so the meter needle lines up with the redline on the meter face. If this cannot be accomplished, the batteries must be replaced. Recalibration should be done at the factory.

Maintenance

The only maintenance required is battery replacement. Two "D" size alkaline flashlight cells, such as Eveready E95 or equivalent, will provide 200 hours of operation. Accuracy will not be maintained if zinc-carbon "D" cells are used. Battery replacement is indicated when the redline adjustment cannot be accomplished.

Replace batteries every six months to reduce the danger of corrosion due to leaky batteries. To replace batteries, remove the screws from the rear cover. The battery holders are color coded. The positive end must contact the red holder.

Data Validation

All instrument calibrations will be documented, indicating the meter readings before and after the meter has been adjusted. This is important, not only for data validation, but also to establish maintenance schedules and component replacement.

CALIBRATION AND MAINTENANCE OF THE TLV SNIFFER COMBUSTIBLE GAS DETECTOR

Accuracy

A Bacharach TLV Sniffer, model number 0023-7356 or equivalent, will be used on site for monitoring the concentration of toxic or flammable gases in the breathing zone on the site. The TLV Sniffer will be equipped with three range settings of 0 to 10,000 ppm, 0 to 1000 ppm and 0 to 100 ppm.

Calibration

Prepare the TLV Sniffer Combustible Gas Detector for operation in accordance with the following steps:

Battery Test

Turn MODE SELECTOR knob from OFF position to BATT TEST position. Meter pointer should come to rest in BATTERY GOOD range of meter scale. (Both a meter reading below BATTERY GOOD range and an audible signal warn of batteries too weak to sustain normal operation.)

Setting Meter Pointer to Zero

Set meter pointer to zero as follows:

1. Attach air sampling probe connector to instrument intake on left side of case by pulling back spring collar of connector, pressing connector over intake, and releasing spring collar.
2. Place TLV Sniffer in position in which meter indications will be read.

Note: Heat distribution from active and reference filaments of the detector sensor changes from vertical to horizontal position. The resulting change in electrical balance between elements causes a shift in pointer zero from one position to the other.

3. Set MODE SELECTOR switch to PPM X 100 and operate instrument for 10 minutes to allow circuits to stabilize.

4. In fresh air, set ZERO ADJUST knob at midpoint (five full turns from either extreme position). If fresh air is not available, use Bacharach Kit #51-7199 to apply known pure air to the Sniffer intake (instructions in kit).
5. If necessary, turn coarse adjustment screw, located under ZERO ADJUST knob, to move meter pointer to zero on the meter scale.
6. Turn MODE SELECTOR TO PPM X 10 position and turn ZERO ADJUST knob to set pointer to zero.
7. Turn MODE SELECTOR to PPM X 1 position and turn ZERO ADJUST knob to set pointer to zero.

Note: The TLV Sniffer is extremely sensitive in the PPM X 1 range. CO₂ from breath too close to the intake, cigarette smoke, auto fumes, etc., can interfere with accurate setting of the pointer to meter zero.

Setting Meter Pointer Deflection (Gain Calibration)

Quantitative Gas Test (Refer to Figures B-2, B-3, and B-4).

To ensure proper operation and to check calibration, it is necessary to periodically check the instrument against a known, standard blend of calibrating gas. This calibration will be performed on at least a weekly basis, prior to using the TLV Sniffer.

The Bacharach Code 51-7199 Gas Calibration Kit and optionally available Code 51-1120 Certified Gas Cylinder containing 500 PPM Hexane-in-air will be used to meet this requirement if fresh air is not available.

Refer to Figure B-3 and connect the gas transfer assembly as shown, making certain all connections are air-tight. Use the retaining clips (two each) to mount Flowmeter (06-6163) to its Mounting Bracket (51-1201). Make certain to connect rubber tubing at the base inlet connection on the Flowmeter, then to the barbed fitting on the Regulator and to the Quick Connect fitting previously installed on the TLV Sample-In (inlet fitting). Turn Regulator Valve (03-4318) fully counterclockwise (closed position) before attempting to screw regulator into calibration gas tank.

NOTE: DO NOT OPEN REGULATOR VALVE AT THIS TIME.

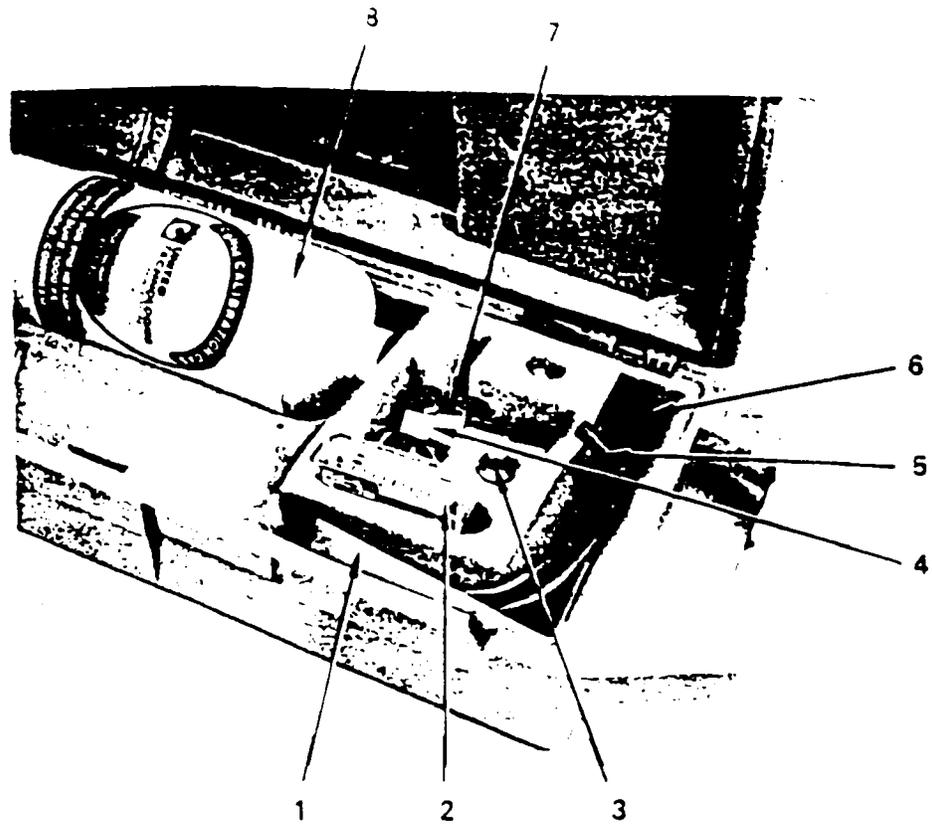


Figure B-2. Bacharach Code 51-7199 Gas Calibration Kit

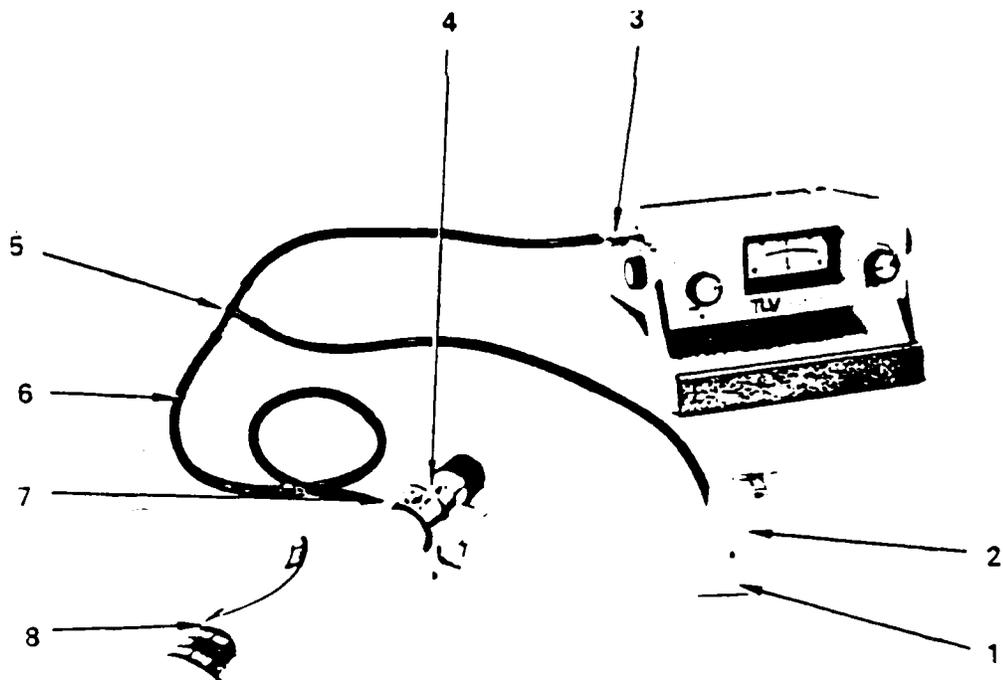


Figure B-3. Calibration Gas Transfer Assembly Properly Hooked Up.

This test is to be performed in a clean, fresh air (explosive-free) environment. If this is not possible, refer to Figure B-2 and substitute Code 51-7131 Zero Calibration Gas for the Code 51-1120 Cylinder of Hexane-in-air mixture.

Disregard Step 1) and connect the gas transfer assembly at the TLV Sample-In (inlet) fitting before performing Steps 4) and 5).

Open the Regulator Valve (clockwise) and adjust for flowmeter indication of (1) cfh to ensure adequate pump flow.

Remove Code 51-7131 Zero Calibration Gas and substitute the Code 51-1120 Cylinder of Hexane-in-air mixture before proceeding with Step 6).

To calibrate the instrument in a fresh air (explosive-free) environment, proceed as follows:

- 1) Remove case cover for access to internal adjustments and temporarily break gas transfer assembly connection at the TLV Sample-In (inlet) fitting.
- 2) Turn FINE ZERO ADJUST (pot) full clockwise and then five turns counterclockwise to mid-range. Then turn COARSE ADJUST (pot) full clockwise and then ten turns counterclockwise to mid-range.
- 3) Turn MODE SELECTOR TO BATT. TEST position. The meter pointer must indicate within BATTERY GOOD range, if not, recharge.

Refer to Figure B-4 locating TP-3 and connect a Voltmeter between TP-3 (+) and ground (-); check for 6VDC. If not, refer to Figure B-3 locating R-20 and adjust for $6\text{VDC} \pm .01 \text{ VDC}$.

- 4) After allowing for five-minute warm-up, turn MODE SELECTOR switch to PPM X 100 position and adjust R-13 (see Figure B-3) for meter pointer indication of scale zero.
- 5) Turn MODE SELECTOR switch to PPM X 10 position and adjust COARSE ADJUST for meter pointer indication of scale zero. Readjust as per Steps 4 and 5 until meter pointer indicates a relatively constant scale zero when MODE SELECTOR is switched between PPM X 10 and PPM X 100 range.
- 6) Turn MODE SELECTOR switch to PPM X 10 position. Reconnect Gas Transfer Assembly to TLV Sample-In (inlet) fitting. Open Regulator Valve (clockwise) and adjust for Flowmeter indications of (1) cfh to ensure adequate pump flow. Allow one minute for meter pointer to achieve maximum indication (refer to Figure B-4), adjust R-3 the X10 Span Adjuster until meter pointer indicates mid-scale (50) or 500 ppm. Remove gas, close Regulator Valve (fully CCW) and allow about two minutes for meter pointer to return to zero.

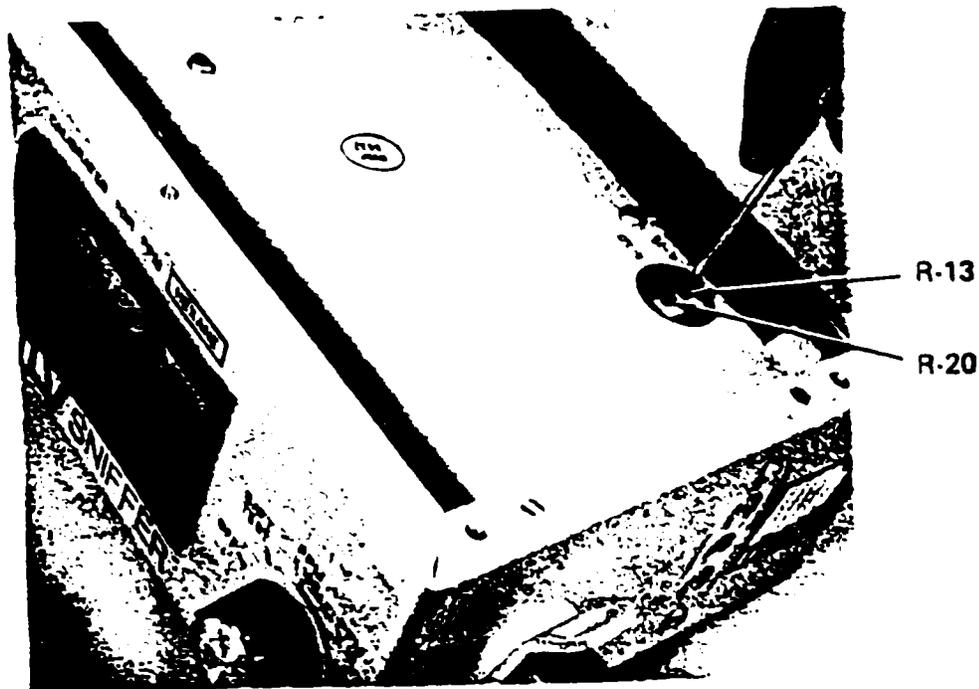


Figure B-4. Locating and adjusting R-13 on PPM X 100 position for meter pointer indication of scale zero.

- 7) Turn MODE SELECT switch to PPM X 10 position. Then turn the FINE ZERO ADJUST until meter pointer indicates full scale 1000 ppm. Turn MODE SELECT switch to PPM X 100 position and adjust R4 the X100 Span Adjuster until meter pointer indicates (10) or 1000 ppm. Turn FINE ZERO ADJUST until meter pointer indicates scale zero.
- 8) Turn MODE SELECT switch to PPM X 10 position, then turn FINE ZERO ADJUST until meter pointer indicates 10 on the scale or 100 ppm.
- 9) Turn MODE SELECT switch to PPM X 1 position and adjust the X1 Span Adjuster until meter pointer indicates 100 (full scale) or 100 ppm.
- 10) Turn FINE ZERO ADJUST until meter pointer indicates scale zero. The TLV is now calibrated and ready for use on the low range 0-100 ppm as a gas leak detector.

Operation

Monitor explosive gas and vapors to determine concentrations with respect to Threshold Limit Values as follows:

Direct Readings and Alarm

1. Turn MODE SELECTOR control to desired operating range, selected in accordance with the Threshold Limit Value for the toxic gas to be monitored (PPM X 1 for TLV from 0 to 100 ppm; PPM X 10 for TLV from 0 to 1000 ppm; PPM x 100 for TLV from 0 to 10,000 ppm).
2. Allow ten-minute warm-up period with instrument in same position as it is to be used in service (meter facing up or meter facing to the side).
3. In fresh air before entering monitoring area, turn ZERO ADJUST control knob until meter pointer resets on zero.
4. For monitoring in noisy areas, insert jack of accessory earphone in plug on right side of instrument case.
5. Enter monitoring area and read ppm gas concentrations on meter. Audible warning sounds if gas concentration causes readings at mid-point of scale or above, or if toxic Threshold Limit Value has been exceeded, provided the alarm has been set for this response.

Converting Hexane-Calibrated Meter ppm Readings to ppm Readings for Other Gases

Hexane gas is commonly used for factory calibration and subsequent in-service recalibrations of the TLV Sniffer. To determine ppm concentrations of gases other than hexane with instruments calibrated for hexane, multiply the ppm meter reading by the factor for the gas detected as listed in the table below. (Note meter range setting in making ppm readings and calculations.)

TABLE B-1

**MULTIPLYING FACTORS FOR CONVERTING ppm METER READINGS OF
HEXANE-CALIBRATED INSTRUMENTS TO ppm CONCENTRATIONS
OF OTHER GASES**

Gas Detected	Factor	Gas Detected	Factor
Acetone	1.50	Hydrogen Sulfide	18.60
Acetylene	1.78	Isopropanol	1.59
Acrylonitrile	1.54	M.E.K.	1.60
Benzene	1.02	Methane	1.58
1,3-Butadiene	1.52	Methanol	3.71
Butane	1.04	Methyl Acrylate	3.37
Butyl Acetate	2.08	Methyl Chloride	4.02
Carbon Disulfide	5.92	Methyl Chloroform	4.44
Carbon Monoxide	5.11	Pentane	1.04
Cyclohexane	1.02	Perchloroethylene	13.66
Ethane	1.36	Propane	1.14
Ethanol	1.90	Propylene	1.30
Ethyl Acetate	2.22	Styrene	2.25
Ethyl Ether	1.30	Tetrahydrofuran	1.41
Ethylene	1.38	Toluene	1.03
Ethylene Oxide	2.05	Trichloroethylene	6.40
Heptane	1.05	Vinyl Acetate	2.00
Hexane	1.00	Vinyl Chloride	2.24
Hydrogen	1.45	o-Xylene	1.64

Converting ppm Readings to Percent Level of Lower Explosive Limit (%L.E.L.)

To determine gas concentration levels in terms of percent of lower explosive limit (%L.E.L.) from direct ppm readings for Hexane or from calculated ppm concentration levels for other gases:

1. Read ppm on TLV Sniffer indicating meter.
2. On 0 to 10,000 "PPM CONCENTRATION IN SAMPLE" horizontal scale at bottom of %L.E.L. Conversion Chart, Figure B-5, locate position left-to-right representing ppm reading.
3. On slanted chart line representing kind of gas detected, find the point in vertical alignment over ppm reading point on horizontal scale.
4. On vertical scale at left labeled "%L.E.L. EQUIVALENT", read the percent-of-lower-limit equivalent found in horizontal alignment with the point located on the slanted line.

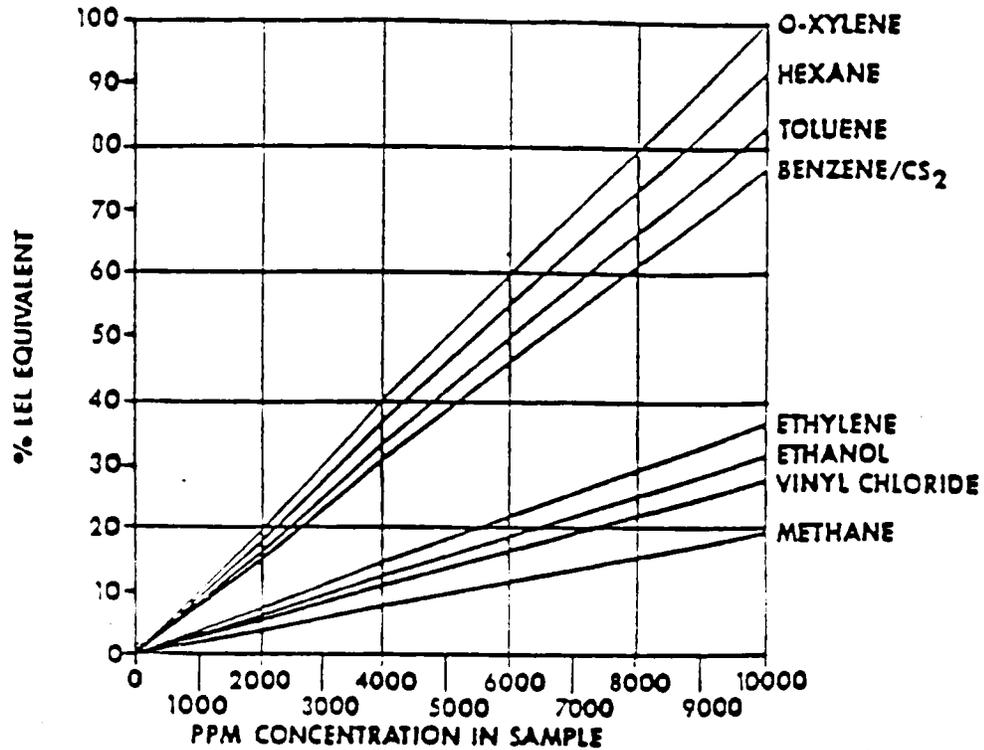


Figure B-5 Conversion Curves Showing Relationship of PPM Concentrations

Data Validation

All instrument calibrations will be documented indicating meter readings before and after adjustment. The gases used to calibrate the TLV Sniffer will also be documented.

CALIBRATION AND MAINTENANCE OF TURBIDIMETER

Accuracy

A Hach Model 16800 Portable Turbidimeter will be used for all turbidity measurement. The Hach 16800 will be operated in the range of 0 to 100 nephelometric turbidity units (NTU). A nickel/cadmium battery with approximately ten hours operating time per charge is built into the 16800 meter. Readings are repeatable to within $\pm 1\%$ of full scale.

Calibration and Operation

To ensure consistently accurate results, perform standardization before each set of tests.

1. Turn the instrument off and check the mechanical zero setting. Adjust the screwdriver adjustment control on the meter face if necessary to obtain a zero-NTU reading.
2. Press the power switch to ON and perform a battery check by pressing the BATT CHECK switch and verifying that the meter indicates in the BATTERY CHECK area. If not, charge the battery pack.
3. Place the focusing template into the cell holder. The focusing template will block all light from reaching the detector and allow the instrument to be zeroed electronically in Steps 4 and 5.
4. Press the 1.0 range switch and adjust the ZERO control for a reading of zero NTU.
5. Press the 10 range switch and verify that the meter still indicates zero NTU. Readjust the ZERO control if necessary.
6. Remove the focusing template and the 90-NTU turbidity standard into the cell holder. Use the black dot on the standard vial to orient the vessel in the same position each time, thereby eliminating variations due to rotation.
7. Place the light shield over the turbidity standard and allow the meter to stabilize.
8. Adjust the SPAN control for a reading of 90 NTU. Remove the light shield and turbidity standard. The instrument is now ready for use.

Taking the Turbidity Measurement

1. Press the appropriate range switch. Select the range that will exceed the expected turbidity of the sample under test.
2. Place the focusing template into the cell holder and adjust the ZERO control for a reading of zero NTU. Remove the focusing template. In the 100 range, place the cell riser into the cell holder before inserting the test sample.
3. Fill a clean sample cell to the white line with the sample to be measured and placed it into the cell holder. Use the white dot on the sample cell to orient the cell in the same position each time. Cover the sample cell with the light shield and allow the meter to stabilize. Read the turbidity of the sample.

Operational Notes

1. The sample size for all turbidity measurements should be 18 ml. Use the line on the sample cell as a level indicator. Variations in sample volume can affect the accuracy of the determinations.
2. When operating the instrument under bright ambient light conditions, protect the detector between measurements by inserting the focusing template or covering the cell holder with the light shield.

Maintenance

1. The battery pack will be recharged overnight subsequent to its use in the field.
2. Broken or highly scratched sample cells will be replaced. Small, slight scratches may be covered with a light coat of silicone oil. Cells with a build up of matter which cannot be removed will be discarded.
3. Lamp and focusing adjustments are not considered routine maintenance and will be performed only when the instrument readings are suspect.

Data Validation

All instrument calibrations will be documented, indicating the meter readings before and after the meter has been adjusted.

CALIBRATION AND MAINTENANCE OF THE WATER QUALITY MONITORING SYSTEM

The YSI Model 3560 Water Quality Monitoring System is a flow through device which can simultaneously measure conductivity, temperature, and pH in one sample chamber. The instrument is fully described in the following sections.

YSI MODEL 3520 FLOW-THROUGH CONDUCTIVITY CELL

Description

The YSI 3520 Flow-Through Conductivity Cell is designed for use with the YSI 3560 Water Quality Monitoring System. It is constructed of rigid and durable chlorinated polyvinyl chloride (PVC).

Conductivity is measured using two stainless steel electrodes. The cell constant is $K - 5.0/\text{cm} \pm 2\%$ at 25°C (77°F) at 1.00, 50.0 and 100.0 millimhos/cm, referenced to YSI standards which have been calibrated with standard solutions prepared in accordance with recommendation 56-1981 of the Organization Internationale De Metrologie Legale (OIML). Measurements above 100.0 millimhos/cm will not be within specification accuracy.

Attached to the cell body with a stainless steel bend relief is a three-foot polyurethane jacketed cable terminated with a watertight MS type connector.

The time constant of the cell is 10 seconds for registering 95% of a change in conductivity. Measurement is accurate with flow rates up to 1-1/2 gallons per minute.

Operation

The YSI 3520 Flow-Through Conductivity Cell is designed to be used in the YSI 3550 Sample Chamber Assembly. For use of the 3550, see its instruction or the 3560 Water Quality Monitoring System instructions.

1. Insert the 3520 into the designated port on the 3550 Sample Chart Assembly sensor mounting plate. Two sensor monitoring plate o-rings provide a watertight seal.
2. Press the adapter provided (or a length of 1/2" OD hard plastic tubing) into the elbow until you reach the stop. Then, press the elbow into the top of the 3520 until you reach the stop. Another two o-rings inside the top port of the 3520 provide a watertight seal.
3. Attach the MS connector to the receptacle marked **COND** on the Model 3500 and fit the lead into the cable harness.
4. Begin fluid flow as described in the 3560 system instructions.
5. To use the 3520 as a conductivity cell other than in the 3550 Sample Chamber Assembly, it is necessary to immerse the cell body in the fluid under test up to the midpoint on the knurled portion of the cell. Do not immerse the entire cell body, as this will change the cell constant (**K**).

Maintenance

Cleaning: The cell will be kept clean at all times to assure proper operation and accuracy. A dirty cell will contaminate the sample and cause the conductivity to change. Any of the foaming acid tile cleaners such as Dow Chemical "Bathroom Cleaner" will be used to clean the cell adequately. When a stronger cleaning preparation is required, a

solution of 10 parts each of distilled water and isopropyl alcohol and one part 10 normal hydrochloric acid will be used.

The cell will be dipped into the cleaning solution and agitated for two or three minutes. A small test tube brush will be used to gently clean the electrodes and flow-through port. Careful handling will be used so not to scratch the stainless steel electrodes. The cell will then be rinsed in several changes of distilled or deionized water.

Storage: The conductivity cells will be stored in deionized water. If the 3520 cell is stored dry, it will be soaked in deionized water for a minimum of 1 hour before use.

The o-rings will be changed annually to maintain their sealing integrity.

Calibration

The YSI 3520 Flow-Through Conductivity Cell is calibrated at the factory. The cell constant may vary slightly with the conductivity of the solution being measured. Calibration may also be affected by electrode fouling, mechanical shock or scratched electrodes. The 3520 cell will be calibrated as a system with the Model 3500, using YSI 3160-3169 Conductivity Calibrator Solutions.

YSI MODEL 3510 TEMPERATURE PROBE

Description

The YSI 3510 Temperature Probe is designed for use with the YSI 3560 Water Quality Monitoring System. When it is connected to the **TEMP** receptacle on the 3500, it provides a signal for both temperature measurement and for automatic temperature compensation (ATC) of conductivity measurements. When it is connected to the **pH ATC** receptacle, it provides automatic temperature compensation for pH measurements. One 3510 probe is provided with the 3560 system; two may be used at the same time to provide these function simultaneously.

The 3510 can be used over a temperature range of -5 to 50°C with an accuracy of $\pm .2^\circ\text{C}$, traceable to the National Bureau of Standards. The black polyurethane cable is three feet long and is terminated at one end with a watertight MS connector. The sensor end of the probe contains a YSI Thermilinear thermistor assembly mounted in an epoxy sealed sheath 3.25" long by .15" diameter. The time constant of the probe is less than 4 seconds for registering 95% of a change in temperature.

Specifications

Temperature Measurement (using YSI 3500 and 3510)

Measurement Range: -5 to 50.0°C

Accuracy of temperature measurements: $\pm 0.4^\circ\text{C}$

Resolution: 0.1°C

Operation

When using the 3510 in any ATC mode, be sure it is located beside the sensor for which it is to provide ATC measurement, whether in the YSI 3550 Sampler Chamber Assembly or in any other container.

Insert the 3510 into either of the designated ports on the sensor mounting plate of the 3550. Two o-rings in each port provide a watertight seal.

Maintenance

The 3510 requires very little maintenance when used in routine operations. The durable stainless steel sheath and polyurethane cable will be cleaned with a mild soap and water solution when required. Alcohol will be used to remove stains and mineral deposits.

When storing the 3510, it will be put into the shipping box provided and kept in a dry location.

Calibration

The 3510 is assembled with a YSI Thermilinear thermistor assembly and will be checked with an ohmmeter. With the sheath submerged in a $0.0 \pm 1^\circ\text{C}$ ice bath, the thermistor resistances will be compared to the values in this table:

Across Pins A & B	=	94.98 K \pm 482 Ohms
Across Pins B & C	=	19.59 K \pm 103 Ohms
Across Pins A & C	=	114.6 K \pm 585 Ohms
Across Pins B & D	=	0 \pm 1 Ohms

YSI MODEL 3530 pH ELECTRODE ASSEMBLY

Description

The YSI 3530 pH Electrode is designed for use with the YSI 3560 Water Quality Monitoring System, but it may also be used with other pH measuring systems that require pH probes with similar specifications. The rugged 5.5" long by .76" diameter polymer body will withstand demanding field and laboratory use. A spin-off bulb guard is provided for easy cleaning and protection. (The silver/silver chloride reference electrode and the silver working electrode are held within a porous Teflon matrix, surrounded with a 4 molar potassium chloride gel, and sealed to eliminate the need for adding electrolyte and to prolong their working life.)

The 3530 has a 36 inch long black polyurethane cable and a retractable black BNC cover. A black end cap distinguishes it from the similar-appearing ORP probe, which has a yellow end cap. The unit is shipped in a soaker bottle containing pH 4.0 buffer. To prevent the probe from drying out, the soaker bottle should be used to store it whenever it is not in use.

Specifications

pH Range:	0 to 14.00 pH
Operating Temperature Range:	-5 to 50°C
Accuracy:	Accuracy is subject to calibration with available pH buffer solutions in the desired measurement range.
Sodium Error:	.05 pH in 0.1 Molar Na ⁺ Ion at 12.8 pH
Response Time:	95% of reading in 10 seconds
Zero Potential:	7.00 ±0.2 pH
Impedance:	60 megohms at 25°C

Operation

The 3530 is designed to be used in the YSI 3550 Sample Chamber Assembly. Once the 3530 is calibrated, install the electrode into the 3550 in the port marked pH. Set the pH function switch on the 3500 to **pH** if manual compensation is desired, and set the

temperature compensation knob to the correct temperature in °C. Set the pH function switch to **pH ATC** if a pH ATC probe is in use, and disregard the manual compensation knob setting. See the 3500 instruction manual for further instructions.

Maintenance

pH Electrode Aging: All pH electrodes age with time. The typical electrode begins to deteriorate after 3 to 6 months of use. Age is characterized by a lessened capacity for slope adjustment and slower speed of response. The best way to detect aging effects is when performing a slope adjustment. For example, if you calibrate with a pH 7.0 buffer and then cannot make the slope adjustment for a pH 4.0 or pH 10 buffer, the electrode will be cleaned and retested or reconditioned (see below). If performance is not restored, the electrode will be replaced.

pH Electrode Cleaning: If a coating forms on the bulb, erroneous readings and a shortened slope adjustment may result. The type of coating will determine the cleaning technique. First, remove the bulb guard. Soft coatings will be removed by vigorous stirring or by use of squirt bottle. Organic chemicals or hard coatings will be chemically removed by soaking the probe for half an hour in an industrial strength detergent. Only in extreme cases will the bulb be mechanically cleaned as abrasion can lead to permanent damage. If cleaning does not restore performance, reconditioning may be tried.

pH Electrode Reconditioning: When reconditioning is required due to electrode aging or severe fouling, the following chemical treatments will be tried. They are presented in the order of the severity of their attack on the glass bulb, and may not improve (and may in some cases actually further impair) electrode performance.

NOTE: USE PROPER PRECAUTIONS WHEN HANDLING THESE HAZARDOUS CHEMICALS.

1. Immerse the electrode tip in 0.1 normal hydrochloric acid for 15 seconds, rinse in tap water then immerse the tip in 0.1 normal sodium hydroxide for 15 seconds and rinse in tap water. Repeat this sequence three times and then recheck the electrode. If performance has not been restored, try the next step.
2. Immerse the electrode tip in a solution of 20% ammonium bifluoride and 80% water for two to three minutes, rinse in tap water and recheck. If performance has not been restored, try the next step.
3. Immerse the electrode tip in a solution of 5% hydrofluoric acid and 95% water for 10 to 15 seconds, rinse well in tap water, quickly rinse in 5 normal HCl,

rinse well in tap water and recheck. If performance has not been restored, replace the electrode.

Calibration

A two-point calibration, between 7 and 4, or between 7 and 10 (whichever is closest to the expected pH value), will be done before sample testing.

pH Calibration (Manual Temperature Compensation):

1. Rinse the pH electrode and a YSI 3510 Temperature Probe with distilled or deionized water. Follow with a rinse of pH 7.00 buffer.
2. Pour pH 7.00 buffer into a sample cup. (Suitable cups are provided in the YSI 3565 Sample Cup Pack.) Immerse the pH electrode and temperature probe in the pH 7.00 buffer. Turn the meter on and set the function switch to pH.
3. Allow the sensors to equilibrate in the buffer.
4. Read the temperature and adjust the manual temperature compensation knob to the same value.
5. Adjust the CAL knob for a $7.00 \pm .01$ display reading. Discard the buffer.
6. Rinse the sensors with deionized or distilled water, followed by a rinse of the next desired buffer.
7. Immerse the sensors in the next buffer.
8. Allow the sensors to equilibrate. Adjust the Slope control until the display is within 0.01 units of the buffer's stated value. This complete calibration.

ATC pH Calibration: ATC calibration is achieved the same way described above, except that the temperature probe is connected for automatic compensation, and manual compensation adjustment is not performed.

YSI MODEL 3550 SAMPLE CHAMBER ASSEMBLY

Description

The YSI 3550 Sample Chamber Assembly is an integral part of the YSI 3560 Water Quality Monitoring System. It is designated to be attached to a pump outlet, but it can also be used as a non-flowing sample chamber. It will hold up to five sensors and provide inlet and outlet ports for fluid movement through the chamber. The sample circulates through

the chamber at up to 1-1/2 gallons per minute. The chamber provides good mixing of fluids so residual sample is not a problem. Clear acrylic sides allow the user to see fluids flowing through the chamber.

Two black EPR gaskets keep fluids from leaking around the sensor mounting plate and base plate assemblies, and two orange silicone o-rings in each of the sensor ports provide excellent seals. The sensor mounting plate is permanently marked to indicate the port for each sensor. This sample chamber holds approximately one liter in volume and operates with flowing sample over a temperature range of -20 to 50°C. A convenient handle is provided for carrying the chamber between test sites.

Operation

To use the 3550, first install the sensors to be used with the system into their respective ports. Two o-rings in each port provide effective water seals. The sensor ports not in use should be plugged to close the system. Plugs are provided with the 3550 package. Next, connect the chamber to a pump. Push an adaptor onto the tubing provided, then press the adapter into an elbow. Insert the elbow into the top of the YSI 3520 Flow-Through Conductivity Cell and push down on the elbow until it stops (see 3560 Water Quality Monitoring System Instruction Manual). To finish the installation, insert the remaining tubing and adapter into the second elbow provided and install that assembly in the **OUT** port of the sensor mounting plate. Push the elbow down until it stops and place the other end of the tubing where the fluid under test is to be collected or drained. The pump can now be turned on and regulated so that it does not exceed the chamber maximum flow rate of 1-1/2 gallons per minute.

-----WARNING-----

Do not block the outlet port or crimp the outlet hose. Pressure within the sample chamber must not exceed 10 psi or else sample will leak or sensors will be pushed out of the sensor mounting plate.

Maintenance

The 3550 is easy to disassemble and clean. The O-ring seals in the ports and the chamber gaskets will be replaced annually. The tweezers provided in the O-ring maintenance kit will be used to remove the old O-rings and install new ones, making sure they are properly seated all the way in the back of the grooves. When reassembling the

sample chamber after replacing the gaskets, the thumb screws will be resecured only finger-tight. Use of any tool could cause the gaskets to be cut and fail to seal.

The disassembled chamber and all of its associated parts will be cleaned with a mild soap solution or isopropyl alcohol for tough stains. The cleaned components will be thoroughly rinsed with water to remove any residual soap or alcohol which would cause interference with measurements. The plugs and elbows of the 3550 will also be cleaned this way.

ATTACHMENT I
SITE SPECIFIC CDAP
FIREFIGHTER TRAINING AREA

ATTACHMENT I
SITE-SPECIFIC CHEMICAL DATA ACQUISITION PLAN
FIREFIGHTER TRAINING AREA
FORT STORY, VIRGINIA

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ATTACHMENT I
SITE SPECIFIC CHEMICAL DATA ACQUISITION PLAN
FIREFIGHTER TRAINING AREA

I-1.0 SITE LOCATION AND DESCRIPTION

The Firefighter Training Area (FTA) is located in a sandy flat area situated adjacent to the northern flank of the central sand ridge in the southwestern section of Fort Story along Hospital Road. Figure I-1 provides the location of the site.

A temporary hospital facility was located on the site until 1960 when it's operations were relocated and the structure demolished. From 1960 through 1978, the area adjacent to the southern boundary along U.S. Route 60 was used as a wildlife game preserve. The site was cleared and used for fire training exercises in the latter part of 1978. Prior to 1980, these exercises consisted of extinguishing JP-4 aviation fuel, which was released and ignited directly to the surface soils of the site. The releases were reportedly extinguished by a mixture of firefighting foam and water.

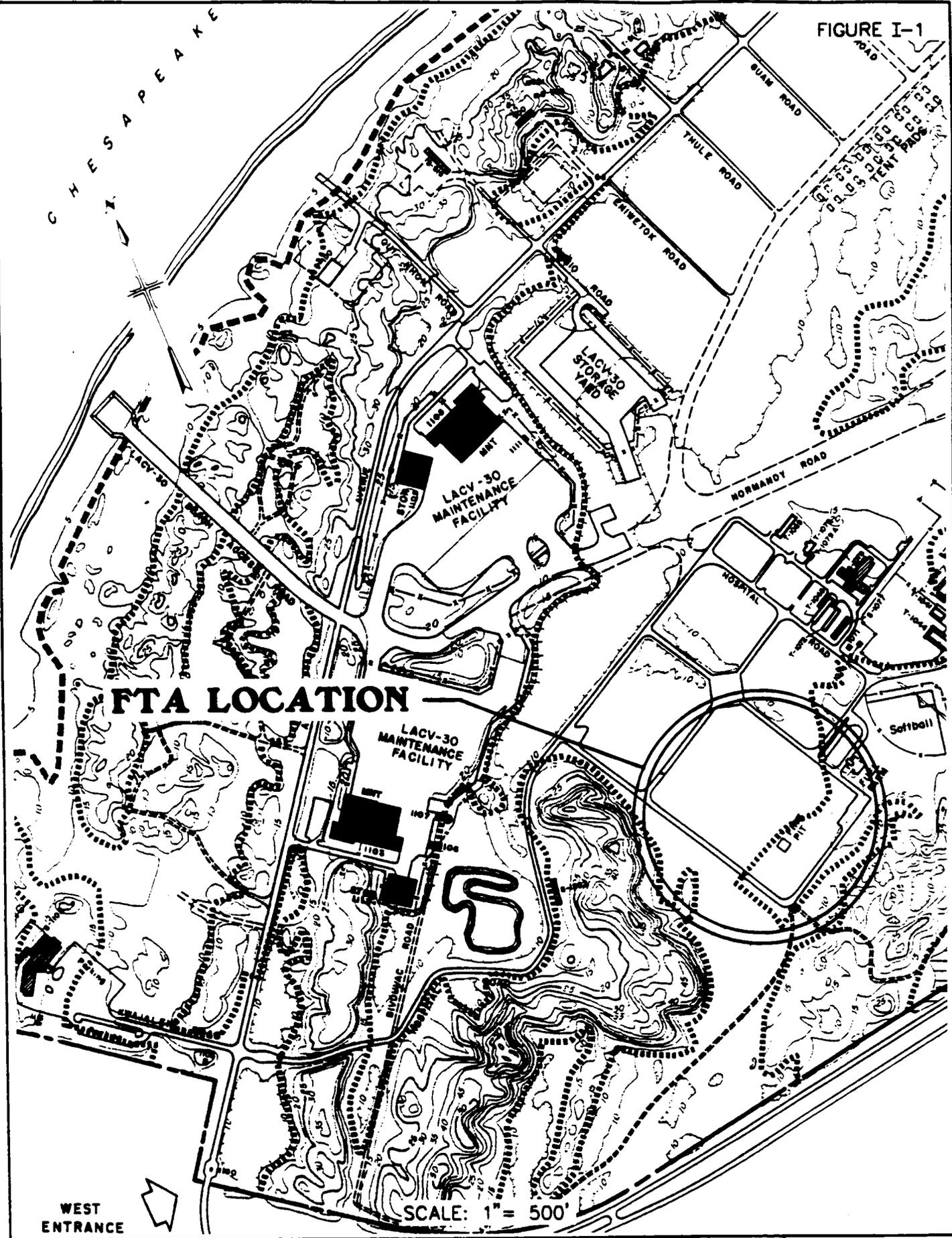
A concrete pit was constructed in 1980 and used for firefighting training exercises. The 100 foot square by 2 foot deep pit was used on a monthly basis. Procedures included:

- Filling the pit with several inches of water and 75 to 400 gallons of fuel (i.e., JP-4, contaminated fuels and hydraulic fluid).
- Igniting the mixture and allowing it to burn.
- Extinguishing the fire with 50 to 150 gallons of firefighting foam.
- Allowing the residues of the fuel and extinguishing mixtures to evaporate naturally.

Additionally, during 1980 through 1986, many installation personnel reportedly used the area as an unauthorized dumping site. The site is currently free of any surface debris or evidence of buried debris. In June 1988, firefighting training activities were discontinued at this site.

The site is underlain by Holocene Age sand deposits. The sand is typically subrounded to subangular, usually poorly graded and medium to coarse grained. The coarse

FIGURE I-1



FTA LOCATION

LACV-30
MAINTENANCE
FACILITY

LACV-30
MAINTENANCE
FACILITY

SCALE: 1" = 500'

WEST
ENTRANCE

**MALCOLM
PIRNIE**

FORT STORY, VIRGINIA
CHEMICAL DATA ACQUISITION PLAN
FTA SITE LOCATION MAP

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DECEMBER 1994

grained facies is generally restricted to depths in excess of 4 feet. Silty sand is present to a depth of 2 to 4 feet in the eastern area of the site.

Water table elevations range from 8.5 feet NGVD in the northern portion of the site to less than 8.3 feet NGVD in the southern portion. Groundwater flow is directed from the northwest across the site to the south and east. Hydraulic conductivity values calculated at the site range from 1.17×10^{-2} to 1.37×10^{-2} centimeters per second (cm/sec) with an average value of 1.24×10^{-2} cm/sec.

I-2.0 FIELD ACTIVITIES

I-2.1 Field Equipment

Equipment required to implement the field activities for the RI include:

- Photoionization Detector (PID)
- Explosimeter
- Specific Conductance and Temperature Meter
- pH Meter
- Electronic water level indicator
- Direct Push Technology (DPT) Rig
- Hollow stem auger drill rig
- Disposable teflon bailers
- Portable GC Instrument
- Portable filtering kit including vacuum pump, 0.45 micron filters, disposable filter holder, plastic tubing, and disposable flask.
- Stainless steel scoop and hand auger
- Stainless steel bowls and spoons for soil mixing
- Sample collection containers
- Bailer cord
- Polyethylene sheeting

- Decontamination solutions
- Personal protective equipment including latex gloves, nitrile gloves, steel toed boots and work gloves.

I-2.2 Sampling Locations

Samples will be collected to physically and chemically characterize the surface and subsurface soils, groundwater, sediment and surface water. Section 4.2 of the Field Investigation Plan discusses the order in which field activities will take place. A site map with proposed sample locations is provided as Figure I-2.

Soil Samples

Twenty-two (22) soil boring locations have been established for the site to determine the vertical and horizontal extent of contamination in surface and subsurface soils. Eight (8) of these borings will be installed in the vicinity of the former fire training pit (FTP). Six (6) soil borings will be installed in the northern section of the site. The final eight (8) soil borings will be installed at the solvent plume area in the southeast corner of the site.

A hand augered sample will be collected from a depth of 0 to 12 inches as described in Section 4.3.2. The DPT rig will then be used to collect soil samples from two other depths at that location; 2 to 3 feet below ground surface and from immediately above the water table interface (estimated to be 5 to 6 feet below ground surface).

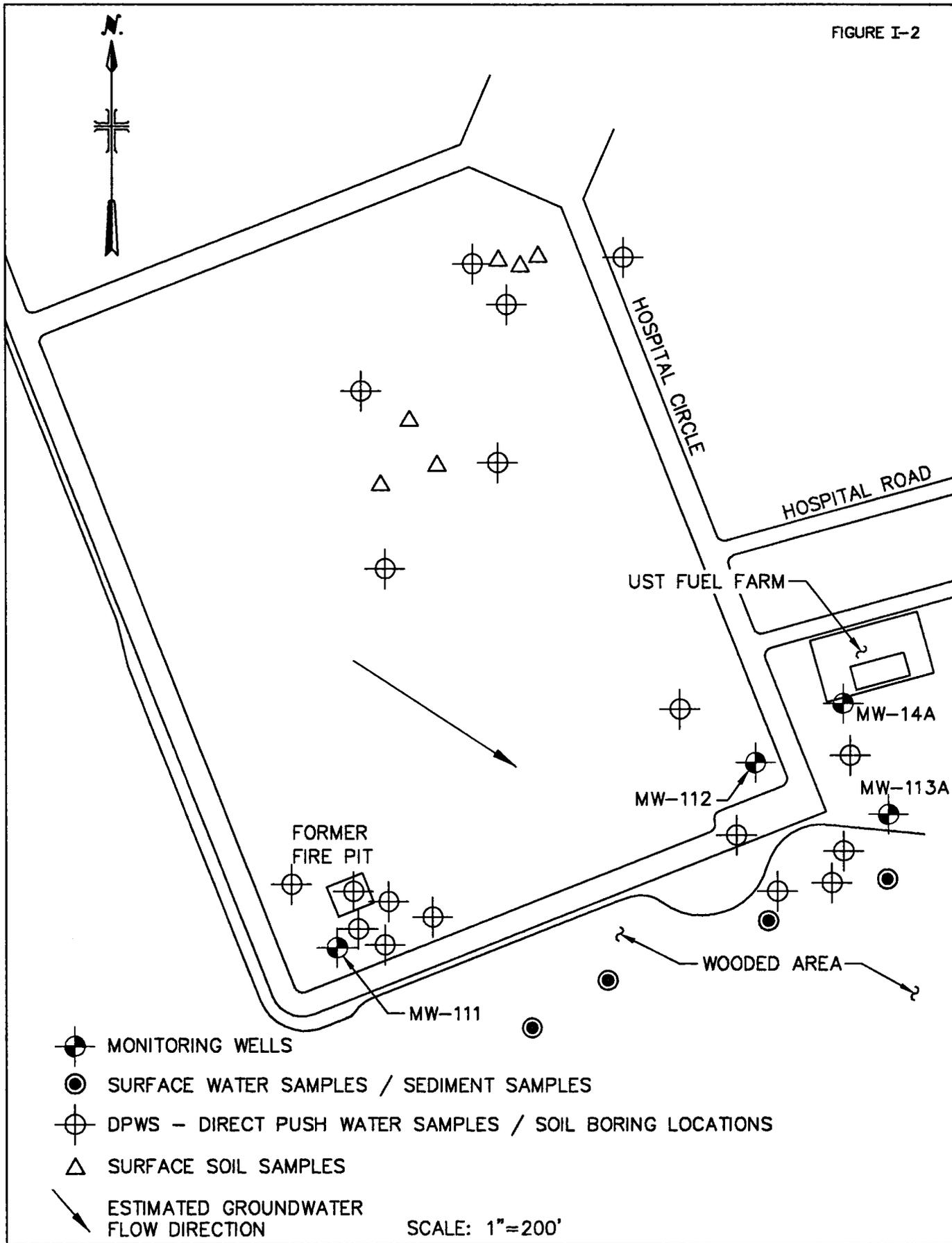
In addition, six (6) surface soil samples will be collected at the northern section of the site in areas of visible soil staining.

Groundwater Samples

Groundwater samples will be collected by DPT from eighteen (18) locations to determine the nature and extent of contamination in groundwater. The depth to groundwater at the site is approximately 6 feet below ground surface. It is estimated that 15 of the DPT locations will be shallow samples collected at a depth of approximately 5 feet below to assess the vertical extent of contamination. Samples will be collected at depth intervals of every 10 feet until organics are no longer detected by the on-site GC.

Groundwater samples will be collected from four (4) existing and four (4) new permanent groundwater monitoring wells. Existing wells will be redeveloped prior to sampling. The new wells will be installed to a depth of approximately 8 feet below the water

FIGURE I-2



- ⊗ MONITORING WELLS
 - SURFACE WATER SAMPLES / SEDIMENT SAMPLES
 - ⊕ DPWS - DIRECT PUSH WATER SAMPLES / SOIL BORING LOCATIONS
 - △ SURFACE SOIL SAMPLES
 - ↘ ESTIMATED GROUNDWATER FLOW DIRECTION
- SCALE: 1"=200'

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PIRNIÉ**

FORT STORY, VIRGINIA
CHEMICAL DATA ACQUISITION PLAN
FTA SITE MAP

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table elevation. Screened intervals will be established from two feet above the water table to 8 feet below the water table.

Seven (7) temporary direct push well points will be installed but not sampled. Their location will be based on on-site GC analysis. The screens will be placed at a depth of 5 feet below the water table elevation for four shallow points and at unknown depths for the three deep points. These well points may be used for short-term groundwater monitoring.

Sediment Samples

Four (4) sediment samples will be collected from within the wetlands area located to the south of the site.

Surface Water Samples

Four (4) surface water samples will be collected at the same locations as the sediment samples from within the wetlands area located to the south of the site.

I-2.3 Sampling and Preservation Procedures

Surface soil samples will be collected at 28 locations with a stainless steel hand auger at a depth of 0 to 12 inches below ground surface. Twenty subsurface borings will be performed by a DPT rig with samples collected at two depths; 2 to 3 feet below ground surface and immediately above the water table interface (approximately 5 to 6 feet below ground surface). Groundwater samples will be collected at 18 locations by using DPT while 8 groundwater samples will be collected from permanent monitoring wells. Four surface water and 4 sediment samples will be collected from the wetland area south of the site. Standard sampling procedures are detailed in Section 4.3.

After collecting soil samples for VOC analysis, the samples will be homogenized prior to collection for other analyses. Homogenization of soil samples is accomplished by the procedures outlined in Section 4.3.2.2.

Container type and volume, preservation, and holding time requirements for the samples are listed in Table 4-2.

I-2.4 Sample and Analysis Requirements

The total number of field samples and QA/QC samples are presented by matrix in Table I-1. This table also provides each laboratory's allotment of samples and their

**TABLE I-1
FTA SAMPLE SUMMARY**

Sampling Task	Media	Analysis Requirements						
		TAL Metals	TAL Hg	TAL Cyanide	TCL VOCs	TCL SOCs	TPH Heavy	TPH Light
Groundwater Sampling by DPT:								
Field	Water	6	6	6	18	18	18	18
Duplicates ⁽¹⁾	Water	2	2	2	1	1	1	1
Rinsates ⁽²⁾	Water	1	1	1	4	4	4	4
Trip Blanks ⁽³⁾	Water	0	0	0	4	0	0	0
MS/MSD ⁽⁴⁾	Water	1	1	1	1	1	1	1
ACNED QA Samples ⁽⁵⁾	Water	1	1	1	1	1	1	1
Groundwater Well Sampling:								
Field	Water	4	4	4	8	8	8	8
Duplicates	Water	0	0	0	1	1	1	1
Rinsates	Water	1	1	1	2	2	2	2
Trip Blanks	Water	0	0	0	2	0	0	0
MS/MSD	Water	0	0	0	1	1	1	1
ACNED QA Samples	Water	0	0	0	1	1	1	1
Subsurface Soil Sampling by DPT:								
Field	Soil	9	9	9	44	44	44	44
Duplicates	Soil	1	1	1	4	4	4	4
Rinsates	Water	1	1	1	2	2	2	2
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	1	1	1	2	2	2	2
ACNED QA Samples	Soil	1	1	1	4	4	4	4
Surface Soil Samples:								
Field	Soil	5	5	5	28	28	28	28
Duplicates	Soil	0	0	0	3	3	3	3
Rinsates	Water	0	0	0	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	1	1	1	1
ACNED QA Samples	Soil	1	1	1	3	3	3	3
Sediment Samples:								
Field	Soil	4	4	4	4	4	4	4
Duplicates	Soil	1	1	1	1	1	1	1
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	1	1	1	1
ACNED QA Samples	Soil	1	1	1	1	1	1	1
Surface Water Samples:								
Field	Water	4	4	4	4	4	4	4
Duplicates	Water	1	1	1	1	1	1	1
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Water	0	0	0	0	0	0	0
ACNED QA Samples	Water	1	1	1	1	1	1	1
Decontamination Water:								
Field Blanks - DI & Tap Water	Water	2	2	2	2	2	2	2

Notes:

- (1) Duplicates collected at a rate of 10 percent of samples.
- (2) Rinsates - One every other day for soil samples, one per day for water samples.
- (3) Trip Blanks - One per cooler for water samples collected for VOC analysis.
- (4) MS/MDS - Matrix spike/matrix spike duplicates collected at a rate of 5 percent of samples.
- (5) Split samples submitted to Army Corps of Engineers New England Division at a rate of 10 percent of samples.

associated duplicates. Where possible, locations of QA/QC samples will be selected to be representative of the full range of contaminant concentrations.

I-2.5 Field Documentation

For all sampling events, entries shall be made in a field notebook and logbook as specified in Section 4.4. Sample labels shall contain the information and be numbered as specified in Section 5.2.

I-3.0 LABORATORY ANALYTICAL PROCEDURES

Total number of samples and duplicates and parameters for analysis are specified in Table I-1. Table 6-1 lists the laboratory method to be used for each sample.

ATTACHMENT II
SITE SPECIFIC CDAP
LARC 60 MAINTENANCE AREA

ATTACHMENT II
SITE-SPECIFIC CHEMICAL DATA ACQUISITION PLAN
LARC 60 MAINTENANCE AREA
FORT STORY, VIRGINIA

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ATTACHMENT II
SITE SPECIFIC CHEMICAL DATA ACQUISITION PLAN
LARC 60 MAINTENANCE AREA

II-1.0 SITE LOCATION AND DESCRIPTION

The Lighter Amphibious Resupply Carco (LARC) 60 maintenance area, which is the maintenance and wash rack area for LARC vehicles is located in the sand flat area that lies between the coastal dune complex to the north and the central sand ridge to the south. The LARC area includes Buildings 1081, 1082, 1083 and 1084. The location of the site is provided on Figure II-1.

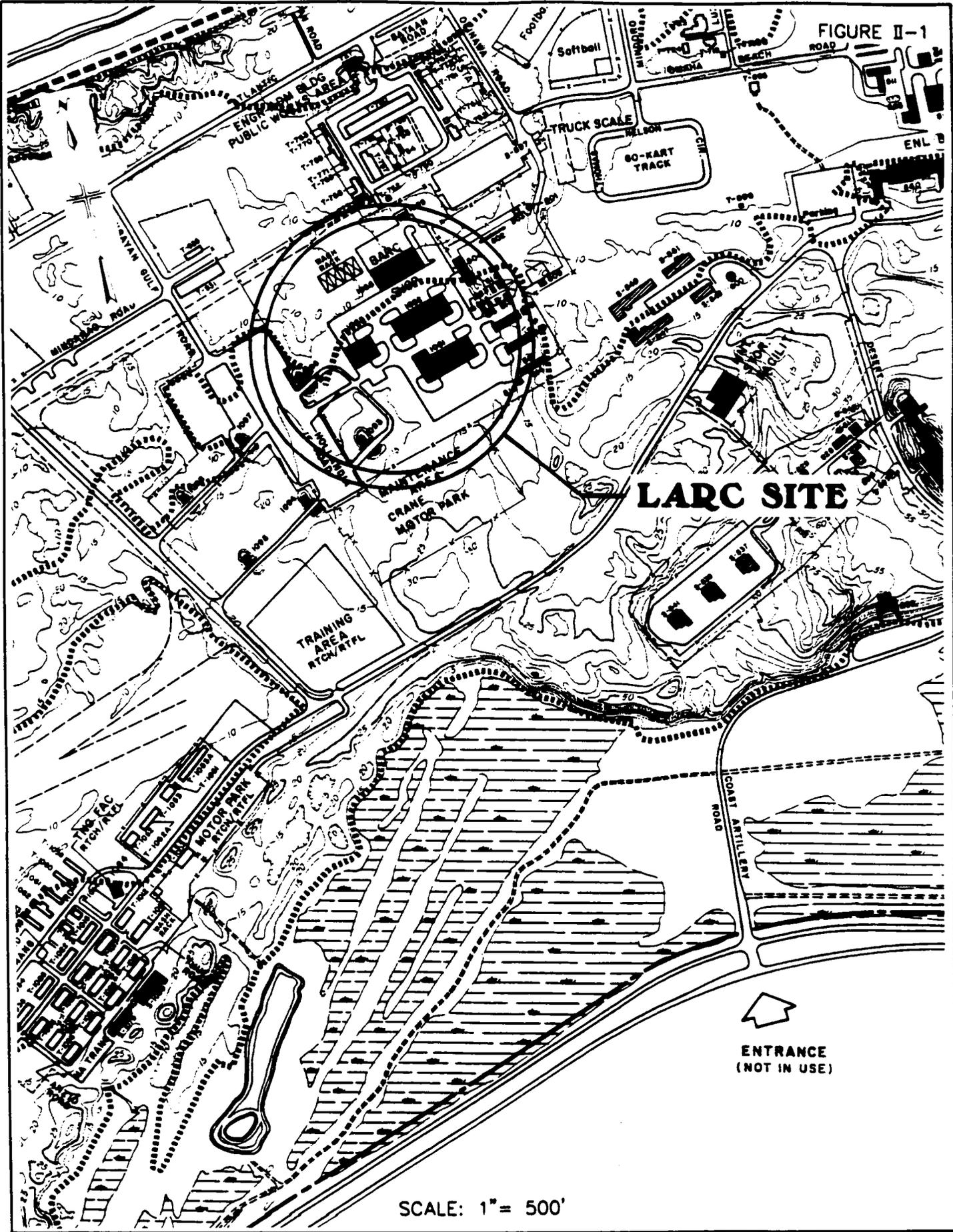
During the 1950s, the wash rack area was first used as the barge amphibious resupply cargo (BARC) motor pool and maintenance facility. In 1964, the BARC vehicle was phased out and the LARC vehicle was prototyped. Presently, this is the only facility on the East Coast available to the Army Transportation Corps for amphibious training.

In 1982, the LARC facility was modified with the construction of a concrete wash rack pad. In 1987, the U.S. Army Environmental Hygiene Agency (USAEHA) conducted a study at the LARC and concluded that the soil north of the wash rack area was contaminated with grease, oil, lead and chromium but that this contaminated material did not pose a significant health hazard.

The underground storage tank (UST) area is located approximately 600 feet south of the wash rack area. A 10,000 gallon UST is located at the north gate of the LARC vehicle motor pool. This tank was installed in 1983. Although JMM's April 1990 field visits to this area identified soil-stained zones around the UST, no reports of tank failing or leaking have been documented. These soil-stained areas may have been caused by overfilling or spillage during use. In 1987, the USAEHA sampled the UST and found it contained oil, water, 1,1,1-trichloroethane and chromium. This UST is not presently being used.

The LARC area is underlain by Holocene age sand deposits. The sand is typically described as fine to medium grained, poorly graded, subrounded and occasionally slightly silty. At one location within the site area, a peat lense less than 1 foot in thickness was encountered at relatively shallow depths.

The measured depth to groundwater at the site ranged from 7.47 below ground surface to 5.07 feet below ground surface. Measured groundwater elevations ranged from



LARC SITE

SCALE: 1" = 500'

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PIRNIE**

FORT STORY, VIRGINIA
CHEMICAL DATA ACQUISITION PLAN
LARC SITE LOCATION MAP

MALCOLM PIRNIE, INC.

DECEMBER 1994

6.5 feet NGVD to 4.97 feet NGVD. Based on water level data from on-site and nearby off-site wells, the water table elevation ranges from approximately 8 feet NGVD in the southern portion of the site to less than 5 feet NGVD in the unpaved, wash rack area. Additionally, the water level data suggest the possible existence of a cone of depression in the vicinity of the wash rack supply well located at the southwestern corner of the wash rack area. The minimum groundwater level elevation within the cone of depression is approximately 4 feet NGVD. Though locally variable in magnitude and direction, the prevailing hydraulic gradient for the site is directed in a northward direction toward the coastline. Hydraulic conductivity values calculated range from 1.99×10^{-3} to 1.84×10^{-2} centimeters per second (cm/sec) with an average value of 7.42×10^{-2} cm/sec.

II-2.0 FIELD ACTIVITIES

II-2.1 Field Equipment

Equipment required to implement the field activities for the RI include:

- Photoionization Detector (PID)
- Explosimeter
- Specific Conductance and Temperature Meter
- pH Meter
- Electronic water level indicator
- Direct Push Technology (DPT) Rig
- Hollow stem auger drill rig
- Disposable teflon bailers
- Portable filtering kit including vacuum pump, 0.45 micron filters, disposable filter holder, plastic tubing, and disposable flask.
- Stainless steel scoop and hand auger
- Stainless steel bowls and spoons for soil mixing
- Sample collection containers
- Bailer cord

- Polyethylene sheeting
- Decontamination solutions
- Personal protective equipment including latex gloves, nitrile gloves, steel toed boots and work gloves.

II-2.2 Sampling Locations

Samples will be collected to physically and chemically characterize the surface and subsurface soils, groundwater, sediment and surface water. Section 4.2 of the Field Investigation Plan discusses the order in which field activities will take place. A site map with proposed sample locations is provided as Figure II-2.

Soil Samples

Twenty-three (23) soil boring locations have been established for the site to determine the vertical and horizontal extent of contamination in surface and subsurface soils. Four (4) of these borings will be installed in the vicinity of the waste oil UST on the southern end of the site. Four (4) soil borings will be installed near the oil-water separator in the central section of the site. The final fifteen (15) soil borings will be installed near the "sandbox" area in the northern section of the site.

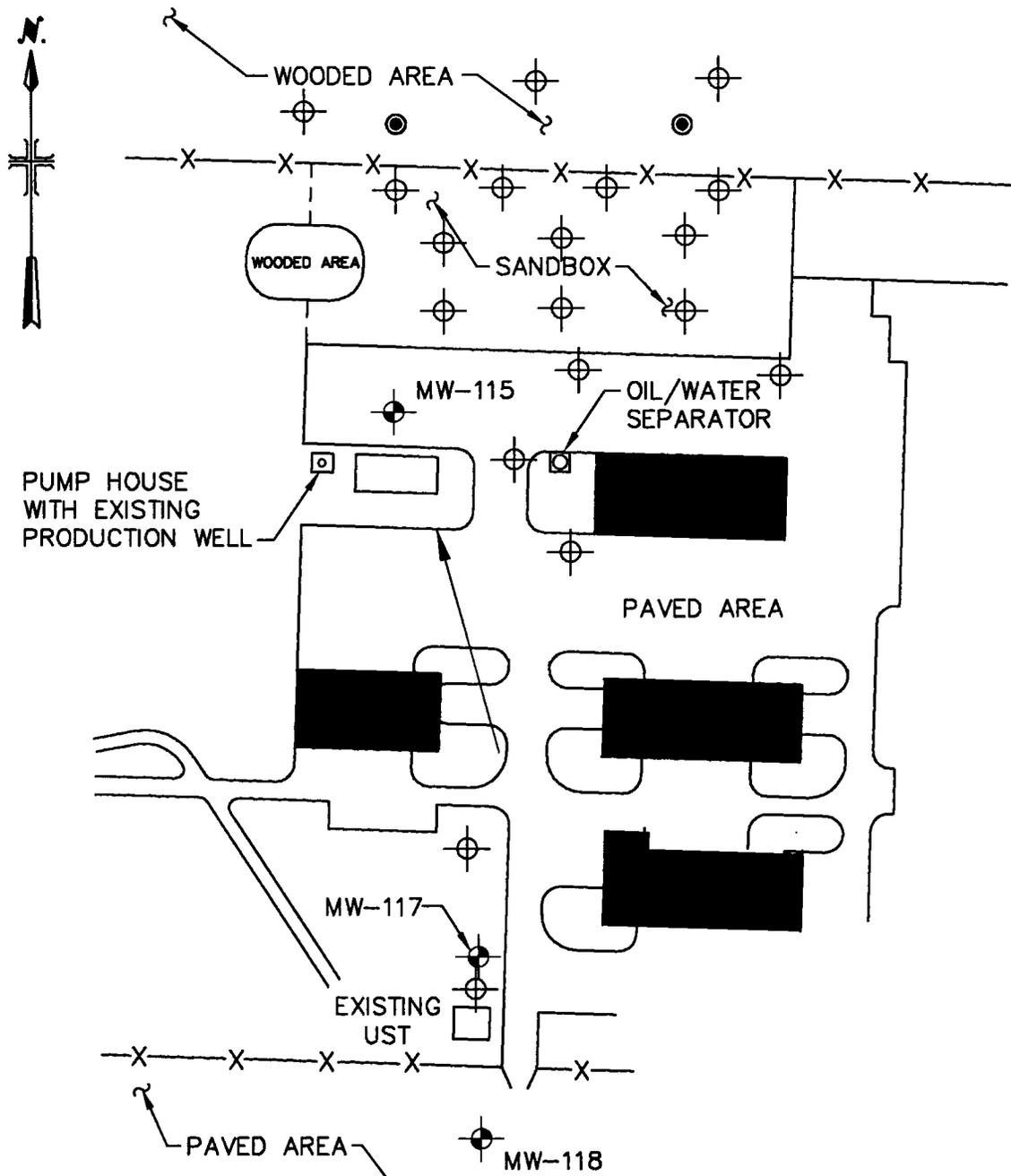
A hand augered sample will be collected from a depth of 0 to 12 inches as described in Section 4.3.2. The DPT rig will then be used to collect soil samples from two other depths at that location; 2 to 3 feet below ground surface and from immediately above the water table interface (estimated to be 5 to 6 feet below ground surface). One of the soil boring locations will be upgradient of the site to provide background data.

Groundwater Samples

Groundwater samples will be collected by DPT from eighteen (18) locations to determine the nature and extent of contamination in groundwater. The depth to groundwater at the site is approximately 6 feet below ground surface. It is estimated that 15 of the DPT locations will be shallow samples collected at a depth of approximately 5 feet below to assess the vertical extent of contamination. Samples will be collected at depth intervals of every 10 feet until organics are no longer detected by the on-site GC.

Groundwater samples will be collected from four (4) existing and four (4) new permanent groundwater monitoring wells. Existing wells will be redeveloped prior to

FIGURE II-2



SCALE: 1"=200'

sampling. The new wells will be installed to a depth of approximately 8 feet below the water table elevation. Screened intervals will be established from two feet above the water table to 8 feet below the water table.

Seven (7) temporary direct push well points will be installed but not sampled. Their location will be based on on-site GC analysis. The screens will be placed at a depth of 5 feet below the water table elevation for four shallow points and at unknown depths for the three deep points. These well points may be used for short-term groundwater monitoring.

Sediment Samples

Two (2) sediment samples will be collected from within the drainage ditch located between the sandbox and the wooded area.

Surface Water Samples

Two (2) surface water samples will be collected from within the drainage ditch located between the sandbox and the wooded area.

II-2.3 Sampling and Preservation Procedures

Surface soil samples will be collected at 23 locations with a stainless steel hand auger at a depth of 0 to 12 inches below ground surface. Twenty-three subsurface borings will be performed by a DPT rig with samples collected at two depths; 2 to 3 feet below ground surface and immediately above the water table interface (approximately 5 to 6 feet below ground surface). Groundwater samples will be collected at 19 locations by using DPT while 4 groundwater samples will be collected from permanent monitoring wells. Two surface water and 2 sediment samples will be collected from the drainage ditch between the "sandbox" area and the wooded area north of site. Standard sampling procedures are detailed in Section 4.3.

After collecting soil samples for VOC analysis, the samples will be homogenized prior to collection for other analyses. Homogenization of soil samples is accomplished by the procedures outlined in Section 4.3.2.2.

Container type and volume, preservation, and holding time requirements for the samples are listed in Table 4-2.

II-2.4 Sample and Analysis Requirements

The total number of field samples and QA/QC samples are presented by matrix in Table II-1. This table also provides each laboratory's allotment of samples and their associated duplicates. Where possible, locations of QA/QC samples will be selected to be representative of the full range of contaminant concentrations.

II-2.5 Field Documentation

For all sampling events, entries shall be made in a field notebook and logbook as specified in Section 4.4. Sample labels shall contain the information and be numbered as specified in Section 5.2.

II-3.0 LABORATORY ANALYTICAL PROCEDURES

Total number of samples and duplicates and parameters for analysis are specified in Table II-1. Table 6-1 lists the laboratory method to be used for each sample.

**TABLE II-1
LARC 60 SAMPLE SUMMARY**

Sampling Task	Media	Analysis Requirements						
		TAL Metals	TAL Hg	TAL Cyanide	TCL VOCs	TCL SOCs	TPH Heavy	TPH Light
Groundwater Sampling by DPT:								
Field	Water	8	8	8	19	19	19	19
Duplicates ⁽¹⁾	Water	2	2	2	2	2	2	2
Rinsates ⁽²⁾	Water	1	1	1	4	4	4	4
Trip Blanks ⁽³⁾	Water	0	0	0	4	0	0	0
MS/MSD ⁽⁴⁾	Water	1	1	1	1	1	1	1
ACNED QA Samples ⁽⁵⁾	Water	1	1	1	2	2	2	2
Groundwater Well Sampling:								
Field	Water	2	2	2	4	4	4	4
Duplicates	Water	0	0	0	0	0	0	0
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	1	0	0	0
MS/MSD	Water	0	0	0	1	1	1	1
ACNED QA Samples	Water	0	0	0	1	1	1	1
Subsurface Soil Sampling by DPT:								
Field	Soil	9	9	9	46	46	46	46
Duplicates	Soil	1	1	1	5	5	5	5
Rinsates	Water	1	1	1	2	2	2	2
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	1	1	1	2	2	2	2
ACNED QA Samples	Soil	1	1	1	5	5	5	5
Surface Soil Samples:								
Field	Soil	5	5	5	23	23	23	23
Duplicates	Soil	0	0	0	2	2	2	2
Rinsates	Water	0	0	0	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	2	2	2	2
ACNED QA Samples	Soil	1	1	1	2	2	2	2
Sediment Samples:								
Field	Soil	2	2	2	2	2	2	2
Duplicates	Soil	0	0	0	0	0	0	0
Rinsates	Water	0	0	0	0	0	0	0
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	0	0	0	0
ACNED QA Samples	Soil	0	0	0	0	0	0	0
Surface Water Samples:								
Field	Water	2	2	2	2	2	2	2
Duplicates	Water	0	0	0	0	0	0	0
Rinsates	Water	0	0	0	0	0	0	0
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Water	0	0	0	0	0	0	0
ACNED QA Samples	Water	0	0	0	0	0	0	0

Notes:

- (1) Duplicates collected at a rate of 10 percent of samples.
- (2) Rinsates - One every other day for soil samples, one per day for water samples.
- (3) Trip Blanks - One per cooler for water samples collected for VOC analysis.
- (4) MS/MDS - Matrix spike/matrix spike duplicates collected at a rate of 5 percent of samples.
- (5) Split samples submitted to Army Corps of Engineers New England Division at a rate of 10 percent of samples.

ATTACHMENT III
SITE SPECIFIC CDAP
AUTO CRAFT BUILDING AREA

ATTACHMENT III
SITE-SPECIFIC CHEMICAL DATA ACQUISITION PLAN

AUTO CRAFT BUILDING AREA
FORT STORY, VIRGINIA

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ATTACHMENT III
SITE SPECIFIC CHEMICAL DATA ACQUISITION PLAN
AUTO CRAFT BUILDING AREA

III-1.0 SITE LOCATION AND DESCRIPTION

The Auto Craft Building is located in the sand flat area south of the coastal dune complex at the junction of Atlantic Avenue and Cebu Road. The location of the site is provided on Figure III-1.

Two solvent dip tanks were used for the storage of spent degreasing solvents and waste oils when the building was in use. Previously, waste oil generated at the site was piped out of the building and into the adjacent UST. The UST has subsequently been removed.

Prior to its use as the Auto Craft Building, the site was used as a motor pool for wheeled vehicles. During the winter of 1989 and 1990, a portion of the building was destroyed by fire. A portion of the building's concrete foundation and some debris remain in the area. A previous investigation indicated that waste solvents were poured directly on the ground to control weed growth along the fence surrounding the site. A visual inspection by JMM in 1990 verified the presence of an apparent petroleum-based product around the area and distinctive petroleum odor at the site.

The site is underlain by Holocene age sand deposits. The sand is typically characterized as fine to medium grained, subrounded and poorly graded. Discontinuous units of clay and silt are located in the north area of the site at depths of 5 feet and thicknesses of 2 feet.

Depths to groundwater at the site vary from 7.80 feet below ground surface to 10.25 feet below ground surface. Water table elevations at the site ranged from 5.3 feet NGVD near the building to 5.07 feet NGVD. The lateral hydraulic gradient at the site is directed to the northeast. Based upon a limited number of wells, hydraulic conductivity values range from 3.23×10^{-3} to 7.11×10^{-3} centimeters per second (cm/sec) with an average value of 5.17×10^{-3} cm/sec.

III-2.0 FIELD ACTIVITIES

III-2.1 Field Equipment

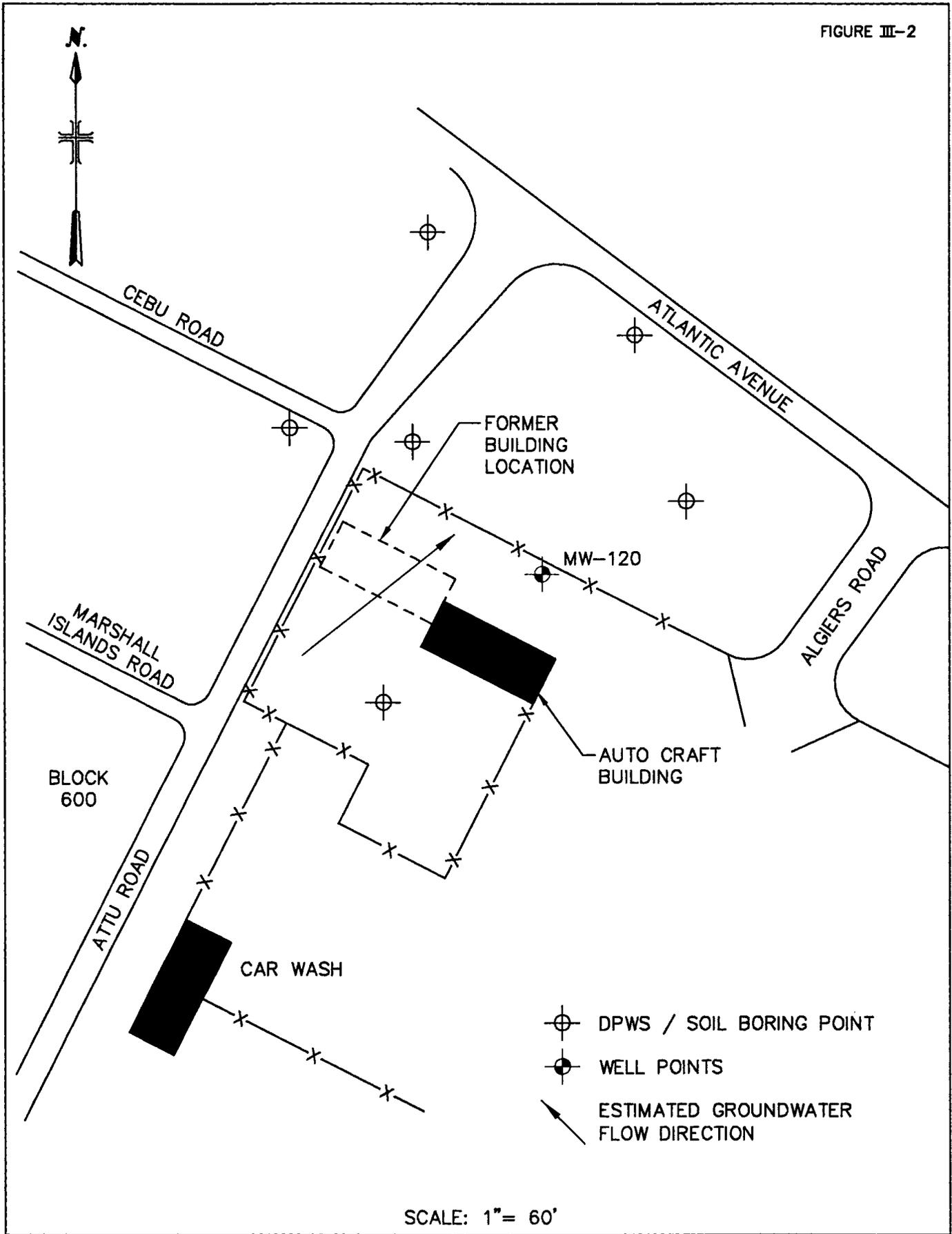
Equipment required to implement the field activities for the RI include:

- Photoionization Detector (PID)
- Explosimeter
- Specific Conductance and Temperature Meter
- pH Meter
- Electronic water level indicator
- Direct Push Technology (DPT) Rig
- Hollow stem auger drill rig
- Disposable teflon bailers
- Portable filtering kit including vacuum pump, 0.45 micron filters, disposable filter holder, plastic tubing, and disposable flask.
- Stainless steel scoop and hand auger
- Stainless steel bowls and spoons for soil mixing
- Sample collection containers
- Bailer cord
- Polyethylene sheeting
- Decontamination solutions
- Personal protective equipment including latex gloves, nitrile gloves, steel toed boots and work gloves.

III-2.2 Sampling Locations

Samples will be collected to physically and chemically characterize the surface and subsurface soils, groundwater, sediment and surface water. Section 4.2 of the Field Investigation Plan discusses the order in which field activities will take place. A site map with proposed sample locations is provided as Figure III-2.

FIGURE III-2



Soil Samples

Six (6) soil boring locations have been established for the site to determine the vertical and horizontal extent of contamination in surface and subsurface soils.

A hand augered sample will be collected from a depth of 0 to 12 inches as described in Section 4.3.2. The DPT rig will then be used to collect soil samples from two other depths at that location; 2 to 3 feet below ground surface and from immediately above the water table interface (estimated to be 8 to 10 feet below ground surface). One of the soil boring locations will be upgradient of the site to provide background data.

Groundwater Samples

Groundwater samples will be collected by DPT from eighteen (18) locations to determine the nature and extent of contamination in groundwater. The depth to groundwater at the site is approximately 6 feet below ground surface. It is estimated that 15 of the DPT locations will be shallow samples collected at a depth of approximately 5 feet below to assess the vertical extent of contamination. Samples will be collected at depth intervals of every 10 feet until organics are no longer detected by the on-site GC.

Groundwater samples will be collected from four (4) existing and four (4) new permanent groundwater monitoring wells. Existing wells will be redeveloped prior to sampling. The new wells will be installed to a depth of approximately 8 feet below the water table elevation. Screened intervals will be established from two feet above the water table to 8 feet below the water table.

Seven (7) temporary direct push well points will be installed but not sampled. Their location will be based on on-site GC analysis. The screens will be placed at a depth of 5 feet below the water table elevation for four shallow points and at unknown depths for the three deep points. These well points may be used for short-term groundwater monitoring.

III-2.3 Sampling and Preservation Procedures

Surface soil samples will be collected at six (6) locations with a stainless steel hand auger at a depth of 0 to 12 inches below ground surface. Six (6) subsurface borings will be performed by a DPT rig with samples collected at two depths; 2 to 3 feet below ground surface and immediately above the water table interface (approximately 8 to 10 feet below ground surface). Groundwater samples will be collected at 6 locations by using DPT while 1 groundwater sample will be collected from an existing permanent monitoring well. Standard sampling procedures are detailed in Section 4.3.

After collecting soil samples for VOC analysis, the samples will be homogenized prior to collection for other analyses. Homogenization of soil samples is accomplished by the procedures outlined in Section 4.3.2.2.

Container type and volume, preservation, and holding time requirements for the samples are listed in Table 4-2.

III-2.4 Sample and Analysis Requirements

The total number of field samples and QA/QC samples are presented by matrix in Table III-1. This table also provides each laboratory's allotment of samples and their associated duplicates. Where possible, locations of QA/QC samples will be selected to be representative of the full range of contaminant concentrations.

III-2.5 Field Documentation

For all sampling events, entries shall be made in a field notebook and logbook as specified in Section 4.4. Sample labels shall contain the information and be numbered as specified in Section 5.2.

III-3.0 LABORATORY ANALYTICAL PROCEDURES

Total number of samples and duplicates and parameters for analysis are specified in Table III-1. Table 6-1 lists the laboratory method to be used for each sample.

**TABLE III-1
AUTO CRAFT SAMPLE SUMMARY**

Sampling Task	Media	Analysis Requirements						
		TAL Metals	TAL Hg	TAL Cyanide	TCL VOCs	TCL SOCs	TPH Heavy	TPH Light
Groundwater Sampling by DPT:								
Field	Water	6	6	6	6	6	6	6
Duplicates ⁽¹⁾	Water	2	2	2	1	1	1	1
Rinsates ⁽²⁾	Water	1	1	1	1	1	1	1
Trip Blanks ⁽³⁾	Water	0	0	0	1	0	0	0
MS/MSD ⁽⁴⁾	Water	1	1	1	1	1	1	1
ACNED QA Samples ⁽⁵⁾	Water	1	1	1	1	1	1	1
Groundwater Well Sampling:								
Field	Water	2	2	2	1	1	1	1
Duplicates	Water	0	0	0	0	0	0	0
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	1	0	0	0
MS/MSD	Water	0	0	0	0	0	0	0
ACNED QA Samples	Water	0	0	0	0	0	0	0
Subsurface Soil Sampling by DPT:								
Field	Soil	3	3	3	12	12	12	12
Duplicates	Soil	1	1	1	1	1	1	1
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	1	1	1	1	1	1	1
ACNED QA Samples	Soil	1	1	1	1	1	1	1
Surface Soil Samples:								
Field	Soil	1	1	1	6	6	6	6
Duplicates	Soil	0	0	0	1	1	1	1
Rinsates	Water	0	0	0	0	0	0	0
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	0	0	0	0
ACNED QA Samples	Soil	0	0	0	1	1	1	1

Notes:

- (1) Duplicates collected at a rate of 10 percent of samples.
- (2) Rinsates - One every other day for soil samples, one per day for water samples.
- (3) Trip Blanks - One per cooler for water samples collected for VOC analysis.
- (4) MS/MDS - Matrix spike/matrix spike duplicates collected at a rate of 5 percent of samples.
- (5) Split samples submitted to Army Corps of Engineers New England Division at a rate of 10 percent of samples.