D.2.5

QUALITY ASSURANCE PROJECT PLAN FOR TASKS I, II, AND III AT MACDERMID INCORPORATED'S FERNDALE, MICHIGAN, FACILITY

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Submitted to:

MacDermid Incorporated
Waterbury, Connecticut

OHM Remediation Services Corp.

G. Jack Herzig
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Project 9961

371-15

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1.0 INTRODUCTION

OHM Remediation Services Corp. (OHM), a wholly owned subsidiary of OHM Corporation, has prepared this quality assurance project plan (QAPP) for use at MacDermid Incorporated's (MACDERMID's) Ferndale, Michigan, facility. The methods will be utilized for the quality assurance/quality control (QA/QC) of the work activities identified in the work plan for Tasks I, II, and III. This document is intended to provide a guideline for not only the analytical support, but also the sampling and data reduction. In order to maintain these standards, the guidelines must be specified clearly and monitored throughout the project. This QAPP will state the guidelines as well as identify key personnel in the implementation of the program.

2.0 PROJECT DESCRIPTION

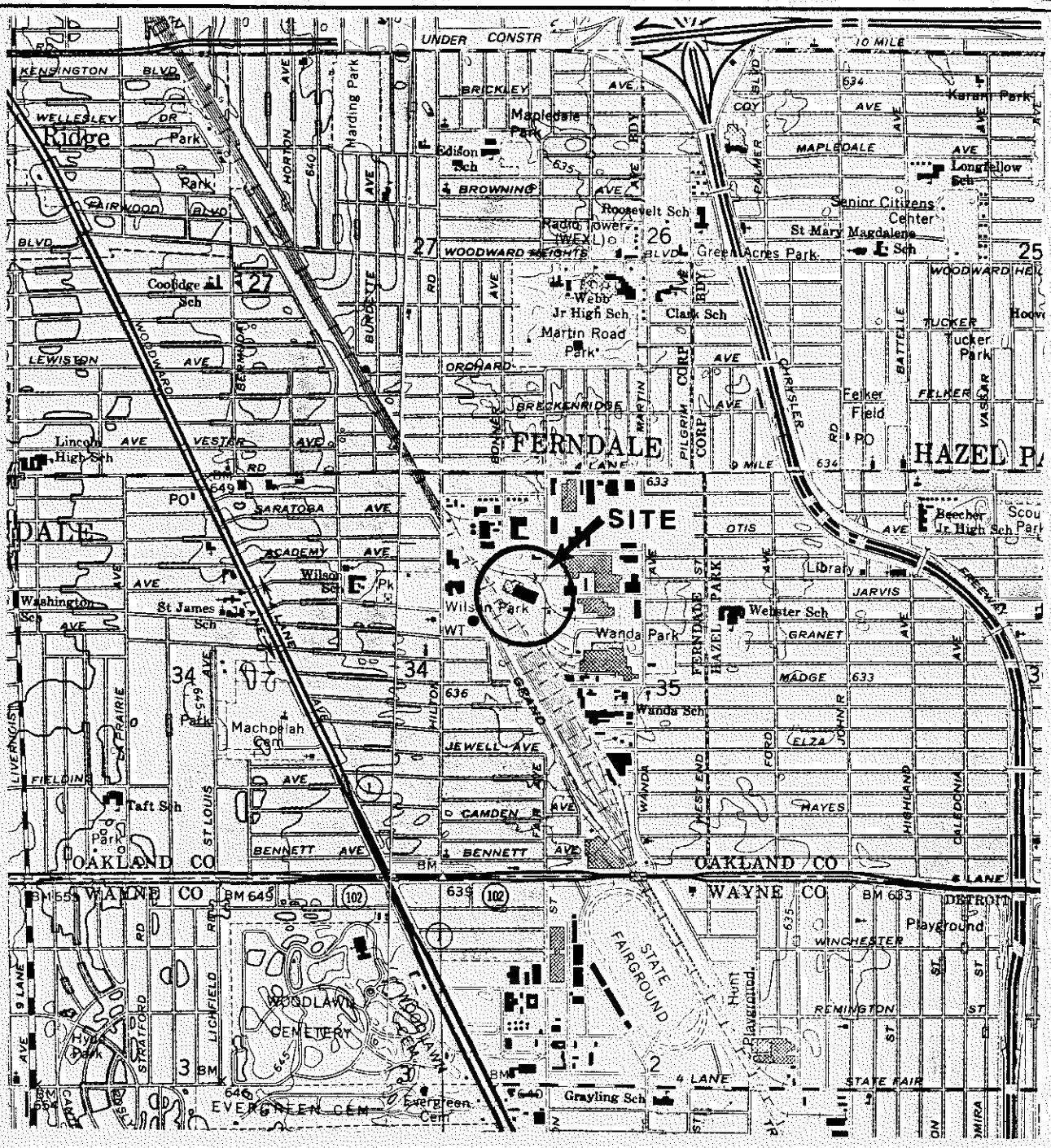
MACDERMID's Ferndale, Michigan, facility is located approximately 7 miles northwest of the Detroit Metropolitan area (see Figure 2.1, Site Location Map). The site and surrounding properties are zoned as a general manufacturing district. To the west and southwest is a business district. A medium density residential area is located northwest of the site. Proprietary chemicals for metal finishing, electronics and micro-electronics, plus surface preparations and finishings for metals, plastics, and other materials are manufactured at this facility. MACDERMID also recycles some chemical products that are returned by its customers for reclaiming.

MACDERMID is a Resource Conservation and Recovery Act (RCRA) transportation, treatment (recycle operation), and storage facility. Initially, the facility was operated under interim status (40 CFR 265) as an existing hazardous-waste management (HWM) facility. Since June 10, 1985, it had been operating under a RCRA Part A permit (40 CFR 270.13). On September 24, 1990, the facility's application for Part B permit status (40 CFR Part 270.14) was concurrently issued by the United States Environmental Protection Agency (USEPA) and the Michigan Department of Natural Resources (MDNR).

Historical and current manufacturing processes and overall wastestream management have been determined by the USEPA and the MNDR to constitute a point of concern as to the past, present, or possible future release of hazardous wastes and constituents into the environment within the scope of Section 3008(h) of RCRA. As a result, USEPA and MACDERMID have entered into an agreement, as part of the Part B permit maintenance, to conduct a RCRA Facility Investigation (RFI) of the site.

The RFI was written with the prior knowledge that a sufficient amount of analytical and historical information is presently available on this site to conduct an extensive data review and provide an accurate characterization of the site during the pre-investigative tasks (i.e. Tasks I and II). Modification of Task III, concentrating sampling efforts on the three solid waste management units (SWMUs) outlined in the Part B permit and any other suspected source areas of contamination would also facilitate a more timely approach in the selection of suitable remediation schemes (Task II) for this site. The ultimate goal of this investigation is focused on cleanup and/or control of the site-related constituents through a better understanding of the following:

- The degree and extent of site constituents in the environmental media
- The pathways of constituent migration from the site, as well as the potential impact of constituents on potential receptors
- On-site physical features and facilities that could affect constituent migration



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1 MILE

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CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

FIGURE 2.1

SITE LOCATION MAP
MACDERMID, INCORPORATED
1221 FARROW AVENUE

PREPARED FOR

MACDERMID, INCORPORATED
FERNDALE, MI 48220
MID 005 338 371

QUADRANGLE LOCATION

PLAT FROM U.S.G.S. QUADRANGLE
7.5 MINUTE SERIES
REVISED 1967
"HIGHLAND PARK" &
ROYAL OAK, MICHIGAN

OHM Corporation

OHM CORPORATION FINDLAY, OHIO	DRAWN BY C.E.MERRIN 1-28-91	CHECKED BY	APPROVED BY	DRAWING NUMBER 9961A1-1

PLOT SCALE: 1" = 1"

This three-task program consists of an initial investigative step (Task I) to determine the nature and extent of site-related constituents, potential pathways of constituent migration, and potential endangerment to public health and the environment from these site constituents. Task II will identify potential corrective measure technologies that may be used on site or off site for containment, treatment, remediation, and/or for the disposal of contaminants. The third task will include the work plan (WP), outlining site sampling events for verification of previous work done and for the acquisition of additional data points pertinent to the three SWMUs specified in the Part B permit and any other areas of concern. This sampling plan will also reinforce or discredit recommendations being considered for remediation (Task II). The draft and final report will present and interpret the data analyzed in Tasks I and II, and the results acquired during the sampling phase of the Final Work Plan (first part of Task III) which will provide a sufficient basis for a determination of endangerment to human health and the environment and the identification and evaluation of remedial action alternatives at the site.

2.1 FACILITY BACKGROUND

The MACDERMID, Ferndale, Michigan, facility has been in operation for over 23 years (foundation borings June 2, 1966).

The property is bounded on the north, east, and west sides by industrial and commercial properties (see Figure 2.2, Site Plan Map). The south side of the property is bounded by the Grand Trunk and Western Railroad yard. One main building covers approximately 76,000 square feet (approximately 27 percent) of the property and houses the manufacturing/storage facility and the company offices.

This facility is designed to store up to 47,520 gallons of hazardous waste in containers (55-gallon drums, 330-gallon totes, and 13-gallon carboys) generated by off-site facilities. There is presently one (temporary) hazardous-waste storage area located under the mezzanine of the liquids department (see Figure 2.3). This area has a 12,000-gallon capacity for storage of hazardous wastes. A concrete containment with a sealant covers and surrounds the area. Floor drains are plumbed into the facility wastewater-treatment system.

An upgraded hazardous-waste storage area is proposed on the south-central side of the building. The new storage area will have adequate secondary containment and provide an additional 35,520 gallons of hazardous-waste storage area. The top concrete (surface) will be sealed with a resin coating (Cielcrete 695) that is resistant to the stored wastes. A 60-millimeter-thick synthetic liner (Gundline) will be laid between the top concrete layers and the foundation concrete layers to prevent any leakage due to breakthrough of the top concrete into the soils and ground water. The upgraded storage area will be constructed upon approval of the engineering plans and specifications by the Waste Management Division of the MDNR. This information was stated in the Fact Sheet for the Proposed State Operating License and Federal Permit, under Description of the Facility Section II, C-2.

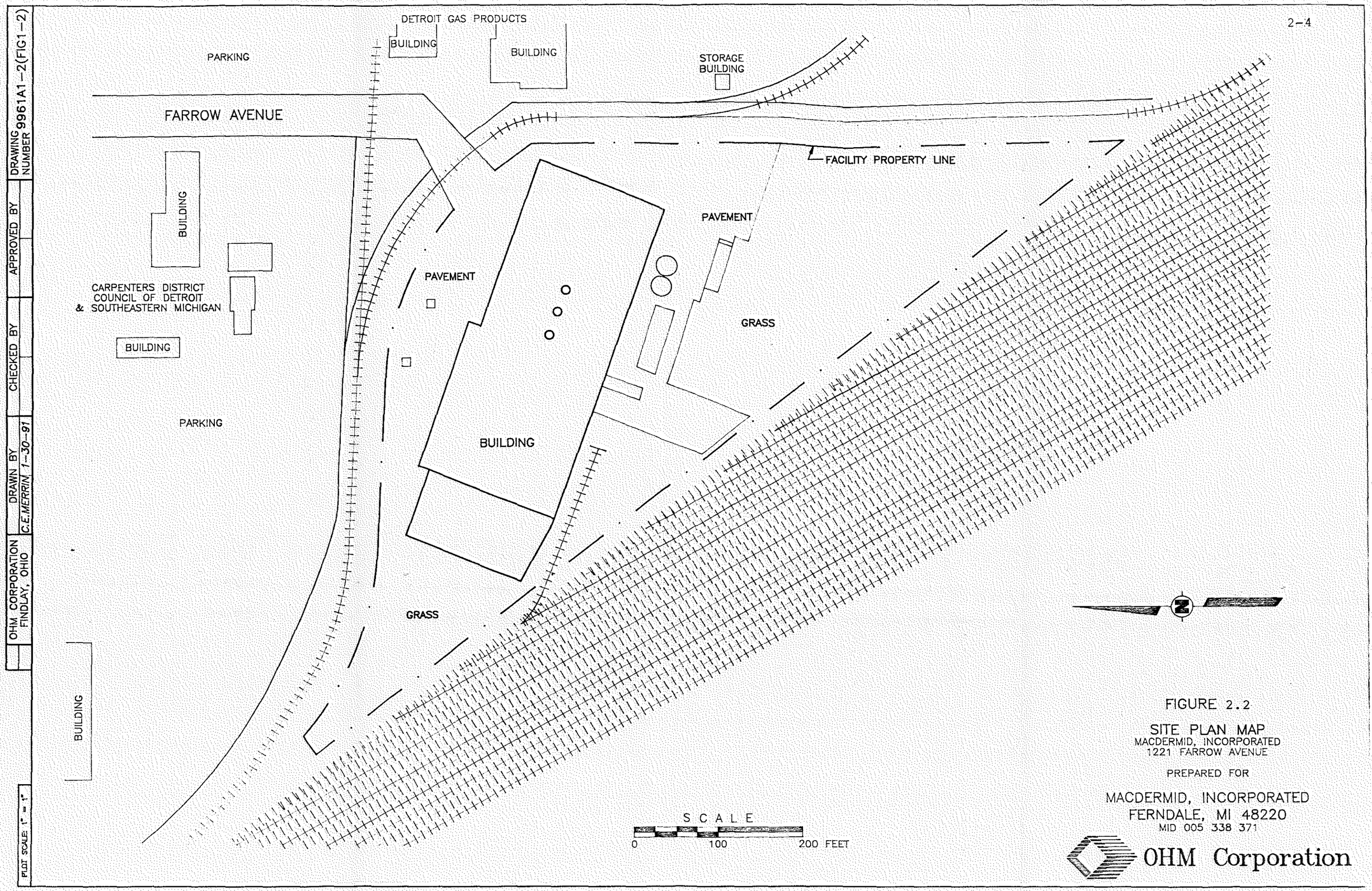


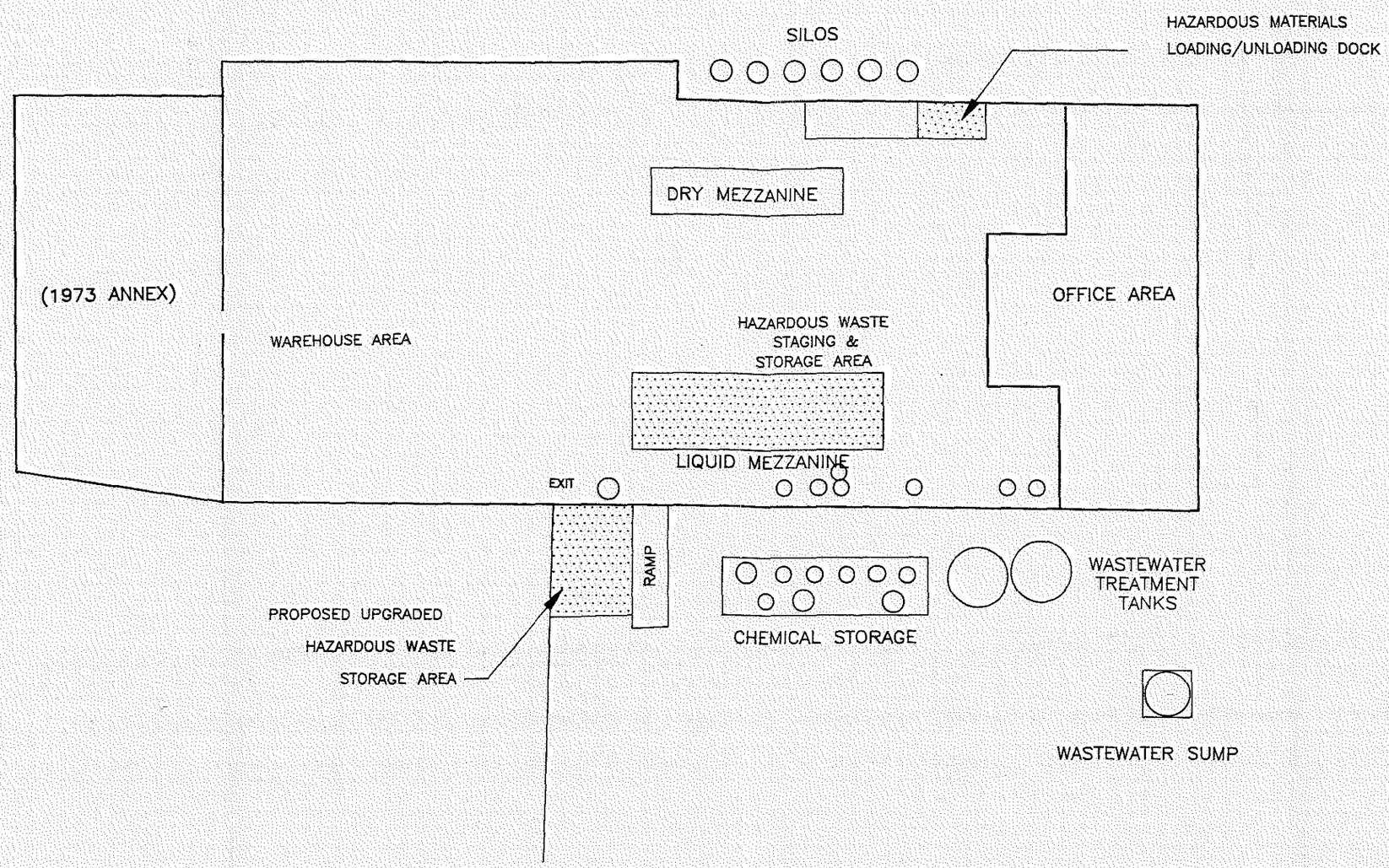
FIGURE 2.2

SITE PLAN MAP
MACDERMID, INCORPORATED
1221 FARROW AVENUE

PREPARED FOR

MACDERMID, INCORPORATED
FERNDALE, MI 48220
MID 005 338 371

OHM Corporation



SCALE
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FIGURE 2.3
HAZARDOUS WASTE AREAS
MACDERMID, INCORPORATED
1221 FARROW AVENUE

PREPARED FOR

MACDERMID, INCORPORATED
FERNDALE, MI 48220
MID 005338371

OHM Corporation

OHM CORPORATION
FINDLAY, OHIO

DRAWN BY C.E.MERRIN 2-9-91
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APPROVED BY
DRAWING NUMBER 9961A1-4(FIG1-3)
PLOT SCALE: 1" = 1'

MACDERMID has manufactured approximately 1,800 new products at the Ferndale facility. Some of these products have been discontinued or are presently in an inactive mode. Over 464 different chemicals are used in the manufacturing and recycling processes at this facility (see Appendix A of the work plan for a list of chemicals and a list of raw materials).

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The OHM project manager will be the primary focal point for control of the project activities and for coordination with the on-site contracting officer. For the MACDERMID project the project manager will be supported by the project management support team which will provide reviews, guidance, and technical advice on project execution issues. Members of this staff will be called upon on an "as-needed" basis to assist in smooth project execution. The project manager will be supported by health-and-safety and QA/QC staff to ensure that the project is safely executed in compliance with applicable laws, regulations, statutes, and industry codes.

3.1 PROJECT MANAGEMENT PERSONNEL

The program management support team for the MACDERMID contract includes a project manager, regional technical manager project QA officer, senior hydrogeologist and project staff. The organization of each project management team varies due to size and types of projects managed. The role and responsibilities of the project manager, regional technical director, field technical services manager, project QA officer, senior hydrogeologist and project staff are described in detail in the following sections of this document. The project management team provides a single point of contact staff. The activities include: ensuring effective project communication, committing resources to accomplishing project objectives, providing continuity for technical direction of project,s planning and scheduling work and resolving workload conflicts, and managing project costs and contractual requirements. It is the responsibility of the project management team to implement the quality practices established for the QAPP.

3.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project management organization for the MACDERMID project has been selected based on the specific project requirements. The project team members' responsibilities are described below:

- Project Manager (R. Veen)--The project manager is responsible for the overall direction of the project executed under his supervision including application of the QA program. The project manager provides the managerial administrative skills to ensure that resource allocations, planning, execution, and reporting meet contract requirements. The project manager is ultimately accountable for QA carried out on each project under his supervision. The individual quality-related responsibilities of the project manager include:

  - Selection of the project supervisor

  - Participation in the project QA review team

- General supervision of the project

- Approval, as required, of project-specific QA documents

- Selection of the QA officer

- Stop work on a project if necessary because the project cannot be completed to the quality levels required, the quality requirements cannot be met, or the schedule or budget do not permit successful completion

• Site Supervisor (T. Furiate)--The project supervisor is accountable for the day-to-day supervision of each assigned project including fulfillment of the QA responsibilities. The site supervisor will be the key operational manager of the project and responsible for maintaining clear, effective, up-to-date, communication with the contracting officer concerning project scoping and planning. Additional responsibilities include coordination of subcontractors, including their compliance with OHM policies and procedures and contractual requirements, developing and maintaining all site-specific plans, and controlling cost and schedule aspects of all site activities. Quality-related responsibilities of the project supervisor are:

  - Participation in the project QA review

  - Communication to the project staff of project-specific client and regulatory requirements, and QA practices

  - Identify, document, and notify the contracting officer and project staff of changes in the scope of work, regulatory requirements, and QA practices

  - Notify the program manager if the project cannot be completed or completed with regards to quality, schedule, or cost

  - Supervision of preparation and approval of project-specific procedures, WP, QAPP, and Sampling and Analysis Plan (SAP).

  - Determination that changes, revisions, and rework are subject to the same QC requirements as the original work

  - Serve as final reviewer prior to release of project information

  - The organization of the project staff and assignment of responsibilities

- Day-to-day execution of the project

- Identify, document, and notify the project manager and staff of changes in the scope of work

- Notify the project manager of nonconformances on the project and provide appropriate documentation for reporting

- Liaison for communication with the contracting officer and subcontractors

• Health-and-Safety Officer (J. Joice)--The health-and-safety officer will be primarily responsible for:

  - Assessing the potential health-and-safety hazards at the site

  - Developing site-specific health-and-safety plans

  - Performing periodic safety audits

• Transportation and Disposal Coordinator (M. Kinder)--The transportation and disposal coordinator will be responsible for:

  - Assuring all waste documentation such as profiles and manifests are completed properly

  - Scheduling of all trucks and waste into the disposal facility.

• Fixed Based Laboratory --Analytical Services Corp. (ASC), a wholly owned subsidiary of OHM Corporation, will be contracted to perform the verification analyses identified in the SAP and QAPP. Details of ASC's QA program can be found in Appendix A of this document

• Quality Assurance Officer (J. Carson)--The on-site QA officer will:

  - Track validation data and ensure adherence to published guidelines

  - Determine if the levels of QA are being met for the project

  - Certify the level of QA that has been achieved during the generation of analytical data

  - Implement QA/QC procedures

- Assure the continuity of chain-of-custody evidence

- Assure the traceability of all standards to primary standards

- Regional Technical Services Director (T. Sole)--The regional technical director will:

  - Act as project coordinator for technical personnel

  - Be a primary technical adviser on scientific matters

  - Manage the QA auditing program during projects

  - Review and update technical procedures

  - Be included in the membership of the QA/QC committee

- Manager, Technical Field Services (J. Herzig)--The manager of field technical services will:

  - Act as project coordinator for field technical personnel

  - Serve as primary technical adviser on scientific matters related to QA/QC for the analytical laboratory

  - Manage the interlaboratory auditing program during field projects

  - Review and update procedures in the sampling and field analytical manuals

  - Serve as a member of the QA/QC committee

- Project Hydrogeologist (T. Andrews)--The project hydrogeologist will:

  - Directly supervises and coordinate all field hydrogeologist field activities including monitoring well installation, development, and sampling

  - Implement the designated QA/QC procedures for hydrogeological field activities

- Report all hydrogeological data to the project manager for review

- Implement corrective actions as required and ordered by the project manager

- Geotechnician (M. Martin)--The geotechnician will be responsible for:

  - Assisting the project hydrogeologist in geotechnical activities.

  - Carrying out any geotechnical sampling in accordance to approved procedures and methodologies as defined in the SAP

  - Generation of trip blanks, equipment blanks, and acquiring replicate samples associated with the geotechnical investigation as defined in the SAP and QAPP.

- Sample Technician (D. Seem, A. Pefley)--The sampling technicians will be responsible for:

  - Carrying out, under the direction of the Senior Sample Technician, all sampling in accordance to approved procedures and methodologies as defined in the SAP

  - Generation of trip blanks, equipment blanks, and acquiring replicate samples as defined in the SAP and QAPP

- Senior Sample Technician (W. Putman)--The Senior Sample Technician will be responsible for supervising the following:

  - Carrying out all sampling in accordance to approved procedures and methodologies as defined in the SAP

  - Generation of trip blanks, equipment blanks, and acquiring replicate samples as defined in the SAP and QAPP

4.0 QUALITY ASSURANCE

OHM expects and analytes of concern for soils to be:

- Metals

  - Chromium, total
  - Copper, total
  - Nickel, total
  - Zinc, total

- Aromatic Volatile Organics

  - Chlorobenzene
  - 1,2 Dichlorobenzene
  - 1,3 Dichlorobenzene
  - 1,3 Dichlorobenzene
  - Ethylbenzene
  - Methylene chloride
  - Toluene

- Semivolatile organics

  - bis(2-ethylhexyl)pthalate

Matrix versus analyte is summarized in Tables 4.1 and 4.2.

4.1 USES AND USERS OF MEASUREMENT DATA

The action levels for each of these criteria are listed in Tables 4.3 and 4.4.

4.2 QA OBJECTIVES FOR CHEMICAL MEASUREMENTS

QA objectives for chemical measurements are presented in the following section in terms of goals for accuracy, precision, completeness, representativeness and comparability. The goals for accuracy, precision, and completeness are summarized in Table 4.5.

4.2.1 Accuracy

Accuracy for chemical measurements is defined as the expected value of the measurement as a percent of the true or known value. Typically, it is measured by some combination of analysis of spiked blanks, spiked samples, standard reference materials, and by zero span calibration checks. Analysis of blanks provides an additional indicator of accuracy by warning of laboratory contamination.

TABLE 4.1

LIST OF ANALYTICAL PARAMETERS
GROUND WATER

Analysis	USEPA Analytical Method (SW-846)*	Detection Limit**
Metals		
Arsenic, total	7060	2
Barium, total	6010	10
Cadmium, total	6010	5
Chromium, total	6010	50
Copper, total	6010	10
Lead, total	6010	50
Mercury, total	7470/71	0.2
Nickel, total	6010	50
Selenium, total	7740	2
Silver, total	6010	10
Zinc, total	6010	10
Aromatic Volatile Organics		
Chlorobenzene	602/8020	0.2 [1]
1,2-Dichlorobenzene	602/8020	0.4 [1]
1,3-Dichlorobenzene	602/8020	0.4 [1]
1,4 Dichlorobenzene	602/8020	0.3 [1]
Ethylbenzene	602/8020	0.2 [1]
Toluene	602/8020	0.2 [1]
Xylenes	602/8020	Not Given
Additional Constituents		
Methylene Chloride	8270	10
Bis(2-ethylhexyl)phthalate	8060	10

* All methods are from USEPA SW-846, 3rd Edition. Alternate USEPA-approved methods may be substituted for the specified method depending on the contract laboratory (ASC, Findlay, Ohio)

**Detection limits are Practical Quantification Limits (PQLs) for organic analytes and Method Detection Limits (MDLs) for metals and anions. Units are microgram per liter (ug/l) for water samples

[1] Determination of PQLs for ground-water matrices = PQL = [MDL] x [factor of 10]. Sample PQLs are highly matrix-dependent. The PQLs given in this table are provided for guidance and may not always be achievable

TABLE 4.2

LIST OF ANALYTICAL PARAMETERS
SOIL

Analysis	USEPA Analytical Method (SW-846)*	Detection Limit**
Metals		
Chromium, total	6010	1,000
Copper, total	6010	200
Nickel, total	6010	1,000
Zinc, total	6010	10
Aromatic Volatile Organics		
Chlorobenzene	602/8020	0.2 [1]
1,2-Dichlorobenzene	602/8020	0.4 [1]
1,3-Dichlorobenzene	602/8020	0.4 [1]
1,4-Dichlorobenzene	620/8020	0.3 [1]
Ethylbenzene	602/8020	0.2 [1]
Toluene	602/8020	0.2 [1]
Xylenes	602/8020	Not Given
Additional Constituents		
Methylene Chloride	8270	500
Bis(2-ethylhexyl)phthalate	8060	200

* All methods are from USEPA SW-846, 3rd Edition. Alternate USEPA-approved methods may be substituted for the specified method depending on the contract laboratory (ASC, Findlay, Ohio)

** Detection limits are PQLs for organic analytes and MDLs for metals and anions. Units are micrograms per kilogram (ug/kg) for soil/sludge samples

1] PQLs are highly matrix-dependent. The PQLs given in this table are provided for guidance and may not always be achievable. Thus PQL = [MDL] x [the following factors that apply for the matrix involved, i.e., for low-level soil, water miscible liquid waste, high-level soil/sludge, or non-water miscible waste. The factors that apply are 10,500, 1,250, and 1,250, respectively.

TABLE 4.3

GROUND-WATER EVALUATION CRITERIA

Constituents	Class*	USEPA Primary Drinking Water Standards (ppm)	MDNR Selected Type B Cleanup Criteria (ppm)
Arsenic	A	0.050	2×10^{-5}
Barium		1	5
Cadmium	B1	0.010	--
Chromium		0.050	--
Copper		--	--
Lead	B2	0.050	0.005
Mercury (Inorganic)	D	0.002	0.002
Nickel	D	--	--
Silver	D	0.050	--
Zinc		--	--
Phosphorus (total)		--	--
Cyanide (total)	D	0.700	0.140
Selenium		0.010	--

* Class A and B = Carcinogen
Class D = Systemic toxicant

TABLE 4.4

INORGANIC CONTAMINANT ACTION
LEVEL RANGES FOR SOILS
(mg/kg, 4 to 6 feet)

Arsenic	21[b] to 80[a]
Barium	162[b] to 281[c]
Cadmium	3.8[b] to 40[a]
Chromium	41[b] to 57[c]
Copper	29[b] to 41[c]
Cyanide	0.5[b] to 2,000[a]
Lead	19[b] to 32[c]
Mercury	0.14[c] to 20[a]
Nickel	42[b] to 2,000[a]
Silver	3.8[c] to 200[a]
Selenium	0.89[c] to 1.2[b]
Zinc	78[b] to 87[c]

a = Action level that the USEPA believes to be appropriate; USEPA Proposed Action levels July 27, 1990 (55 CFR 30798)

b = Action level defined by WMD/MDNR as A.L. = $\bar{x} + 3s$

c = Action level defined using MI Erie clay background soil survey data, A.L. = $\bar{x} + 3s$

TABLE 4.5
QUALITY ASSURANCE GOALS

Parameter	Groundwater			Soils		
	Accuracy	Percision	Completeness	Accuracy	Percision	Completeness
Arsenic	75-125%	20%	95%	-	-	-
Barium	75-125%	20%	95%	-	-	-
Cadmium	75-125%	20%	95%	-	-	-
Chromium	75-125%	20%	95%	75-125%	20%	95%
Copper	75-125%	20%	95%	75-125%	20%	95%
Lead	75-125%	20%	95%	-	-	-
Mercury	75-125%	20%	95%	-	-	-
Nickel	75-125%	20%	95%	75-125%	20%	95%
Selenium	75-125%	20%	95%	-	-	-
Silver	75-125%	20%	95%	-	-	-
Zinc	75-125%	20%	95%	75-125%	20%	95%
Chlorobenzene	55-135%	20%	95%	55-135%	20%	95%
1,2-Dichlorobenzene	37-154%	20%	95%	37-154%	20%	95%
1,3-Dichlorobenzene	50-141%	20%	95%	50-141%	20%	95%
1,4-Dichlorobenzene	42-143%	20%	95%	42-143%	20%	95%
Ethylbenzene	32-160%	20%	95%	32-160%	20%	95%
Methylene Chloride	25-162%	20%	95%	25-162%	20%	95%
Toluene	46-148%	20%	95%	46-148%	20%	95%
Xylene	32-160%	25%	95%	32-160%	25%	95%
bis(2ethylhexyl) phthalate	D-158	25%	95%	D-158	25%	95%

4.2.2 Precision

While accuracy measures determinate or systematic error, indicators of precision provide a measure of indeterminate or random error. Precision for chemical measurements is defined as the expected root mean square deviation of multiple measurements of the same material. Precision will be determined by replicated analyses in the laboratory of the same sample, by the collection and analysis of duplicate samples, by submission of "blind" duplicate samples to the laboratories, and by analysis of split samples by both the field and fixed-based laboratories.

4.2.3 Completeness

Completeness is defined as the percent of the planned data that meets QA goals for accuracy and precision.

4.2.4 Representativeness

Representativeness may be thought of as the amount of information in a sample relative to the purpose for which the sample was collected. The samples of soil should have the same composition as the average composition they are representing. In practice this is difficult to do, since contaminated soil is usually very heterogeneous. A soil sample intended to identify a "hot spot" will not be representative of the site as a whole. In fact, since there is generally very little spatial continuity in the vicinity of the "hot spot" this sample may only be representative of the surrounding 1 or 2 feet.

4.2.5 Comparability

Comparability of measurements will be ensured by the use of standard analytical methods and routine QC in the laboratories, by the use of consistent units of measure in reporting, and by the consistent use of standard, approved sampling techniques in the field. Compatibility of data will be a particularly important issue in later phases of work, particularly in cleanup verification and in planning additional site remediation activities.

For the purpose of this project this can easily controlled. All samples will be collected and documented as grab samples. Any compositing of samples will be performed in the laboratory. This will serve two purposes. First, a composite sample whose results are questionable can be broken down into its component samples. This requires that composite group size be controlled so that the contaminant in a single "hot" sample will not be diluted below the analytical detection limit. Secondly, the individual sample locations will be recorded. Later, when maps of contaminant concentration contours are being prepared, these composite results can be smoothly integrated into a data set of grab sample results by the use of ordinary kriging with appropriate weighting for composite samples and the actual locations of the composited samples.

5.0 SAMPLING PROCEDURES

The sampling tasks for this project include:

- Subsurface soil sampling via soil borings
- Ground-water sampling

The technical approach of the RFI Work Plan for the three SWMUs is described in the following subsections.

5.1 SOIL BORINGS

Fifteen to twenty soil borings will be advanced using a hollow stem auger rig and a 2-foot-long, stainless-steel split spoon sampler. These borings will be advanced several feet into the blue sealing clay or 15 feet (whichever comes first). Soil descriptions will be noted and samples will be screened with a photoionization detector (PID) for headspace. From these headspace readings and visual inspections, specific samples will be selected and sent to the laboratory for analysis.

Upon completion of each boring and the necessary sampling immediately preceeding the advancement of the borehole, a grout slurry will be tremied into the abandoned boreholes and brought to the surface. This will seal the borehole and prevent contamination from unnatural commingling of shallow aquifers and from outside/surface contaminants entering the open hole. Cuttings from the soil borings will be drummed, labeled, and staged for appropriate landfill disposal following the field investigation phase.

5.1.1 Soil Boring Locations

Soil borings will be located according to previous analytical and historical information available on the site. SWMU No. 1 (lagoon area) will require approximately nine soil borings (SB8, SB9, SB10, SB11, SB12, SB13, SB14, SB15, SB16) and two monitor wells (MW4 and MW5) (see Figure 2.1 of the work plan).

SWMU No. 2 (units that emit air contaminants--incinerator) involves two separate areas. The first location on the northwest side of the building involves four soil borings and possibly five. One boring will be placed at each end (north and south) of the building annex area outside (SB1 and SB4). A boring may be needed inside the building annex as it was constructed after the incinerator had been moved or about the same time as when the annex was built. Two borings will be advanced to the west of the annex in conjunction with the higher emissions contaminant concentrations as determined by the ISCLT model (see Appendix I of the work plan).

The second incinerator location, on the south side of the building, had emission concentrations above the closed surface impoundment area. Sampling will be coincident for this incinerator's emissions with the sampling for SWMU No. 1 (lagoons).

SWMU No. 3 is called the railroad spur area, however, contaminants found may be more closely related to the drum wash area that was located on or near the east side of the present concrete ramped area. Evidence of this washing area can be seen in aerial photos dated 1980 to 1985 from the Oakland County Planning Commission. A soil boring in this ramped area (SB7) is proposed, as well as three additional borings westward and toward the building/railroad spur (SB4, SB5, and SB6).

5.1.2 Soil Boring Procedures

The hollow-stem auger (HSA) drilling method will be used for advancing all soil borings (in areas which are accessible to a drill rig) to be performed as part of the RFI. The HSA method is the preferred technique for performing soil borings in shallow unconsolidated sediments because this method does not introduce foreign fluids into the borehole which can interfere with analytical sampling results and representative subsurface samples can be collected for analytical purposes.

All boreholes will be continuously sampled to define the stratigraphy and saturated intervals and allow for the collection of samples for chemical analysis as required. These samples will be obtained by using either a Shelby tube or split spoon sampler, depending on the cohesiveness of the material sampled.

In areas which are not accessible to a drill rig, such as the basin, a hand auger or a small portable power auger will be used to perform the soil borings. The use of portable augers is generally not optimal for collecting continuous samples therefore, samples will be collected for examination at 2- to 3-foot intervals, if possible.

All samples and cuttings will be logged and inspected for signs of contamination by a qualified geologist or geotechnical engineer. A PID will be used as a field screening tool for health-and-safety purposes and screening soil samples for headspace readings to determine whether or not the soil boring samples contain photoionicable compounds relative to the investigation. All soil borings will be grouted to the surface after sampling to avoid artificially induced soil contamination.

To safeguard against potential contamination, precleaned auger flights will be used. All auger flights will be steam-cleaned between each borehole before reuse. All Shelby tubes or split spoon samplers used for collecting samples for analytical field screening or laboratory analysis will also be cleaned between use in accordance to the procedures detailed in Section 5.1.4.

5.1.3 Soil Sampling

Soil samples will be collected in order to determine the extent of contaminant migration from the investigated unit. The soil samples will be collected from continuously sampled borings. Once retrieved, the lithology of the soil sample will be logged by the field geologist/hydrogeologist. The procedures for performing soil borings and the requirement for boring logs are presented in Section 5.1.2.

The soil sample will be visually inspected for discoloration of soil by waste or product leachate. In addition, each split spoon sample will be tested for organic vapors using a calibrated PID. The PID will be calibrated using an appropriate calibration gas provided by the manufacturer. Organic vapor measurements will be recorded for each sample in units of parts per million (ppm). The measurement of volatile emissions from the soil sample will serve as a qualitative indicator of contamination. All soil samples will be tested with the PID and those results will be logged.

Samples that register organic vapor emission, indicating contamination, will be collected in glass jars for archiving until completion of the RFI. The first stratum encountered which does not exhibit obvious contamination, as determined from visual inspection and photoionization meter readings, will be collected for laboratory analysis. The sample collected for laboratory analysis will be immediately placed in a glass jar with a Teflon-lined lid.

Since it is anticipated that many of the soil borings will be drilled in areas of potential contamination, the following procedure will be followed:

- Prior to drilling, all augers, rods, and core samplers will be cleaned in accordance to Section 5.1.4.

- After obtaining a sample, the sampling device will be stacked in a separate pile for cleaning prior to reuse.

- After describing the soil sample and retaining a portion of the sample in a glass jar, any remaining soil sample will be placed in a drum for storage and disposal.

- After completion of the boring and installation of the well, any contaminated soils and discarded soil samples will be placed in drums for disposal at an approved landfill.

- The augers, rods, and sampling devices will then be cleaned before the next boring is drilled.

Sampling equipment (i.e., Shelby tubes, trowels, etc.) will be cleaned thoroughly to minimize sample contamination and cross contamination as detailed in Section 5.1.4.

The borehole will be terminated once the retrieved soil sample does not exhibit contamination or exhibits stiff, blue clay, whichever comes first.

5.1.4 Decontamination Procedures

All bits, augers, sampling tools, and other drilling equipment that come in contact with the soils or ground water at each boring location will be decontaminated prior to initial usage on site and before being reused for another boring. In addition, the soil sampling device (split spoon, core barrel, etc.) will be decontaminated before each sampling event.

Between soil borings, hollow-stem augers and associated equipment will be decontaminated with a high-pressure steam cleaner. Detergent (biodegradable non-phosphatic, Alconox) may be added to the steam if sticky, greasy, or oily residues persist on the equipment. Detergent-steam washes will be followed by a straight steam rinse.

Between sampling events, the sampling device and hand tools that contact the samples will go through a four-step decontamination procedure. These steps are:

- A detergent (Alconox or equivalent) wash
- Two potable water immersion rinses
- A rinse with distilled water

As part of the project QA/QC procedures, samples of the potable water used for decontamination will be analyzed for the constituents shown in Table 5.1. Additional decontamination methods, such as acetone or methanol rinses, will only be used if warranted by the type, extent, and physical characteristics of the contamination.

A decontamination area will be established on site. All decontamination water will be collected, contained, and disposed in the MACDERMID wastewater-treatment system.

5.1.4.1 Sample Containers

Bottles prepared according to USEPA specifications for environmental sampling will be provided by the laboratory performing the analyses. The bottles will not be opened prior to filling. Table 5.1 lists the bottle type to be used and the minimum volume of water to be collected for each specific analytical parameter.

5.1.4.2 Order of Sample Collection

Samples will collected and containerized in the order of volatilization sensitivity of the analytical parameters as follows:

- Volatile organic compounds (VOCs)
- Extractable organics
- Total metals

TABLE 5.1

LIST OF ANALYTICAL PARAMETERS
SOIL

Analysis	USEPA Analytical Method (SW-846)*	Detection Limit**	Bottle Type and Sample Volume	Preservative	Holding Time
Metals					
Chromium, total	6010	1,000	10-g, glass	Cool to 4° C	6 months
Copper, total	6010	200	10-g, glass	Cool to 4° C	6 months
Nickel, total	6010	1,000	10-g, glass	Cool to 4° C	6 months
Zinc, total	6010	10	10-g, glass	Cool to 4° C	6 months
Aromatic Volatile Organics					
Chlorobenzene	602/8020	0.2 [1]	5-g, glass	Cool to 4° C	14 days
1,2-Dichlorobenzene	602/8020	0.4 [1]	5-g, glass	Cool to 4° C	14 days
1,3-Dichlorobenzene	602/8020	0.4 [1]	5-g, glass	Cool to 4° C	14 days
1,4 Dichlorobenzene	602/8020	0.3 [1]	5-g, glass	Cool to 4° C	14 days
Ethylbenzene	602/8020	0.2 [1]	5-g, glass	Cool to 4° C	14 days
Toluene	602/8020	0.2 [1]	5-g, glass	Cool to 4° C	14 days
Xylenes	602/8020	Not Given	5-g, glass	Cool to 4° C	14 days
Additional Constituents					
Methylene Chloride	8270	500	10-g, glass	Cool to 4° C	14 days
Bis(2-ethylhexyl)pthalate	8060	200	10-g, glass	Cool to 4° C	14 days

TABLE 5.1

LIST OF ANALYTICAL PARAMETERS
SOIL
(CONTINUED)

* All methods are from USEPA SW-846, 3rd Edition. Alternate USEPA-approved methods may be substituted for the specified method depending on the contract laboratory (ASC, Findlay, Ohio).

** Detection limits are PQLs for organic analytes and MDLs for metals and anions. Units are ug/kg for soil/sludge.

[1] PQLs are highly matrix-dependent. The PQLs given in this table are provided for guidance and may not always be achievable. Thus, PQL = [MDL] x [the following factors that apply for the matrix involved, i.e., for low-level soil, water miscible liquid waste, high-level soil/sludge, or non-water miscible waste. The factors that apply are 10, 500, 1,250, and 1,250, respectively].

Table 5.1 also presents a comprehensive listing of analytical parameters which will be used to assess contaminant migration for SWMU No. 1. VOCs will not be analyzed in samples collected in SWMU Areas Nos. 2 and 3. Any additional constituents that are not listed in Table 5.1 will be analyzed following USEPA, SW-846 Test Methods For Evaluating Solid Waste. A select list of parameters will be applied to water or soil samples collected at each waste management unit.

Volatile Organics

Sample containers for VOCs will be filled with unfiltered water. The bottles will be carefully filled to ensure that there is no air trapped in the sample. Water will be slowly poured into the sample bottle to allow formation of a meniscus on the water surface in the bottle. Once the bottle lid has been secured, the sample will be checked for air entrapment by inverting the bottle, firmly tapping the bottle, and checking for air bubbles.

Extractable Organics

Sample containers for non-volatile organic analyses will not be rinsed in the field before sample collection. Containers will be completely filled.

Metals

Sample water for metals analysis will be filtered through a 0.45-micron filter unit before filling laboratory prepared bottles. New filters will be used for each sample. Tubing, if used for filtration, will be triple rinsed with distilled or deionized water before collection of the sample or a new piece of tubing will be dedicated for each sample.

When the sample is too turbid to field filter, the sample will be put on ice in bottles with no acid preservative and immediately delivered to the laboratory for filtration and acidification.

5.1.5 Driller's Log

It is imperative that drilling logs be concise, complete, and described in a manner that is easily understandable to all who read them. The following items will be included in the logging data (see Figure 5.1, Bore Hole Log):

- Hole number and location
- Description of soils and subsurface conditions (if applicable)
- Type of drilling equipment, drilling company (if applicable)
- Method of drilling
- Type and size of casing
- Type and size of well screen
- Depth to well screen
- Type of pump and pumping rate

OHM Corporation

VISUAL CLASSIFICATION OF SOILS

Project Number _____
Project Name _____
Boring Number _____

Elevation _____ Location _____ Page _____ of _____
Engineer/Geologist _____ GWL: Depth _____ Date/Time ____/____ Date _____
Drilling Co. _____ Depth _____ Date/Time ____/____ Date Started _____
Driller _____ Casing Size/Depth: ____/____ Date Completed _____
Drilling Method _____ Date Backfilled _____

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS

Notes: _____

F-204 8/4/89

- Drilling and sampling times
- Depth to water table and date and time measured
- Type of samples taken and depths taken
- Volume of water purged
- Type of well (permanent or temporary)
- Type of sampling equipment and/or cleaning procedure
- Depth of sampling and description (if applicable)

5.2 MONITORING WELL INSTALLATION PROCEDURES

The HSA method will be used to install the new (shallow) wells as part of the RFI. This method is the preferred technique for shallow monitor well installation for the same reasons described previously. To provide an additional safeguard against potential contamination, precleaned auger flights will be used. All auger flights will be steam-cleaned between each borehole before reuse. All boreholes will be continuously sampled to define the shallow stratigraphy and determine the appropriate screen interval. All samples and cuttings will be logged and inspected for signs of contamination by a qualified geologist or geotechnical engineer.

Once the total depth is reached, the well casing and screen will be installed through the auger stem. Each auger will be slowly raised and removed, one flight at a time, to minimize formation collapse. The annulus will be sounded during this procedure to determine if collapse has occurred.

If little or no collapse is observed, filter sand will be poured into the annulus between the well casing and auger stem until the sand pack fills the well bore annulus to the appropriate height relative to the screen. The slow withdrawal of the augers significantly reduces the suction effect which can cause formation collapse. If collapse does occur, the amount will be documented and the remaining annulus to be sand packed will be filled using this same procedure.

A minimum of 1 foot of bentonite pellets will then be placed on top of the filter sand. The preferred method of bentonite pellet placement is by dropping the pellets through the auger flight annulus, although this can result in bridging. If this occurs, the augers will be removed slowly, the borehole sounded, and then the bentonite seal placed.

5.2.1 Ground-Water Monitoring Wells

A total of five 2-inch-diameter, stainless-steel monitoring wells will be installed at this site. A hollow-stem auger drill rig with 6.25-inch inside diameter augers will be used to advance the boreholes as continuous 2-foot-long split spoon samples are collected. Decontamination before usage and after each borehole according to Section 5.1.4 is required. Decontamination of the split spoon sampler will be done prior to use and after each sample is collected. The decontamination of the stainless-steel monitoring well pipe will be done before installation.

Monitoring of the breathing air zone and field headspace screening of soil samples will be conducted using a PID. Soil samples will be retained for laboratory analysis on the basis of headspace readings and visual inspection. Monitoring wells will be set between 15 and 20 feet deep as site conditions dictate. There will be 10 to 15 feet of screen in each well depending on the depth to water. When possible, 5 feet of screen will be set above the water table depth. If water levels are above 10 feet deep, less than 5 feet of screen above the water table will have to suffice.

In an effort to screen the monitoring wells at the accurate depth to water, it is important not to sacrifice the necessary depth to ensure a good annular seal between the top of the screened interval and the ground surface. This seal must consist of a foot of bentonite approximately 1 to 2 feet above the top of the screened interval, followed by a concrete/grout mixture which is brought to within 0.5 feet of the surface. A manhole/road-box will be installed flush-mounted with the surface and sealed around the well bore and on the surface with finishing cement. The monitoring wells will have sealing, locking well caps.

Two monitoring wells will be designed as upgradient background monitoring points for soils analysis and ground-water sampling (i.e., MW1 and MW2), (see Figure 5.2). The three additional monitoring wells will be located within the SWMUs, downgradient. Soil boring and monitoring well locations were selected using a 60-foot grid pattern with random locations.

5.2.2 Air Monitoring In Wells

If a ground-water monitoring well is suspected of being highly contaminated or containing non-aqueous phase-separated liquid (NAPL) that may contain volatile constituents, the air space will be monitored using a PID in the monitoring well prior to any sampling. The air in highly contaminated wells may be sampled by inserting the probe of a PID about 4 inches into the well prior to taking a water level measurement, purging the well, or collecting a water sample. The PID will be calibrated using an appropriate calibration gas provided by the manufacturer. PIDs measure organic vapor present in the air in ppm. Appendix L of the work plan describes the type of meter that will be used. Measurements will be recorded in the field log book.

5.2.3 Ground-Water Level Measurement

The static water level will be measured in each well. In particular, the distance to the top of the water in the well from the top of the well casing will be measured. The measurement will be made from a surveyed reference point which is clearly and permanently marked on the top of the casing. This will enable water level elevations to be referenced to mean sea level (MSL).

The depth to water will be measured using an electric line (E-line) or the air pressure method where appropriate equipment is installed. All measurements and calculations made in the field will be recorded in the field log book.

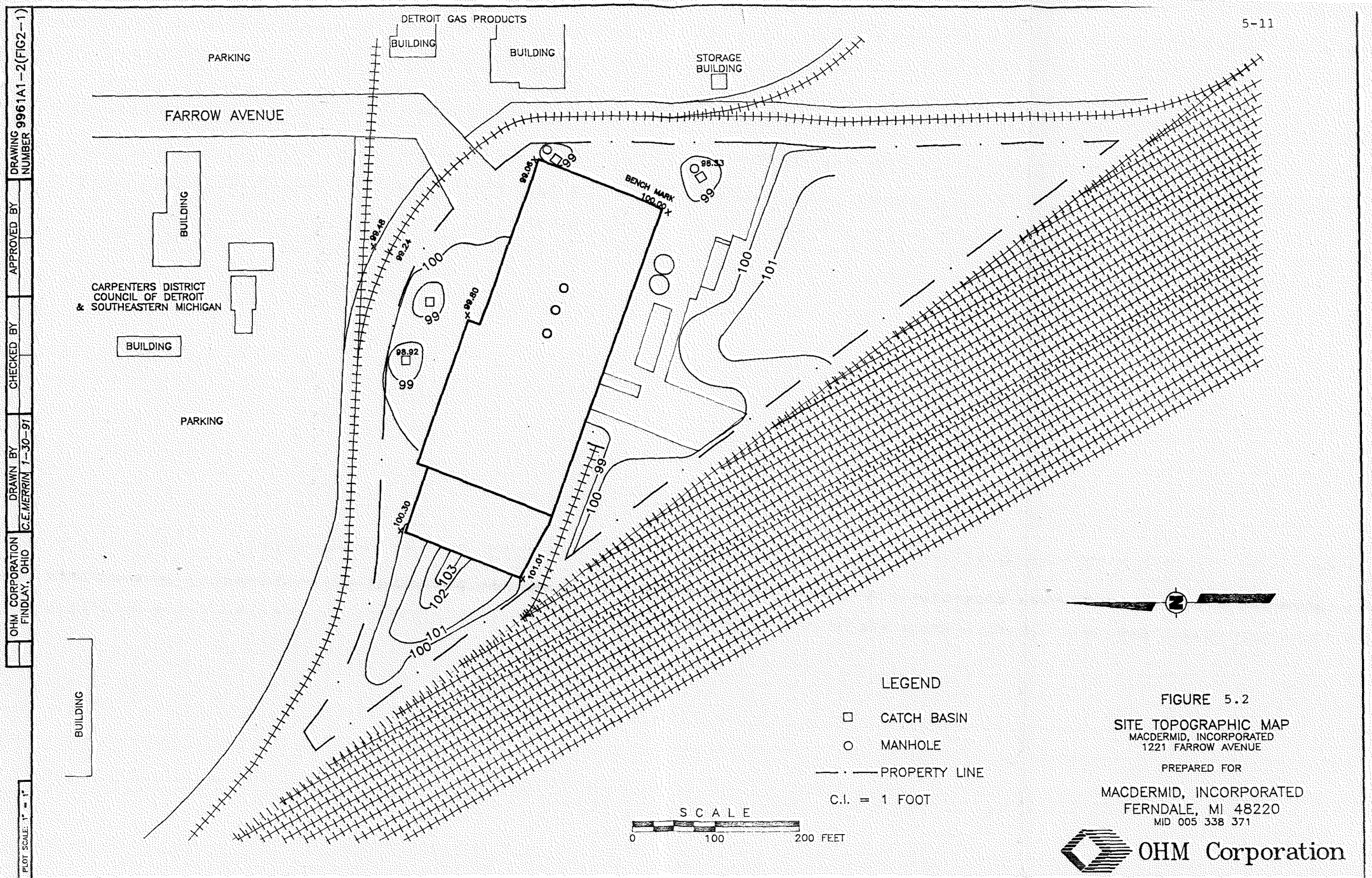

FIGURE 5.2

SITE TOPOGRAPHIC MAP
MACDERMID, INCORPORATED
1221 FARROW AVENUE

PREPARED FOR

MACDERMID, INCORPORATED
FERNDALE, MI 48220
MID 005 338 371

5.2.3.1 E-Line Method

The E-line method provides a direct reading of the distance to the water level utilizing a calibrated electric probe, water-level sensor, or equivalent measuring device. After removing the dedicated bailer present in the well, the E-line will be lowered down the well until the meter needle moves indicating contact of the probe with the water.

The water level will be measured before any water is removed from the well (i.e., prior to well evacuation during sampling events). Water levels will be measured to the nearest 0.01 foot. Any submerged portion of the water level measurement device will be rinsed with deionized water between wells so that it will not introduce external contamination into a well. In the case that an immiscible layer of hydrocarbon is present in the well, the submerged portion of the device will be wiped with hexane and rinsed with deionized water.

5.2.3.2 Air Pressure Method

The air pressure method of measuring depth of water uses a bubbler device to measure the air pressure required to lift a column of water from the surface of the water to the top of the casing. The distance to the top of water is calculated as follows:

Air pressure (pounds) x 2.31 = feet of air space

5.2.4 Detection of Immiscible Layers In Wells

During the initial sampling of the well, the well will be checked for the presence of NAPL defined in Section 5.2.2 before removing any water from the well. An interface probe will be used to determine the presence and measure the thickness of the immiscible layer(s) indicated by a beeping sound. These probes are designed to give a steady (continuous) tone when submerged in water. The probe will be slowly lowered into the well to carefully measure the top and bottom of the light immiscible layer referenced to the top of casing (TOC). After recording these data to the nearest 0.01 foot, the interface probe will be lowered to the bottom of the well to determine the presence of a heavier immiscible layer. All measurements made in the field will be recorded in the field log book.

A sample of the NAPL will be collected from the well. If the thickness of a light fraction NAPL layer is 2 feet or more, a decontaminated Teflon sample bailer with a bottom check valve will be used for sampling. If the layer is less than 2 feet, a bailer modified to allow filling from the top will be used. If the NAPL occurs at the bottom of the well, a bailer with a bottom check valve will be used for collecting a sample.

The sample will be analyzed for specific gravity, or density with respect to water, and selected chemical parameters. The chemical parameters selected for analysis at each of the waste management units are presented in Table 5.2 and are based upon previous analyses and site history.

TABLE 5.2

LIST OF ANALYTICAL PARAMETERS
GROUND WATER

Analysis	USEPA Analytical Method (SW-846)*	Detection Limit**	Bottle Type and Sample Volume	Preservative	Holding Time
Metals					
Arsenic, total	7060	2	200-ml, P	HNO_3, pH <2	6 months
Barium, total	6010	10	200-ml, P	HNO_3, pH <2	6 months
Cadmium, total	6010	5	200-ml, P	HNO_3, pH <2	6 months
Chromium, total	6010	50	200-ml, P	HNO_3, pH <2	6 months
Copper, total	6010	10	200-ml, P	HNO_3, pH <2	6 months
Lead, total	6010	50	200-ml, P	HNO_3, pH <2	6 months
Mercury, total	7470/71	0.2	100-ml, P	HNO_3, pH <2	28 days
Nickel, total	6010	50	200-ml, P	HNO_3, pH <2	6 months
Selenium, total	7740	2	200-ml, P	HNO_3, pH <2	6 months
Silver, total	6010	10	200-ml, P	HNO_3, pH <2	6 months
Zinc, total	6010	10	200-ml, P	HNO_3, pH <2	6 months
Aromatic Volatile Organics					
Chlorobenzene	602/8020	0.2 [1]	40-ml, G T-L Septum	[2]	14 days
1,2-Dichlorobenzene	602/8020	0.4 [1]	40-ml, G T-L Septum	[2]	14 days
1,3-Dichlorobenzene	602/8020	0.4 [1]	40-ml, G T-L Septum	[2]	14 days
1,4 Dichlorobenzene	602/8020	0.3 [1]	40-ml, G T-L Septum	[2]	14 days
Ethylbenzene	602/8020	0.2 [1]	40-ml, G T-L Septum	[2]	14 days
Toluene	602/8020	0.2 [1]	40-ml, G T-L Septum	[2]	14 days
Xylenes	602/8020	Not Given	40-ml, G T-L Septum	[2]	14 days

TABLE 5.2

LIST OF ANALYTICAL PARAMETERS
GROUND WATER

Analysis	USEPA Analytical Method (SW-846)*	Detection Limit**	Bottle Type and Sample Volume	Preservative	Holding Time
Additional Constituents					
Methylene Chloride	8270	10	1-liter, G	Cool to 4° C	14 days
Bis(2-ethylhexyl)pthalate	8060	10	1-liter, G	Cool to 4° C	14 days

* All methods are from USEPA SW-846, 3rd Edition. Alternate USEPA-approved methods may be substituted for the specified method depending on the contract laboratory (ASC, Findlay, Ohio).

** Detection limits are PQLs for organic analytes and MDLs for metals and anions. Units are ug/l for water samples.

[1] Determination of PQLs for ground-water matrices = PQL = [MDL] x [factor of 10]. Sample PQLs are highly matrix-dependent. The PQLs given in this table are provided for guidance and may not always be achievable.

[2] Cool to 4 degrees Celsius, 0.008 percent sodium thiosulfate, HCl to pH <2.

P Polyethylene
G Glass
T-L Teflon-lined

5.2.5 Monitoring Well Depth Measurement

After completion and development of each monitoring well, the depth to the bottom of the well casing will be measured to determine if an appreciable amount of sediment has settled in the bottom of the well, thereby obstructing the lower portion of the screened interval of the well. The procedure will be repeated at the time of each sampling event conducted in the investigation.

The depth of the well will be measured using a weighted measuring tape constructed of inert materials or the interface probe. The depth measurement from the top of the casing will be compared to the original well depth on the well construction details. If the difference between the depth measurement and the original well depth is greater than 12 inches, the well may require additional development to remove the sediments and thereby provide for representative sampling results.

Sediments may be removed by bailing and surging techniques. The dedicated bailer is lowered to the bottom of the well and gently surged to fluidize and collect the sediment. The water is removed from the well and emptied into a container so that an estimate of the amount of sediment and a description of the material can be made and recorded. Bailing will be repeated until the sediments are removed and the turbidity is reduced. Purged water will be disposed in the MACDERMID wastewater-treatment system.

5.2.6 Field Records

All measurements will be recorded in the field log book, or on a printed sampling information form similar to that shown in Figure 5.3. Particular care will be taken to accurately record units of measurement and the reference points from which the measurements were made.

5.2.7 Ground-Water Samples

Wells installed as part of the RFI work plan will be sampled to determine the presence of chemical constituents. The following sections describe procedures to be used to collect RFI related samples from the monitoring wells.

5.2.7.1 Well Evacuation

The purpose of evacuating water from the well prior to sampling is to eliminate stagnant water in the wellbore, thus allowing collection of a ground-water sample that is representative of the water quality in the formation.

The volume of water to be evacuated from the monitoring wells will be calculated during the sampling event and will be based on the height of standing water in the well, i.e., the difference between the original total depth of the well and the measured water level depth.

FIGURE 5.3

SAMPLING INFORMATION FORM

SITE _____ PROJECT NO. _____
SAMPLING POINT ID. (WELL NO.) _____ WEATHER _____

WATER LEVEL MEASUREMENT
Top of Casing Elev. (MSL) _____ ft. Orig. Well Depth _____
Static Water Level Depth _____ ft. Date/Time _____
Static Water Level Elev. (MSL) _____ ft. Technician _____

WELL DEPTH Date/Time _____ Technician _____
Obstructed (Yes/No) _____ Depth to Well Bottom _____ ft.
Sediment Thickness _____ ft. Removal Method _____
Description of Sediment _____

PURGE DATA Method _____ Technician _____

for 2-inch well	(.16 gals/ft)	x	Height of	= _____
for 4-inch well	(.66 gals/ft)	x	Standing Water	= _____
for 5-inch well	(1.02 gals/ft)	x	In Well _____	= _____

	Volume (gallons)	Date/Time	Visual Turbidity/Color/Odor
Purge Volume 1			
Purge Volume 2			
Purge Volume 3			
Total Volume			

SAMPLING DATA Method _____ Date/Time _____
Sample ID No. _____ Filter No. _____ Preservative _____
Technician _____

FIELD PARAMETERS Technician _____

Time	Temperature (°C)	Specific Conductance (μmhos/cm)	pH (std units)

NAPL MEASUREMENTS Technician _____

Interface Measurements from	FT BELOW TOP OF CASING	ELEVATION
(a) Air-light liquid	_____ feet	_____ feet
(b) Light liquid water	_____ feet	_____ feet
(c) Water-heavy liquid	_____ feet	_____ feet
(d) Bottom of the well	_____ feet	_____ feet

(e) Thickness of light liquid = (b - a) = _____ feet
(f) Thickness of heavy liquid = (d - c) = _____ feet

A minimum of one to three well volumes of water will be evacuated from the well prior to sampling depending on the water yielding characteristics of the well. Low-yield wells (wells that can be bailed dry) will be evacuated to dryness once and allowed to recover before sample collection. Higher yielding wells will have a minimum of three casing volumes removed prior to sampling.

An effort will be made to avoid contamination of the bailer or bailer rope through contact with the ground. Where deemed appropriate, a clean plastic sheet will be placed at the base of the well while the well is being purged to avoid contact of the bailer or bailer rope with the ground surface.

Purged water will be contained in drums. The total volume of water evacuated from the well and the time involved in purging will be recorded. Purged water will be disposed in the MACDERMID wastewater-treatment system.

5.2.7.2 Sampling Method

Each ground-water well will be equipped with a dedicated Teflon bailer. The bailer will be stored inside the well by suspending the bailer from a steel hook attached to the well cap. The well will be sampled by slowly lowering the bailer into the water column, thereby minimizing degassing of the water. Once retrieved, the water collected in the bailer will be transferred to the sample container at a slow rate in order to minimize agitation and aeration of the water.

5.2.7.3 Sample Containers

Bottles prepared according to USEPA specifications for environmental sampling will be provided by the laboratory performing the analyses. The bottles will not be opened prior to filling. Table 5.2 lists the bottle type to be used and the minimum volume of water to be collected for each specific analytical parameter.

5.2.7.4 Order of Sample Collection

Samples will be collected and containerized in the order of volatilization sensitivity of the analytical parameters as follows:

- VOCs
- Extractable organics
- Total metals

Table 5.2 presents a comprehensive listing of analytical parameters which will be used to assess contaminant migration for SWMU No. 1. VOCs will not be analyzed in samples collected in SWMU Area Nos. 2 and 3. Any additional constituents that are not listed in Table 5.2 will be analyzed following USEPA, SW-846 Test Methods For Evaluating Solid Waste. A select list of parameters will be applied to water or soil samples collected at each waste management unit.

Volatile Organics

Sample containers for VOCs will be filled with unfiltered water. The bottles will be carefully filled to ensure that there is no air trapped in the sample. Water will be slowly poured into the sample bottle to allow formation of a meniscus on the water surface in the bottle. Once the bottle lid has been secured, the sample will be checked for air entrapment by inverting the bottle, firmly tapping the bottle, and checking for air bubbles.

Extractable Organics

Sample containers for non-volatile organic analyses will not be rinsed in the field before sample collection. Containers will be completely filled.

Metals

Sample water for metals analysis will be filtered through a 0.45-micron filter unit before filling laboratory prepared bottles. New filters will be used for each sample. Tubing, if used for filtration, will be triple rinsed with distilled or deionized water before collection of the sample or a new piece of tubing will be dedicated for each sample.

When the sample is too turbid to field filter, the sample will be put on ice in bottles with no acid preservative and immediately delivered to the laboratory for filtration and acidification.

5.2.7.5 Preservatives

Preservation of all ground-water samples will be performed in accordance to the procedures detailed in Table 5.2.

5.2.8 Field Parameters

Specific conductance, pH, and temperature will be measured in the field. These field parameters will be measured in sample aliquots collected after the laboratory samples are collected. Monitoring probes should not be placed in sample bottles containing samples for laboratory analysis. Temperature will be measured first to enable compensation of specific conductance to 25 degrees Celsius. Any sample odor and color will also be noted. The field parameter samples will be discarded upon completion of testing.

Four replicate measurements of pH and specific conductance will be performed on four replicate aliquots of water. These field analyses will be separated by a minimal time period (approximately 1 minute). Temperature measurement need only be performed before the first analysis to calibrate the probes.

Measuring and test equipment used in the field will be controlled by a formal calibration program. The program will provide equipment of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Instrument calibration will be verified and recorded in the field log book before each sampling event. Responsibility for the calibration of field equipment rests with the individual performing the sampling. Instruments will be calibrated according to the manufacturer's recommended procedures each day prior to sampling. A record of calibration of the field instruments will be recorded in the log book or on sampling forms (see Figure 5.3). Acceptable limits or ranges in calibration accuracy will follow the manufacturer's standards.

5.3 SAMPLE TRACKING AND CUSTODY

A critical aspect of sound sample collection and analysis protocols is the maintenance of strict chain-of-custody procedure. Chain-of-custody procedures include inventorying and documentation during sample collection, shipment, and laboratory processing. A sample is considered to be in an individual's custody if the sample is:

- In the physical possession or view of the responsible party
- Secured in a locked container to prevent tampering
- Placed in a restricted area by the responsible party

5.4 FIELD SAMPLING OPERATION

Sample tracking is accomplished in the field by assigning each sample a unique number as it is collected. This number is traceable back to the date, time, site, and pertinent sampling parameter. This number is recorded on the sample label and the chain-of-custody form as well as in the field logbook. All containers are labeled prior to sampling.

5.4.1 Sample Number Assignment

Each sample will be labeled and uniquely identified with a sample number. The sample number will represent project number and a consecutive identifier number. A typical sample identification number for this project will be:

9961-7

Thus giving information as project number 9961, as the seventh sample taken.

After collection and identification the sample label is completed and the sample is then preserved and maintained using the chain-of-custody procedures.

5.4.2 Sample Label

Figure 5.4 below shows an example of an OHM sample label.

FIGURE 5.4

OHM SAMPLE LABEL

OHM Remediation Services Corp.

Findlay, OH 45840
419-423-3526 1 of 2

JOB #: 9961 DATE: 6-20 TIME: 1631
SAMPLE: 9961-7 soil overburden
(coordinates N1+100 E25)
H_2SO_4 Added
TAKEN BY: BS
WITNESS: EB

The following information is recorded on the label:

- Job number
- Date--Month, day, year
- Time--Military time (1000, 1400, 2320)
- Sample--Description of sample
- Analyte--Analysis which will be performed
- Preservative--If used
- Taken By--Initials of person taking sample
- Witness--Initials of person witnessing or assisting in taking sample
- Sample Number--Assigned from laboratory log book. Write number in blank corners of label
- Number of Jars--e.g., 1 or 2. Used with duplicate samples or when one jar cannot hold all of the sample

Every sample taken will be labeled in the above manner. Information should be printed neatly, except for initials which can be written.

After the sample is taken and the label is securely attached, the sample is logged into the sample logbook and the sample number is written on the sample label.

5.4.3 Field Log

The field logbook is a bound field notebook of water-resistant paper. All entries are made in indelible ink, signed, and dated. Information that is recorded in the field logbook includes:

- Date--Date sample was obtained
- Sample Number--Consecutive series of numbers in which every sample is assigned
- Location--Description of area sampled (abbreviated form if sampled twice or more--log explaining locations and abbreviations should be attached to or written in front of the logbook)
- Time--Military time sampled
- Samplers--Persons obtaining sample (usually two, at least witnessing if not involved in actual sampling task)
- Description of Sample--Physical description of sample (e.g., clear red, organic/cloudy, aqueous/brown sludge, or light sandy soil)
- Weight or Volume--Size of sample (20-ml, 200 grams, 1-ounce, etc.)
- Released By--Person turning sample in to laboratory for analysis
- Chain-of-Custody No.--For samples sent off site
- Composite Number--For PCB or bulking composites

All abbreviations of sample points and types of analysis are inserted in the front of the logbook. Writing in the logbook will be neat and in black ink. If a mistake is made, one line will be drawn through it and it will be initialed by the person correcting the mistake. White-out will never be used in a logbook. Other notations that will be in the field logbook include:

- Termination of a sample point, reasons
- Unusual appearance of a sample

- Measurements
- Additional samples, reasons
- Weather
- Levels of protection used (with justification)
- Meetings and telephone conversations held with MACDERMID representatives, regulatory agencies and citizens
- Details concerning any samples split with another party

Notes will be dated and signed (each page) for validity in a court of law. When a consultant is used for making decisions, his remarks will also appear in these notes. Any consultant used will submit a written report (draft) including his opinions and conclusions. A copy of this report will be placed in the project file and one copy kept in the sampling file for reference.

The Senior Sample Technician, Walt Putman, will review these notes daily and initial them at the bottom of each page. This person is also responsible for sending a copy of these notes to the Technical Field Services Manager, G. Jack Herzig, in Findlay, Ohio, on a weekly basis. These notes will be reviewed for troubleshooting, QC, and compiling information for progress reports.

5.4.4 Chain-of-Custody Procedures

Because of the evidentiary nature of samples collected during enforcement investigations, the possession of samples will be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. To maintain and document sample possession, chain-of-custody procedures will be followed as described below. A sample chain-of-custody form is included as Figure 5.5.

5.4.5 Field Custody Procedures

- In collecting samples for evidence, only that number which provides a fair representation of the media being sampled will be collected. To the extent possible, the quantities and types of samples and sample locations have been determined prior to the actual field work. As few people as possible will handle samples.

- The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or properly dispatched.

FIGURE 5.5

OHM Corporation

CHAIN-OF-CUSTODY RECORD

Form 0019
Field Technical Services
Rev. 08/89

No. 87052

O.H. MATERIALS CORP. • P.O. BOX 551 • FINDLAY, OH 45839-0551 • 419-423-3526

PROJECT NAME	PROJECT LOCATION
PROJ. NO. / PROJECT CONTACT	PROJECT TELEPHONE NO.
CLIENT'S REPRESENTATIVE	PROJECT MANAGER/SUPERVISOR

ITEM NO.	SAMPLE NUMBER	DATE	TIME	COMP	GRAB	SAMPLE DESCRIPTION (INCLUDE MATRIX AND POINT OF SAMPLE)	NUMBER OF CONTAINERS	ANALYSIS DESIRED (INDICATE SEPARATE CONTAINERS)								REMARKS
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																

TRANSFER NUMBER	ITEM NUMBER	TRANSFERS RELINQUISHED BY	TRANSFERS ACCEPTED BY	DATE	TIME
1					
2					
3					
4					

REMARKS

SAMPLER'S SIGNATURE

LAB COPY

- Sample tags will be completed for each sample using waterproof ink unless prohibited by weather conditions.

- Throughout the course and at the end of the field work, The Senior Sample Technician, Walt Putman, determines whether these procedures have been followed and whether additional samples are required.

5.4.6 Transfer of Custody and Shipment

- Samples will be accompanied by a chain-of-custody record. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, a mobile laboratory, or an analytical laboratory specified by MACDERMID.

- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate record prepared for each laboratory. Shipping containers will be sealed for shipment to the laboratory. Custody seals will be used on the shipping container to verify the absence of tampering.

- Whenever samples are split with a facility or government agency, a separate chain-of-custody record is prepared for those samples and marked to indicate with whom the samples are being split.

- All packages will be accompanied by the chain-of-custody record showing identification of the contents. The original record will accompany the shipment and a copy will be retained by the OHM site supervisor.

- If sent by mail, the package will be registered with return receipt requested. If sent by common carrier, the carrier will be indicated on the chain-of-custody record as receiving the samples and, if possible, the bill-of-lading number will be recorded on the chain-of-custody record. Receipts from post offices and bills-of-lading will be retained as part of the permanent documentation.

5.5 FIELD QA/QC PROGRAM

The field QA/QC program includes:

- Documentation of sample collection methods (Section 5.1.4)

- Calibration of field testing equipment (Section 5.2.8)

- Handling of collected samples including sample preservation and chain-of-custody control (Sections 5.2.7.5 and 5.4.5)

- Analysis and collection of duplicate, field and trip blanks is discussed in the following subsections

5.5.1 Duplicate Samples

A duplicate sample will be collected for analysis of the same parameters as for the other samples at the waste management unit. A minimum of one duplicate sample will be analyzed for each media tested at each of the waste management units. The duplicate samples will be given a unique identification number to distinguish it from the primary sample. Sample bottles for the duplicate and primary sample will be filled as close together in time as possible. For example, after filling the bottle for the primary organic sample, the duplicate bottle will be filled before proceeding to collect samples for each chemical analysis.

5.5.2 Field Blanks

A field blank will be collected during the sampling event to determine potential adsorption of organics from the air into a sample. A field blank for organics will be collected by filling the sample bottles received from the laboratory with deionized water. The bottles will be filled at the well site and recorded on the chain-of-custody sheet. Sample bottles will be filled by pouring the deionized water into the sample bottles without involving any intermediary tubes or vessels. The bottles will be labeled "Field Blank" and standard chain-of-custody procedures will be followed.

5.5.3 Trip Blank

The trip blank will be used to detect and quantify potential chemical artifacts originating from sample containers, deionized water or laboratory handling procedures. One bottle of each type used for analyses (i.e., two 40-ml vials, one 1-liter glass, amber) will be selected and filled with deionized water in the laboratory prior to field mobilization. These bottles will be transported to the sampling location and returned to the laboratory with the bottle sets used to collect the ground or surface water samples. The trip blank will not be opened in the field. Trip blanks will be subjected to the same analysis as the samples. The concentration levels of any contaminant found in a trip blank will be noted and compared to the field sample results. If the levels in the trip blank are significant, the site may need to be resampled.

5.6 SAMPLE PRESERVATION AND HANDLING

Sample preservation is intended to 1) retard biological action, 2) retard hydrolysis, and 3) reduce absorption effects. Preservation methods include pH control, refrigeration, and protection from light. The preservation methods to be used are described in the following section.

5.6.1 Soils

The soil samples collected for analysis will be preserved as follows:

- Volatiles - cool to 4 degrees Celsius
- Semi-volatiles - cool to 4 degrees Celsius
- Metals - cool to 4 degrees Celsius

The ground-water samples collected for analysis will be preserved as follows:

- Volatiles - cool to 4 degrees Celsius, 0.008 percent sodium thiosulfate, HCl to pH less than 2

- Semi-volatiles - cool to 4 degrees Celsius

- Metals - cool to 4 degrees Celsius, HNO_3 to pH less than 2

The acid preservative will be added to the sample container in the laboratory prior to field mobilization. Samples will be preserved in the field immediately after sample collection by placing the samples in an insulated ice chest containing ice. Upon receipt, the authorized laboratory personnel will store and/or prepare the samples for analysis, taking into consideration sample holding times for the analytical parameter of interest.

5.7 SAMPLE DOCUMENTATION

A sample documentation program will be implemented to allow for the tracing of possession and handling of water and soil samples from the time of field collection through laboratory analysis. The program will include:

- Sample labels which clearly identify samples

- Sample seals to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory

- Field log book to record information about each sample collection during the monitoring program

- Chain-of-custody record to establish sample possession from the time of collection to analysis

- Sample analysis request sheets which serve as official communication to the laboratory of the particular analysis required for each sample and provide further evidence that the chain-of-custody record is complete

- Laboratory logbook which is maintained at the laboratory and records all pertinent information about the sample

5.7.1 Sample Labels

To prevent misidentification of samples, legible labels will be affixed to each sample container. The labels will be sufficiently durable to remain legible even when wet and will contain the following information:

- Project name and number
- Sampling point identification name and/or number
- Name or initials of collector
- Date and time of collection
- Analysis required (if space on label allows)

5.7.2 Sample Seals

In cases where samples are to be shipped off site, a security seal will be placed on the shipping container of individual bottles to ensure the samples have not been disturbed during transportation.

5.7.3 Field Log Book

A field log book or sampling information forms (see Figure 5.3) will be maintained for all sample collection activities. The following specific data will be documented where applicable:

- Name of collector
- Identification of sampling point
- Depth to water in wells (referenced from top of casing)
- Well total depth
- Well yield characteristics
- Well evacuation method
- Purge volume
- Method of measuring immiscible layer
- Thickness of immiscible layer
- Sample withdrawal procedures
- Types of sample containers used
- Preservatives used
- Climatic conditions, including air temperature

- Sequence and time of field activities conducted
- Results of field analyses
- Field observations (broken lock, cracked casing, etc.)
- Sample observations (color, odor, etc.)

5.7.4 Chain-of-Custody Record

The ability to demonstrate that the samples were obtained from the locations stated and reached the laboratory without alteration is an important consideration. Evidence of collection, shipment, laboratory receipt, and laboratory custody until completion of analyses will be documented to accomplish this. Documentation will be accomplished through a chain-of-custody form that records for each sample the signature of the individuals collecting, shipping, and receiving the samples. An example of the chain-of-custody record is included as Figure 5.5.

A sample is considered in custody if it is:

- In a person's actual possession
- In view, after being in physical possession
- Locked so that no one can tamper with it, after having been in physical custody
- In a secured area, restricted to authorized personnel

Chain-of-custody forms will be used by all personnel to record collection and shipment of all samples. A qualified laboratory will not accept samples collected for analysis without a correctly prepared chain-of-custody form. The chain-of-custody procedure will be as follows for samples of soil, sludge, and water subject to chemical or geotechnical analysis for this project:

- The chain-of-custody record for all samples will be initiated in the field by the person collecting the sample. Each sample will be assigned a unique identification number that is entered on the chain-of-custody form. Samples can be grouped for shipment on a common form.
- If the person collecting the samples does not transport the samples to the laboratory or deliver the sample containers for shipment, the first "Relinquished By," or "Accepted By," entry will be completed in the field for the first transfer of possession.
- The person transporting the samples to the laboratory or delivering them for shipment will sign the record form as "Relinquished By."

- If the samples are shipped to the laboratory by commercial carrier, the chain-of-custody form will be sealed in a watertight container, placed in the shipping container, and the shipping container sealed prior to giving it to the carrier.

- If the samples are directly transported to the laboratory, the chain-of-custody record will remain with the samples.

- For samples shipped by commercial carrier, the waybill will serve as an extension of the chain-of-custody record between the final field custodian and receipt in the laboratory.

- Upon receipt in the laboratory, a designated individual will open the shipping containers, compare the contents with the chain-of-custody record, and sign and date the record. Any discrepancies will be noted on the chain-of-custody form.

- If discrepancies occur, the samples in question will be segregated from normal sample storage and the field personnel immediately notified.

- The chain-of-custody form is completed after sample disposal. Samples not consumed during analysis will be kept for 6 months or as otherwise established by MACDERMID.

- Chain-of-custody records, including waybills, if any, will be maintained with the records for the project, becoming part of the analytical data record.

- The following documentation may supplement the chain-of-custody records:

  - Sample label on each sample

  - Sample collection log and request for analysis forms (see Figure 5.6).

FIGURE 5.6

SAMPLING ANALYSIS REQUEST

Collector _____ Date Sampled _____ Time _____ hours

Affiliation of Sampler _____

Address _____
number street city state zip

Telephone ( ) _____ Company Contact _____

LABORATORY SAMPLE NUMBER	COLLECTOR'S SAMPLE NO.	TYPE OF SAMPLE*	FIELD INFORMATION**

Analysis Requested _____

Special Handling and/or Storage _____

PART II: LABORATORY SECTION**

Received by _____ Title _____ Date _____

Analysis Required _____

* Indicate whether sample is soil, sludge, etc.
**Use back of page for additional information relative to sample location.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

The following paragraphs outline the calibration procedures and frequencies for analytical instrumentation used for this project.

6.1 GAS CHROMATOGRAPH FOR EXTRACTABLE ORGANIC ANALYSIS

OHM will prepare calibration standards at a minimum of five concentration levels for each parameter of interest. Preparations for standards will follow standard volumetric procedures. One of the external standards will be at a concentration at or near the MDL and the other concentrations will correspond to the expected range of concentrations found in the field samples or will define the working range of the detector.

Using injections of 1 to 5 microliters of each calibration standard, area responses against the injected mass will be tabulated. The results will be used to prepare a calibration curve for each compound. Alternatively, if the ratio of response to concentration (calibration factor) is constant over the working range (less than 20 percent RSD), linearity through the origin will be assumed and the slope of this line is calculated as the calibration factor. The calibration curve or calibration factor will be verified on each working day by the measurement of one or more calibration standards. If the response for any parameter varies from the predicted response by more than plus or minus 15 percent, the test will be repeated using a fresh calibration standard. Alternatively, a new calibration curve or calibration factor will be prepared for that compound.

6.1.1 GC/MS Tuning Criteria

This section describes the requirements for gas chromatography/mass spectrometry (GC/MS) tuning for both analytical methods. The section is divided into two parts. The first part is for semivolatiles analysis, Method 8270 and the second is for volatiles analysis, Method 8240.

6.1.1.1 Tuning Criteria for Semivolatile Analysis

Each GC/MS system will be hardware-tuned to meet the criteria in Table 6.1 for a 50-nanogram (ng) injection of DFTPP (decafluorotriphenylphosphine). The standard solution will also contain 50 ng of each 4,4'-DDT, pentachlorophenol, and benzidine to verify injection port inertness and GC column performance. Analysis will not begin until all the criteria in Table 6.1 have been met. Background subtraction should be straightforward and designed only to eliminate column bleed or instrument background ions. Degradation of DDT to DDE and DDD should not exceed 20 percent. Benzidine and pentachlorophenol should be present at their normal responses. If degradation is excessive or chromatography is poor, the system may need maintenance.

TABLE 6.1

KEY ION ABUNDANCE CRITERIA FOR DFTPP

Mass	Ion Abundance Criteria for DFTPP
51	30 to 60 percent of Mass 198
68	Less than 2 percent of Mass 69
70	Less than 2 percent of Mass 69
127	40 to 60 percent of Mass 198
197	Less than 1 percent of Mass 198
198	Base peak, 100 percent relative abundance
199	5 to 9 percent of Mass 198
275	10 to 30 percent of Mass 198
365	Greater than 1 percent of Mass 198
441	Present but less than Mass 443
442	Greater than 40 percent of Mass 198
443	17 to 23 percent of Mass 442

Tuning will be done every 12 hours and after any maintenance to the instrument. A tuning record is maintained on the instrument chronicle.

6.1.1.2 Tuning Criteria for Volatile Analysis

Tuning criteria is included in Table 6.2 for the injection or purging of 50 ng of BFB (4-bromofluorobenzene). Analysis will not begin until the tuning criteria in Table 6.1 is met.

TABLE 6.2

KEY ION ABUNDANCE CRITERIA FOR BFB

Mass	Ion Abundance Criteria for DFTPP
50	15 percent to 40 percent of Mass 95
75	30 to 60 percent of Mass 95
95	Base peak, 100 percent relative abundance

TABLE 6.2

KEY ION ABUNDANCE CRITERIA FOR BFB

Mass	Ion Abundance Criteria for DFTPP
96	5 to 9 percent of Mass 95
173	Less than 2 percent of Mass 174
174	Greater than 50 percent of Mass 95
175	5 to 9 percent of Mass 174
176	Greater than 95 percent but less than 101 percent of Mass 174
177	5 to 9 percent of Mass 176

Tuning will be done every 12 hours and after any maintenance to the instrument. A tuning record is maintained on the instrument chronicle.

6.2 ATOMIC ABSORPTION SPECTROPHOTOMETER FOR TRACE METALS ANALYSIS

Calibration standards are prepared volumetrically at the time of analysis. Calibration standards are prepared daily and are discarded after use. A blank and at least three calibration standards are prepared for the appropriate range. The calibration standards are prepared using the same acids as the samples. Beginning with the blank and working towards the highest concentration standard, each solution is aspirated and the readings are rendered and processed. Each result is used to develop a calibration curve. The working calibration curve is verified during each working day, at least once an hour, by the measurement of one or more calibration standards. If the response varies more than plus or minus 15 percent from the predicted response, the standard is re-analyzed. If the response is still more than plus or minus 15 percent from the predicted response, all analyses performed after the last calibration standard will be repeated after instrument calibration.

6.3 METALS BY INDUCTIVELY COUPLED ARGON PLASMA

Following a period of time sufficient to warm up the instrument, the Inductively Coupled Argon Plasma (ICP) will be calibrated prior to each analytical run or minimally every 24 hours. Calibration standards will be prepared from reliable reference materials and contain all metals for which analyses are being conducted. Triplicate readings will be made from each QC and investigative sample and the average value used. When the standard deviation of the three readings is greater than 20 percent and one of the three analyses appears to be in error (e.g., from poor sample injection), duplicate readings may be used. All report results are based on at least two readings. If the standard deviation

criteria still do not meet, the analysis must be repeated. Working calibration standards are prepared fresh daily. Calibration data is recorded and archived with the respective sample data.

6.3.1 ICP: Initial Calibration

Quarterly, multi-concentration calibration is performed. On a day-to-day basis, a single standard is analyzed for initial calibration as described below.

Prior to an analytical run, the instrument is calibrated using a standard near the high end of the calibration range and a blank. An initial calibration verification (ICV) standard will be analyzed immediately after standardization, followed by an initial calibration blank (ICB). The ICV must be from a source other than that used for initial calibration. The ICV must be within ± 10 percent recovery of the true value and the ICB must be free of target analytes at and above the reporting limit, or the initial calibration must be repeated.

A standard at two times the reported detection limit (CRI) will be analyzed after the ICB to verify linearity near the reporting limit for ICP analysis. The CRI will be analyzed again at the end of the 8-hour analytical sequence, prior to analysis of the final continuing calibration verification standard/continuing calibration blank (CCV/CCB). The CRI is not required for Al, Ba, Ca, Fe, Mg, Na, and K, but must indicate a positive recovery for all other metals.

ICP Interference Check Samples (ICSA/ICSAB) will be analyzed consecutively at the beginning of each 8-hour analytical sequence, after the ICV/ICB, and again at the end of each 8-hour analytical sequence, prior to the final CCV/CCB. The ICSA/ICSAB verify the absence of spectral interferences.

6.3.2 ICP: Continuing Calibration

The initial calibration is verified during the analysis sequence by analysis of a CCB and a CCV after every ten samples are analyzed. The response of the CCV must be within ± 10 percent recovery of the true value. The CCB must be free of target analytes at and above the reported detection limit.

If any initial/continuing calibration verifications or blanks exceed their acceptance criteria, analysis is terminated and the instrument is recalibrated. All samples since the last valid calibration verification are reanalyzed.

6.4 ANALYTICAL BALANCE

For preparing standards from concentrated or pure materials, a Mettler analytical balance capable of weighing to the 0.1 milligram (mg) is used. This balance incorporates a built-in calibration weight.

Calibration procedures for each model Mettler are from the Mettler manual for that type unit. The calibration procedures will be followed at least monthly. The calibration will be checked by using Class S1 weights. At least yearly, the balance will be serviced by a certified technician.

6.5 CALIBRATION STANDARDS AND TRACEABILITY

Standards for analysis of metals will be purchased stock standards. These standards will be traceable to National Bureau of Standards reference materials. Dilutions of the standards will be made to prepare working standards on a daily basis. Standards for organic analysis will be prepared from neat materials. These materials will be obtained from Chem Service, Inc., or an appropriate vendor and will be "Standard Grade" material. These materials are normally greater than 95 percent pure, pre-analyzed, purity certified, expiration dated, and lot numbered. Primary standards are usually either not available or are too expensive to be used on a routine basis. Therefore, secondary standards must be prepared in-house and compared to primary standards. If all the steps in the comparison are recorded in the standards log then the secondary standard is traceable. Primary standards will not be used for routine analytical purposes. Because of the limited availability and cost however, they will be used for standardization of secondary standards (stock and working). The QA supervisor will review the standards log to ensure the traceability of all standards. If traceability is broken, re-analysis of the secondary standards must be performed in parallel with the primary standards.

7.0 DATA REDUCTION, VALIDATION, AND REPORTING

The following paragraphs outline the method detection limit plan and data reduction plan for the collected, data criteria used to validate the data and the decision flow from raw data to the validated concentrations.

7.1 DATA REDUCTION

Data reduction includes the identifications and calculations necessary to convert the raw instrument readings to the final reported compounds and their respective concentrations.

7.1.1 Conventional Parameters

Data calculation and reduction will be performed as described in the individual USEPA approved methods.

7.1.2 Trace Metal Parameters

Atomic Absorption Spectrophotometry is based upon the principle in which the amount of light of a particular wavelength absorbed by a specific metal will enable the percent absorption to be determined and then used to ultimately calculate the absorbance. Since absorbance is directly related to concentration, a plot of the two parameters is linear in certain operable ranges and allows for the determination of unknown concentrations in solutions (direct samples or extracts) after measurement of absorbance. The computer system controlling the instrument actually completes the calculations and reports the concentration in milligrams per liter (mg/l). The following equations show how the final sample concentration is calculated using the instrument calculated concentration.

$$\text{mg/l metal} = \frac{A\ (Vi)\ (D)}{(Vf)}$$

where:

A = Concentration from instrument in mg/l
Vi = Initial volume (before digestion) ml
Vf = Final volume (after digestion) ml
D = Dilution factor if necessary

$$\text{mg/kg metal} = \frac{A\ (Vf)\ (D)}{W\ (P)}$$

where:

A = Concentration from instrument in mg/l
Vf = Final volume of sample in ml
D = Dilution factor if necessary
W = Sample weight in g
P = Percent solids in decimal (if results in dry weight are needed)

7.1.3 Organics

7.1.3.1 Gas Chromatograph Results

Calculations are performed for each analyte after its identification is determined. Identification is based upon the retention time of the suspect peak compared to the retention time of the external standard. The concentration of the analyte is determined by using the calibration curve and the peak area of the analyte. A calibration factor is determined from the calibration curve and used to calculate the concentration.

7.1.3.2 Gas Chromatograph/Mass Spectrometry Results

Qualitative identification of an analyte is determined by obtaining the extracted ion current profiles (EICPs) for the three identifying mass ions and following the criteria listed below:

- The intensity of the three characteristic masses of each analyte must maximize within one scan of one another.

- The relative peak height ratios of the three characteristic masses must be within ± 20 percent when compared to the mass spectrum of the reference standard analyte.

- The relative retention time of the suspect peak must be within ± 0.06 of the standard reference peak.

In order to list structural isomers as separate analytes they must have acceptable resolution. Acceptable resolution is achieved if the baseline to valley height between the isomers is less than 25 percent of the sum of the two peaks. Otherwise structural isomers must be identified as unresolved isomeric pairs.

The following equations demonstrate how the actual sample calculations are carried out.

7.1.3.3 GC Volatiles

$$\text{ug/l (ug/kg)} = \frac{\text{As (D)}}{\text{CF (Vf) (P)}}$$

where:

As = Area response of targeted analyte
D = Dilution factor if necessary
Vf = Volume purged in ml or g
CF = Calibration factor from standard analysis
P = Percent solids in decimal (if results in dry weight are needed)

$$CF = \frac{As}{AMT}$$

where:

As = Area response of targeted analyte
AMT = Amount of targeted analyte in ng

7.1.3.4 GC/MS Volatiles

$$ug/l\ (ug/kg) = \frac{As\ (AMT)\ (D)}{Ais\ (RF)\ (Vf)\ (P)}$$

where:

As = Area response for targeted analyte
AMT = Amount of internal standard in ng
D = Dilution factor if necessary
Ais = Area of internal standard
Vf = Volume purged in ml or g
P = Percent solids in decimal (if results in dry weight are needed)
RF = Response factor from standard analysis calculated as

$$RF = \frac{As\ (AMTis)}{Ais\ (AMTs)}$$

where:

As = Area response for targeted analyte
AMTis = Amount of internal standard in ng
Ais = Area response of the internal standard
AMTs = Amount of the targeted analyte in ng

7.1.4.5 GC Extractable

$$ug/l\ (ug/kg) = \frac{As\ (Vf)}{(CF)\ (Vi)\ (P)}$$

where:

As = Area response for targeted analyte
CF = Calibration factor as explained above
Vf = Final extract volume in uL
Vi = Initial volume in ml or weight in g
P = Percent solids in decimal (if results in dry weight are needed)

To quantitate multicomponent mixtures (i.e., PCBs, chlordane) area summations are used. For PCBs at least five peaks where possible are included in the area summation for quantitation. The same relative peaks (based on pattern and retention times) are used to calculate the calibration factor from the standard. For toxaphene and chlordane total area summations are used for quantitation.

7.1.3.6 GC/MS Extractable

$$\text{ug/l (ug/kg)} = \frac{\text{As (AMTis) (Vf) (D)}}{\text{Ais (RF) (Vi) (P)}}$$

where:

As = Area response for targeted analyte
AMTis = Amount of internal standard in ng
Vf = Final extract volume in uL
D = Dilution factor if necessary
Ais = Area of internal standard
RF = Response factor as listed above
Vi = Initial volume in ml or weight in g
P = Percent solids in decimal (if results in dry weight are needed)

7.2 DATA VALIDATION

All data generated within the laboratory is extensively checked for accuracy and completeness. The data validation process consists of data generation, reduction, and three levels of review.

The analyst who generates the raw data has the prime responsibility for the correctness and completeness of the data. All data generated and reduced follows protocols specified in the laboratory (SOP). Each analyst reviews the quality of his work based on an established set of guidelines. The guidelines are:

- Sample preparation information is correct and complete
- Analysis information is correct and complete
- The appropriate SOPs have been followed
- Analytical results are correct and complete
- QC samples are within established control limits

- Blanks are within appropriate QC limits
- Special sample preparation and analytical have been met
- Documentation is complete

The next level of review is performed by the ASC section supervisor or data review specialist. The review is structured to ensure that:

- Calibration data are scientifically sound, appropriate to method, and completely documented.
- QC samples are within established limits.
- Quantitative results are correct.
- Documentation is complete.
- The data is ready for incorporation into a final report.
- The data package is complete and ready for data archive.

Level 2 review is structured to ensure all calibration data and QC sample results are reviewed and all of the analytical results from 10 percent of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is complete. If problems exist an additional 10 percent is reviewed, the process continues until no errors are found or the package has been reviewed in its entirety.

The final level of review by the laboratory comes from the ASC program administrator. He reviews the report to ensure that the data meets the overall objectives of the project.

7.3 DATA REPORTING

Once the data has been validated it is ready for report production. The report will contain:

- Description of sample types
- Tests performed, problems encountered during testing
- Dates sampled
- Date received
- Date extracted
- Analytical results

- Reportable limit
- QC information: percent recovery, relative percent difference, control limits, blanks analyzed, matrix spikes, and other additional special QC information
- Methodology

The report from the laboratory will also include a copy of the original COC for the samples analyzed.

The reports generated from the laboratory for the site work will also be reviewed by the site QA/QC officer for any discrepancies.

8.0 INTERNAL QUALITY CONTROL

This section outlines the procedures used by both field and laboratory personnel ensuring that the appropriate QC requirements are met.

8.1 FIELD OPERATIONS

Collection and analysis of field QC samples are intended as checks on the integrity of sample collection, handling procedures, and equipment decontamination procedures. The specific QC procedures for each sampling task are found in the site-specific sampling and analysis plan. Listed below are items found in that section:

- Experienced personnel
- Traceability of sample through sampling and analysis
- Necessity of replicant/duplicate field samples as a measure of the sampling precision
- Trip blanks
- Field blanks
- Equipment blanks
- Field spike samples

8.2 LABORATORY OPERATIONS

Responsibility for internal QC checks rests with the laboratory supervisor and analyst. The QC officer will monitor the performance of the laboratory for implementation of proper QC checks and will approve all data. Minimum QC checks that will be verified are:

- Initial calibration and calibration verification
- Continued calibration verification
- Procedural blank analysis
- Matrix spike analysis
- Blind QC sample analysis

8.3 QUALITY CONTROL

8.3.1 Determination of Practical Quantitation Limit

The PQL is defined as the low standard used in the calibration curve (0.5 ug/ml for mixed standards and 5.0 ug/ml for toxaphene) times the dilution factor used in the sample analysis. Based on a 10 g sample extraction and a final volume of 1 ml of extract, the PQL is 0.05 ug/g.

8.3.2 Control Charts

Generation of control charts for determining method performance will be constructed utilizing the following:

Upper Warning Limit (UWL) = R+2S
Lower Warning Limit (LWL) = R-2S
Upper Control Limit (LCL) = R+3S
Lower Control Limit (LCL) = R-3S

where:

R = average percent recovery
S = standard deviation

The recovery of method spikes verses analytical standards will be plotted over time to develop Shewhart Control Charts. These Shewhart Control Charts will be updated with each analytical batch.

8.3.3 Summary of QC Related Activities

Method Blank--One every batch
Replicate Sample Analysis--One every batch
Method Spike--One every batch

8.4 QUALITY CONTROL SAMPLES

QC samples will be obtained and submitted by the QA officer on a routine basis as an audit of methodologies and control limits.

9.0 PERFORMANCE AND SYSTEM AUDITS

Audit is defined as systematic check to determine the quality of operation of field and laboratory activities. It is comprised of the following:

- Performance audit
- System audits

9.1 FIELD PERFORMANCE AUDITS

Field performance audits are performed on an ongoing basis during the project as field data is generated, reduced, and analyzed. All numerical analyses, including manual calculations are documented. All records of numerical analysis are legible, of reproduction quality, and supporting to complete permit logical reconstruction by a qualified individual other than the originator.

Other indicators of the level of field performance are the analytical results of the blank, duplicate, and replicate samples. Each blank analysis is an indirect audit of effectiveness of measures taken in the field to ensure sample integrity. The results of the field duplicate and replicate analysis is an indirect audit of the ability of each field team to collect representative sample portions of each matrix type.

9.2 FIELD SYSTEM AUDITS

System audits of site activities are accomplished by an inspection of all field audit activities by the QA officer. This audit is composed of comparisons between current field practices and standard procedures. The following is a list of criteria to be used in the evaluation of field activities:

- Overall level of organization and professionalism
- All activities conducted in accordance with work plan
- All procedures and analyses conducted according to procedures outlined in this document
- Sample collection techniques versus sampling and analysis plan
- Level of activity and sample documentation
- Working order of instruments and equipment
- Level of QA conducted per each field team

- Contingency plans in case of equipment failure or other event preventing the planned activity from proceeding decontamination procedures

- Level of efficiency which each team conducts planned activities at the site

- Sample packaging and shipment

After the audit, any deficiencies are discussed with the field staff, and corrections are identified. If any of these deficiencies might affect the integrity of the samples being collected, the QA officer informs the field staff immediately, so corrections can be made. The field performance audit will be conducted at the start of the project, one before the end of the project, and as directed by the project manager.

9.3 LABORATORY PERFORMANCE AUDIT

The laboratory performance audit verifies the ability of the laboratory to correctly identify the quantitate compounds in blind check samples submitted by the auditing agency. The laboratory participates in laboratory evaluation programs.

The field laboratory will undergo performance audits throughout the project consisting of control samples and replicant samples. System audits are conducted by the QA officer and include the following:

- Verification of written procedures and analyst understanding
- Verification and documentation of procedures and documents
- Review of analytical data and calculations

9.4 LABORATORY SYSTEM AUDITS

The system audit is a review of laboratory operations conducted to verify that the facility has the necessary equipment, staff, and procedures in place to generate acceptable data. An on-site inspection is done by an audit team or laboratory certification personnel to review the laboratory QC program. The laboratory participates in multiple state certification programs which satisfy the criteria of system audits for this contract. If the laboratory is in question, a system audit can be directed by the client.

The field laboratory system audit is conducted by the site QA officer. Any recommendations made or deficiencies identified will be considered for implementation and corrective actions taken to correct deficiencies. The field laboratory system audit will be performed at the beginning of the project. An outline of a laboratory audit appears in Figure 9.1.

FIGURE 9.1

AUDIT OUTLINE

I. Laboratory Audit--General Considerations

A. Sample flow Through Laboratory

1. Chain of Custody
2. Usual
3. Strict

B. Sample Storage

1. Controlled Access
2. Proximity to Chemical Storage
3. Physical Conditions, (e.g., temperature)
4. Holding Times

C. Sample Workup and/or Analysis

1. Standard of Procedures
2. Logbooks
3. Standards Preparation
4. Instruments--Sample Analysis
5. Calibration/Tune
6. Standards Analyses
7. Check Samples
8. Balance
9. Temperature

D. Notebooks

1. Dates
2. Signature
3. Filled Pages
4. Initialed Errors with Single-Line Cross outs
5. Units Recorded

E. QC Samples

1. Blanks
2. Spikes
3. Duplicates
4. Surrogates
5. Control Charts

F. Data File Storage

1. Hard Copies
2. Other Media--Magnetic Tape, Disk

10.0 PREVENTATIVE MAINTENANCE

Critical to the performance and minimization of downtime of all equipment whether it is measurement or support, is proper maintenance. Preventative maintenance will be performed as recommended by the manufacturer of the respective equipment.

All of the routine maintenance and problem troubleshooting for each piece of equipment will be documented in the instrument maintenance logbook for field instruments. This information includes a description of the problem, steps followed through the procedure and parts replaced, initials of the person completing the procedure, and amount of downtime recorded.

10.1 CONTINGENCY PLANS FOR MINIMIZATION OF DOWNTIME

Essential in the minimization of downtime is an inventory of user-replaceable spare components. Each measurement system will be equipped with spare components in the field. These include such components as fuses, printed circuit boards, and cables etc., for replacement in the field for downtime minimization. OHM also has an electronics department that is able to help troubleshooting the affected instrument and make needed repairs.

11.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

11.1 FIELD DATA

11.1.1 Precision

Duplicate and replicate samples analyzed by the laboratory assess the precision of the sampling effort. Control limits for duplicate/replicate RPDs is set at 0 to 20 percent to provide interim guidelines. Once a sufficient amount of replicate data becomes available, field precision control charts are constructed similar to the laboratory precision charts. For any given concentration, the mean and the standard deviation(s) of the replicates are calculated. The mean is the centerline of the control chart. Data from each sample set are pooled with the previous sample sets to generate control and warning limits for the next set. Warning and control limits for water samples are set at $\pm$ 2s and $\pm$ 3s, respectively. Control limits for solid samples are more liberally established due to matrix heterogeneity. Data outside any control limit are subject to QA review.

11.1.2 Accuracy

Field instruments are calibrated daily or more frequent, if needed, to ensure accuracy of the measurement of field parameters. Specifically, the pH measurement will be accurate to $\pm$ 0.1 unit, temperature will be to $\pm$ 0.5 degrees Celsius, and specific conductance will be $\pm$ 10 umhos/cm. Each well be purged until the above parameters are stable within the specified limits.

All blanks associated with each sample set are to be analyzed and evaluated for cross contamination. Blank contamination and the resulting corrective action are assessed on an individual basis.

11.1.3 Completeness

The field supervisor is responsible for ensuring that all field instrumentation and equipment are functioning properly and calibrated according to set procedures, and that all data are recorded accurately and legibly. In addition, the field supervisor will ensure all sites are sampled for all the specified analyses, that sufficient sample volume has been provided to complete those analyses, and that all of the QA samples have been included with each sample set. The goal for completeness for each sample set shipped to the laboratory is 100 percent. The minimum acceptable completeness limit is 95 percent.

11.2 LABORATORY DATA

11.2.1 Accuracy Control

Data accuracy is a reflection of the efficiency of the analytical procedure. It is determined by use of spiked samples and standard reference materials or laboratory control samples performed at the rate of one set every 20 samples. A control chart is generated using historical laboratory data where warning and control limits are established to assess data accuracy.

The accuracy (check standards) samples will have concentration values of the mid-standard. During analysis, a minimum of 10 percent of samples will be accuracy samples. The accuracy samples will be staggered throughout the analysis, not placed one after another. After a minimum of seven accuracy samples are analyzed, the percent recovery is calculated for each sample by the following equation:

$$\% \text{ Recovery} = \frac{\text{Observed Value} \times 100}{\text{True Value}}$$

The accuracy criteria is determined by calculating the standard deviation of seven or more percent recovery values and setting the upper and lower control limits using the following equations:

$$\text{Upper control limit} = p + 3Sp$$
$$\text{Lower control limit} = p - 3Sp$$

where:

p = average percent recovery
Sp = standard deviation

After the standard deviation, for the seven or more samples has been calculated, the accuracy control limits will be used to determine if the analysis is out of control. This is done by checking the results against the control limits. If any values are above the upper control limit or below the lower control limit, all sample results after the last qualifying accuracy sample will be repeated or discarded. If seven consecutive values fall below the lower control limit, new limits will be calculated using the new accuracy check values. If the values fall between the upper and lower limits, then conditions are reported as "within limits."

11.2.2 Precision Control

Precision is based upon the results of the relative percent differences as calculated from the percent recoveries of the matrix spike and duplicate samples. The control limits for precision is based on historical laboratory data.

Present practice is to include MS and MSD samples on a per batch basis or a minimum frequency of 5 percent. Duplicate results are compared and the relative percent difference (RPD) is then determined according to the following formula:

$$RPD = \frac{(D1 - D2)}{(D1 + D2)/2} \times 100$$

where:

D1 = Determination No. 1
D2 = Determination No. 2

The RPD will be entered into the laboratories data system and will be used to define the Precision of the analysis. This value should be less than 20 percent.

11.2.3 Recovery Control

Recovery control is necessary to determine if the sample matrix is interfering with the constituent being analyzed. A minimum 5 percent of samples will be recovery check samples (matrix spikes). Samples involving different types of matrices will have at least one recovery check for each type. The percent recovery of the matrix spike is determined by the following equation:

$$\% \text{ Recovery} = \frac{(SSR - SR)}{SA} \times 100$$

where:

SRR = Spiked sample result
SR = Sample result
SA = Spike added

Control limits will be determined for each matrix, determining the deviation for seven or more percent recovery values.

11.2.4 Completeness Control

Completeness is expressed as the percentage of the amount of valid data obtained to the amount of data expected. For a set of data to be considered complete, it must include all QC data verifying its accuracy and precision.

If samples analyzed do not meet all QC requirements in terms of accuracy and precision for any specific parameter, the sample preparation and analysis will be repeated pending adequate volume.

$$\% \text{ Complete} = \frac{\text{Acceptable results} \times 100}{\text{Total analyses}}$$

12.0 CORRECTIVE ACTION

For the analytical methods employed for this project, precision and accuracy will be regularly tracked by evaluating the results of spiked samples, replicates, and blanks. The mean recovery and the precision of the results for spiked samples will be computed. These statistics will be updated from batch to batch as additional analyses are being performed and more experience is gained. Whenever the control limits are exceeded and the percent recovery (accuracy) or precision falls below the objectives of this project, corrective action will be taken as soon as possible to improve performance on the next batch of samples. Batches will be rerun as required, so valid results will be obtained.

If, during system or performance audits, weaknesses or problems are uncovered, corrective action will be initiated immediately.

Corrective action will include, but is not necessarily limited to: modifications to sampling procedures, recalibration of instruments using freshly prepared calibration standards, replacement of large quantities of solvent or other reagents that give unacceptable blank values, additional remaining of laboratory personnel in correct implementation of sample preparation and analysis methods, and reassignment of personnel.

Whenever a long-term corrective action is necessary to eliminate the cause of non-conformance, the following closed-loop corrective-action system will be used. As appropriate, the OHM project chemist, project QA officer, and corporate QA officer will ensure that each of these steps is followed:

- The problem will be defined.
- Responsibility for investigating the problem will be assigned.
- The cause of the problem will be investigated and determined.
- A corrective action to eliminate the problem will be determined.
- Responsibility for implementing the corrective action will be assigned and accepted.
- The effectiveness of the corrective action will be established and the correction implemented.
- The fact that the corrective action has eliminated the problem will be verified.

13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The OHM project manager, project chemist, and project QA officer will converse on a regular basis to review possible or potential problem areas. It is important that all data abnormalities be investigated to ensure that they are not a result of operator or instrument deviation but are a true reflection of the methodology or task function. The project final report, prepared for each project, will contain a separate section that covers the data quality and validity. At a minimum, the following information will be covered:

- Assessment of measurement data precision, accuracy, and completeness
- System and performance audit results
- Significant QA problems and solutions implemented

The project QA officer will be responsible for preparing this report, as well as monthly written QA reports to management. The QA program manager is responsible for reviewing and approving these monthly reports. Verbal reports will be made on a more frequent basis.

APPENDIX A

ANALYTICAL SERVICES CORP.
QUALITY ASSURANCE PROGRAM

QUALITY ASSURANCE PROGRAM PLAN

Prepared By

ANALYTICAL SERVICES CORP.
16406 US ROUTE 224 EAST
FINDLAY, OHIO 45840

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1.0 INTRODUCTION

1.1 BACKGROUND

Analytical Services Corporation (ASC) is a full-service environmental laboratory specializing in emergency response, field support services, analytical consulting, and hazardous waste analysis.

ASC is a wholly-owned subsidiary of OHM Corporation (OHMC) which is ranked as the nation's fifth largest firm offering environmental services relating to hazardous waste cleanup and remediation.

1.2 HISTORY

ASC opened in 1980 as a limited support facility for OHM Corporation's Emergency Response and Environmental Remediation Group. During the next five years, the laboratory expanded its scope of operations and continued to acquire more instrumentation and personnel, filling out their existing facility. The laboratory's scope was also changed from that of a limited support group analyzing samples for a select set of parameters to a full-service organization with state-of-the-art instrumentation. Personnel also assumed the added distinction of being called on regularly to perform non-routine analysis on a wide range of matrices for potentially dangerous and environmentally significant compounds.

In 1987, the laboratory's parent company, OHM Corporation, looking towards the future, opened a new 16,000-square-foot laboratory specializing in emergency response environmental analysis. Analytical capabilities were expanded correspondingly and the resulting organization now processes in excess of 1700 samples per month following accepted USEPA methodologies and guidelines.

The laboratory's ability to provide efficient service and high-quality data to its clients is due to the dedication and commitment of staff and management.

1.3 INTRODUCTION TO QUALITY ASSURANCE

The importance of analytical data validity cannot be underestimated when making decisions concerning environmental issues. The principle mechanism by which a laboratory strives to ensure the useability of it's analytical data is the development and maintenance

of a Quality Assurance (QA) Program. The QA Program is a complete and comprehensive program which ultimately assures that the analytical data generated is accurate, reproducible, valid, and defensible.

Any project or contract may specify additional or alternative QA/QC. When this occurs, the development of a Quality Assurance Project Plan (QAPP) is usually required. This document details the minimum quality assurance guidelines that ASC intends to use for all analytical results generated within the laboratory.

2.0 STATEMENT OF POLICY

Sound analytical measurements are essential to provide the data necessary to ensure the effective completion of an environmental assessment or remedial action. The following Laboratory Quality Assurance Plan will be the guideline by which analysis, data reduction, and data interpretation will be performed for all projects. The plan outlines the minimum procedures that will be routinely used to assure the quality of the samples obtained, analysis performed, and data generated.

ASC is committed to providing all of its clients with the highest quality service available in all its fields of operation. The following sections will confirm this commitment to provide precise, accurate, and complete environmental measurements by outlining the QA/QC procedures that will be enforced and employed on all projects.

3.0 ORGANIZATION AND RESPONSIBILITY

The following figures detail the corporate structure, laboratory structure, and project organizational relationships between ASC and the CLIENT.

3.1 CORPORATE ORGANIZATION

Figure 3.1 outlines the corporate structure of OHM Corporation and its various divisions.

3.2 LABORATORY ORGANIZATION

Figure 3.2 outlines the structure of ASC. The laboratory is divided into three principle analytical departments: Inorganic, Organic, and Sample Preparation. The Inorganic Department is further subdivided into ion chromatography and trace metals, while the Organic Department is divided into gas chromatography, high performance liquid chromatography, and gas chromatography/mass spectrometry. The Sample Preparation Department consists of two sections: conventional analyses and sample preparation.

3.3 CLIENT PROJECT ORGANIZATION

Figure 3.3 outlines the organization between ASC and the CLIENT.

3.4 RESPONSIBILITIES

Specific responsibilities are summarized in the following sections.

3.4.1 Laboratory Manager

The laboratory manager has overall responsibility for the technical data quality, cost control, laboratory personnel management, and adherence to project schedules. His overall management involves overseeing the quality assurance of the following items:

- adherence to delivery schedules
- deliverable reports
- subcontractor work product (if required)
- project/contract cost control and accounting
- performance of the personnel

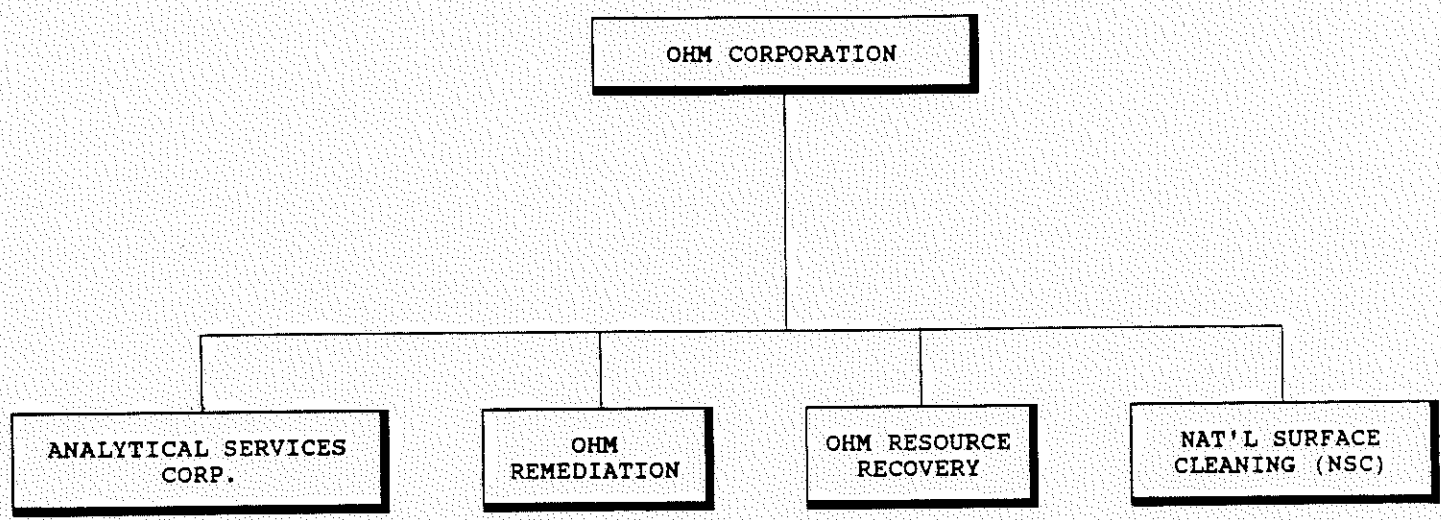

FIGURE 3.1 - OHM CORPORATE ORGANIZATION

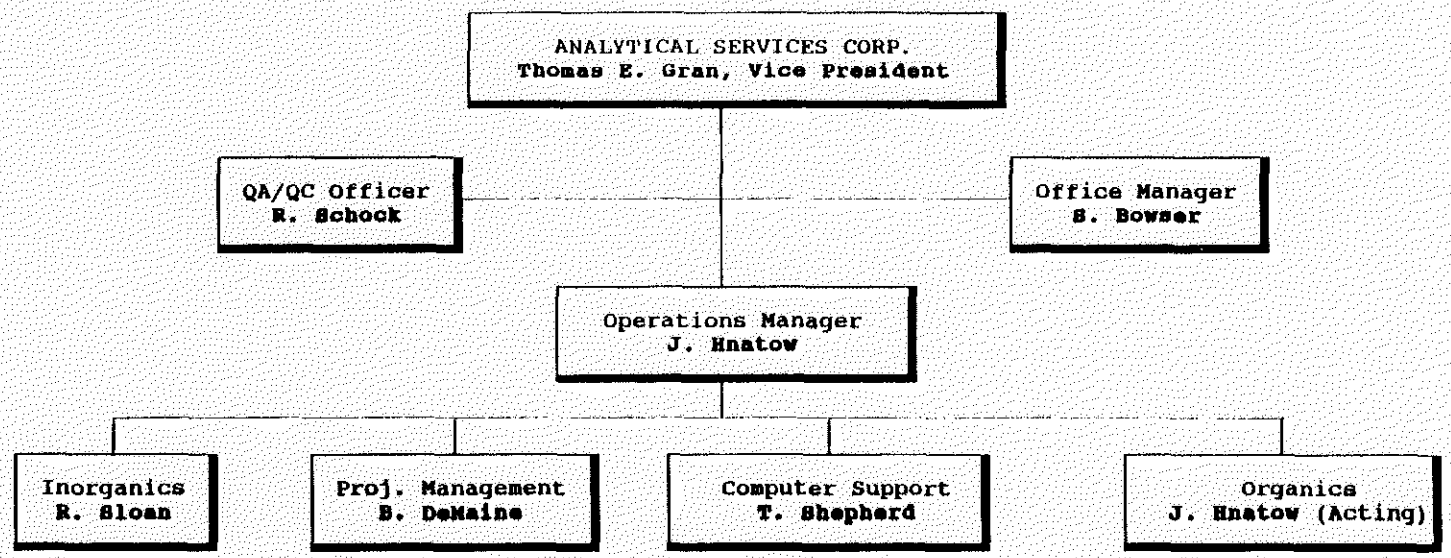

FIGURE 3.2 - ASC ORGANIZATION

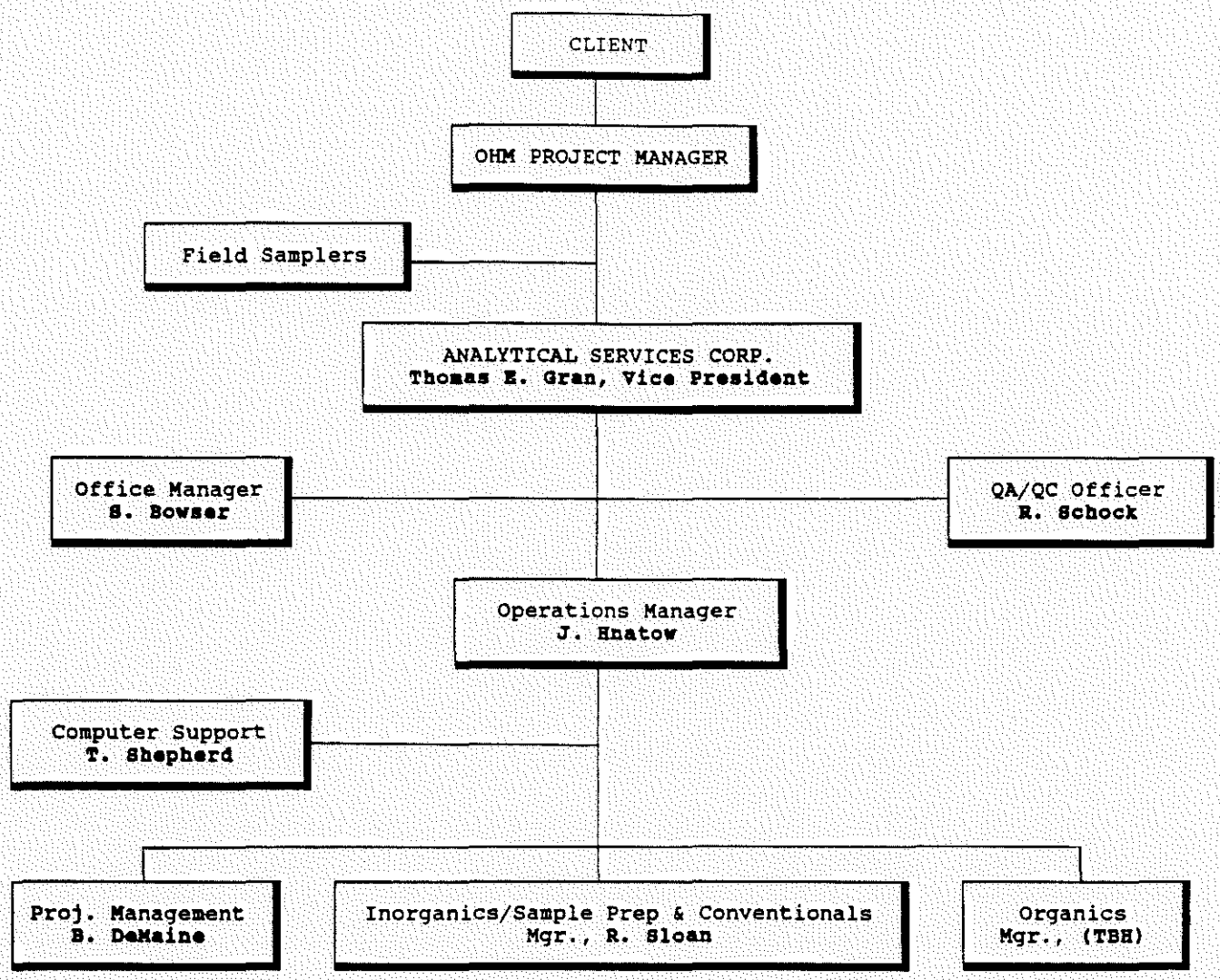

FIGURE 3.3 - CLIENT PROJECT ORGANIZATION

3.4.2 Laboratory Quality Assurance Officer

The QA Officer is responsible for monitoring the quality of the laboratory work and taking appropriate actions to ensure that the standards are being met. The QA Officer reports directly to the Laboratory Director and the corporate QA Manager in reviewing the work of teams and individuals. The QA Officer is responsible for the following items:

- o preparing and overseeing preparation of the laboratory QA/QC plan;
- o establishing QC procedures, providing control samples, and setting warning and action limits for every test and/or parameter in order to standardize laboratory operation for quality performance;
- o monitoring compliance with the laboratory's QA/QC plan by:
  - reviewing QC-related activities and documentation for completeness in accordance with the QA/QC plan;
  - identifying and referring any instances in which the QA/QC objectives are not being met to section heads or laboratory service managers for remedial and/or corrective action; and
  - following up on the remedial and/or corrective action to ensure that QC objectives are once again being met.
- o serving as the laboratory point-of-contact for the exchange of QA/QC information with the authority to approve or disapprove, along with the Laboratory Director, the release of analytical data;
- o providing input for all on-site QA/QC inspections;
- o coordinating a corrective action plan in response to deficiencies identified during laboratory inspections;
- o project compliance screening for all data reports.

3.4.3 Laboratory Department Manager

The Laboratory Department Managers are responsible for the fiscal, technical, and personnel management within their respective departments. The laboratory department managers report to the Laboratory Manager. The laboratory Department Managers are responsible for the following items:

- o Fiscal and technical objectives of their department
- o Direction and coordination of the various work groups within the department
- o Monitoring department-wide QA/QC objectives
- o Ensuring that the correct analytical methodology is used within their department

3.4.4 Laboratory Section Supervisors

The laboratory Section Supervisors ensure that the sample analyses are conducted within the required QC parameters and are responsible for instrument calibrations and maintenance procedures. They monitor the quality/quantity of all reagents, solvents, and other materials used in the analysis. They are responsible for technical quality and adherence to delivery schedules. Together with the bench chemist and personnel assigned to do the task, they are responsible for the bench-level QC of the samples to be analyzed.

4.0 QUALITY ASSURANCE OBJECTIVES

4.1 DEFINITION OF TERMS

To avoid misinterpretations, the following subsections outline the definition of various terms used within this QA/QC manual.

4.1.1 Quality Assurance

A quality assurance program is an essential part of a sound analytical protocol used by individuals and/or laboratories to detect and correct problems in the measurement process or to demonstrate attainment of a state of statistical control. The objective of a quality assurance program is to reduce the measurement errors to agreed-upon limits and to produce results of acceptable quality. Two concepts are involved in quality assurance: 1) quality control, the mechanism established to control errors, and 2) quality assessment, the system used to verify that the analysis is operating within acceptable limits (Reference 1)

4.1.2 Quality Control

A quality control program includes the following:

- Development of and strict adherence to principles of good laboratory practice
- Consistent use of standard operating procedures
- Establishment of and strict adherence to carefully designed protocols for specific measurement programs
- The consistent use of qualified personnel
- Reliable and well maintained equipment
- Appropriate calibrations and standards
- The close supervision of all operations by management and senior personnel

When properly conceived and executed, a quality control program will result in a measurement system operating in a state of statistical control, which means errors have been reduced to acceptable levels and have been characterized statistically. (Reference 1)

4.1.3 Quality Assessment

Quality assessment involves employing various techniques to assess the quality of the measurement process and the results. The establishment of a system of "control charts" is a basic principle. Control charts are plots of multiple data points from the same or similar samples or processes versus time. An example of a typical laboratory control chart may be found in Figure 4.1.

Control charts are used to determine if a system is in a state of statistical control. The charts should be used to visualize or monitor the relative variability of repetitive data. They can be used with reference materials, spiked samples, and the analysis of surrogates as a means of assessing the accuracy of the measurements. (Reference 1)

4.1.3.1 Quality Assessment Procedure

Procedures used to assess the effectiveness of the quality control system include:

- o Internal Performance Audits: conducted by the use of control samples, replicate measurements, and the use of reference materials in conjunction with control charts.

- o External Performance Audits: conducted by the use of inter-laboratory checks such as:

  - Participation in laboratory evaluation programs
  - Participation in round-robin method and performance evaluation studies
  - Participation in performance evaluation samples available from the EPA
  - Analysis of split samples and comparison of the results with other laboratories

4.1.3.2 Quality Assessment Procedure Summary

A simplified working document or chart which enables one to preview the basic quality control program and its effectiveness shall be maintained on a routine basis. The following parameters are to be tracked and charted:

- o Surrogate spike recoveries for all samples
- o Targeted analyte method spike recoveries on a per batch basis
- o Matrix spike duplicate sample results as a measure of precision

4.1.4 Data Quality (Reference 2)

Data quality is the totality of features and characteristics of data that bear on their ability to satisfy a given purpose.

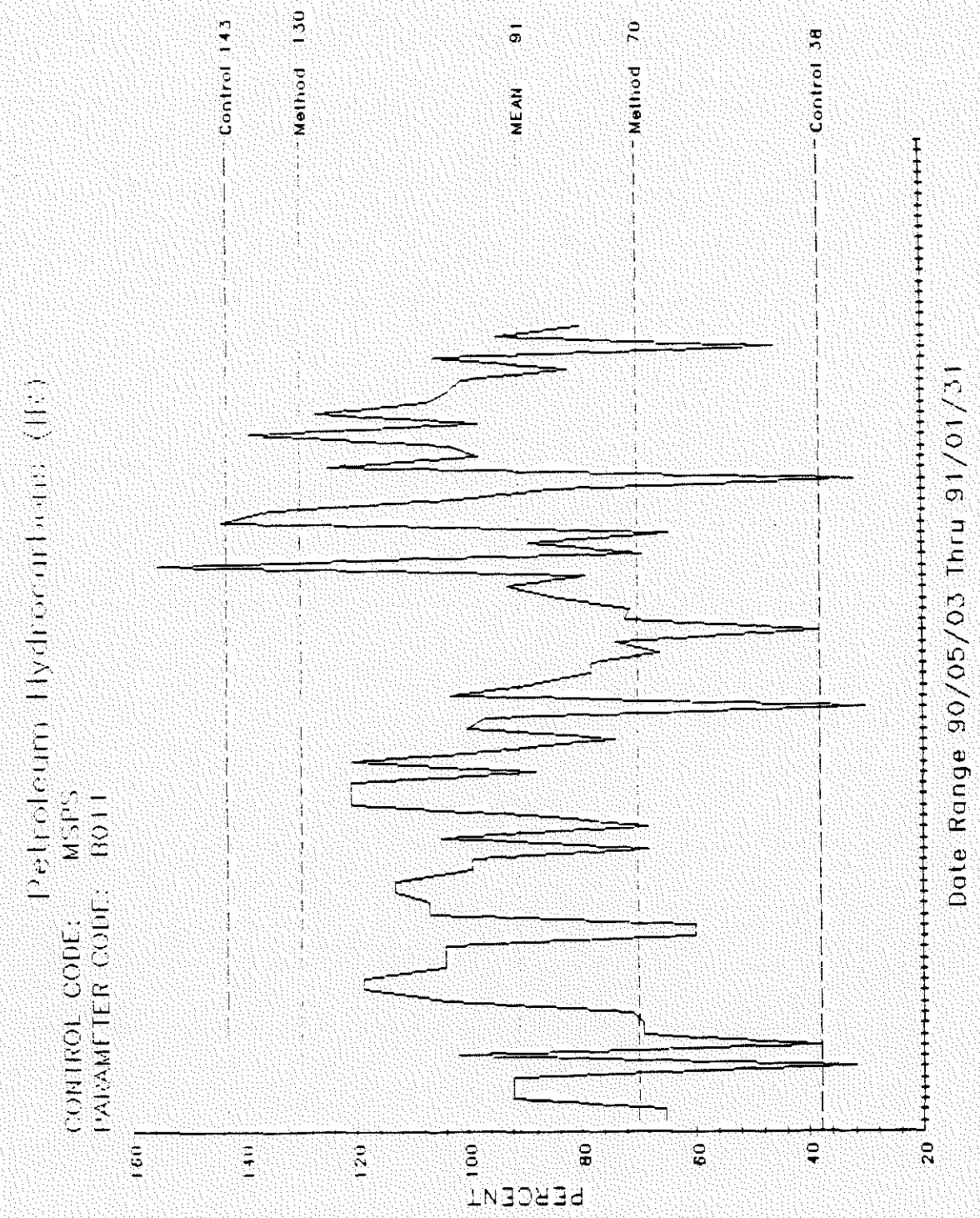

FIGURE 4.1 - LABORATORY CONTROL CHART

Parameters of major importance are accuracy, precision, completeness, representativeness, and comparability. These are defined as follows:

- o Accuracy: degree of the difference between the measured or calculated values and the true values.
- o Precision: reproducability or degree of agreement among replicate measurements of the same quantity.
- o Completeness: expressed as the percentage of valid data obtained from a measurement system.
- o Representativeness: degree to which the data accurately represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.
- o Comparability: the confidence with which one data set can be compared to another.

4.2 QUALITY ASSURANCE OBJECTIVES

The purpose of ASC's quality assurance program is to ensure that the laboratory provides high-quality and cost-effective services and products to its clients. Although specific quality assurance procedures may be designed to meet the needs of a specific project or individual program, the general objectives are:

- o Data should be accurate in terms of their agreement with a reference or true value;
- o Data should be precise in that there is agreement among the individual measurements made under similar conditions;
- o Data should be complete in terms of the amount of data available versus the amount of data evaluated;
- o Data should be comparable to prior relevant data for evaluation and testing purposes;
- o Data should be representative of the overall population or data base of parameter measurements;
- o Data should be reproducibly obtainable under similar conditions, whether generated by ASC or by another firm;

o There should be a continual improvement in overall laboratory performance.

All of the above objectives are ensured by the QA/QC program which monitors all phases of data generation ranging from sample handling to the actual analysis and data reporting that involve measurements of both inorganic and organic constituents. These procedures will be followed by all personnel and will routinely be reviewed by both the Laboratory Director and the QA Officer.

4.3 QUALITY ASSURANCE APPROACH RELATING TO MEASUREMENT OF DATA

The laboratory scope and approach to producing data of known and sufficient quality are described in this section. Guidelines are provided for the assessment and reporting of data quality for any environmentally related measurements and for the incorporation of such assessments into major environmental data bases.

Controlled sample receiving, logging, and tracking throughout the length of the project/contract are maintained to ensure sample integrity throughout the analysis scheme. Documentation of instrument performance and preventative maintenance is used to provide a permanent record for data validation. The ASC laboratory routinely checks the quality of analytical work through the analysis of quality control (QC) reference samples, duplicate samples or matrix spike duplicates, and spike samples.

4.3.1 Accuracy

The accuracy of the measurement data is evaluated by the comparison of the percent recovery of QC reference materials of known or established concentration independent of routine calibration. It is used as prepared or diluted with an inert matrix as a blind environmental sample. Statistically based control limits are established for each method of analysis and sample matrix.

A spiked sample is analyzed routinely for each batch of 20 samples and is dependent upon the sample matrix, method of analysis, and concentration level. A more frequent analysis is performed on a method-specific basis. Recoveries are assessed to determine method efficiency and matrix interference effects.

Analytical accuracy is expressed as the percent recovery of an analyte/parameter which has been added to the environmental samples at a known concentration before preparation and analysis. The equation used to calculate percent recovery is as follows:

$$\text{Percent Recovery} = [\text{Spike Sample Result} - \text{Sample Result}]100/\text{Amount of Spike Added}$$

Table 4.1 outlines the QA objectives for the measurement parameters currently performed at the laboratory.

4.4 REFERENCES

1. "Principles of Environmental Analysis," *Analytical Chemistry*, Volume 55, pp 2210 - 2218, December 1983.

2. DER Guidelines for Preparing Quality Assurance Plans, DER - QA-001185, Florida Department of Environmental Regulation, January 1986.

TABLE 4.1 - LABORATORY QA OBJECTIVES

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Aluminim	EPA 200.7/202.1	Water	+/- 20%	75-125	90+
Antimony	EPA 200.7/204.2	Water	+/- 20%	75-125	90+
Arsenic	EPA 200.7/206.2	Water	+/- 20%	75-125	90+
Barium	EPA 200.7/208.2	Water	+/- 20%	75-125	90+
Beryllium	EPA 200.7/210.1	Water	+/- 20%	75-125	90+
Cadmium	EPA 200.7/213.2	Water	+/- 20%	75-125	90+
Calcium	EPA 200.7/215.1	Water	+/- 20%	75-125	90+
Chromium (Total)	EPA 200.7/218.2	Water	+/- 20%	75-125	90+
Cobalt	EPA 200.7/219.1	Water	+/- 20%	75-125	90+
Copper	EPA 200.7/220.1	Water	+/- 20%	75-125	90+
Iron	EPA 200.7/236.1	Water	+/- 20%	75-125	90+
Lead	EPA 200.7/239.2	Water	+/- 20%	75-125	90+
Magnesium	EPA 200.7/242.1	Water	+/- 20%	75-125	90+
Manganese	EPA 200.7/243.1	Water	+/- 20%	75-125	90+
Mercury	EPA 245.1	Water	+/- 20%	75-125	90+
Molybdenum	EPA 200.7/246.2	Water	+/- 20%	75-125	90+
Nickel	EPA 200.7/249.1	Water	+/- 20%	75-125	90+
Potassium	EPA 200.7/258.1	Water	+/- 20%	75-125	90+
Selenium	EPA 200.7/270.2	Water	+/- 20%	75-125	90+
Silver	EPA 200.7/272.2	Water	+/- 20%	60-120	90+
Sodium	EPA 200.7/273.1	Water	+/- 20%	75-125	90+
Thalium	EPA 200.7/279.2	Water	+/- 20%	75-125	90+
Tin	EPA 200.7/282.1	Water	+/- 20%	75-125	90+
Titanium	EPA 200.7/283.1	Water	+/- 20%	75-125	90+
Vanadium	EPA 200.7/286.1	Water	+/- 20%	75-125	90+
Zinc	EPA 200.7/289.1	Water	+/- 20%	75-125	90+
Chloride	EPA 325.3	Water	+/- 20%	75-125	90+
Chlorine Total Residual	EPA 330.5	Water	+/- 20%	75-125	90+
Cyanide, Amenable to Chlorination	EPA 335.1	Water	+/- 20%	75-125	90+
Cyanide, Total	EPA 335.2	Water	+/- 20%	75-125	90+
Fluoride	EPA 340.2	Water	+/- 20%	75-125	90+
Nitrogen Ammonia	EPA 350.3	Water	+/- 20%	75-125	90+
Nitrogen Nitrate	EPA 352.1	Water	+/- 20%	75-125	90+
Nitrogen Nitrite	EPA 354.1	Water	+/- 20%	75-125	90+
Oxygen, Dissolved	EPA 360.1	Water	+/- 20%	N/A	90+
Sulfate	EPA 375.1	Water	+/- 20%	75-125	90+
Oil & Grease, Total Recoverable	EPA 413.1	Water	+/- 20%	75-125	90+
Phenolics, Total Recoverable	EPA 420.1	Water	+/- 20%	75-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Residue					
Filterable	EPA 160.1	Water	N/A	N/A	90+
Nonfilterable	EPA 160.2	Water	N/A	N/A	90+
Total	EPA 160.3	Water	N/A	N/A	90+
pH, Electrometric	EPA 150.1	Water	N/A	N/A	90+
Bromodichloromethane	EPA 601	Water	+/- 20%	75-125	90+
Bromoform	EPA 601	Water	+/- 20%	75-125	90+
Bromomethane	EPA 601	Water	+/- 20%	75-125	90+
Carbon Tetrachloride	EPA 601	Water	+/- 20%	75-125	90+
Chlorobenzene	EPA 601	Water	+/- 20%	75-125	90+
Chloroethane	EPA 601	Water	+/- 20%	75-125	90+
2-Chloroethylvinyl ether	EPA 601	Water	+/- 20%	75-125	90+
Chloroform	EPA 601	Water	+/- 20%	75-125	90+
Chloromethane	EPA 601	Water	+/- 20%	75-125	90+
Dibromochloromethane	EPA 601	Water	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 601	Water	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 601	Water	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 601	Water	+/- 20%	75-125	90+
Dichlorodifluoromethane	EPA 601	Water	+/- 20%	75-125	90+
1,1-Dichloroethane	EPA 601	Water	+/- 20%	75-125	90+
1,2-Dichloroethane	EPA 601	Water	+/- 20%	75-125	90+
1,1-Dichloroethene	EPA 601	Water	+/- 20%	75-125	90+
trans-1,2-Dichloroethene	EPA 601	Water	+/- 20%	75-125	90+
1,2-Dichloropropane	EPA 601	Water	+/- 20%	75-125	90+
Cis-1,3-Dichloropropene	EPA 601	Water	+/- 20%	75-125	90+
trans-1,3-Dichloropropene	EPA 601	Water	+/- 20%	75-125	90+
Methylene Chloride	EPA 601	Water	+/- 20%	75-125	90+
1,1,2,2-Tetrachloroethane	EPA 601	Water	+/- 20%	75-125	90+
Tetrachloroethene	EPA 601	Water	+/- 20%	75-125	90+
1,1,1-Trichloroethane	EPA 601	Water	+/- 20%	75-125	90+
1,1,2-Trichloroethane	EPA 601	Water	+/- 20%	75-125	90+
Trichoroethene	EPA 601	Water	+/- 20%	75-125	90+
Trichlorofluoromethane	EPA 601	Water	+/- 20%	75-125	90+
Vinyl Chloride	EPA 601	Water	+/- 20%	60-120	90+
Benzene	EPA 602	Water	+/- 20%	75-125	90+
Chlorobenzene	EPA 602	Water	+/- 20%	75-125	90+
Ethylbenzene	EPA 602	Water	+/- 20%	75-125	90+
Toluene	EPA 602	Water	+/- 20%	75-125	90+
Xylenes	EPA 602	Water	+/- 20%	75-125	90+
4-Chloro-3-methylphenol	EPA 8270	Water	+/- 20%	75-125	90+
3-Chlorophenol	EPA 8270	Water	+/- 20%	60-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
2,4-Dichlorophenol	EPA 8270	Water	+/- 20%	60-125	90+
2-Methyl-4-6-dinitrophenol	EPA 8270	Water	+/- 20%	70-125	90+
2-Nitrophenol	EPA 8270	Water	+/- 20%	50-125	90+
4-Nitrophenol	EPA 8270	Water	+/- 20%	40-125	90+
Pentachlorophenol	EPA 8270	Water	+/- 20%	60-125	90+
Phenol	EPA 8270	Water	+/- 20%	40-125	90+
2,4,6-Trichlorophenol	EPA 8270	Water	+/- 20%	60-125	90+
Aldrin	EPA 8270	Water	+/- 20%	75-125	90+
a-BHC	EPA 608	Water	+/- 20%	75-125	90+
b-BHC	EPA 608	Water	+/- 20%	75-125	90+
g-BHC	EPA 608	Water	+/- 20%	75-125	90+
y-BHC (Lindane)	EPA 608	Water	+/- 20%	75-125	90+
Chlordaneane	EPA 608	Water	+/- 20%	75-125	90+
4,4'-DDD	EPA 608	Water	+/- 20%	75-125	90+
4,4'-DDE	EPA 608	Water	+/- 20%	75-125	90+
4,4'-DDT	EPA 608	Water	+/- 20%	75-125	90+
Dieldrin	EPA 608	Water	+/- 20%	75-125	90+
Endosulfan I	EPA 608	Water	+/- 20%	75-125	90+
Endosulfan II	EPA 608	Water	+/- 20%	75-125	90+
Endosulfan Sulfate	EPA 608	Water	+/- 20%	75-125	90+
Endrin	EPA 608	Water	+/- 20%	75-125	90+
Endrin Aldehyde	EPA 608	Water	+/- 20%	75-125	90+
Heptachlor	EPA 608	Water	+/- 20%	75-125	90+
Heptachlor epoxide	EPA 608	Water	+/- 20%	75-125	90+
Methoxychlor	EPA 608	Water	+/- 20%	75-125	90+
Toxaphene	EPA 608	Water	+/- 20%	75-125	90+
PCB-1221	EPA 608	Water	+/- 20%	75-125	90+
PCB-1232	EPA 608	Water	+/- 20%	75-125	90+
PCB-1242	EPA 608	Water	+/- 20%	75-125	90+
PCB-1248	EPA 608	Water	+/- 20%	75-125	90+
PCB-1254	EPA 608	Water	+/- 20%	75-125	90+
PCB-1260	EPA 608	Water	+/- 20%	75-125	90+
2,4-Dinitrotoluene	EPA 8270	Water	+/- 20%	60-120	90+
2,6-Dinitrotoluene	EPA 8270	Water	+/- 20%	60-120	90+
Isophorone	EPA 8270	Water	+/- 20%	60-120	90+
Nitrobenzene	EPA 8270	Water	+/- 20%	60-120	90+
Acenaphthene	EPA 8270	Water	+/- 20%	75-125	90+
Acenaphthylene	EPA 8270	Water	+/- 20%	75-125	90+
Anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(a)anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(a)pyrene	EPA 8270	Water	+/- 20%	75-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Benzo(b)fluorathene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(ghi)perylene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(k)fluoranthene	EPA 8270	Water	+/- 20%	75-125	90+
Chrysene	EPA 8270	Water	+/- 20%	75-125	90+
Dibenzo(ab)anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Fluoranthene	EPA 8270	Water	+/- 20%	75-125	90+
Fluorene	EPA 8270	Water	+/- 20%	75-125	90+
Indeno(1,2,3-c,d)pyrene	EPA 8270	Water	+/- 20%	75-125	90+
Naphthalene	EPA 8270	Water	+/- 20%	75-125	90+
Acrolein	EPA 8270	Water	+/- 20%	75-125	90+
Acrlonitrile	EPA 8270	Water	+/- 20%	75-125	90+
Benzene	EPA 8270	Water	+/- 20%	75-125	90+
Bromomethane	EPA 8270	Water	+/- 20%	75-125	90+
Bromodichloromethane	EPA 8270	Water	+/- 20%	75-125	90+
Bromoform	EPA 8270	Water	+/- 20%	75-125	90+
Carbon Tetrachloride	EPA 8270	Water	+/- 20%	75-125	90+
Chlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
Chloroethane	EPA 8270	Water	+/- 20%	75-125	90+
2-Chloroethylvinyl ether	EPA 8270	Water	+/- 20%	75-125	90+
Chloroform	EPA 8270	Water	+/- 20%	75-125	90+
Chloromethane	EPA 8240	Water	+/- 20%	75-125	90+
Dibromochloromethane	EPA 8240	Water	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 8240	Water	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 8240	Water	+/- 20%	75-125	90+
1,1-Dichloroethane	EPA 8240	Water	+/- 20%	75-125	90+
1,2-Dichloroethane	EPA 8240	Water	+/- 20%	75-125	90+
1,1-Dichloroethene	EPA 8240	Water	+/- 20%	75-125	90+
trans-1,2-Dichloroethene	EPA 8240	Water	+/- 20%	75-125	90+
1,2-Dichloropropane	EPA 8240	Water	+/- 20%	75-125	90+
cis-1,2-Dichloropropene	EPA 8240	Water	+/- 20%	75-125	90+
trans-1,3-Dichloropropene	EPA 8240	Water	+/- 20%	75-125	90+
Ethylbenzene	EPA 8240	Water	+/- 20%	75-125	90+
Methylene Chloride	EPA 8240	Water	+/- 20%	75-125	90+
1,1,2,2-Tetrachloroethane	EPA 8240	Water	+/- 20%	75-125	90+
Tetrachloroethene	EPA 8240	Water	+/- 20%	75-125	90+
1,1,1-Trichloroethane	EPA 8240	Water	+/- 20%	75-125	90+
1,1,2-Trichloroethane	EPA 8240	Water	+/- 20%	75-125	90+
Trichloroethene	EPA 8240	Water	+/- 20%	75-125	90+
Trichlorofluoromethane	EPA 8240	Water	+/- 20%	75-125	90+
Toluene	EPA 8240	Water	+/- 20%	75-125	90+
Vinyl Chloride	EPA 8240	Water	+/- 20%	75-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Total Xylenes	EPA 8240	Water	+/- 20%	75-125	90+
Acetone	EPA 8240	Water	+/- 20%	75-125	90+
2-Butanone (MEK)	EPA 8240	Water	+/- 20%	75-125	90+
Carbon Disulfide	EPA 8240	Water	+/- 20%	75-125	90+
Ethyl ether	EPA 8240	Water	+/- 20%	75-125	90+
Ethylene Dibromide	EPA 8240	Water	+/- 20%	75-125	90+
2-Hexanone	EPA 8240	Water	+/- 20%	75-125	90+
4-Methyl-2-Pentanone (MIBK)	EPA 8240	Water	+/- 20%	75-125	90+
Styrene	EPA 8240	Water	+/- 20%	75-125	90+
Tetrahydrofuran	EPA 8240	Water	+/- 20%	75-125	90+
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8240	Water	+/- 20%	75-125	90+
Vinyl Acetate	EPA 8240	Water	+/- 20%	75-125	90+
Acenaphthene	EPA 8270	Water	+/- 20%	75-125	90+
Acenaphthylene	EPA 8270	Water	+/- 20%	75-125	90+
Anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Benzidine	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(a)anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(b)fluoranthene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(k)fluoranthene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(a)pyrene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(g,h,i)perylene	EPA 8270	Water	+/- 20%	75-125	90+
Bis(2-chloroethyl)ether	EPA 8270	Water	+/- 20%	75-125	90+
Bis(2-chloroethoxy)methane	EPA 8270	Water	+/- 20%	75-125	90+
Bis(2-ethylhexyl)phthalate	EPA 8270	Water	+/- 20%	75-125	90+
Bis(2-chloroisoropyl)ether	EPA 8270	Water	+/- 20%	75-125	90+
4-Bromophenyl phenyl ether	EPA 8270	Water	+/- 20%	75-125	90+
Butyl benzyl phthalate	EPA 8270	Water	+/- 20%	75-125	90+
2-Chloronaphthalene	EPA 8270	Water	+/- 20%	75-125	90+
4-Chlorophenyl phenyl ehter	EPA 8270	Water	+/- 20%	75-125	90+
Chrysene	EPA 8270	Water	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
Dibenzo(a,h)anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Di-n-butylphthalate	EPA 8270	Water	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
3,3-Dichlorobenzidine	EPA 8270	Water	+/- 20%	75-125	90+
Diethylphthalate	EPA 8270	Water	+/- 20%	75-125	90+
Dimethylphthalate	EPA 8270	Water	+/- 20%	75-125	90+
2,4-Dinitrotoluene	EPA 8270	Water	+/- 20%	75-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
2,6-Dinitrotoluene	EPA 8270	Water	+/- 20%	75-125	90+
Dioctylphthalate	EPA 8270	Water	+/- 20%	75-125	90+
1,2-Diphenyl hydrazine	EPA 8270	Water	+/- 20%	75-125	90+
Fluoranthene	EPA 8270	Water	+/- 20%	75-125	90+
Fluorene	EPA 8270	Water	+/- 20%	75-125	90+
Hexachlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
Hexachlorobutadiene	EPA 8270	Water	+/- 20%	75-125	90+
Hexachloroethane	EPA 8270	Water	+/- 20%	75-125	90+
Hexachlorocyclopentadiene	EPA 8270	Water	+/- 20%	75-125	90+
Indeno-(1,2,3-c,d)pyrene	EPA 8270	Water	+/- 20%	75-125	90+
Isophorone	EPA 8270	Water	+/- 20%	75-125	90+
Naphthalene	EPA 8270	Water	+/- 20%	75-125	90+
Nitrobenzene	EPA 8270	Water	+/- 20%	75-125	90+
N-Nitrosodi-n-propylamine	EPA 8270	Water	+/- 20%	75-125	90+
N-Nitrosodiphenylamine	EPA 8270	Water	+/- 20%	75-125	90+
Phenanthrene	EPA 8270	Water	+/- 20%	75-125	90+
Pyrene	EPA 8270	Water	+/- 20%	75-125	90+
1,2,4-Trichlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
4-Chloro-3-Methylphenol	EPA 8270	Water	+/- 20%	75-125	90+
2-Chlorophenol	EPA 8270	Water	+/- 20%	75-125	90+
2,4-Dichlorophenol	EPA 8270	Water	+/- 20%	75-125	90+
2,4-Dimethylphenol	EPA 8270	Water	+/- 20%	75-125	90+
2,4-Dinitrophenol	EPA 8270	Water	+/- 20%	75-125	90+
2-Methyl-4,6-Dinitrophenol	EPA 8270	Water	+/- 20%	75-125	90+
2-Nitrophenol	EPA 8270	Water	+/- 20%	75-125	90+
4-Nitrophenol	EPA 8270	Water	+/- 20%	75-125	90+
Pentachlorophenol	EPA 8270	Water	+/- 20%	75-125	90+
Phenol	EPA 8270	Water	+/- 20%	75-125	90+
2,4,6-Trichlorophenol	EPA 8270	Water	+/- 20%	75-125	90+
Aniline	EPA 8270	Water	+/- 20%	75-125	90+
Benzyl Alcohol	EPA 8270	Water	+/- 20%	75-125	90+
4-Chloroaniline	EPA 8270	Water	+/- 20%	75-125	90+
Dibenzofuran	EPA 8270	Water	+/- 20%	75-125	90+
2-Methylnaphthalene	EPA 8270	Water	+/- 20%	75-125	90+
2-Methylphenol	EPA 8270	Water	+/- 20%	75-125	90+
4-Methylphenol	EPA 8270	Water	+/- 20%	75-125	90+
2-Nitroaniline	EPA 8270	Water	+/- 20%	75-125	90+
3-Nitroaniline	EPA 8270	Water	+/- 20%	75-125	90+
4-Nitroaniline	EPA 8270	Water	+/- 20%	75-125	90+
2,4,5-Trichlorophenol	EPA 8270	Water	+/- 20%	75-125	90+
Bis(2-chloroethyl)ether	EPA 611	Water	+/- 20%	75-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Bis(2-chloroethoxy)methane	EPA 611	Water	+/- 20%	75-125	90+
Bis(2-chloroisopropyl)ether	EPA 611	Water	+/- 20%	75-125	90+
4-Bromophenyl phenyl ether	EPA 611	Water	+/- 20%	75-125	90+
4-Chlorophenyl phenyl ether	EPA 611	Water	+/- 20%	75-125	90+
2-Chloronaphthalene	EPA 612	Water	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 612	Water	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 612	Water	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 612	Water	+/- 20%	75-125	90+
Hexachlorobenzene	EPA 612	Water	+/- 20%	75-125	90+
Hexachlorobutadiene	EPA 612	Water	+/- 20%	75-125	90+
Hexachlorocyclopentadiene	EPA 612	Water	+/- 20%	75-125	90+
Hexachloroethane	EPA 612	Water	+/- 20%	75-125	90+
1,2,4-Trichlorobenzene	EPA 612	Water	+/- 20%	75-125	90+
2,4-D	EPA 8150	Water	+/- 20%	60-120	90+
2,4-DB	EPA 8150	Water	+/- 20%	60-120	90+
2,4,5-T	EPA 8150	Water	+/- 20%	60-120	90+
2,4,5-TP (Silvex)	EPA 8150	Water	+/- 20%	60-120	90+
Dalapon	EPA 8150	Water	+/- 20%	60-120	90+
Dicamba	EPA 8150	Water	+/- 20%	60-120	90+
Dichloroprop	EPA 8150	Water	+/- 20%	60-120	90+
Dinoseb	EPA 8150	Water	+/- 20%	60-120	90+
MCPA	EPA 8150	Water	+/- 20%	60-120	90+
MCPP	EPA 8150	Water	+/- 20%	60-120	90+
Antimony	EPA 6010/7041	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Arsenic	EPA 6010/7061	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Barium	EPA 6010/7081	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Beryllium	EPA 6010/7091	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Cadmium	EPA 6010/7031	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chromium, Total	EPA 6010/7191	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Cobalt	EPA 219.1/6010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Copper	EPA 6010/7211	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Lead	EPA 6010/7421	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Mercury	EPA 7471	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Molybdenum	EPA 246.2/6010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Nickel	EPA 6010/7521	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Selenium	EPA 6010/7741	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Silver	EPA 6010/7761	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
Thallium	EPA 6010/7841	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Vanadium	EPA 6010/7911	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Zinc	EPA 6010/7951	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bromodichloromethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Bromoform	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bromomethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Carbon Tetrachloride	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chlorobenzene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Chloroethylvinyl ether	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloroform	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dibromochloromethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dichlorodifluoromethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1-Dichloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1-Dichloroethene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
trans-1,2-Dichloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichloropropane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
cis-1,3-Dichloropropene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
trans-1,3-Dichloropropene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Methylene Chloride	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,2,2-Tetrachloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Tetrachloroethene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,1-Trichloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,2-Trichloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Trichloroethene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Trichlorofluoromethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Vinyl Chloride	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzene	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chlorobenzene	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Ethylbenzene	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Toluene	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Xylene	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Carbon disulfide	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Diethyl ether	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Methyl ethyl ketone	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Methyl isobutyl ketone	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Acrolein	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Acrylonitrile	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzene	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bromomethane	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Bromodichloromethane	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bromoform	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Carbon Tetrachloride	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chlorobenzene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Chloroethylvinyl ether	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloroform	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloromethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dibromochloromethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1-Dichloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1-Dichloroethene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
trans-1,2-Dichloroethene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichloropropane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
cis-1,2-Dichloropropene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
trans-1,3-Dichloropropene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Ethylbenzene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Methylene Chloride	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,2,2-Tetrachloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Tetrachloroethene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,1-Trichloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,2-Trichloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Trichloroethene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Trichlorofluoromethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Toluene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Vinyl Chloride	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Total Xylenes	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Acetone	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Butanone (MEK)	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Carbon Disulfide	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Ethyl ether	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Ethylene Dibromide	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Hexanone	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Methyl-2-Pentanone (MIBK)	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Styrene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Tetrahydrofuran	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Vinyl Acetate	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Acenaphthene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Acenaphthylene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Anthracene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzidine	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzo(a)anthracene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzo(b)fluoranthene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzo(k)fluoranthene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzo(a)pyrene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzo(g,h,i)perylene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bis(2-chloroethyl)ether	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bis(2-chloroethoxy)methane	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bis(2-ethylhexyl)phthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bis(2-chloroisopropyl)ether	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Bromophenyl phenyl ether	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Butyl benzyl phthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Chloronaphthalene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Chlorophenyl phenyl ether	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chrysene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dibenzo(a,h)anthracene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Di-n-butylphthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
3,3-Dichlorobenzidine	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Diethylphthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dimethylphthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4-Dinitrotoluene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,6-Dinitrotoluene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dioctylphthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Diphenyl hydrazine	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Fluoranthene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Fluorene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Hexachlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Hexachlorobutadiene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Hexachloroethane	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Hexachlorocyclopentadiene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Indeno-(1,2,3-c,d)pyrene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Isophorone	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Naphthalene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Nitrobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
N-Nitrosodi-n-propylamine	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
N-Nitrosodiphenylamine	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Phenanthrene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Pyrene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2,4-Trichlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Chloro-3-Methylphenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Chlorophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4-Dichlorophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4-Dimethylphenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4-Dinitrophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Methyl-4,6-Dinitrophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Nitrophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Nitrophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Pentachlorophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Phenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4,6-Trichlorophenol	EPA 8040/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Aniline	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzyl Alcohol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Chloroaniline	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dibenzofuran	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Methylnaphthalene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Methylphenol	EPA 8040/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Methylphenol	EPA 8040/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Nitroaniline	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
3-Nitroaniline	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Nitroaniline	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Aldrin	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
a-BHC	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
b-BHC	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
g-BHC	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
y-BHC (Lindane)	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chlordane	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4,4'-DDD	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4,4'-DDE	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4,4'-DDT	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dieldrin	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Endosulfan I	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Endosulfan II	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Endosulfan sulfate	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Endrin	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Endrin aldehyde	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Heptachlor	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Heptachlor epoxide	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Methoxychlor	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Toxaphene	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1221	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1232	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1242	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1248	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1254	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1260	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4-D	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4-DB	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4,5-T	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4,5-TP (Silvex)	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dalaphon	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dicamba	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dichloroprop	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dinoseb	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
MCPA	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
MCPP	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Ignitability	EPA 1020	Soil/Waste Solid/Liquid	N/A	N/A	90+
Corrosivity toward steel	EPA 1110	Soil/Waste Solid/Liquid	N/A	N/A	90+
Extraction Procedure (EP) Toxicity Test Method	EPA 1310	Soil/Waste Solid/Liquid	N/A	N/A	90+
Oxidizer Spot Test	EPA 038	Soil/Waste Solid/Liquid	N/A	N/A	90+
pH Paper Test	EPA 038	Soil/Waste Solid/Liquid	N/A	N/A	90+
Sulfide Spot Test	EPA 038	Soil/Waste Solid/Liquid	N/A	N/A	90+
Cyanide Spot Test	EPA 038	Soil/Waste Solid/Liquid	N/A	N/A	90+
Flashpoint Determination	EPA 1020	Soil/Waste Solid/Liquid	N/A	N/A	90+

NOTE: The QA objectives are targeted internal laboratory GC limits.

5.0 SAMPLING PROCEDURES

5.1 INTRODUCTION

ASC does not provide on-site sampling services to its clients. It is the responsibility of each organization submitting samples to the laboratory to ensure that proper procedures have been followed in the collection, preservation, and documentation of all samples submitted to the laboratory for analysis.

5.2 REQUIRED SAMPLE VOLUMES

The volume of sample obtained should be sufficient to perform all required analyses with an additional amount collected to provide for quality control needs, split samples, or repeat examinations. Individual aliquots of a composite sample should be at least 100 milliliters in order to minimize sample solids bias when using a peristaltic pump.

Although the volume of sample required by analytical laboratories depends on the analyses to be performed, the amount of sample required for a complete water or wastewater analysis is normally two gallons (7.6 liters) for each laboratory receiving a sample. However, the laboratory receiving the sample should be consulted for any specific volume requirements.

The volume of samples collected from waste sources at hazardous waste sites or samples from sources which are known to be toxic should be kept to an absolute minimum.

5.3 SELECTION AND PROPER PREPARATION OF SAMPLE CONTAINERS

The type of sample container is dictated by the analyses required. Standard sample containers used by sampling personnel are presented in Table 5.1.

In special cases, the laboratory may be required to supply sample containers to clients for the collection of field samples. Where this requirement is part of the contract, the laboratory will only supply containers that have been purchased from a known source and have been certified to have been cleaned to USEPA protocols.

5.4 SAMPLE PRESERVATION

Samples for some analyses must be preserved in order to maintain their integrity. Preservatives required for routine analyses of samples collected are given in Table 5.1. All chemical preservatives used will be supplied by the samplers. All samples should be

TABLE 5.1 - SAMPLING INFORMATION

PARAMETER	CONTAINER[2]	PRESERVATION	HOLDING TIME	MIN VOL (ml)
Chloride	P, G	None	28 days	50
Chlorine Total Residual				
Cyanide	P, G	1ON NaOH to pH $\geq$ 12 0.6 g Ascorbic Acid[3]	28 days	500
Fluoride	P	None	28 days	500
Metals- Dissolved	P, G	Filter on-site HNO_3 to pH < 2	6 months Hg - 28 days	200
Suspended	P, G	HNO_3 to pH < 2	6 months Hg - 28 days	200
Total	P, G	HNO_3 to pH < 2	6 months Hg - 28 days	100
Nitrogen - Ammonia	P, G	Cool 4°C H_2SO_4 to pH < 2	28 days	
Nitrate	P, G	Cool 4°C H_2SO_4 to pH < 2	28 days	
Nitrite	P, G	Cool 4°C H_2SO_4 to pH < 2	28 days	
Oxygen, dissolved	G	Determine on-site	2 hours	300
Sulfate	P, G	4°C	28 days	50
pH	P, G	Determine on-site	2 hours	25
Oil and Grease Total Recoverable	G	4°C H_2SO_4 to pH < 2	28 days	1000
Phenolics Total Recoverable	G	4°C H_2SO_4 pH < 2	24 hours	1000
Residue - Filterable	P, G	4°C	7 days	100

TABLE 5.1 - SAMPLING INFORMATION (Continued)

PARAMETER	CONTAINER[2]	PRESERVATION	HOLDING TIME	MIN VOL (ml)
Residue -				
Non-Filterable	P, G	$4^{o}C$	7 days	100
Total	P, G	$4^{o}C$	7 days	100
Organics -				
Extractable (base/ neutrals/acid)	Glass, TFE[4] lined screw closure	$4^{o}C$	7 days Extraction, 30 days after extraction	1000
Organics (Cont'd)				
Volatile Organics	Glass, TFE lined septum	$4^{o}C$ with NaThio SO_4 or HCL	14 days	40
Pesticides/PCBs	Glass, TFE lined screw closure	$4^{o}C$	7 days Extraction, 30 days after extraction	1000

1. Table taken from Characterization of Hazardous Waste Sites - A Methods Manual, Vol. II, EPA 600/4-84-079, December 1984, pages A49-A52.
2. P = Plastic; G = Glass
3. Addition of Ascorbic only in the presence of residual chlorine
4. TFE = Teflon

Note: Solid and non-aqueous liquid samples will not be subjected to the preservation techniques outlined in the above table. These samples will be placed in the proper containers as previously outlined and kept at $4^{o}C$ until analysis. Maximum holding times as per the appropriate analytical methodologies will be adhered too.

preserved immediately upon collection in the field. The only samples that should not be immediately preserved in the field are:

- o Samples collected within a hazardous waste site known or thought to be highly contaminated with toxic materials. Barrel, drum, closed container, spillage, or other source samples from hazardous waste sites are not to be preserved with any chemical. These samples may be preserved with ice, if necessary.

- o Samples that have extremely low or high pH or samples that may generate potentially dangerous gases if they were preserved.

- o Well or ground water samples that contain visible sediment that are not filtered in the field, shall not be preserved with nitric acid in the field. These samples shall be preserved with ice and returned to the laboratory for additional sample preparation.

All samples preserved with chemicals shall be clearly identified by indicating on the sample tag that the sample is preserved. If the samples were not preserved, field records shall indicate why.

5.5 SAMPLE HOLDING TIMES

The elapsed time between sample collection and initiation of laboratory analyses must be within a prescribed time frame for each individual analysis to be performed. Sample holding times for all routine samples collected are shown in Table 5.1.

5.6 REFERENCES

1. Memorandum re: "National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Environmental Laboratory Samples." U.S. Environmental Protection Agency, Office of Planning and Management, March 6, 1981.

2. NPDES Compliance Inspection Manual, United States Environmental Protection Agency, Enforcement Division, Office of Water Enforcement and Permits, EN-338, 1984.

3. Handbook for Monitoring Industrial Wastewater, United States Environmental Protection Agency, Technology Transfer, 1973.

4. Handbook for Evaluating Water Bacteriological Laboratories, United States Environmental Protection Agency, ORD, Municipal Environmental research Laboratory, Cincinnati, Ohio, 1975.

5. Microbiological Methods for Monitoring the Environment, Water and Wastes, United States Environmental Protection Agency, ORD, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, 1978.

6. Kittrell, F. W., "A Practical Guide to Water Quality Studies of Streams," United States Department of Interior, Federal Water Pollution Control Administration: Cincinnati, Ohio, 1969.

7. Lauff, G. H., ed., Estuaries, American Association for the Advancement of Science: Washington, D.C., Publication No. 83, 1967.

8. Fischer, H. B., E. J. List, R. C. Koh, J. Inberger, and N. H. Brooks, Mixing in Inland and Coastal Waters, Academic Press: New York, 1979.

9. Ippen, A. T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, Inc.: New York, 1966.

10. Reid, G. K. and R. D. Wood, Ecology of Inland Waters and Estuaries, 2nd Edition, D. Van Nostrand Company: New York, 1976.

11. Kaplovsky, A. J., "Estuarine Pollution Investigation Employing " Same-Slack" Technique," Journal of the Water Pollution Control Federation, Volume 29, No. 9, pg. 1042, 1957.

12. Freed, J. R., P. R. Abell, D. A. Dixon, R. E. Huddleston, M. W. Slimak, and J. Pawlow, "Sampling Protocols for Analysis of Toxic Pollutants in Ambient Water, Bed Sediment, and Fish," Interim Final Report, 3 February 1980, for Office of Water Planning and Standards, United States Environmental Protection Agency, 1980.

13. "RCRA Ground-Water Monitoring Enforcement Guidance: RCRA Ground-Water Monitoring Compliance Order Guidance (Final) and RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (Draft),: USEPA, Office of Waste Programs Enforcement and Office of Solid Waste and Emergency Response, August 1985.

14. "Groundwater," Section 18, USDA-SCS National Engineering Handbook, United States Department of Agriculture, Soil Conservation Service, 1978:

15. Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities, United States Environmental Protection Agency, Office of Water and Waste Management, SW-611, 1977.

16. Water Quality Monitoring at Solid Waste Disposal Sites in Minnesota, Minnesota Pollution Control Agency, Solid Waste Division, 1979.

17. Manual of Ground-Water Sampling Procedures, United States Environmental Protection Agency, Robert S. Kerr Environmental Research Laboratory, 1981 and Waste Management, SW-611, December 1980.

18. Barcelona, Michael J., et.al., A Guide to the Selection of Materials for Monitoring Well Construction and Groundwater Sampling, Illinois State Water Survey, Department of Energy and Natural Resources, Champaign, Illinois, SWS Contract Report 327, August 1983.

19. Sampling for Organic Chemicals and Microorganisms in the Subsurface, United States Environmental Protection Agency, EPA-600/2-77-176, 1977.

20. "Engineering Geology," Section 8, National Engineering Handbook, United States Department of Agriculture, Soil Conservation Service, 1978.

21. Geologic Site Exploration, United States Department of Agriculture, Soil Conservation Service, EWP Technical Guide No. 4, 1969.

22. Preparation of Soil Sampling Protocol: Techniques and Strategies, US-EPA-600/4-83-020, EMSL, Las Vegas, August, 1984.

23. Field Health and Safety Manual, United States Environmental Protection Agency, Region IV, August, 1984.

24. Safety Manual for Hazardous Waste Site Investigations, United States Environmental Protection Agency, Draft, 1979.

25. Characterization of Hazardous Waste Sites - A Methods Manual: Volume 1 - Site Investigations, US-EPA, EMSL Las Vegas, EPA-600/4-84-075, April 1985.

26. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II - Available Sampling Methods, 2nd Edition, US-EPA, EMSL, Las Vegas, EPA-600/4-84-076, December 1984.

27. Enforcement Considerations for Evaluation of Uncontrolled Hazardous Waste Disposal Sites by Contractors, US-EPA, NEIC, 1980.

28. Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (SW-846), USEPA, Office of Solid Waste and Emergency Response, Washington, D.C., July 1982.

6.0 SAMPLE CUSTODY

6.1 INTRODUCTION

A critical aspect of sound sample collecting and analysis is the maintenance of strict Chain-of-Custody Record (COC) procedures. COC procedures include inventorying and documentation during sample collection, shipment, and laboratory processing. A sample is considered to be in an individual's custody if the sample is: 1) in the physical possession or view of the responsible party; 2) secured to prevent tampering; or 3) placed in a restricted area by the responsible party.

6.1.1 Sample Label

A sample label is attached to all sample containers at the time of collection. The label is written in indelible ink and contains the following information:

- project number
- sample number
- sample location and depth
- date and time collected
- preservative used (if any)
- name of sampler and witness

A typical sample label is illustrated in Figure 6.1.

6.1.2 Sample Custody

Sample custody is initiated by the detailed recordkeeping of the field sampling personnel. COC establishes the documentation and control necessary to identify and trace a sample from collection through analysis. It includes field-sample labeling to prevent sample mix-up, custody seals to prevent sample tampering and to secure custody, and to provide the support information for potential litigation.

6.1.3 Chain-of-Custody Records (COC)

The COC's are used to document integrity of all samples (see Figure 6.2). To maintain a record of sample collection, transfer between personnel, and shipment and receipt by the laboratory. A COC will be filled out for each sample set at each sampling location and will contain the following information:

JOB #: _____ Sample #: _____

Date: _____

Time: _____

Sample: _____

_____

Taken by: _____

Witness: _____

FIGURE 6.1 - SAMPLE LABEL

OHM Corporation

CHAIN-OF-CUSTODY RECORD

Form 0019
Field Technical Services
Rev. 08/89

No. 93626

O.H. MATERIALS CORP. • P.O. BOX 551 • FINDLAY, OH 45839-0551 • 419-423-3526

PROJECT NAME		PROJECT LOCATION
PROJ. NO	PROJECT CONTACT	PROJECT TELEPHONE NO
CLIENT'S REPRESENTATIVE		PROJECT MANAGER/SUPERVISOR

ITEM NO	SAMPLE NUMBER	DATE	TIME	COMP	GRAB	SAMPLE DESCRIPTION (INCLUDE MATRIX AND POINT OF SAMPLE)	NUMBER OF CONTAINERS	ANALYSIS DESIRED (INDICATE SEPARATE CONTAINERS)								REMARKS
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																

TRANSFER NUMBER	ITEM NUMBER	TRANSFERS RELINQUISHED BY	TRANSFERS ACCEPTED BY	DATE	TIME	REMARKS
1						
2						
3						
4						SAMPLER'S SIGNATURE

LAB COPY

FIGURE 6.2 - CHAIN-OF-CUSTODY RECORD

- o project name
- o project location
- o project contact and phone number
- o project number
- o sample number
- o date and time collected
- o preservative used (if any)
- o number of containers
- o description of the sample
- o analysis desired
- o name of sampler and signature
- o Signature of people in possession of the sample and when samples were transferred
- o Any remarks concerning discrepancies between the sample, sample label, and the COC

6.1.4 Field Sample Shipment

The individual in charge of shipping samples to the laboratory is responsible for ensuring the completion of the COC. This individual will also inspect the form for completeness and accuracy. Any changes made to the COC will be initialed by the person making the change.

Samples are to be accompanied by an approved COC. When possession of the samples is transferred, the individual relinquishing the samples signs and records the date and time on the document. The individual receiving the samples also signs and records the date and time of transfer. This record represents the official documentation for all transference of the sample custody until the samples have arrived at the laboratory.

If samples are to be split with another laboratory facility or government agency, a separate COC is prepared for those samples. This COC indicates with whom the samples have been split and is appropriately signed and dated with the time of transfer of the splits.

The following is a description of the procedure followed when transporting environmental samples from the sampling site to the laboratory:

- o The outer surface of all sample containers is cleaned with bottled water and paper towels.

- o Log book entries, sample tags, and COC's are all completed.

- o Samples and trip blanks are placed into a sample cooler along with the ice packs. After the cooler is filled, the appropriate COC is placed inside the cooler and the outer surface of the cooler is cleaned.

- Glass sample containers are wrapped with insulating material to prevent contact with other sample containers or the inner walls of the cooler.

- Once all packaging is completed, each cooler is sealed with identifying labels or custody seals which are initialed by the field samplers for COC.

- Samples are classified according to the Department of Transportation (DOT) regulations pursuant to Title 49 CFR.

- The laboratory is then notified prior to shipment that samples are being sent to the laboratory for analysis. This notice should be given at least 24 hours in advance of the expected sample arrival date.

Samples are packaged in thermally insulated, rigid coolers according to DOT specifications 173.510, 172 Subparts B, C, and D and Subparts A and B of Part 173. Sample containers are placed in a cooler containing blue ice and absorbent packing for liquids or styrofoam packing for solids. The completed COC is placed inside the shipping container unless otherwise noted.

The cooler is marked as follows:

- Proper Shipping Name: hazardous substance, liquid or solid

- Hazardous Class: "To be Determined" (label placed in upper left corner of outer container)

- Labels: "This Side Up" or arrows placed on the opposite side of the outer container if a liquid is to be shipped

A hazardous material shippers certification is filled out and will accompany the shipment. The container is secured with strapping tape to prevent leakage. It is recommended that an overnight express service (i.e., Federal Express) be used for sample transport.

6.2 LABORATORY OPERATIONS

Delivery of the samples to the laboratory will be accomplished by direct transfer, overnight courier, or common carrier as dictated by the specific project. Sample delivery by either special courier or common carrier will require a custody seal on the sample chest. Should the samples arrive with the seal broken, it should be written on the COC and the samples will not be processed until a thorough investigation has been completed. Upon arrival at the laboratory, all sample containers are opened and inspected. Field sampling

personnel or the project manager are notified on the same day of any problems concerning the samples or documents associated with the shipment. If samples arrive on Saturday and the field personnel are unavailable, notification will be made on the next working day.

6.2.1 Sample Receipt

All samples will be received by the Sample Custodian or, in his/her absence, by any member of the laboratory staff. All samples received will be considered to be hazardous samples, thus all shipping containers should be opened in the sample receipt area of the warehouse by the walk-in exhaust hood. All personnel associated with sample receipt are required to become familiar with all safety procedures for the handling of hazardous samples.

The objective of the sample receipt procedure is to ensure that all pertinent information about the condition of the sample is recorded. The Sample Custodian will examine the shipping container and shall record the following information on the COC:

- The condition of the shipping container, noting any damage
- The presence/absence of COC seals and their condition
- The labeling on the shipping container

The shipping containers should not be opened except under or in an approved hood or in an approved, well-ventilated area. Approved hood space and/or approved well-ventilated areas should be determined by the laboratory's Health and Safety Officer or the Corporate Health and Safety Officer. Prior to the removal of samples, plastic-backed absorbent pads should be laid out to receive the sample bottles. The Sample Custodian will note on the sample COC (or the Project Problem Sheet, Figure 7, if the COC is missing) the following information:

PROJECT PROBLEM SHEET

DATE: _____ **TIME:** _____

TO: _____

FROM: _____

Project #: _____ **COC#:** _____

==========

PROBLEMS: Please mark the box of the item which is missing or has a problem associated with it.

[ ]	Proj Name/Location	[ ]	Matrix on COC and Jar don't agree
[ ]	Proj #/Sample #	[ ]	Color on COC and Jar don't agree
[ ]	Proj Contact/Phone #	[ ]	Health Warnings Listed
[ ]	Date Sample Collected/Time	[ ]	Quantity of Sample
[ ]	Number of Containers	[ ]	Arrived Broken
[ ]	Preserved Properly	[ ]	Name of Sampler/Signature
[ ]	Custody Transfer	[ ]	Required Analyses Listed/TAT
[ ]	Sample has Odor	[ ]	PCBs listed as present

Other Remarks: _____

_____

_____

_____

_____

_____

PROBLEM CONTACT NAME: _____

ACTION TO BE TAKEN: _____

_____

_____

_____

_____

CC: _____

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FIGURE 6.3 - PROJECT PROBLEM SHEET

- o presence/absence of the COC Record
- o presence/absence of airbills and/or bills of lading documenting shipment of samples
- o any necessary project and/or sample information enclosed with the shipment

Upon removal of the samples, the following information must be recorded:

- o The condition of the samples (intact, broken, leaking, cold or ambient, headspace in the VOA vials, etc.).
- o The presence/absence of sample tags.

If the sample tags are present:

- o Record sample tag document control numbers.
- o Compare sample tags with the COC's and document whether these numbers agree.
- o If the sample tag numbers are not listed on the COC, record this fact.

If an odor is noticed after opening the shipping container prior to sample removal, it must be noted on the COC record. Once the COC, sample labels, and sample tags have been compared, the Sample Custodian shall document agreement among the forms and note any discrepancies found on the Project Problem Sheet.

- o If all samples recorded on the COC are received and no problems are observed, the Sample Custodian will sign the COC in the "TRANSFER ACCEPTED BY" box.
- o If problems are noted, the Sample Custodian will sign the COC and note the problems in the "REMARKS" box and note the problems on the Project Problem Sheet.
- o If discrepancies have been discovered, they shall be reported to the appropriate Client Services personnel for clarification.

Following the inspection of the shipping containers, sample bottles, and accompanying documentation, the Sample Custodian will place the samples in the walk-in cooler and deliver the written documentation, including the COC, the Project Problem Sheet, etc., to the Client Services personnel. The Client Services personnel will review all of the sample documentation and compare it with any documentation previously supplied by the client. If necessary, the Client Services personnel will make the necessary contacts to verify any

discrepancies and carry out the client's directives. All communications by the Client Services personnel will be documented in logbooks assigned to each person. The information recorded will consist of the following items:

- o date of the communication
- o person contacted
- o detailed account of all directives given by the client

Once all of the sample information has been verified and checked against other project documentation, the Client Services personnel will proceed to log-in the sample.

6.2.2 Sample Splitting

When clients supply their own containers or when bulk samples are received, the Sample Custodian shall split the sample to provide sufficient aliquots for each analytical procedure that is to be performed. The following guidelines should be used to determine the manner in which samples will be split.

6.2.3 Water Samples - Inorganic Parameters Only

The Sample Custodian along with the appropriate laboratory supervisor will determine the minimum sample quantities required for the analysis. If insufficient sample exists to produce the aliquots needed, the Sample Custodian shall contact Client Services personnel for a priority list of parameters. Based upon this information, the Sample Custodian will split the sample into the proper containers so the laboratory may proceed with the analysis.

6.2.4 Water Samples - Organic and Inorganic Parameters

When bulk samples arrive for both inorganic and organic analyses, the Sample Custodian, or the personnel completing the volatile analysis, will split out a portion for any required volatile analyses and transfer the sample to the instrumentation room volatile refrigerators. The remainder of the sample will be split for other organic or inorganic parameters as necessary.

6.2.5 Sediment/Soil Samples

Every effort will be made to acquire duplicate aliquots of these matrices. The sample will be made homogeneous after any portion required for the volatile organic analysis has been removed by one or all of the following procedures:

- o stirring
- o air drying and grinding
- o particle separation
- o quartering

The Sample Custodian, or personnel completing sample splitting, shall obtain the aliquot for the organic analysis and the remainder will be given to the inorganic laboratory for further splitting, if necessary. If insufficient material exists to provide the minimum quantities for analysis, the client shall be notified to either schedule a resampling event or to provide a list of priority parameters.

6.2.6 Sample Storage

All samples are kept in either the walk-in cooler or the volatile analysis refrigerator located in the organic instrumentation laboratory. Once the sample has been accepted and placed within these storage areas, any laboratory personnel has access in order to complete the analysis. The Sample Custodian is responsible for the following items:

- o Samples are to be removed from the shipping container and stored in their original container unless the container has been damaged. If the container has been damaged, the Sample Custodian is responsible for transferring the sample to an appropriate container for further storage.

- o The Sample Custodian will remove any samples from the storage areas for shipment off site when necessary.

- o Ensure that the volatile samples are stored separately from other samples.

- o Ensure that standards are not stored with any samples.

6.2.7 Long-Term Storage/Sample Disposal

Upon completion of the analysis, the samples will remain stored in either the walk-in cooler or the volatile refrigerator for an additional thirty days. After thirty days, the samples will be moved to the waste disposal room where they will be stored for an additional thirty days. If during the sixty-day storage period arrangements have not been made to return the sample to the site or to initiate any further analysis, the sample is properly disposed of according to internal disposal procedures.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

The following subsections outline the calibration procedures and frequencies for ASC laboratory analytical instrumentation.

7.1 GAS CHROMATOGRAPH FOR VOLATILE ORGANIC ANALYSIS

Prepare calibration standards at a minimum of five concentration levels for each parameter. One of the external standards should be at a concentration near but above the Minimal Detection Limit (MDL) and the other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the detector. These standards should be prepared fresh on a routine basis. Analyze each calibration standard and tabulate area responses versus the concentration in the standard. The results can be used to prepare a calibration curve for each compound. Alternatively, if the ratio of response to concentration (calibration factor) is a constant over the working range [< 20% relative standard deviation, (RSD)], linearity through the origin can be assumed and the average ratio or calibration factor can be used in place of a calibration curve. The working calibration curve or calibration factor must be verified on each working day by the measurement of one or more calibration standards. If the response for any parameter varies from the predicted response by more than +/- 10%, the test must be repeated using a fresh calibration standard. Alternatively, a new calibration curve or calibration factor must be prepared for that parameter.

7.2 GAS CHROMATOGRAPH FOR EXTRACTABLE ORGANIC ANALYSIS

Prepare calibration standards at a minimum of five concentration levels for each parameter of interest by adding volumes of one or more stock standards to a volumetric flask and diluting to volume with the appropriate solvent. One of the external standards should be at a concentration near but above the MDL and the other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the detector.

Using injections of one to five microliters of each calibration standard, tabulate area responses against the mass injected. The results can be used to prepare a calibration curve for each compound. Alternatively, if the ratio of response to concentration (calibration factor) is constant over the working range < 20% RSD, linearity through the origin can be assumed and the average ratio or calibration factor can be used in place of a calibration curve. The working calibration curve or calibration factor must be verified on each working day by the measurement of one or more calibration standards. If the response for any

parameter varies from the predicted response by more than +/- 10%, the test must be repeated using a fresh calibration standard. Alternatively, a new calibration curve or calibration factor must be prepared for that compound.

7.3 ATOMIC ABSORPTION SEPCTROPHOTOMETER FOR TRACE METALS ANALYSIS

Calibration standards are prepared by dilution of a stock solution (~1000 ug/mL) at the time of analysis. Calibration standards are prepared fresh daily and are discarded after use. A blank and at least three calibration standards are prepared in graduated amounts in the appropriate concentration range. The calibration standards are prepared using the same acids as the samples. Beginning with the blank and working toward the highest standard, each solution is aspirated and the readings are rendered and processed. Each result is used to develop a calibration curve (computer generated from the system software). The working calibration curve is verified during each working day, at least one time per hour, by the measurement of one or more calibration standards. If the response varies more than +/- 15% from the predicted response, the standard is re-analyzed. If the response is still more than +/- 15% from the predicted response, all analyses performed after the last calibration standard will be repeated after instrument calibration.

7.4 SPECTROPHOTOMETER FOR COLORIMETRIC DETERMINATIONS

Calibration standards are prepared by dilution of a stock solution (~1000 ug/mL) to appropriate working standards and to calibration standards on a daily basis. Concentrations of stock and working standards will be dependent on the specific methods of analysis. A blank and at least five calibration standards are prepared in graduated amounts in the appropriate concentration range. Calibration standards will be prepared exactly as the samples unless specified differently in the method.

A standard curve is prepared by plotting absorbance versus concentration for the calibration standards. The working calibration curve is verified by analysis of a standard. If the response varies more than +/- 10% from the predicted response, the standard is re-analyzed. Should the response still vary more than +/- 10%, a new standard curve will be prepared.

7.5 SPECIFIC ION METER

This calibration procedure is specific for the Orion 901 specific ion meter and associated specific ion electrodes. Typical electrode response curves are given in each specific electrode instruction manual. The standard calibration method that follows is valid over the entire range of response. The necessary solutions consist of the following:

- Adjustors: Ionic strength adjustors (ISA), pH adjustors, and/or decomplexing agents are added in equal proportions to all samples, standards, and blanks. Necessary adjustors are described in specific electrode manuals.

- Standards: Two standards are prepared that bracket the expected concentration range of the samples.

- Blank laboratory grade water with adjustors added.

The specific calibration procedures is as follows:

1. The instrument is set up with electrode(s) as described in the electrode instruction manual.

2. Preset slope from electrode instruction manual.

3. Set standard thumbwheels to display concentration of first standard.

4. Set mode switch to "CONCN".

5. Place electrode(s) in first standard and add adjustors.

6. Press "Clear/Read MV", all reading to stabilize.

7. Press "Set CONCN".

8. Remove electrode(s), rinse with lab grade water, shake off excess water.

9. Place electrode(s) in lab grade water, add adjustors, and allow reading to stabilize, press "Set Blank".

10. Repeat Step #8.

11. Place electrode(s) in second standard and add adjustors; allow readings to stabilize.

12. Adjust slope thumbwheel so that exact concentration of standard two is shown on display.

13. Analyze samples by adding adjustors and allowing readings to stabilize.

14. Recalibrate every two hours or as necessary as indicated by analysis of a middle standard.

7.6 PH METER

7.6.1 Equipment

A pH meter - Orion 901 Ionalyzer equipped with a temperature compensating electrode.

7.6.2 Solution

The pH buffers that bracket the expected pH range (usually pH 4 and pH 10); a third median value pH (usually pH 7).

7.6.3 Procedure

1. Instrument set up as described in electrode manual.

2. Preset slope from temperature compensation table.

3. Set "Standard" thumbwheel to display pH value of higher buffer.

4. Set mode switch to "pH".

5. Place electrode in pH buffer of higher value.

6. Press "Clear/Read MV"; allow reading to stabilize.

7. Press "Set CONCN".

8. Remove electrode(s) and rinse with lab grade water; shake off excess water.

9. Place electrode(s) in pH buffer of lowest value; allow reading to stabilize.

10. Adjust slope thumbwheels so display reads exact pH of the lower buffer.

11. Repeat step #8.

12. Immerse electrode(s) in middle pH buffer and allow for stabilization; value should be +/- 0.1 pH unit - if not, check electrode as described in the manual.

13. Determine pH values of samples by immersing electrode in sample; allow reading to stabilize.

14. Analyze middle pH buffer after each ten samples.

7.7 ANALYTICAL BALANCE

For preparing standards from concentrated or pure material, a Mettler analytical balance capable of weighing to 0.1 mg is used. This balance incorporates a built-in calibration weight. Calibration procedure is as follows:

1. Allow balance to stabilize by being left on power supply for one hour.

2. Remove objects from the pan and close doors.

3. Press control bar until "CAL" is displayed.

4. Release control bar, "CAL ---" appears on display.

5. Slide calibration lever slowly towards the rear when "CAL 100" is displayed.

6. "CAL--" will be displayed, then "100,000"; at this time, the balance has been calibrated to 100.000 g +/- 0.00001g.

7. "CAL 0" will next appear - slide calibration lever back to original position - "---" will be displayed, then "0.00000"; at this time the balance has been zeroed to 0.0000 g +/-0.00001g.

8. At least monthly, the calibration of each analytical balance will be checked using Class S1 weights. At least yearly, the balance will be serviced and calibrated by a certified technician.

7.8 CALIBRATION STANDARDS AND TRACEABILITY

Standards for analysis of metals will be purchased stock standards each at a concentration of approximately 1000 ppm. These standards, where possible, are traceable to National Bureau of Standards reference materials. Dilutions of the standards will be made to prepare working standards on a daily basis. Standards for organic, extractable, and volatile organic analyses will be prepared, when available, from neat materials. These

materials will be obtained from Chem Service, Inc., or an appropriate vendor and will be "Standard Grade" material. These materials are normally greater than 95% pure, pre-analyzed, purity certified, expiration dated, and lot numbered. Primary standards are usually either not available in sufficient quantities or are too expensive to be used on a routine basis. Therefore, secondary standards must be prepared in-house (or, in some cases, purchased) and compared to primary standards. If all steps in the comparison are documented, the secondary standard is said to be traceable. Secondary standards prepared at a later date can then be compared to the first secondary standard. This process is called "maintaining the traceability of standards." Standard preparation is recorded in a bound standard log book. The details are recorded in the standard log book on the pre-printed pages. Identity numbers from each standard are assigned for each sequential log and listed in the standard log book. Primary standards will not be used for routine analytical purposes. Because of the limited availability of such standards, they will be used to standardize secondary stock and working standards. The QA supervisor will maintain data to ensure the traceability of all standards. If traceability is broken, the re-analysis of the secondary standard must be performed in parallel with the primary standard.

8.0 ANALYTICAL PROCEDURES

Refer to Table 4.1 for the USEPA approved analytical procedures that will be used.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

The following section outlines the data reduction plan for the collected data, criteria used to validate the data, and the decision flow from raw data to the validated concentrations.

9.1 DATA REDUCTION

Data reduction includes the identifications and calculations necessary to convert the raw instrument readings to the final reported compounds and their respective concentrations.

9.1.1 Conventional Parameters

Data calculation and reduction will be performed as described in the individual USEPA approved methods.

9.1.2 Trace Metal Parameters

Atomic absorption spectrophotometry is based upon the principle in which the amount of light of a particular wavelength absorbed by a specific metal will enable the percent absorption to be determined and then used to ultimately calculate the absorbance. Since absorbance is directly related to concentration, a plot of the two parameters is linear in certain operable ranges and allows for the determination of unknown concentrations in solutions (direct samples or extracts) after measurement of absorbance. The computer system controlling the instrument actually completes the calculations and reports the concentration in mg/L. The following equations show how the final sample concentration is calculated using the instrument calculated concentration.

$$\text{mg/L metal} = [A(Vi)(D)]/Vf$$

Where:

A = concentration from instrument in mg/L
Vi = initial volume (before digestion) mL
Vf = final volume (after digestion) mL
D = dilution factor if necessary

$$\text{mg/kg metal} = [A(Vf)(D)]/W(P)$$

Where:

A = concentration from instrument in mg/L
Vf = final volume of sample in mL
D = dilution factor if necessary
W = sample weight in grams
P = percent solids in decimal (if results in dry weight are needed)

9.1.3 Organics

9.1.3.1 Chromatograph Results

Calculations are performed for each analyte after its identification is determined. Identification is based upon the retention time of the suspect peak compared to the retention time of the external standard. The concentration of the analyte is determined by using the calibration curve and the peak area of the analyte. A calibration factor is determined from the calibration curve and used to calculate the concentration.

9.1.3.2 Gas Chromatograph/Mass Spectrometry Results

Qualitative identification of an analyte is determined by obtaining the extracted ion current profiles (EICP's) for the three identifying mass ions and following the criteria listed below:

- The intensity of the three characteristic masses of each analyte must maximize within one scan of one another.
- The relative peak height ratios of the three characteristic masses must be within $\pm$ 20% when compared to the mass spectrum of the reference standard analyte.
- The relative retention time of the suspect peak must be within $\pm$ 0.06 of the standard reference peak.

In order to list structural isomers as separate analytes, they must have acceptable resolution. Acceptable resolution is achieved if the baseline to valley height between the isomers is less than 25 percent of the sum of the two peaks. Otherwise, structural isomers must be identified as unresolved isomeric pairs.

The following equations demonstrate how the actual sample calculations are carried out.

GC Volatiles

$$ug/L\ (ug/kg) = As(D)/CF(Vf)(P)$$

where:

As = area response of targeted analyte
D = dilution factor if necessary
Vf = volume purged in ml or g
CF = calibration factor from standard analysis
P = percent solids in decimal (if results in dry weight are needed)

$$CF = As/AMT$$

where:

As = area response of targeted analyte
AMT = amount of targeted analyte in ng

GC/MS Volatiles

$$ug/L\ (ug/kg) = As(AMT)(D)/Ais(RF)(Vf)(P)$$

where:

As = area response for targeted analyte
AMT = amount of internal standard in ng
D = dilution factor if necessary
Ais = Area of internal standard
Vf = volume purged in mL or g
P = percent solids in decimal (if results in dry weight are needed)
RF = response factor from standard analysis calculated as

$$RF = As(AMTis)/Ais(AMTs)$$

where:

As = area response for targeted analyte
AMTis = amount of internal standard in ng
Ais = area response of the internal standard
AMTs = amount of the targeted analyte in ng

GC Extractable

$$ug/L\ (ug/kg) = As(Vf)/(CF)(Vi)(P)$$

where:

As = area response for targeted analyte
CF = calibration factor as explained above
Vf = final extract volume in uL
Vi = initial volume in mL or weight in g
P = percent solids in decimal (if results in dry weight are needed)

To quantitate multicomponent mixtures (i.e., PCBs, chlordane), area summations are used. For PCBs, at least five peaks, where possible, are included in the area summation for quantitation. The same relative peaks (based on pattern and retention times) are used to calculate the calibration factor from the standard. For toxaphene and chlordane, total area summations are used for quantitation.

GC/MS Extractable

$$ug/L\ (ug/kg) = As(AMTis)(Vf)(D)/Ais(RF)(Vi)(P)$$

where:

As = area response for targeted analyte
AMTis = amount of internal standard in ng
Vf = final extract volume in uL
D = dilution factor if necessary
Ais = area of internal standard
RF = Response factor as listed above
Vi = initial volume in ml or weight in g
P = percent solids in decimal (if results in dry weight are needed)

9.2 DATA VALIDATION

Data validation is performed by the analyst, the section supervisor, department manager, and the QA Officer. Validation is accomplished through routine audits of the data collection and work-flow procedures and by monitoring the QC sample results. The minimum requirements for each analytical sequence are as follows:

- A minimum three-point calibration and one calibration check standard. The calibration check standard must be made up from a different source than that of the initial calibration standards.

- One reagent blank per analytical batch (i.e., one per twenty samples).

- Laboratory control samples on a per batch basis.

- o Matrix spike and matrix spike duplicate analysis per sample batch.

In addition to the requirements listed above, the GC/MS instruments must also complete the items listed below:

- o The decafluorotriphenylphosphine (DFTPP) or bromofluoro-benzene (BFB) required tuning criteria must be met.
- o Percent recovery calculated from the surrogates added to every sample analyzed by GCMS must fall within control limits or be reanalyzed.
- o Area counts of the internal standards are monitored (-50% to + 100%)

The data collection and procedures used within the laboratory are audited as follows:

- o Review of the sample documents for completeness by the analyst at each step of the analysis.
- o Daily review of instrument logs, performance test results, and analyst performance by the section supervisor.
- o Daily review of performance indicators such as blanks, surrogate recoveries, matrix spike and matrix spike duplicate results.
- o Random calculation checks.
- o Review of all reports prior to and subsequent to data entry.
- o Review and approval of the final report by the lab manager and/or the QC Officer.

The review of data quality involves several levels of evaluation. Each of the section supervisors, department managers, and the QA Officer are responsible for ensuring that the data is validated at various stages throughout the analytical scheme. Any problems with the validity of the data must be corrected as soon as possible for obvious reasons. It is also imperative that the actions taken to correct the problem be documented completely.

In general, the analysts and the laboratory section supervisors are responsible for reviewing the data relative to instrument calibration, standard preparations, method blanks, raw data, calculations, and transcriptions. The analyst normally reviews 100% of the raw analytical data generated including the calibration data and all calculations. Upon completion of the analyst review, a second level of the raw data review is performed by either the section supervisor or the department manager where data quality indicators such

as method blanks, replicate analyses, and spike recoveries are reviewed for acceptance. At the next level of data quality review, the QA Officer is generally responsible for a complete review of about 15% of the data generated. The emphasis is on the data acceptability relative to the laboratory, program, or project data-quality objectives. All analytical problems encountered during sample analysis must be properly addressed to provide explanations to the data users.

9.3 DATA REPORTING

Once the data has been validated, it is ready for report production. A cover page is prepared which includes the following information:

- client name
- number of analyzed samples contained within the report
- types of analyses completed
- date of sample receipt
- date when the analytical results for the entire project were available for reporting
- notice of confidentiality
- signature by the laboratory manager authorizing the release of the hard-copy report

An example of a typical cover page is shown in Figure 8. Immediately following the cover page is a listing of the methods used by the laboratory to complete the work. These method summaries appropriately describe the analytical method or list the reference from which the analytical method was derived. Typical method summaries are shown in Figure 9. After the method references, the analytical data is reported. An example of a typical report page is shown in Figure 10. A copy of the original COC is also included in the final report for reference purposes.

Analytical Services Corp.

ANALYTICAL REPORT

CLIENT:

ATTN:

PROJECT NUMBER: **SAMPLE TYPE:**

ANALYSIS PERFORMED:

DATE RECEIVED:

This report is PROPRIETARY AND CONFIDENTIAL and delivered to, and intended for the exclusive use of the above named client only. Analytical Services Corp. assumes no responsibility or liability for the reliance hereon or use hereof by anyone other than the above named client.

The analyses and data interpretation that form the basis of this report was prepared under the direct supervision and control of the undersigned who is solely responsible for the contents and conclusions therein.

Reviewed and
Approved by: _____ Date: _____

Gateway Business Park ■ P.O. Box 1404 ■ Findlay, Ohio 45839-1404 ■ 419-423-3526

FIGURE 9.1 - REPORT COVER PAGE

10.2 QUALITY CONTROL SAMPLES

QC samples obtained from NBS or EMSL Cincinnati are analyzed on a routine basis as an internal audit of methodologies and control limits. In addition, the laboratory maintains several state certifications that require analysis of USEPA-EMSL Water Supply and/or Water Pollution Study PE samples or PE samples as supplied by the appropriate state agencies.

10.3 REFERENCES

1. Field QC Blanks, DER QAS Guidance #89-02, Florida Department of Environmental Regulation, April 28, 1989.

11.0 PERFORMANCE AND SYSTEM AUDITS

An audit is defined as a systematic check to determine the quality of operation of field and laboratory activities. It is comprised of the following: 1) a performance audit and 2) system audits.

11.1 LABORATORY PERFORMANCE AUDITS

Procedures used to assess the effectiveness of the quality control system are noted in the following subsections.

11.1.1 Internal Performance Audits

These are accomplished by the laboratory through the use of control samples, replicate measurements, and the use of reference materials in conjunction with control charts.

Sample analysis system audits are conducted by the QA Officer and include the following:

- o Verification of written procedures and analyst(s) understanding
- o Verification and documentation of procedures and documents
- o Review of analytical data and calculations

11.1.2 External Performance Audits

These are accomplished by the laboratory through inter-laboratory checks such as:

- o Participation in laboratory evaluation programs (see Table 11.1)
- o Participation in performance evaluation samples available from USEPA (see Table 11.1)
- o Analysis of split samples and comparing results with other laboratories

TABLE 11.1 - LABORATORY EVALUATION PROGRAMS

Proficiency Evaluation Program	Regulatory Agency or Client
Drinking Water PE Program	New Jersey DEP A280
Drinking Water USEPA WS Program	South Carolina DHEC
	United States Environmental Protection Agency
	Wisconsin Department of Natural Resources
	Louisiana State Department of Health and Hospitals
	Ohio Department of Health, Division of Public Drinking Water
Waste Water PE Program	US Corps of Engineers Missouri River Division
Solid Waste PE Program	US Corps of Engineers Missouri River Division
Hazardous Waste PE Program	California Department of Health Services
	Chemical Waste Management, Inc.
	New York Department of Health
Waste Water USEPA WP Program	New Jersey DEP

11.2 LABORATORY SYSTEM AUDITS

An on-site inspection is done by an audit team or laboratory certification personnel to review the laboratory quality control system which covers sample handling, sample analysis, records control, preventive maintenance, and proficiency testing. When EPA or laboratory certification personnel initiate a system audit of the laboratory, any recommendations made or deficiencies identified will be considered and corrective actions taken to correct deficiencies.

12.0 PREVENTIVE MAINTENANCE

Critical to the performance and minimization of downtime of all equipment, whether it be measurement or support, is proper maintenance. Preventative maintenance will be performed as recommended by the manufacturer of the respective equipment. This maintenance will consist of, but not be limited to, the following minimum procedures at the specified time intervals.

All of the routine maintenance and problem troubleshooting for each piece of equipment must be documented in the instrument maintenance logbook. The information which is recorded includes a description of the problem or maintenance procedure, steps followed throughout the procedure, parts replaced, initials of the person completing the procedure, the amount of downtime, and the dates through which the instrument was unavailable for production. When personnel from outside the laboratory work on the equipment, they must also record their activities in the maintenance logbook. It is the responsibility of the section supervisors to ensure that the documentation is completed as required.

12.1 PH METERS AND COMBINATION PH ELECTRODES

Preventive maintenance for the pH meter and electrodes primarily involves the proper care of the electrode. Proper electrode care involves storage of the probe in a 1:1 solution of pH = 7 buffer and deionized water. Also, the port for the addition of internal filling solution must be plugged at all times to prevent evaporation of the solution when the electrode is not in use. When the internal filling solution has dried out, the chamber will be rinsed with deionized water before replacement of the filling solution. This step prevents clogging of the probe and poor (<100 percent) slope adjustments when calibrating the electrode. Whenever slope readings are deteriorating or a low ionic strength sample gives erroneous readings, treatment of the electrode with 1N KOH and 1N HCl should be performed. Spare parts such as a replacement probe and fresh buffer solutions will be available for the system at all times.

12.2 ANALYTICAL BALANCES

Analytical balances will be cleaned and calibrated on a yearly basis by a manufacturer's representative. Monthly, the accuracy of analytical balances will be compared to standard weights.

12.3 ATOMIC ABSORPTION SPECTROPHOTOMETERS AND INDUCTIVELY COUPLED ARGON PLASMA SPECTROPHOTOMETERS

Routine maintenance of the AA's includes inspection of all hoses and O-rings for wear and replacement as necessary. The spray chamber is removed, totally disassembled at regular intervals, and each component is thoroughly cleaned. The furnace graphite shield, chimney, rinse chamber, rinse bottle, and syringe are regularly cleaned. The spray chamber and nebulizer are cleaned daily by aspirating at least 50ml of H_2O. The liquid in the trap is flushed and changed. The burner is cleaned with hot water. The lamp window and quartz windows of the furnace assembly are cleaned daily.

12.4 GAS CHROMATOGRAPHS

Routine maintenance of the GC's includes daily checks of gas inventory, changes of septum, and changes of glass wool for packed columns. Detectors are inspected and cleaned according to manufacturer's specifications.

12.5 SPECTROPHOTOMETERS

Routine maintenance of the spectrophotometer includes daily check of the sample compartment for spills, inspection of external stray light filters, and electrical connection inspections. The instrument is disassembled and cleaned as required according to the instrument manual.

12.6 DISSOLVED OXYGEN, CONDUCTIVITY, AND TURBIDITY METERS

These meters will be checked daily for spills and inspected for proper connections. The instruments will be disassembled and cleaned according to the instrument's manual.

Probes associated with the D.O. and conductivity meter will be inspected daily and expendable parts replaced as necessary.

12.7 GAS CHROMATOGRAPH/MASS SEPCTROMETERS

Routine maintenance of the GC/MS systems includes daily checks of the system operating parameters, gas supplies, septum changes, changes of injection ports or glass wool when required, and inspection of the vacuum system. All systems are operated on a standard twelve (12) hour clock to ensure correct system operation. Additional routine maintenance will be according to manufacturers specifications.

12.8 CONTINGENCY PLANS FOR MINIMIZATION OF UNSCHEDULED DOWNTIME

Essential in the minimization of downtime is an inventory of user-replaceable spare components. Each measurement system will be equipped with spare components such as fuses, printed circuit boards, and cables for replacement in the event of a downtime situation. This will reduce downtime and allow for more effective troubleshooting in the event of equipment failure. OHM also has an Electronics Department that is able to help troubleshoot the affected instrument and make needed repairs.

13.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

13.1 LABORATORY DATA

13.1.1 Accuracy Control

Data accuracy is a reflection of the efficiency of the analytical procedure. It is determined by use of spiked samples and standard reference materials or laboratory control samples performed at the rate of one set every 20 samples. A control chart is generated using historical laboratory data where warning and control limits are established to assess data accuracy.

The accuracy (check standards) samples will have concentration values of the mid-standard. During analysis, a minimum of ten percent (10%) of samples must be accuracy samples. The accuracy samples must be staggered throughout the analysis, not placed one after another. After a minimum of seven (7) accuracy samples are analyzed, the percent recovery is calculated for each sample by the following equation:

$$\% \text{ Recovery} = (\text{Observed Value})100/\text{True Value}$$

The accuracy criteria is determined by calculating the standard deviation of seven (7) or more percent recovery values and setting the upper and lower control limits using the following equations:

$$\text{Upper control limit} = p + 3Sp$$

$$\text{Lower control limit} = p - 3Sp$$

Where:

p = average percent recovery
Sp = standard deviation

After the standard deviation, for the seven (7) or more samples has been calculated, the accuracy control limits will be used to determine if the analysis is out of control. This is done by checking the results against the control limits. If any values are above the upper control limit or below the lower control limit, all sample results after the last qualifying accuracy sample must be repeated or discarded. If seven (7) consecutive values fall below

the lower control limit, new limits must be calculated using the new accuracy check values. If the values fall between the upper and lower limits, then conditions are reported as "within limits."

13.1.2 Precision Control

Precision is based upon the results of the relative percent differences as calculated from the percent recoveries of the matrix spike and duplicate samples. The control limits for precision are based on historical laboratory data.

Present practice is to include MS and MSD samples on a per batch basis or a minimum frequency of 5%. Duplicate results are compared and the relative percent difference (RPD) is then determined according to the following formula:

$$RPD = (D1 - D2)/[(D1 + D2)/2]100$$

Where:

D1 = Determination #1
D2 = Determination #2

The RPD will be entered into the lab's data system and will be used to define the precision of the analysis. This value should be less than 20%.

13.1.3 Recovery Control

Recovery control is necessary to determine if the sample matrix is interfering with the constituent being analyzed. A minimum five percent (5%) of samples will be recovery check samples (matrix spikes). Samples involving different types of matrices must have at least one recovery check for each type. The percent recovery of the matrix spike is determined by the following equation:

$$\% \text{ Recovery} = [(SSR - SR)/SA]100$$

Where:

SRR = Spiked sample result
SR = Sample result
SA = Spike added

Control limits will be determined for each matrix, determining the deviation for seven (7) or more percent recovery values.

13.1.4 Completeness Control

Completeness is expressed as the percentage of the amount of valid data obtained to the amount of data expected. For a set of data to be considered complete, it must include all QC data verifying its accuracy and precision.

If samples analyzed do not meet all Quality Control requirements in terms of accuracy and precision for any specific parameter, the sample preparation and analysis will be repeated pending adequate volume.

% Complete = (Acceptable results/Total Analysis)100

14.0 CORRECTIVE ACTIONS

The results from the following Quality Assurance activities may initiate a corrective action:

- o Performance audits
- o System audits
- o Inter-laboratory comparison study
- o Calibration data out of specified limits
- o Failure to adhere to Quality Assurance plan
- o Failure to adhere to standard operating procedures
- o Data completeness below required limits
- o Problems detected by the field personnel
- o Any and all problems detected which effect or potentially effect the quality of the work effort devoted to the project.

Upon notification of a problem, or when a potential problem is identified, the Project Manager notifies the QA Officer. At this time, a thorough investigation of the reported problem is immediately performed to determine if corrective action should be initiated.

Corrective actions may be initiated by any laboratory individual, as well as the laboratory QA Officer. The laboratory manager will be responsible for approving the corrective action and the Quality Assurance Officer insures the corrective action is carried out. Follow-up procedures for either case will not be considered complete until the problem has been effectively and permanently solved. These procedures will consist of, but not be limited to, the following:

- o Determining when the problem occurred and the systems affected by the problem.
- o Assign responsibility and time schedule to implement the corrective action.
- o Determine the desired effectiveness and implement the corrective action.

- o Verification and documentation that the corrective action has eliminated the problem.

The Laboratory Manager has the authority to require that all measurements that may be in doubt due to the problem be stopped or limited until the corrective action is complete. The QA Officer also has the authority to order new samples be obtained and re-analyzed after the corrective action is complete. Formal notification to ASC management and incorporation into the project file will be the ultimate disposition of any corrective action.

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance reports will be prepared on a quarterly basis by the Manager of Analytical Services and the QA Officer. The report will consist of an assessment of data accuracy, precision, and completeness; results of performance audits; results of system audits; and documentation of any corrective actions that were initiated during the reporting period.

16.0 PERSONNEL QUALIFICATIONS

Table 16.1 lists the current ASC Findlay laboratory personnel, their education, and their respective work experience.

TABLE 16.1 - ASC LABORATORY PERSONNEL

EMPLOYEE	DEGREE	YEARS OF EXP	ADMIN	GC/VOA	GC/SVA	GC/MS VOA	GC/MS SVA	AA/ICP	CONV/SMPL PREP	COMPUTER SYSTEM
A. Aloqaili	HS+	4							X	
C. Begin	HS	4							X	
S. Bowser	AD+	28	X							
C. Breitigan	HS+	2							X	
T. Cina	BS+	6		X	X	X	X	X	X	
S. Clark	HS+	6							X	
C. Clawson	HS	2							X	
M. Conry	Ph.D.	2		X	X	X	X			
S. Dean	HS	3							X	
W. DeLong	BS	2						X	X	
B. DeMaine	BS+	11	X	X	X	X	X	X	X	
E. Dillon	HS	2							X	
S. Dotson	HS+	2							X	
L. DuPont	BS	1			X				X	
S. Earl	BA	10		X	X		X		X	
R. Firestone	HS	4						X	X	
G. Gallello	BS	9	X	X	X	X	X		X	
A. Gran	HS+	1							X	
T. Gran	Ph.D.	18	X	X	X	X	X	X	X	
J. Hnatow	BS	9	X	X	X	X	X		X	
P. Jagucki	HS+	<1							X	
D. Jensen	HS+	3							X	
J. Johnson	HS+	6		X					X	
J. Kelly	BS	2		X	X				X	
D. Kinder	BS	3						X	X	
A. Klos	BS	3		X	X				X	
G. Knieriem	BS+	8	X	X	X				X	
C. Koehler	HS	1							X	
L. Lauck	HS+	5							X	
D. Lease	BS	1		X	X					
T. McKee	BS	1							X	
J.L. Powell	HS	2							X	
J.S. Powell	HS	3							X	
M. Radabaugh	BS	6	X	X	X			X	X	
W. Renner	HS+	7	X							
A. Schimmel	HS+	3							X	
R. Schock	MA+	13	X	X	X	X	X	X	X	
T. Shepherd	AS	5	X							X
R. Sloan	BS+	15	X	X	X			X	X	
L. Stewart	BS	7		X	X	X			X	
D. Swan	HS+	8						X	X	
A. Vodicka	BS+	7		X	X				X	
J. Warren	HS	8							X	
L. Whitaker	AD	3								

D25 LP

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Management Consultants

No. 68-W9-0040
Rec'd AUG 26
By MD
File 05-18-01
AT KEARNEY

August 16, 1991

MID 005 338 371

Mr. Bernie Orenstein
Regional Project Officer
U.S. Environmental Protection Agency
Region V, 5HR
230 South Dearborn
Chicago, IL 60604

Reference: EPA Contract No. 68-W9-0040; Work Assignment No. R05-18-01; Technical Review of Site-Specific Quality Assurance Project Plans for Macdermid Incorporated; Final Deliverable (Task 03)

Dear Mr. Orenstein:

Enclosed please find the final deliverable for the above-referenced project.

As discussed with Ms. Kolak, the EPA WAM, the materials submitted as a Quality Assurance Project Plan (QAPjP) include a Laboratory Quality Assurance Program Plan (QAPP). The submitted QAPP follows an appropriate format but does not provide the required site-specific information. This review provides general guidance in developing a site-specific QAPjP from the submitted materials and additional information.

Please do not hesitate to call me or Dr. John Goode, the Kearney Team Work Assignment Manager (who can be reached at 415/595-4300), if you have any questions.

Sincerely,

Greg M. Tendich for

Ann L. Anderson
Technical Director

cc: A. Debus, EPA Region V
S. Kolak, EPA Region V
G. Schupp, EPA Region V
A. Glazer
L. Poe
J. Goode
A. Williams

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230 South Dearborn
Chicago, IL 60604

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G. Schupp, EPA Region V
A. Glazer
L. Poe
J. Goode
A. Williams

RECEIVED
AUG 16 1991
OFFICE OF RCRA
Waste Management Division
U.S. EPA, REGION V

FINAL DELIVERABLE
(TASK 03)

TECHNICAL REVIEW OF QUALITY ASSURANCE PROJECT PLANS (QAPjPs) for MACDERMID INCORPORATED, FERNDALE, MICHIGAN

Submitted by:

A.T. Kearney, Inc.
222 S. Riverside Plaza
Chicago, Illinois 60606

Submitted to:

Mr. Bernie Orenstein
Regional Project Officer
Region V
230 South Dearborn Street
Chicago, Illinois 60604

In response to:

EPA Contract No. 68-W9-0040
Work Assignment No. R05-18-01

August 16, 1991

Quality Assurance Project Plan (QAPjP)
General Comments/Deficiencies
for
Macdermid Incorporated, Ferndale, Michigan

GENERAL COMMENTS/DEFICIENCIES

The materials submitted, a laboratory Quality Assurance Program Plan (QAPP) and an RFI Work Plan, do not fulfill the Region V requirements for a Quality Assurance Project Plan (QAPjP). However, a review was performed by matching, to the extent possible, the contents of these documents to the following sixteen (16) required elements of a Region V QAPjP (as defined by Region V Model QAPjP, and Content Requirements for RFI QAPjPs). The (submitted) QAPP follows this format, but lacks the required site-specific details of a QAPjP. This review provides general guidance in developing a site-specific QAPjP from the submitted materials and additional information.

The majority of the deficiency comments deal with the inclusion and/or submittal of information and procedures specific to the proposed project. Detailed information/procedures must be included in the QAPjP in lieu of stating that "standard" procedures will be followed.

I. Title Page and QAPjP Approval
II. Table Of Contents
III. Project Description
IV. Project Organization and Responsibility
V. Quality Assurance Objectives for Measurement Data
VI. Sampling Procedures
VII. Sample Custody
VIII. Calibration Procedures and Frequency
IX. Analytical Procedures
X. Internal Quality Control Checks
XI. Data Reduction, Validation and Reporting
XII. Performance and System Audits
XIII. Preventative Maintenance
XIV. Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness
XV. Corrective Action
XVI. Quality Assurance Reports to Management

A site-specific QAPjP is to be a "stand alone" document. If references to other documents cannot be avoided, they should contain the title of the reference, section, and page number. The information in these references should be included within the QAPjP or as an Attachment or Appendix, if possible. However, attachment of manuals or voluminous references is discouraged.

I. TITLE PAGE AND QAPjP APPROVAL

The QAPjP is required to have an approval page with space for the signatures of the individuals filling the following (at a minimum) positions:

- EPA Region V Project Coordinator
- EPA Regional Quality Assurance Manager
- Contractor Project Manager
- Contractor QA Officer
- Any subcontractors as appropriate
- Project Manager
- Project QA Officer

It is not necessary to include the names of the individuals in these positions, thus preventing the need for a revision to the document should that individual no longer occupy that position.

II. TABLE OF CONTENTS

It is a Region V requirement for a QAPjP to list individuals receiving official copies of the QAPjP and any subsequent revisions. Provide this listing after the Table of Contents.

The document control format header must include the following information: the project name; document section number; document revision number; date; and section page number. Provide this format at the top of each page in the QAPjP and number the pages by section number.

III. PROJECT DESCRIPTION

This section, the Project Description, is not provided in the QAPP. However, some of the required information is present in the RFI work plan. Provide this information, preferably in the QAPjP, or include references (document, section, and page number) in the QAPjP for the location of this information. Provide a project description which includes the following:

- <u>Introduction</u> - A description of the project and a brief statement addressing the different phases of the work, the general objectives and investigative plan.

- <u>Site Description</u> - A description of the site-specific features including location, size, borders, physical features, geologic and hydrogeologic information. These items should be addressed in separate paragraph/ sections within the QAPjP.

- Site History or Background - A chronological history of the site including any information on the environmental history (i.e., sampling, spills, available data). Data should be summarized in a table which includes the analytical methods, results, and method detection limits if available.

- Target Compounds - Brief discussion of the relevant (important) site contaminants or target compounds, including required detection limits for RFI/CMS.

- Project Objectives - This should include an expanded description of the following elements: Specific objectives; intended data usages; and data quality objective (DQO) summaries.

- Sampling Network and Rationale - A detailed description of the sampling network and the rationale for the selection of the locations, methods, parameters, etc. This may be achieved by referencing a readily available work plan (RFI) and/or sampling plan and indicating where in these documents the salient items of the plan can be found.

- Project Schedule - A description of the anticipated start date, any milestone dates, and the anticipated completion date of the project or monitoring/sampling activities. An appropriate method for this requirement is a bar chart with project tasks and time lines

IV. PROJECT ORGANIZATION AND RESPONSIBILITY

This section must contain additional information regarding the project management, organization, responsibility and authority. At present, information in the QAPP only addresses this section for laboratory personnel. Provide this information for all personnel involved in the project, including EPA Region V personnel, contractor team personnel and any subcontractor personnel. Identify their responsibilities on the project, management hierarchy, and key personnel for different tasks. This information can be found, in part, in the Task III RFI workplan, sections 1.1 and 2.4 and incorporated with the QAPP information. An organization chart is required for this section.

Additionally, clarify which individuals from the laboratory will be involved in the project. Page 2-8 of the Task III RFI Workplan indicates that Bob Schock will be the laboratory manager for the project while the laboratory QAPP does not list this individual in any capacity at the lab.

V. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

Laboratory-specific information was found in the QAPP in section 4.3, but lacks the site-specific details required in a QAPjP. This information must be tailored to fit the specific needs of the project. Provide specific Quality Assurance Objectives (e.g., Method Detection Limit, Precision, Accuracy, Completeness Representativeness and Comparability) for your project and detail the procedures and means (e.g., blanks, spikes, etc.) of achieving these objectives.

Note: Region V requires duplicates and blanks to be collected at the following frequencies:

- Trip Blanks must be collected at a frequency of one per cooler in which aqueous matrix VOC samples are shipped.

- Field Blanks (equipment, field) must be collected for all aqueous matrix parameters at a rate of one sample for every 10 or fewer investigative samples.

- Duplicates must be collected for all matrices and parameters at a rate of one sample for every 10 or fewer investigative samples.

These blanks and duplicate samples must be treated as regular investigative samples, with regards to sample volumes, containers, preservation and shipping.

VI. SAMPLING PROCEDURES

Provide the detailed sampling procedures to be used at the facility. This requirement may be fulfilled by referencing (by document, section, and page number) a detailed sampling plan, the RFI Workplan and/or presenting a detailed listing in the QAPjP.

The information supplied in the Task III RFI Workplan pages 3-2 to 3-21 provides information on these requirements but needs to be addressed/included in a QAPjP. In addition, information in the laboratory QAPP provides general sampling procedures for every possible sampling situation. The information, if used, would need to be modified to include site-specific procedures for sampling. Do not include the procedures found in the QAPP that do not relate to the type of sampling to occur at the facility. The following information is required in detailing sampling procedures for a QAPjP:

- Detailed procedures, criteria, or guidelines used for sampling point selection.

- Detailed procedures, criteria, or guidelines used for collecting background samples, if any. Detailed procedures for collecting and preparing composite samples, if composite samples are to be collected.

- Detailed procedures for the collection of samples for each sample matrix and parameter(s).

- Detailed procedures for sample packaging, handling and shipment, including time considerations, and field filtration requirements and procedures.

- Sample containers, reagents, preservation and holding time requirements (a table is appropriate/recommended).

- Any special conditions for the preparation of sampling containers and time requirements, (a table is appropriate).

- Chain-of-custody procedures, including an acceptable and logical numbering system.

- Detailed procedures for preparing/collecting trip blank samples, field blank samples, and field duplicate samples.

- Adequate documentation of the sampling activities, including forms, notebooks, bound logbooks and detailed procedures for recording sample history, site and sample conditions, and analysis to be taken, etc.

- A detailed summary of the sampling and analysis performed, using a table is appropriate.

- Details of any field filtering and/or sample compositing that may have occurred during sampling activities.

VII. SAMPLE CUSTODY

Provide discussion of the three (3) distinct/separate issues for sample custody (chain-of-custody (COC)) on the following areas related to this project:

- COC procedures for all field activities, including sampling, field measurement, and screening.

- COC procedures for laboratory activities, including sample receiving, log-in, storage, tracking of custody transfer during sample preparation and analysis, etc.

- Final evidence file, including the description of file contents and specifying a file custodian.

Provide this information in detail in the QAPjP, as information provided in section 3.8 of Task III of the RFI Workplan does not adequately cover the required elements and formatting.

VIII. CALIBRATION PROCEDURES AND FREQUENCY

Provide specific procedures and frequencies for the calibration of all field instruments to be used during the investigation/field activities. Identify all field instruments which may be used and discuss the procedures for the initial calibration, and follow-up calibration checks during a particular field activity. In addition, list any conditions which may trigger or warrant a calibration check or recalibration during the course of the field activity.

The calibration of the laboratory equipment is detailed in section 7.0, pages 103 to 108 of the laboratory QAPP. Provide direct detailed references (document, section, and page number) in the QAPjP for the applicable procedures for the types of analysis to be run and the equipment to be used.

IX. ANALYTICAL PROCEDURES

The analytical procedures and parameters listed in Table 3.1 do not adequately describe all of the analysis that will/may be performed. Include a description/listing of all analysis to be performed or provide detailed references to a document (SW-846, QAPP, etc.) by section and page number for any analysis not listed. Do not list those that will not be performed, only those that will or may be performed.

Provide in the QAPjP the analytical procedures that shall be followed by the laboratory in analyzing the project samples. Detail or reference only those procedures that will/do apply to the type of analysis run.

X. INTERNAL QUALITY CONTROL CHECKS

Provide information on the following (many of the following are addressed elsewhere but must be reiterated to aid in

assessing effectiveness of quality control procedures) issues for both the field activities and laboratory analysis:

Field Activities (measurements and screening)

- Continuing calibration checks
- Replicate analysis
- Spike sample analysis
- Blanks (trip, field, duplicate)
- Quality Control samples
- Zero and Span gases (i.e., air monitoring)
- Calibration standards and devices

Laboratory Analysis

- Method Blanks
- Reagent/Preparation Blanks
- Matrix Spike and Matrix Spike Duplicates
- Calibration Standards
- Internal Standards
- Surrogate Standards
- Continuing Calibration Check
- Calibration Check Standard
- Laboratory duplicate/replicate analysis, etc.

Provide this information for each of the specific sampling and analytical methods used. In addition, indicate at what stage in the analysis each of these checks will/do occur and at what frequency. Provide a table (if possible) to outline these steps.

XI. DATA REDUCTION, VALIDATION AND REPORTING

In completing this section more detail is needed and the field activities must be addressed. The information in section 3.10 of Task III of the RFI Workplan provides for a general overview of the required procedures. Provide additional details to this information in the QAPjP or provide detailed references to a document (section and page number) where the information can be found.

Specifically, the following need to be addressed:

- Discussion that assures the resulting data package will comply with Functional Guidelines for Evaluating Organic/Inorganic Analysis - U.S.E.P.A.

- Summary of data reduction procedures

- Statistical approach summary and details of how (and which) the statistical functions relate to data reduction, validation and reporting.

- Detail the methods to be used for the reduction of both field and laboratory data.

- Describe the criteria/guidelines/procedures to be used (by an individual independent of the laboratory) for data validation.

- Describe the data reporting format which will be followed, including all reporting forms and units. Include in this listing all contents of the lab data package.

Provide this information, realizing that these procedures must be developed/performed independently of the laboratory. The information found in section 9.0 of the QAPP does not adequately address this requirement.

XII. PERFORMANCE AND SYSTEM AUDITS

The requirements of this section cannot be addressed by the laboratory QAPP and must be clearly defined within the site-specific QAPjP. These requirements deal with the performance of the sampling and measurement activities related to the field program. Provide, within the QAPjP, the following elements, noting that external audits are the responsibility of EPA.

Elements to be addressed for both field and laboratory internal audits:

- Identify the <u>responsible party</u> for these audits;

- Specify the <u>frequency</u> of these audits to be conducted; and

- Describe the <u>methods/procedures</u> to be used for conducting these audits. This should include:

  - independence of audit; and

  - examination of sample handling and other records.

XIII. PREVENTATIVE MAINTENANCE

This requirement is not specifically addressed in the RFI Workplan. Provide procedures in the QAPjP for the

preventative maintenance of the field equipment that will be used as part of the investigative field program.

Information regarding preventative maintenance of laboratory equipment may be incorporated from the QAPP, but only if these procedures allow for the maintenance of the equipment in a manner that assures the quality of the analytical results. Alternatively information regarding preventative maintenance of laboratory equipment may reference SW 846 or other standardized methods.

XIV. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

Details of the procedures to address this requirement were not found within the RFI Workplan (except sparsely and only verbally in sections 3.10, and 3.11). Information was found in section 13.0 of the laboratory QAPP. Incorporate this information into the QAPjP and include greater detail and example equations for percent recovery, relative percent difference (RPD), relative standard deviation (RSD), Method detection limits (MDL), and percent valid data. This information must be supplied in the QAPjP or may reference a Data Management Plan (DMP) which contains all of this information. However, the supplied DMP (with the RFI Workplan) does not adequately address these issues. Provide detailed procedures for assessing data precision, accuracy and completeness.

XV. CORRECTIVE ACTION

In general this section must provide adequate detail to addressing corrective actions for field and/or laboratory activities. Incorporate sections 14.0 of the QAPP and section 4.4 of the Task III RFI Workplan into the QAPjP and ensure that the following elements are included:

- The pre-specified conditions that automatically trigger corrective action.
- Personnel who initiate, approve, implement, evaluate, and report corrective action (by title).
- Procedures to initiate, develop, approve and implement corrective actions.
- Alternative corrective actions to be taken.

XIV. QUALITY ASSURANCE REPORTS TO MANAGEMENT

The requirements of this section may be fulfilled by combining the information found in section 15.0 of the QAPP with that of sections 2.5, 4.5, and 4.6 (including subsections) found in Task III of the RFI Workplan. Quality assurance reports are required to be submitted to management on a periodic basis to ensure that any problems are investigated and proper corrective actions are taken.

QUALITY ASSURANCE PROGRAM PLAN

Prepared By

ETC-FINDLAY LABORATORY
16406 US ROUTE 224 EAST
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Submitted to

APPROVED BY:

Thomas Gran

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VICE PRESIDENT,
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QUALITY ASSURANCE MANAGER, ETC-FINDLAY

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DATE

371-10

QUALITY ASSURANCE PROGRAM PLAN

ETC-FINDLAY LABORATORY

MARCH 1990

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1.0 INTRODUCTION

1.1 BACKGROUND

Environmental Testing and Certification Corporation (ETC) is a full-service environmental organization specializing in laboratory analytical services, computerized data management, consulting, and field support services.

ETC is a wholly-owned subsidiary of OHM Corporation (OHMC). OHMC, formerly Environmental Treatment and Technologies Corporation (ETTC), was created in 1986 through the merger of O.H. Materials Corp. and ETC.

The ETC organization is a network of four integrated laboratories located throughout the United States with over 300 employees. Each of the four laboratories is linked electronically to the central mainframe computer located in Edison, New Jersey, which in turn can be electronically accessed by our clients.

The ETC laboratories are located as follows:

ETC-Edison	Edison, New Jersey
ETC-Findlay	Findlay, Ohio
ETC/Multi-Tech	Santa Rosa, California
ETC-Toxicon	Baton Rouge, Louisiana

Detailed information such as mailing addresses and telephone numbers for each of the laboratories are presented in Table 1.1.

1.2 HISTORY OF ETC

ETC was founded in 1981 by former senior level EPA administrators, who saw the need for a laboratory to provide high quality analytical testing and data management capabilities in response to the requirements of environmental regulations. This laboratory, which now serves as ETC's corporate headquarters, is located in Edison, New Jersey. ETC-Edison is the largest and most diverse of the six network laboratories. The ETC Marketing, Network QA, Systems Groups, and Central Database are located in Edison, New Jersey.

In December 1985, ETC increased its service capabilities and established a regional presence through the acquisition of Toxicon Laboratories located in Baton Rouge, Louisiana. ETC-Toxicon has nine years of experience in the environmental analytical business

TABLE 1.1 ETC NETWORK LOCATIONS

ETC-EDISON
284 Raritan Center Parkway
Edison, New Jersey 08837
(Phone) 201-225-5600
(Fax) 201-225-6777

ETC-Findlay
16406 U.S. Route 224 E.
Findlay, Ohio 45840
(Phone) 800-537-9540
419-423-3526
(Fax) 419-424-4998

ETC/Multi-Tech
320 Tesconi Circle, Suite G
Santa Rosa, California 95401
(Phone) 707-544-5570
(Fax) 707-544-4906

ETC-Toxicon
3213 Monterrey Boulevard
Baton Rouge, Louisiana 70814
(Phone) 504-925-5012
(Fax) 504-926-5326

and was one of the sixteen charter Environmental Protection Agency Contract Laboratory Program Laboratories; and has participated in the program for both organic and inorganics.

In July of 1987, ETC again expanded its network (a total of six laboratories) and established its presence in California through the acquisition of Multi-Tech Laboratories. ETC/Multi-Tech, located in northern California, was founded 15 years ago and was one of the first laboratories certified by the California Department of Health Services (DOHS) when they began their certification program.

1.3 INTRODUCTION TO QUALITY ASSURANCE

The importance of analytical data validity can not be underestimated when making decisions concerning environmental issues. The principle mechanism by which a laboratory strives to ensure the useability of laboratory generated analytical data is the development and maintenance of a Quality Assurance (QA) Program. The QA Program is a complete and comprehensive program which ultimately assures that the analytical data generated is accurate, reproducible, valid, and defensible.

Any project or contract may specify additional or alternative QA/QC. When this occurs the development of a Quality Assurance Project Plan (QAPP) is usually required. This document details the quality assurance project plan ETC-Findlay Laboratory intends to use for the CLIENT.

2.0 STATEMENT OF POLICY

Sound environmental analytical measurements are essential to provide the data necessary to ensure the effective completion of an environmental assessment or remedial action. The following Generic QA Plan will be the guideline by which sampling, analysis, data reduction, and data interpretation will be performed for all projects. The plan outlines the minimum procedures that will be routinely used to assure the quality of the samples obtained, analysis performed, and data generated.

ETC is committed to providing all of its clients with the highest quality of service available in all of its fields of operation. The following sections will confirm this commitment to providing precise, accurate, and complete environmental measurements by outlining the QA/QC procedures that will be enforced and employed on all projects.

3.0 ORGANIZATION AND RESPONSIBILITY

The following figures detail the corporate structure, laboratory structure, and project organizational relationships between ETC-Findlay Laboratory and the CLIENT.

3.1 CORPORATE ORGANIZATION

Figure 1.1 outlines the corporate structure of the ETC organization. The ETC laboratory network is comprised of three sections: ETC-Edison, ETC-Toxicon, and the Operation Support Laboratories (OSL). The OSL laboratories are: ETC-Findlay, ETC-Florida, ETC-Minnesota, and ETC/Multi-Tech.

3.2 FINDLAY LABORATORY ORGANIZATION

Figure 1.2 outlines the structure of the ETC-Findlay Laboratory. The laboratory is divided into three principle analytical departments: Inorganic, Organic, and Sample Preparation. The Inorganic Department is further subdivided into ion chromatography and trace metals, while the Organic Department is divided into gas chromatography, high performance liquid chromatography, and gas chromatography/mass spectrometry. The Sample Preparation Department consists of two sections: conventional analyses and sample preparation.

3.3 CLIENT PROJECT ORGANIZATION

Figure 1.3 outlines the organization between ETC-Findlay Laboratory and the CLIENT.

3.4 RESPONSIBILITIES

Specific responsibilities are summarized in the following sections.

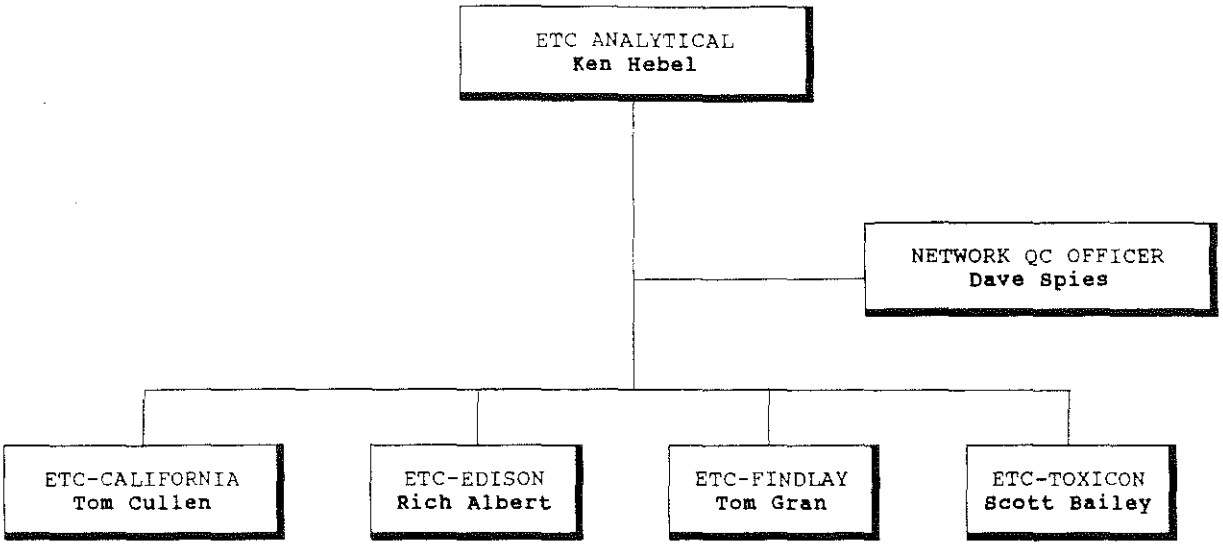

FIGURE 1.1 - ETC CORPORATE ORGANIZATION

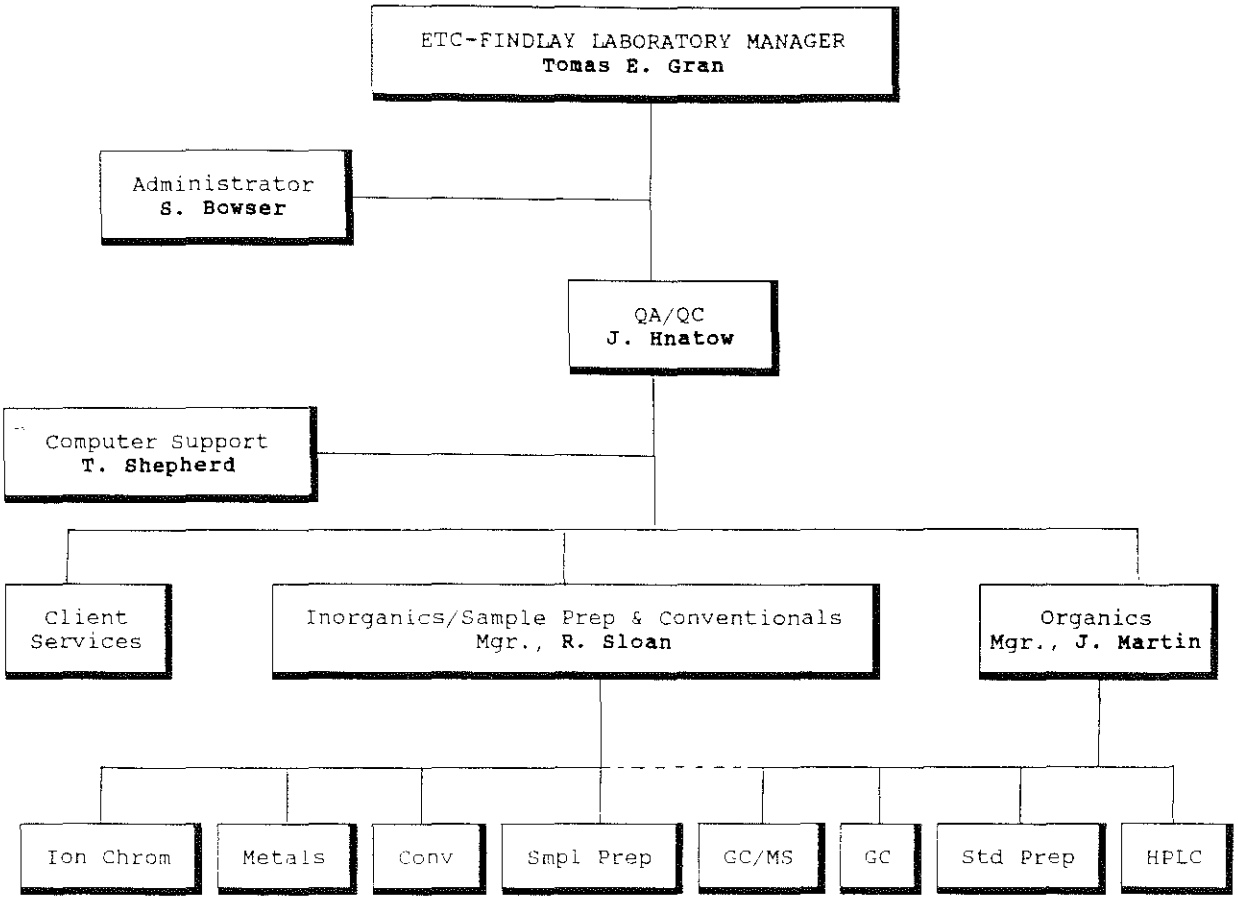

FIGURE 1.2 - ETC FINDLAY ORGANIZATION

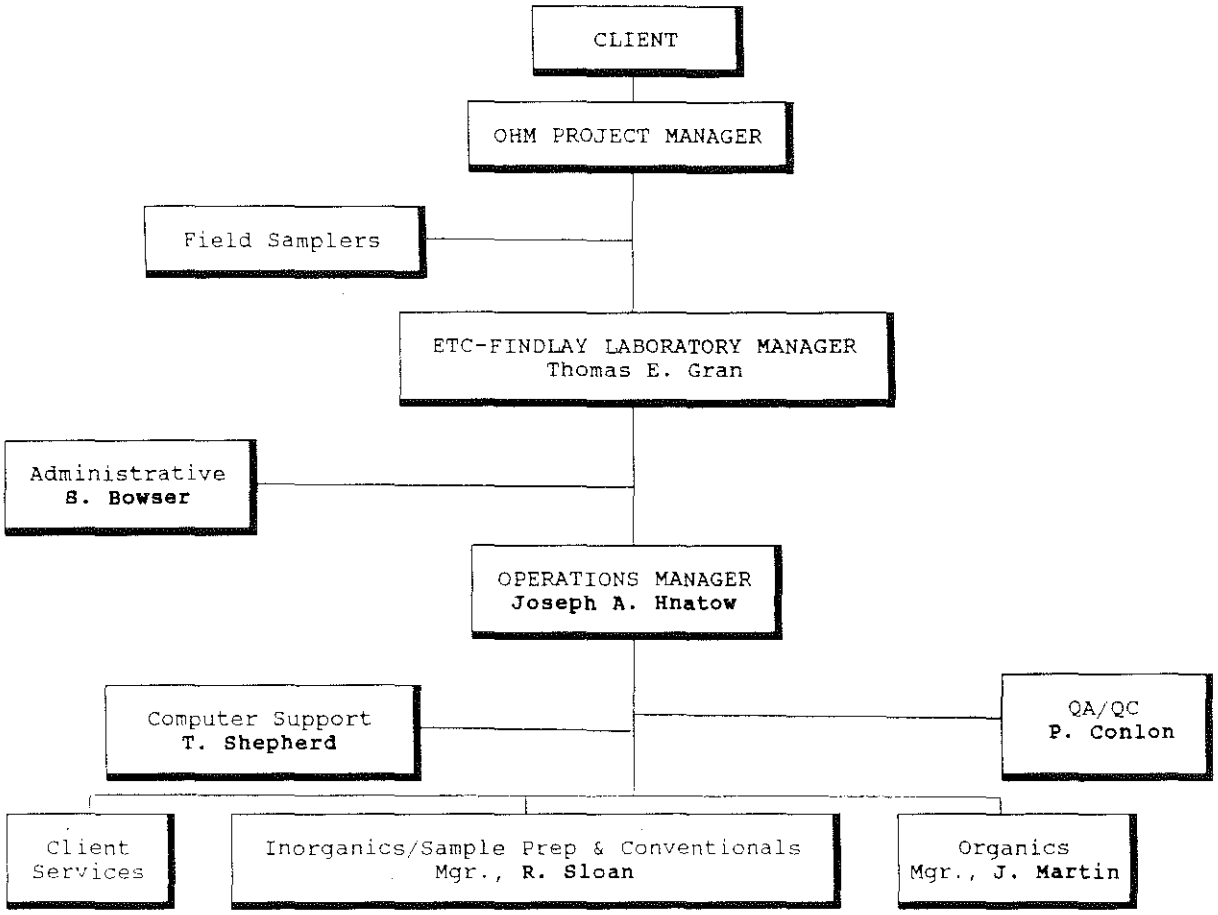

FIGURE 1.3 - CLIENT PROJECT ORGANIZATION

3.4.1 Laboratory Manager

The laboratory manager has overall responsibility for the technical quality, cost control, laboratory personnel management, and adherence to project schedules. His overall management involves the quality assurance of the following items:

- adherence to delivery schedules
- deliverable reports
- subcontractor work product if required
- project/contract cost control and accounting
- performance of the key personnel

3.4.2 Laboratory Quality Assurance Officer

The QA Officer is responsible for monitoring the quality of the laboratory work and taking appropriate actions to ensure that the standards are being met. The QA Officer reports directly to the Laboratory Manager and the corporate QA Manager in reviewing the work of teams and individuals. The QA Officer is responsible for the following items:

- preparing and overseeing the preparation of the laboratory QA/QC plan

- establishing QC procedures, providing control samples and setting warning and action limits for every test/or parameter to standardize laboratory operation for quality performance

- monitoring compliance with the laboratory's QA/QC plan by:

  - reviewing QC-related activities and documentation for completeness in accordance with the QA/QC plan

  - identifying and referring any instances in which the QA/QC objectives are not being met to section heads or laboratory service managers for remedial and/or corrective action and

  - following up on the remedial and/or corrective action to assure that QC objectives are once again being met:

- serving as the laboratory point-of-contact for the exchange of QA/QC information with the authority to approve or disapprove, along with the Laboratory Director the release of analytical data.

- providing input for all on-site QA/QC inspections
- coordinating a corrective action plan in response to deficiencies identified during laboratory inspections
- project compliance screening for all data reports.

3.4.3 Laboratory Department Manager

The Laboratory Department Managers are responsible for the fiscal, technical and personnel management within each of their respective departments. The laboratory department managers report to the laboratory manager. The laboratory department managers are responsible for the following items:

- Departments fiscal and technical objectives
- Direct and coordinate the various work groups within the department
- Monitoring department wide QA/QC objectives
- Ensuring that the correct analytical methodology is used within their department

3.4.4 Laboratory Section Supervisors

The laboratory section supervisors ensure that the sample analyses are conducted within the required QC parameters and they are responsible for instrument calibrations and maintenance procedures. They monitor the quality/quantity of all reagents, solvents and other materials used in the analysis. They are responsible for the technical quality and adherence to delivery schedules. Together with the bench chemist and personnel assigned to do the task, they are responsible for the bench level QC of the samples to be analyzed.

4.0 QUALITY ASSURANCE OBJECTIVES

4.1 DEFINITION OF TERMS

To avoid misinterpretations, the following subsections describe the definition of various terms used within this QA/QC manual.

4.1.1 Quality Assurance

A quality assurance program is an essential part of a sound analytical protocol used by individuals and/or laboratories to detect and correct problems in the measurement process or to demonstrate attainment of a state of statistical control. The objective of a quality assurance program in analysis is to reduce the measurement errors to agreed-upon limits and to produce results of acceptable quality. Two concepts are involved in quality assurance: 1) quality control, the mechanism established to control errors, 2) quality assessment, the system used to verify that the analysis is operating within acceptable limits. (REF. 1)

4.1.2 Quality Control

A quality control program includes the following:

- Development of and strict adherence to principles of good laboratory practice.
- Consistent use of standard operating procedures.
- Establishment of and strict adherence to carefully designed protocols for specific measurement programs.
- The consistent use of qualified personnel.
- Reliable and well maintained equipment.
- Appropriate calibrations and standards.
- The close supervision of all operations by management and senior personnel.

When properly conceived and executed, a quality control program will result in a measurement system operating in a state of statistical control, which means errors have been reduced to acceptable levels and have been characterized statistically. (REF. 1)

4.1.3 Quality Assessment

Quality assessment is the various techniques used to assess the quality of the measurement process and the results. The establishment of a system of "control charts" is a basic principle. Control charts are plots of multiple data points from the same or similar samples or processes versus time. An example of a typical laboratory control chart may be found in Figure 1.4.

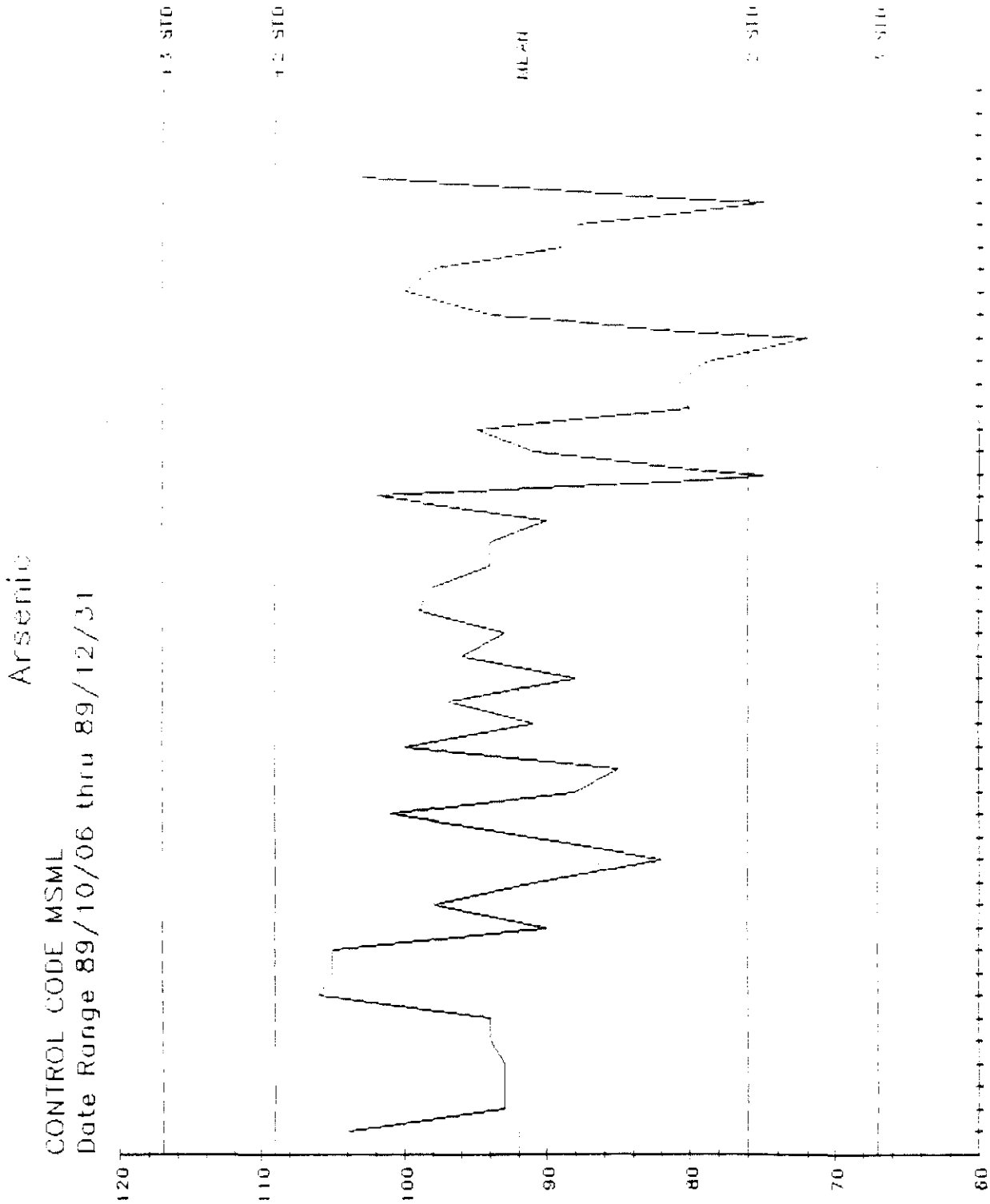

FIGURE 1.4 - LABORATORY CONTROL CHART

They are used to determine if a system is in a state of statistical control. Control charts should be used to visualize or monitor the relative variability of repetitive data. They can be used with reference materials, spiked samples and the analysis of surrogates as a means of assessing the accuracy of the measurements. (REF. 1)

Quality Assessment Procedure

Procedures used to assess the effectiveness of the quality control system include:

- o Internal Performance Audits -- conducted by the use of control samples, replicate measurements, and the use of reference materials in conjunction with control charts.
- o External Performance Audits -- conducted by the use of inter-laboratory checks such as:
  - Participation in laboratory evaluation programs.
  - Participation in round-robin method and performance evaluation studies.
  - Participation in performance evaluation samples available from EPA.
  - Analysis of split samples and comparing results with the other laboratory.

Quality Assessment Procedure Summary

A simplified working document or chart which enables one to preview the basic quality control program and its effectiveness shall be maintained on a routine basis. The following parameters are to be tracked and charted:

- o surrogate spike recoveries for all samples
- o targeted analyte method spike recoveries on a per batch basis
- o matrix spike duplicate sample results as a measure of precision.

4.1.4 Data Quality (REF. 2)

Data quality is the totality of features and characteristics of data that bear on their ability to satisfy a given purpose.

Parameters of major importance are accuracy, precision, completeness, representativeness and comparability. These are defined as follows:

- Accuracy -- degree of the difference between the measured or calculated values and the true values.
- Precision -- reproducability or degree of agreement among replicate measurements of the same quantity.
- Completeness -- expressed as the percentage of valid data obtained from a measurement system.
- Representativeness -- degree to which the data accurately represents a characteristic of a population, parameter variations at a sampling point, a process condition or an environmental condition.
- Comparability -- the confidence with which one data set can be compared to another.

4.2 Quality Assurance Objectives

The purpose of ETC-Findlay's quality assurance program is to ensure that the laboratory provides high-quality and cost-effective services and products to its clients. Although specific quality assurance procedures may be designed to meet the needs of specific projects individual program, the general objectives are:

- Data should be accurate in terms of their agreement with a reference or true value.
- Data should be precise in that there is agreement among the individual measurements made under similar conditions.
- Data should be complete in terms of the amount of data available versus the amount of data evaluate.
- Data should be comparable to prior relevant data for evaluation and testing purposes.
- Data should be representative of the overall population or data base of a parameter measurements.
- Data should be reproducibly obtainable under similar conditions, whether generated by the ETC-Findlay Laboratory or by another firm.

- o There should be an upgrade of the overall laboratory performance.

All of the above objectives are ensured by the QA/QC program which monitors all phases of the data generation, ranging from the sample collection to sample handling, to the actual analysis and data reporting that involve measurements of both inorganic and organic constituents. These procedures will be followed by all personnel and will routinely be reviewed by both the Laboratory Director and the QA Officer.

4.3 QUALITY ASSURANCE APPROACH RELATING TO MEASUREMENT OF DATA

The laboratory scope and approach to produce data of known and sufficient quality are described in this section. Guidelines are provided for the assessment and reporting of data quality for any environmentally related measurements and for the incorporation of such assessments into major environmental data bases.

Controlled sample receiving, logging and tracking throughout the length of the project/contract is maintained to ensure sample integrity throughout the analysis scheme. Documentation of instrument performance and preventative maintenance is used to provide a permanent record for data validation. The ETC-Findlay laboratory routinely checks the quality of analytical work through the analysis of quality control (QC) reference samples, duplicate samples or matrix spike duplicate, and spike samples.

4.3.1 Accuracy

The accuracy of the measurement data is evaluated by the comparison of the percent recovery of QC reference materials of known or established concentration, independent of routine calibration. It is used as prepared or diluted with an inert matrix as a blind environmental sample. Statistically based control limits are established for each method of analysis and sample matrix.

A spiked sample is analyzed routinely for each batch of 20 samples and is dependent upon the sample matrix, method of analysis and concentration level. A more frequent analysis is performed on a method specific basis. Recoveries are assessed to determine method efficiency and matrix interference effects.

Analytical accuracy is expressed as the percent recovery of an analyte/parameter which has been added to the environmental samples at a known concentration before preparation and analysis. The equation used to calculate percent recovery is as follows:

$$\text{Percent Recovery} = \frac{\text{Spike Sample Result} - \text{Sample Result X 100}}{\text{Amount of Spike Added}}$$

4.3.2 Precision

The laboratory uses matrix spike duplicates to assess precision. A matrix spike duplicate is analyzed for each batch of 20 samples for in-house QC and is dependent upon the sample matrix and method of analysis. A more frequent analysis is performed on a method specific basis if necessary. The basic precision statistics obtained from the multiple batch frequency may be compared to develope a graph assessment, using control limits, for a given sample matrix.

Analytical precision is expressed as a percentage of the difference between results of matrix spike duplicate samples for a given analyte. Relative Percent Difference (RPD) is calculated as follows:

$$\text{RPD} = \frac{\text{MS Result} - \text{MS Duplicate Result x 100}}{\text{Mean of MS and MS Duplicate Results}}$$

where:

MS = Matrix Spike

4.3.3 Completeness

For the data to be valid, it must meet all the acceptance criteria including accuracy, precision and any other specified by the analytical method used. Data validation procedures are employed to minimize the amount of bad data getting through data collection.

4.3.4 Representativeness

Data generated by the laboratory shall be representative of the overall population of samples collected and analyzed. It shall be representative of the laboratory data base of accuracy, precision measurements of the particular parameter(s), matrix, and analytical method. If the same results are reproducible, the data can be said to represent the environmental condition.

4.3.5 Comparability

Data generated shall be used to evaluate completeness of extensive monitoring programs and testing purposes based on the previous data measurements of the parameter(s), matrix, and analytical method. It shall be comparable to data sets recorded in the past to check for historical consistency. In order to maximize its usefulness, data shall be reported in appropriate units and in a consistent manner. Appropriate units are in accordance with the requirements stated in the October 26, 1984, proposed rules 40 CFR, Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants. Data should be reproducible under similar conditions whether generated by the laboratory or by another firm.

The following table (Table 1.2) outlines the QA objectives for the measurement parameters currently performed at the laboratory.

4.4 REFERENCES

1. "Principles of Environmental Analysis", Analytical Chemistry, Volume 55, pp 2210 - 2218, December 1983.

2. DER Guidelines for Preparing Quality Assurance Plans, DER - QA-001185, Florida Department of Environmental Regulation, January 1986.

5.0 SAMPLING PROCEDURES

5.1 INTRODUCTION

This section discusses the standard practices and procedures utilized by sampling personnel during field operations to ensure the collection of representative samples. All sampling activities are conducted with the expectation that they will be used for enforcement purposes, unless specifically stated to the contrary in advance of the field investigation. Therefore, the use of proper sampling procedures cannot be over emphasized. The collection of representative samples depends upon:

- Ensuring that the sample taken is truly representative of the material or medium being sampled.
- Using proper sampling, sample handling, preservation, and quality control techniques.
- Properly identifying the collected samples and documenting their collection in permanent field records.

TABLE 1.2 - LABORATORY QA OBJECTIVES

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Aluminum	EPA 200.7/202.1	Water	+/- 20%	75-125	90+
Antimony	EPA 200.7/204.2	Water	+/- 20%	75-125	90+
Arsenic	EPA 200.7/206.2	Water	+/- 20%	75-125	90+
Barium	EPA 200.7/208.2	Water	+/- 20%	75-125	90+
Beryllium	EPA 200.7/210.1	Water	+/- 20%	75-125	90+
Cadmium	EPA 200.7/213.2	Water	+/- 20%	75-125	90+
Calcium	EPA 200.7/215.1	Water	+/- 20%	75-125	90+
Chromium (Total)	EPA 200.7/218.2	Water	+/- 20%	75-125	90+
Cobalt	EPA 200.7/219.1	Water	+/- 20%	75-125	90+
Copper	EPA 200.7/220.1	Water	+/- 20%	75-125	90+
Iron	EPA 200.7/236.1	Water	+/- 20%	75-125	90+
Lead	EPA 200.7/239.2	Water	+/- 20%	75-125	90+
Magnesium	EPA 200.7/242.1	Water	+/- 20%	75-125	90+
Manganese	EPA 200.7/243.1	Water	+/- 20%	75-125	90+
Mercury	EPA 245.1	Water	+/- 20%	75-125	90+
Molybdenum	EPA 200.7/246.2	Water	+/- 20%	75-125	90+
Nickel	EPA 200.7/249.1	Water	+/- 20%	75-125	90+
Potassium	EPA 200.7/258.1	Water	+/- 20%	75-125	90+
Selenium	EPA 200.7/270.2	Water	+/- 20%	75-125	90+
Silver	EPA 200.7/272.2	Water	+/- 20%	60-120	90+
Sodium	EPA 200.7/273.1	Water	+/- 20%	75-125	90+
Thallium	EPA 200.7/279.2	Water	+/- 20%	75-125	90+
tin	EPA 200.7/282.1	Water	+/- 20%	75-125	90+
Titanium	EPA 200.7/283.1	Water	+/- 20%	75-125	90+
Vanadium	EPA 200.7/286.1	Water	+/- 20%	75-125	90+
Zinc	EPA 200.7/289.1	Water	+/- 20%	75-125	90+
Chloride	EPA 325.3	Water	+/- 20%	75-125	90+
Chlorine Total Residual	EPA 330.5	Water	+/- 20%	75-125	90+
Cyanide, Amenable to Chlorination	EPA 335.1	Water	+/- 20%	75-125	90+
Cyanide, total	EPA 335.2	Water	+/- 20%	75-125	90+
Fluoride	EPA 340.2	Water	+/- 20%	75-125	90+
Nitrogen Ammonia	EPA 350.3	Water	+/- 20%	75-125	90+
Nitrogen Nitrate	EPA 352.1	Water	+/- 20%	75-125	90+
Nitrogen Nitrite	EPA 354.1	Water	+/- 20%	75-125	90+
Oxygen, Dissolved	EPA 360.1	Water	+/- 20%	N/A	90+
Sulfate	EPA 375.1	Water	+/- 20%	75-125	90+
Oil and Grease Total Recoverable	EPA 413.1	Water	+/- 20%	75-125	90+
Phenolics Total Recoverable	EPA 420.1	Water	+/- 20%	75-125	90+
Residue					
Filterable	EPA 160.1	Water	N/A	N/A	90+
Nonfilterable	EPA 160.2	Water	N/A	N/A	90+
Total	EPA 160.3	Water	N/A	N/A	90+
pH, Electrometric	EPA 150.1	Water	N/A	N/A	90+
Bromodichloromethane	EPA 601	Water	+/- 20%	75-125	90+

TABLE 1.2 - LABORATORY QA OBJECTIVES (Continued)

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Bromoform	EPA 601	Water	+/- 20%	75-125	90+
Bromomethane	EPA 601	Water	+/- 20%	75-125	90+
Carbon Tetrachloride	EPA 601	Water	+/- 20%	75-125	90+
Chlorobenzene	EPA 601	Water	+/- 20%	75-125	90+
Chloroethane	EPA 601	Water	+/- 20%	75-125	90+
2-Chloroethylvinyl ether	EPA 601	Water	+/- 20%	75-125	90+
Chloroform	EPA 601	Water	+/- 20%	75-125	90+
Chloromethane	EPA 601	Water	+/- 20%	75-125	90+
Dibromochloromethane	EPA 601	Water	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 601	Water	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 601	Water	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 601	Water	+/- 20%	75-125	90+
Dichlorodifluoromethane	EPA 601	Water	+/- 20%	75-125	90+
1,1-Dichloroethane	EPA 601	Water	+/- 20%	75-125	90+
1,2-Dichloroethane	EPA 601	Water	+/- 20%	75-125	90+
1,1-Dichloroethene	EPA 601	Water	+/- 20%	75-125	90+
trans 1,2-Dichloroethene	EPA 601	Water	+/- 20%	75-125	90+
1,2 Dichloropropane	EPA 601	Water	+/- 20%	75-125	90+
Cis-1,3-Dichloropropene	EPA 601	Water	+/- 20%	75-125	90+
trans 1,3-Dichloropropene	EPA 601	Water	+/- 20%	75-125	90+
Methylene Chloride	EPA 601	Water	+/- 20%	75-125	90+
1,1,2,2-Tetrachloroethane	EPA 601	Water	+/- 20%	75-125	90+
Tetrachloroethene	EPA 601	Water	+/- 20%	75-125	90+
1,1,1-Trichloroethane	EPA 601	Water	+/- 20%	75-125	90+
1,1,2-Trichloroethane	EPA 601	Water	+/- 20%	75-125	90+
Trichoroethene	EPA 601	Water	+/- 20%	75-125	90+
Trichlorofluoromethane	EPA 601	Water	+/- 20%	75-125	90+
Vinyl Chloride	EPA 601	Water	+/- 20%	60-120	90+
Benzene	EPA 602	Water	+/- 20%	75-125	90+
Chlorobenzene	EPA 602	Water	+/- 20%	75-125	90+
Ethylbenzene	EPA 602	Water	+/- 20%	75-125	90+
Toluene	EPA 602	Water	+/- 20%	75-125	90+
Xylenes	EPA 602	Water	+/- 20%	75-125	90+
4-Chloro-3-methylphenol	EPA 8270	Water	+/- 20%	75-125	90+
3-Chlorophenol	EPA 8270	Water	+/- 20%	60-125	90+
2,4-Dichlorophenol	EPA 8270	Water	+/- 20%	60-125	90+
2-Methyl-4-6 dinitrophenol	EPA 8270	Water	+/- 20%	70-125	90+
2-Nitrophenol	EPA 8270	Water	+/- 20%	50-125	90+
4-Nitrophenol	EPA 8270	Water	+/- 20%	40-125	90+
Pentachlorophenol	EPA 8270	Water	+/- 20%	60-125	90+
Phenol	EPA 8270	Water	+/- 20%	40-125	90+
2,4,6-Trichlorophenol	EPA 8270	Water	+/- 20%	60-125	90+
Aldrin	EPA 8270	Water	+/- 20%	75-125	90+
^{a}-BHC	EPA 608	Water	+/- 20%	75-125	90+

TABLE 1.2 - LABORATORY QA OBJECTIVES (Continued)

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
b-BHC	EPA 608	Water	+/- 20%	75-125	90+
g-BHC	EPA 608	Water	+/- 20%	75-125	90+
y-BHC(Lindane)	EPA 608	Water	+/- 20%	75-125	90+
Chlordane	EPA 608	Water	+/- 20%	75-125	90+
4,4'-DDD	EPA 608	Water	+/- 20%	75-125	90+
4,4'-DDE	EPA 608	Water	+/- 20%	75-125	90+
4,4'-DDT	EPA 608	Water	+/- 20%	75-125	90+
Dieldrin	EPA 608	Water	+/- 20%	75-125	90+
Endosulfan I	EPA 608	Water	+/- 20%	75-125	90+
Endosulfan II	EPA 608	Water	+/- 20%	75-125	90+
Endosulfan Sulfate	EPA 608	Water	+/- 20%	75-125	90+
Endrin	EPA 608	Water	+/- 20%	75-125	90+
Endrin Aldehyde	EPA 608	Water	+/- 20%	75-125	90+
Heptachlor	EPA 608	Water	+/- 20%	75-125	90+
Heptachlor epoxide	EPA 608	Water	+/- 20%	75-125	90+
Methoxychlor	EPA 608	Water	+/- 20%	75-125	90+
Toxaphene	EPA 608	Water	+/- 20%	75-125	90+
PCB-1221	EPA 608	Water	+/- 20%	75-125	90+
PCB-1232	EPA 608	Water	+/- 20%	75-125	90+
PCB-1242	EPA 608	Water	+/- 20%	75-125	90+
PCB-1248	EPA 608	Water	+/- 20%	75-125	90+
PCB-1254	EPA 608	Water	+/- 20%	75-125	90+
PCB-1260	EPA 608	Water	+/- 20%	75-125	90+
2,4-Dinitrotoluene	EPA 8270	Water	+/- 20%	60-120	90+
2,6-Dinitrotoluene	EPA 8270	Water	+/- 20%	60-120	90+
Isophorone	EPA 8270	Water	+/- 20%	60-120	90+
Nitrobenzene	EPA 8270	Water	+/- 20%	60-120	90+
Acenaphthene	EPA 8270	Water	+/- 20%	75-125	90+
Acenaphthylene	EPA 8270	Water	+/- 20%	75-125	90+
Anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(a)anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(a)pyrene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(b)fluorathene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(ghi)perylene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(k)fluoranthene	EPA 8270	Water	+/- 20%	75-125	90+
Chrysene	EPA 8270	Water	+/- 20%	75-125	90+
Dibenzo(a,b)anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Fluoranthene	EPA 8270	Water	+/- 20%	75-125	90+
Fluorene	EPA 8270	Water	+/- 20%	75-125	90+
Indeno(1,2,3-c,d)pyrene	EPA 8270	Water	+/- 20%	75-125	90+
Naphthalene	EPA 8270	Water	+/- 20%	75-125	90+
Acrolein	EPA 8270	Water	+/- 20%	75-125	90+
Acrylonitrile	EPA 8270	Water	+/- 20%	75-125	90+
Benzene	EPA 8270	Water	+/- 20%	75-125	90+

TABLE 1.2 - LABORATORY QA OBJECTIVES (Continued)

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Bromomethane	EPA 8270	Water	+/- 20%	75-125	90+
Bromodichloromethane	EPA 8270	Water	+/- 20%	75-125	90+
Bromoform	EPA 8270	Water	+/- 20%	75-125	90+
Carbon Tetrachloride	EPA 8270	Water	+/- 20%	75-125	90+
Chlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
Chloroethane	EPA 8270	Water	+/- 20%	75-125	90+
2-Chloroethylvinyl ether	EPA 8270	Water	+/- 20%	75-125	90+
Chloroform	EPA 8270	Water	+/- 20%	75-125	90+
Chloromethane	EPA 8240	Water	+/- 20%	75-125	90+
Dibromochloromethane	EPA 8240	Water	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 8240	Water	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 8240	Water	+/- 20%	75-125	90+
1,1-Dichloroethane	EPA 8240	Water	+/- 20%	75-125	90+
1,2-Dichloroethane	EPA 8240	Water	+/- 20%	75-125	90+
1,1-Dichloroethene	EPA 8240	Water	+/- 20%	75-125	90+
Trans-1,2-Dichloroethene	EPA 8240	Water	+/- 20%	75-125	90+
1,2-Dichloropropane	EPA 8240	Water	+/- 20%	75-125	90+
Cis-1,2-Dichloropropene	EPA 8240	Water	+/- 20%	75-125	90+
Trans-1,3-Dichloropropene	EPA 8240	Water	+/- 20%	75-125	90+
Ethylbenzene	EPA 8240	Water	+/- 20%	75-125	90+
Methylene Chloride	EPA 8240	Water	+/- 20%	75-125	90+
1,1,2,2-Tetrachloroethane	EPA 8240	Water	+/- 20%	75-125	90+
Tetrachloroethene	EPA 8240	Water	+/- 20%	75-125	90+
1,1,1-Trichloroethane	EPA 8240	Water	+/- 20%	75-125	90+
1,1,2-Trichloroethane	EPA 8240	Water	+/- 20%	75-125	90+
Trichloroethene	EPA 8240	Water	+/- 20%	75-125	90+
Trichlorofluoromethane	EPA 8240	Water	+/- 20%	75-125	90+
Toluene	EPA 8240	Water	+/- 20%	75-125	90+
Vinyl Chloride	EPA 8240	Water	+/- 20%	75-125	90+
Total Xylenes	EPA 8240	Water	+/- 20%	75-125	90+
Acetone	EPA 8240	Water	+/- 20%	75-125	90+
2-Butanone (MEK)	EPA 8240	Water	+/- 20%	75-125	90+
Carbon Disulfide	EPA 8240	Water	+/- 20%	75-125	90+
Ethyl ether	EPA 8240	Water	+/- 20%	75-125	90+
Ethylene Dibromide	EPA 8240	Water	+/- 20%	75-125	90+
2-Hexanone	EPA 8240	Water	+/- 20%	75-125	90+
4-Methyl-2-Pentanone (MIBK)	EPA 8240	Water	+/- 20%	75-125	90+
Styrene	EPA 8240	Water	+/- 20%	75-125	90+
Tetrahydrofuran	EPA 8240	Water	+/- 20%	75-125	90+
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8240	Water	+/- 20%	75-125	90+
Vinyl Acetate	EPA 8240	Water	+/- 20%	75-125	90+
Acenaphthene	EPA 8270	Water	+/- 20%	75-125	90+
Acenaphthylene	EPA 8270	Water	+/- 20%	75-125	90+

TABLE 1.2 - LABORATORY QA OBJECTIVES (Continued)

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Benzidine	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(a)anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(b)fluoranthene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(k)fluoranthene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(a)pyrene	EPA 8270	Water	+/- 20%	75-125	90+
Benzo(g,h,i)perylene	EPA 8270	Water	+/- 20%	75-125	90+
Bis(2-chloroethyl)ether	EPA 8270	Water	+/- 20%	75-125	90+
Bis(2-chloroethoxy)methane	EPA 8270	Water	+/- 20%	75-125	90+
Bis(2-ethylhexyl)phthalate	EPA 8270	Water	+/- 20%	75-125	90+
Bis(2-chloroisopropyl)ether	EPA 8270	Water	+/- 20%	75-125	90+
4-Bromophenyl phenyl ether	EPA 8270	Water	+/- 20%	75-125	90+
Butyl benzyl phthalate	EPA 8270	Water	+/- 20%	75-125	90+
2-Chloronaphthalene	EPA 8270	Water	+/- 20%	75-125	90+
4-Chlorophenyl phenyl ether	EPA 8270	Water	+/- 20%	75-125	90+
Chrysene	EPA 8270	Water	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
Dibenzo(a,h)anthracene	EPA 8270	Water	+/- 20%	75-125	90+
Di-n-butylphthalate	EPA 8270	Water	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
3,3-Dichlorobenzidine	EPA 8270	Water	+/- 20%	75-125	90+
Diethylphthalate	EPA 8270	Water	+/- 20%	75-125	90+
Dimethylphthalate	EPA 8270	Water	+/- 20%	75-125	90+
2,4-Dinitrotoluene	EPA 8270	Water	+/- 20%	75-125	90+
2,6-Dinitrotoluene	EPA 8270	Water	+/- 20%	75-125	90+
Dioctylphthalate	EPA 8270	Water	+/- 20%	75-125	90+
1,2-Diphenyl hydrazine	EPA 8270	Water	+/- 20%	75-125	90+
Fluoranthene	EPA 8270	Water	+/- 20%	75-125	90+
Fluorene	EPA 8270	Water	+/- 20%	75-125	90+
Hexachlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+
Hexachlorobutadiene	EPA 8270	Water	+/- 20%	75-125	90+
Hexachloroethane	EPA 8270	Water	+/- 20%	75-125	90+
Hexachlorocyclopentadiene	EPA 8270	Water	+/- 20%	75-125	90+
Indeno-(1,2,3-c,d)pyrene	EPA 8270	Water	+/- 20%	75-125	90+
Isophorone	EPA 8270	Water	+/- 20%	75-125	90+
Naphthalene	EPA 8270	Water	+/- 20%	75-125	90+
Nitrobenzene	EPA 8270	Water	+/- 20%	75-125	90+
N-Nitrosodi-n-propylamine	EPA 8270	Water	+/- 20%	75-125	90+
N-Nitrosodiphenylamine	EPA 8270	Water	+/- 20%	75-125	90+
Phenanthrene	EPA 8270	Water	+/- 20%	75-125	90+
Pyrene	EPA 8270	Water	+/- 20%	75-125	90+
1,2,4-Trichlorobenzene	EPA 8270	Water	+/- 20%	75-125	90+

TABLE 1.2 - LABORATORY QA OBJECTIVES (Continued)

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
4-Chloro-3-Methylphenol	EPA 8270	Water	+/- 20%	75-125	90+
2-Chlorophenol	EPA 8270	Water	+/- 20%	75-125	90+
2,4-Dichlorophenol	EPA 8270	Water	+/- 20%	75-125	90+
2,4-Dimethylphenol	EPA 8270	Water	+/- 20%	75-125	90+
2,4-Dinitrophenol	EPA 8270	Water	+/- 20%	75-125	90+
2-Methyl-4,6-Dinitrophenol	EPA 8270	Water	+/- 20%	75-125	90+
2 Nitrophenol	EPA 8270	Water	+/- 20%	60-120	90+
4-Nitrophenol	EPA 8270	Water	+/- 20%	60-120	90+
Pentachlorophenol	EPA 8270	Water	+/- 20%	60-120	90+
Phenol	EPA 8270	Water	+/- 20%	70-130	90+
2,4,6-Trichlorophenol	EPA 8270	Water	+/- 20%	75-125	90+
Aniline	EPA 8270	Water	+/- 20%	75-125	90+
Benzyl Alcohol	EPA 8270	Water	+/- 20%	75-125	90+
4-Chloroaniline	EPA 8270	Water	+/- 20%	75-125	90+
Dibenzofuran	EPA 8270	Water	+/- 20%	75-125	90+
2-Methylnaphthalene	EPA 8270	Water	+/- 20%	75-125	90+
2-Methylphenol	EPA 8270	Water	+/- 20%	75-125	90+
4-Methylphenol	EPA 8270	Water	+/- 20%	75-125	90+
2-Nitroaniline	EPA 8270	Water	+/- 20%	75-125	90+
3-Nitroaniline	EPA 8270	Water	+/- 20%	75-125	90+
4-Nitroaniline	EPA 8270	Water	+/- 20%	75-125	90+
2,4,5-Trichlorophenol	EPA 8270	Water	+/- 20%	75-125	90+
Bis(2-chloroethyl)ether	EPA 611	Water	+/- 20%	75-125	90+
Bis(2-chloroethoxy)methane	EPA 611	Water	+/- 20%	75-125	90+
Bis-(2-chloroisopropyl)ether	EPA 611	Water	+/- 20%	75-125	90+
4-Bromophenyl phenyl ether	EPA 611	Water	+/- 20%	75-125	90+
4-Chlorophenyl phenyl ether	EPA 611	Water	+/- 20%	75-125	90+
2-Chloronaphthalene	EPA 612	Water	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 612	Water	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 612	Water	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 612	Water	+/- 20%	75-125	90+
Hexachlorobenzene	EPA 612	Water	+/- 20%	75-125	90+
Hexachlorobutadiene	EPA 612	Water	+/- 20%	75-125	90+
Hexachlorocyclopentadiene	EPA 612	Water	+/- 20%	75-125	90+
Hexachloroethane	EPA 612	Water	+/- 20%	75-125	90+
1,2,4-Trichlorobenzene	EPA 612	Water	+/- 20%	75-125	90+
2,4-D	EPA 8150	Water	+/- 20%	60-120	90+
2,4-DB	EPA 8150	Water	+/- 20%	60-120	90+
2,4,5-T	EPA 8150	Water	+/- 20%	60-120	90+
2,4,5-TP(Silvex)	EPA 8150	Water	+/- 20%	60-120	90+
Dalapon	EPA 8150	Water	+/- 20%	60-120	90+
Dicamba	EPA 8150	Water	+/- 20%	60-120	90+
Dichloroprop	EPA 8150	Water	+/- 20%	60-120	90+
Dinoseb	EPA 8150	Water	+/- 20%	60-120	90+

TABLE 1.2 - LABORATORY QA OBJECTIVES (Continued)

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
MCPA	EPA 8150	Water	+/- 20%	60-120	90+
MCPP	EPA 8150	Water	+/- 20%	60-120	90+
Antimony	EPA 6010/7041	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Arsenic	EPA 6010/7061	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Barium	EPA 6010/7081	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Beryllium	EPA 6010/7091	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Cadmium	EPA 6010/7031	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chromium, Total	EPA 6010/7191	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Cobalt	EPA 219.1/6010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Copper	EPA 6010/7211	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Lead	EPA 6010/7421	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Mercury	EPA 7471	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Molybdenum	EPA 246.2/6010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Nickel	EPA 6010/7521	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Selenium	EPA 6010/7741	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Silver	EPA 6010/7761	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
Thallium	EPA 6010/7841	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Vanadium	EPA 6010/7911	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Zinc	EPA 6010/7951	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bromodichloromethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bromoform	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bromomethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Carbon Tetrachloride	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chlorobenzene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Chloroethylvinyl ether	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloroform	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dibromochloromethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dichlorodifluoromethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1-Dichloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1-Dichloroethene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
trans-1,2-Dichloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichloropropane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Cis-1,3-Dichloropropene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
trans-1,3-Dichloropropene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Methylene chloride	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,2,2-Tetrachloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Tetrachloroethene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,1-Trichloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+

TABLE 1.2 - LABORATORY QA OBJECTIVES (Continued)

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
1,1,2-Trichloroethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Trichloroethene	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Trichlorofluoromethane	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Vinyl Chloride	EPA 8010	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzene	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chlorobenzene	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Ethylbenzene	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Toluene	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Xylene	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Carbon disulfide	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Diethyl ether	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Methyl ethyl ketone	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Methyl isobutyl ketone	EPA 8020	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Acrolein	EPA 8240/8270	Soil/Waste Solid/Liquid	+/ 20%	75-125	90+
Acrylonitrile	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzene	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bromomethane	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bromodichloromethane	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bromoform	EPA 8240/8270	Soil/Waste Solid/Liquid	+/ 20%	75-125	90+
Carbon Tetrachloride	EPA 8240/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chlorobenzene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Chloroethylvinyl ether	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chloroform	EPA 8240	Soil/Waste Solid/Liquid	+/ 20%	75-125	90+
Chloromethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dibromochloromethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1-Dichloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1-Dichloroethene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Trans-1,2-Dichloroethene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichloropropane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Cis-1,2-Dichloropropene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Trans-1,3-Dichloropropene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Ethylbenzene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Methylene Chloride	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,2,2-Tetrachloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Tetrachloroethene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,1-Trichloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,2-Trichloroethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Trichloroethene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Trichlorofluoromethane	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Toluene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+

TABLE 1.2 - LABORATORY QA OBJECTIVES (Continued)

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
Vinyl Chloride	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Total Xylenes	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Acetone	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Butanone (MEK)	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Carbon Disulfide	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Ethyl ether	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Ethylene Dibromide	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Hexanone	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Methyl-2-Pentanone (MIBK)	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Styrene	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Tetrahydrofuran	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Vinyl Acetate	EPA 8240	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Acenaphthene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Acenaphthylene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Anthracene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzidine	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzo(a)anthracene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzo(b)fluoranthene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzo(k)fluoranthene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzo(a)pyrene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzo(g,h,i)perylene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bis(2-chloroethyl)ether	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bis(2-chloroethoxy)methane	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bis(2-ethylhexyl)phthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Bis(2-chloroisopropyl)ether	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Bromophenyl phenyl ether	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Butyl benzyl phthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Chloronaphthalene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Chlorophenyl phenyl ether	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chrysene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dibenzo(a,h)anthracene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Di-n-butylphthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,3-Dichlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,4-Dichlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2-Dichlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
3,3-Dichlorobenzidine	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Diethylphthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dimethylphthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4-Dinitrotoluene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,6-Dinitrotoluene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dioctylphthalate	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+

TABLE 1.2 - LABORATORY QA OBJECTIVES (Continued)

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
1,2-Diphenyl hydrazine	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Fluoranthene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Fluorene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Hexachlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Hexachlorobutadiene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Hexachloroethane	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
hexachlorocyclopentadiene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Indeno-(1,2,3-c,d)pyrene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Isophorone	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Naphthalene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Nitrobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
N-Nitrosodi-n-propylamine	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
N-Nitrosodiphenylamine	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Phenanthrene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Pyrene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
1,2,4-Trichlorobenzene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Chloro-3-Methylphenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Chlorophenol	EPA 8270	Soil/Waste Solid/Liquid	+/ 20%	75-125	90+
2,4-Dichlorophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4-Dimethylphenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4-Dinitrophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Methyl-4,6-Dinitrophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Nitrophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Nitrophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Pentachlorophenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Phenol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4,6-Trichlorophenol	EPA 8040/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Aniline	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Benzyl Alcohol	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Chloroaniline	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dibenzofuran	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Methylnaphthalene	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Methylphenol	EPA 8040/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Methylphenol	EPA 8270/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2-Nitroaniline	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
3-Nitroaniline	EPA 8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4-Nitroaniline	EPA 8040/8270	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Aldrin	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
^{a}-BHC	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
^{b}-BHC	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
^{g}-BHC	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
^{y}-BHC(Lindane)	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Chlordane	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4,4'-DDD	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+

TABLE 1.2 - LABORATORY QA OBJECTIVES (Continued)

Parameter	Method	Matrix	Precision RPD	Accuracy % Recovery	Completeness %
4,4'-DDE	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
4,4'-DDT	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Dieldrin	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Endosulfan I	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Endosulfan II	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Endosulfan sulfate	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Endrin	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Endrin aldehyde	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Heptachlor	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Heptachlor epoxide	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Methoxychlor	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
Toxaphene	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1221	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1232	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1242	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1248	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1254	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
PCB 1260	EPA 8080	Soil/Waste Solid/Liquid	+/- 20%	75-125	90+
2,4-D	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
2,4-DB	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
2,4,5-T	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
2,4,5-TP(Silvex)	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
Dalapon	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
Dicamba	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
Dichloroprop	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
Dinoseb	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
MCPA	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
MCPP	EPA 8150	Soil/Waste Solid/Liquid	+/- 20%	60-120	90+
Ignitability	EPA 1020	Soil/Waste Solid/Liquid	N/A	N/A	90+
Corrosivity toward steel	EPA 1110	Soil/Waste Solid/Liquid	N/A	N/A	90+
Extraction Procedure (EP) Toxicity Test Method	EPA 1310	Soil/Waste Solid/Liquid	N/A	N/A	90+
Oxidizer Spot Test	EPA 038	Soil/Waste Solid/Liquid	N/A	N/A	90+
pH Paper Test	EPA 038	Soil/Waste Solid/Liquid	N/A	N/A	90+
Sulfide Spot Test	EPA 038	Soil/Waste Solid/Liquid	N/A	N/A	90+
Cyanide Spot Test	EPA 038	Soil/Waste Solid/Liquid	N/A	N/A	90+
Flashpoint Determination	EPA 1020	Soil/Waste Solid/Liquid	N/A	N/A	90+

The QA objectives are targeted internal laboratory QC limits.

- Maintaining sample chain-of-custody record(s).
- Protecting the collected samples by properly packing and transporting (shipping) them to a laboratory for analysis.

The objectives of this section are to present:

- General considerations that must be incorporated in all sampling operations conducted.
- Specific standard sampling site selection and collection procedures for an individual medium.
- Specific sampling quality assurance procedures as well as equipment calibration and maintenance requirements for the sampling equipment.

5.2 GENERAL CONSIDERATIONS

The following factors and procedures shall be considered and implemented in planning and conducting all sampling operations. All these factors and procedures must be considered in view of specific objectives and scope of each individual field investigation.

5.2.1 Selection of Representative Sampling Sites

Representative sampling sites are dependent on the type of investigation undertaken and are discussed under type of sample procedures for each medium later in this section.

5.2.2 Selection and Proper Preparation of Sampling Equipment

The type of sampling equipment to be used is dictated by the investigation and is discussed for each medium later in this section. Appendix A describes the standard equipment cleaning procedures.

5.2.3 Sampling Equipment Construction Material

The material that sampling equipment is constructed of can affect sample analytical results. Materials used must not contaminate the sample being collected and must be readily cleaned so that samples are not cross-contaminated. The standard materials for sampling equipment used to collect samples for trace organic compounds or metals analyses are, in order of decreasing desirability; Teflon, glass, stainless steel, and steel.

5.2.4 Selection of Parameters to be Measured

Parameters to be measured are usually dictated by the purpose of an investigation and should be based on required monitoring conditions (for example; NPDES or RCRA Permits) or on the field investigator's or requestor's knowledge of the problem being investigated.

5.2.5 Dissolved and Particulate Sample Fractions

A water sample is generally composed of dissolved and particulate fractions. When it is necessary to analyze samples for each fraction, instead of the total sample, it may be necessary to filter the sample in the field. Field filtration should be conducted only for conventional analytical parameters or metals; samples that will be analyzed for organic compounds shall not be filtered in the field.

5.2.6 Required Sample Volumes

The volume of sample obtained should be sufficient to perform all required analyses with an additional amount collected to provide for quality control needs, split samples, or repeat examinations. Individual aliquots of a composite sample should be at least 100 milliliters in order to minimize sample solids bias when using a peristaltic pump.

Although the volume of sample required by analytical laboratories depends on the analyses to be performed, the amount of sample required for a complete water or wastewater analysis is normally two gallons (7.6 liters) for each laboratory receiving a sample. However, the laboratory receiving the sample should be consulted for any specific volume requirements.

The volumes of samples collected from waste sources at hazardous waste sites or samples from sources which are known to be toxic should be kept to an absolute minimum.

5.2.7 Selection and Proper Preparation of Sample Containers

The type of sample container is dictated by the analyses required. Standard sample containers used by sampling personnel are presented in Table 1.3. Special sample container preparation requirements are in Appendix A.

5.2.8 Sample Preservation

Samples for some analyses must be preserved in order to maintain their integrity. Preservatives required for routine analyses of samples collected are given in Table 1.3. All chemical

TABLE 1.3 - SAMPLING INFORMATION

PARAMETER	CONTAINER[2]	PRESERVATION	HOLDING TIME	MIN VOL (ml)
Chloride	P, G	None	28 days	50
Chlorine Total Residual				
Cyanide	P, G	10N NaOH to pH >12 0.6 g Absorbic Acid[3]	28 days	500
Fluoride	P	None	28 days	500
Metals-				
Dissolved	P, G	Filter on-site HNO_3 to pH < 2	6 months Hg - 28 days	200
Suspended	P, G	HNO_3 to pH < 2	6 months Hg - 28 days	200
Total	P, G	HNO_3 to pH < 2	6 months Hg - 28 days	100
Nitrogen -				
Ammonia	P, G	Cool 4°C H_2SO_4 to pH < 2	28 days	
Nitrate	P, G	Cool 4°C H_2SO_4 to pH < 2	28 days	
Nitrile	P, G	Cool 4°C H_2SO_4 to pH < 2	28 days	
Oxygen, dissolved	G	Determine on-site	2 hours	300
Sulfate	P, G	4°C	28 days	50
pH	P, G	Determine on-site	2 hours	25
Oil and Grease Total Recoverable	G	4°C H_2SO_4 to pH < 2	28 days	1000
Phenolics Total Recoverable	G	1g/l $CuSO_4$ pH <4 H_3PO_4 4°C	24 hours	1000
Residue -				
Filterable	P, G	4°C	7 days	100
Non-Filterable	P, G	4°C	7 days	100
Total	P, G	4°C	7 days	100
Organics -				
Extractable (base/ neutrals/acid)	Glass, TFE[4]	4°C	7 days Extraction,	1000

TABLE 1.3 - SAMPLING INFORMATION (Continued)

PARAMETER	CONTAINER[2]	PRESERVATION	HOLDING TIME	MIN VOL (ml)
Organics (Continued)				
Purgeables (aromatic halocarbons)	Glass, TFE lined septum	4°C	14 days	40
Pesticides/PCBs	Glass, TFE lined screw closure	4°C	7 days Extraction, 30 days after extraction	1000

1. Table taken from Characterization of Hazardous Waste Sites - A Methods Manual, Vol. II, EPA 600/4-84-079, December 1984, pages A49-A52.

2. P = Plastic; G = Glass

3. Addition of Absorbic only in the presence of residual chlorine

4. TFE = Teflon

preservatives used will be supplied by the samplers. All samples should be preserved immediately upon collection in the field. The only samples that should not be immediately preserved in the field are:

- Samples collected within a hazardous waste site that are known or thought to be highly contaminated with toxic materials. Barrel, drum, closed container, spillage, or other source samples from hazardous waste sites are not to be preserved with any chemical. These samples may be preserved with ice, if necessary.

- Samples that have extremely low or high pH or samples that may generate potentially dangerous gases if they were preserved.

- Well or ground water samples that contain visible sediment, that are not filtered in the field, shall not be preserved with nitric acid in the field. These samples shall be preserved with ice and returned to the laboratory for additional sample preparation.

All samples preserved with chemicals shall be clearly identified by indicating on the sample tag that the sample is preserved. If the samples were not preserved, field records shall indicate why.

5.2.9 Sample Holding Times

The elapsed time between sample collection and initiation of laboratory analyses must be within a prescribed time frame for each individual analysis to be performed. Sample holding times for all routine samples collected are shown in Table 1.3.

5.2.10 Sample Handling and Mixing

Once a sample has been collected, it may have to be split into separate containers for different analysis. The best way to split liquid samples is to continually stir the sample contents with a clean pipette or precleaned Teflon rod and allow the contents to be alternately siphoned into respective sample containers using Teflon or PVC (Tygon type) tubing. Teflon must be used when analyses for organic compounds or trace metals are to be conducted. Any device used for stirring, or tubing used for siphoning, must be cleaned in the same manner as other equipment (Appendix A).

A true split of soil, sediment, or sludge samples is almost impossible to accomplish under field conditions. The more moisture samples contain, the more difficult it is to split them. Procedures such as the one outlined in Section 5.6.3 (under Mixing)

should be used to obtain a homogeneous sample. Even when such procedures are followed, the sample should be considered a duplicate and not a split sample.

After collection, all samples should be handled as few times as possible. Sampling personnel should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, personnel should ensure that melted ice cannot cause sample containers to become submerged, as this may result in sample cross-contamination. Plastic bags, such as zip-lock bags, should be used when small sample containers (e.g., VOA's or bacterial samples) are placed in ice chests to prevent cross-contamination.

5.2.11 Special Precautions for Trace Contaminant Sampling

Some compounds can be detected in the parts per billion and/or parts-per-trillion range. Extreme care must be taken to prevent cross-contamination of these samples. The following precautions shall be taken when trace contaminants are of concern:

- A clean pair of new disposable gloves will be worn each time a different location is sampled.
- Sample containers for source samples or samples suspected of containing high concentrations of contaminants shall be placed in separate plastic bags immediately after collecting, preserving, tagging, etc..
- If possible, ambient samples and source samples should be collected by different field teams. If separate collection is not possible, all ambient samples shall be collected first and placed in separate ice chests or shipping containers. Samples of waste or highly contaminated samples shall never be placed in the same ice chest as environmental samples. It is good practice to enclose waste or highly contaminated samples in a plastic bag before placing them in ice chests. Ice chests or shipping containers for source samples or samples suspected to contain high concentrations of contaminants shall be lined with new and clean plastic bags.
- If possible, one member of the field team should take all the notes, fill out tags, etc., while the other member does all of the sampling.
- When sampling surface waters, the water sample should always be collected before the sediment sample is collected.

- Sample collection activities should proceed progressively from the least contaminated area to the most contaminated area (if this fact is known).

- Sampling personnel should use equipment constructed of Teflon, stainless steel, or glass that has been properly precleaned (Appendix A) for collecting samples for trace metals or organic compounds analyses. Teflon or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC shall not be used to collect samples for trace organic compounds analyses.

5.2.12 Sample Identification

All samples will be fully documented in the field records; on the field sample Chain-of-Custody Record(s) (COC) and on the sample labels and/or sample tags. An example of a COC and a typical sample label may be found in Figures 1.5 and 1.6 respectively.

5.2.13 Procedures for Identifying Potentially Hazardous Samples

Any sample either known or thought to be hazardous should be so identified on both the sample tag and the field sample COC. Information explaining the hazard, (i.e., corrosive, flammable, poison, etc.) shall also be listed.

5.2.14 Collection of Auxiliary Data

All auxiliary data such as flow measurements, photographs of sampling sites, meteorological conditions, and other observations shall be entered into field records when the auxiliary data are collected. Auxiliary data relative to a particular sampling location should be collected as close to the sample collection time as possible. Specific types of auxiliary data to collect for each medium sampled are discussed later in this section.

5.2.15 Time Records

All records of time shall be kept using local time in the 2400 hour time format and shall be recorded to the nearest five minutes.

5.2.16 Transporting and Shipping of Samples

Samples may be hand delivered to the laboratory or they may be shipped by common carrier. All sampling personnel must be aware that certain samples are hazardous materials and, as such,

JOB #_____SAMPLE #_____
DATE_____
TIME_____
SAMPLE_____
_____
TAKEN BY_____
WITNESS_____

FIGURE 1.5 - SAMPLE LABEL

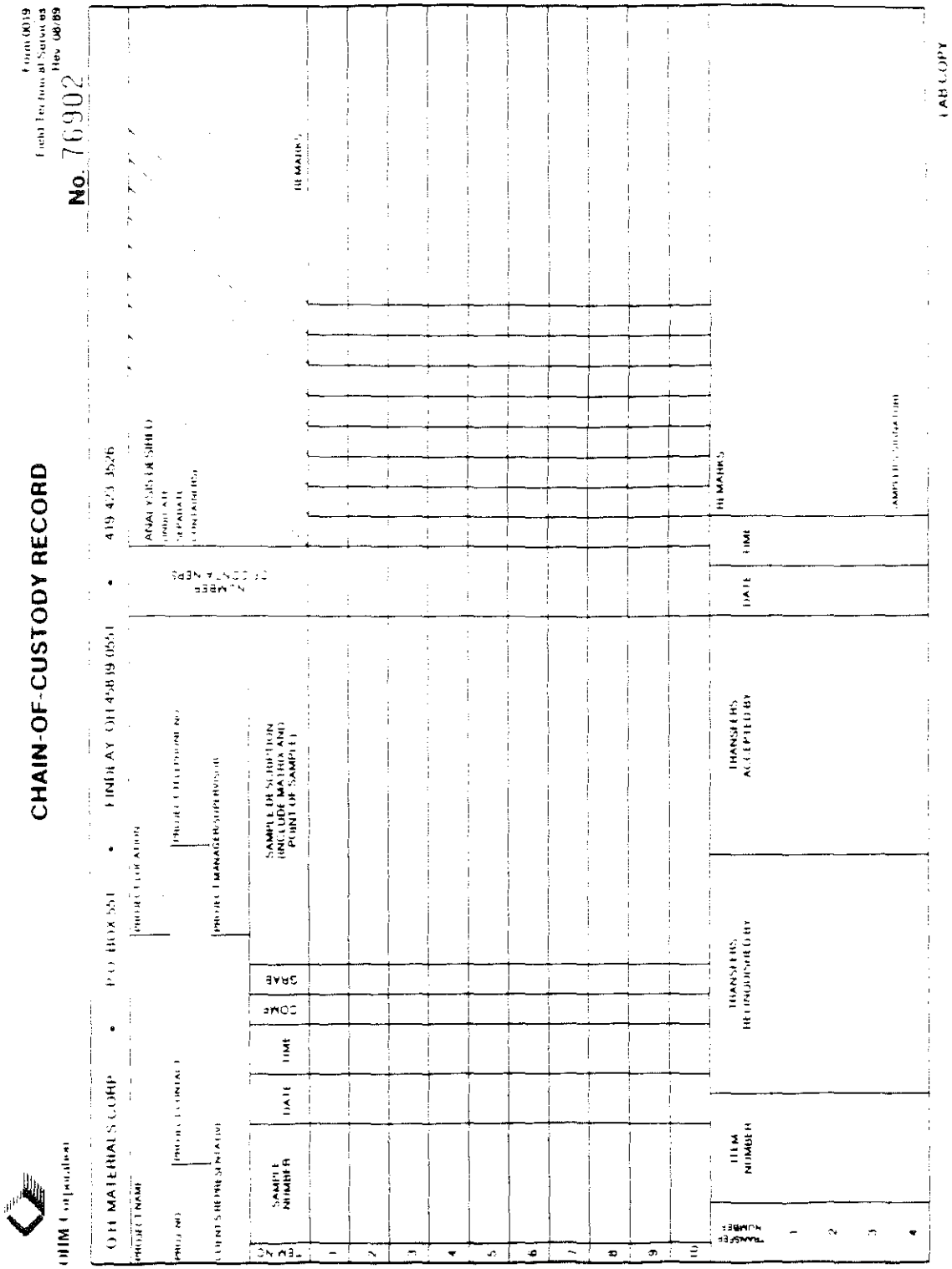

FIGURE 1.6 - CHAIN-OF-CUSTODY RECORD

are regulated by the U.S. Department of Transportation under the Transportation Safety Act of 1974. These regulations are contained in Title 49, CFR, Parts 110-119.

5.2.17 Sample Chain-of-Custody Record

Sampling personnel shall maintain sample COC during all field investigations for all samples collected. The standard sample COC procedures used are given in Section 6.1.3.

5.3 DEFINITIONS

5.3.1 Grab Samples

An individual sample collected over a period of time generally not exceeding 15 minutes. A grab sample is normally associated with water or wastewater sampling. However, soil, sediment, liquid hazardous waste samples, etc., may also be considered grab samples; particular time limit would apply for the collection of such samples. Grab samples are:

- Used to characterize the medium at a particular instant in time.
- Are always associated with instantaneous water or wastewater flow data (where appropriate).

Grab sampling is conducted when:

- The water or wastewater stream is not continuous (e.g., batch-discharges or intermittent flow).
- The characteristics of the water or waste stream are known to be constant or nearly so.
- The sample is to be analyzed for parameters whose characteristics are likely to change significantly with time, (i.e., dissolved gases, bacteria, etc.).
- The sample is to be collected for analysis of a parameter such as oil and grease where the compositing process could significantly affect the actual concentration.
- Data on maximum/minimum concentrations are desired for a continuous water or wastewater stream.

Analyses for which samples of water shall always be collected by the sampling personnel on a grab basis or for which measurements shall be made in-situ include:

- pH
- temperature
- dissolved oxygen
- sulfide
- chlorine residual
- other dissolved gases
- cyanide
- dissolved constituents in field filtered samples (total-P, ortho-P, metals, etc.)
- phenol
- oil and grease
- bacterial
- volatile organic compounds
- specific conductance

5.3.2 Composite Sample

5.3.2.1 Timed Composite

A sample containing a minimum of eight equal volume, discrete samples collected at equal time intervals over the compositing period. (A timed composite may be collected continuously.) Timed composites may be collected where water or wastewater flows do not vary.

5.3.2.2 Flow Proportional Composite

A sample containing a minimum of eight discrete samples collected proportional to the flow rate over the compositing period. Flow proportional samples may be collected where water or wastewater flows vary widely and are not dampened by wastewater treatment units.

5.3.2.3 Timed and Flow Proportional Composite Samples

The following guidance is given concerning the collection of composite samples:

o Composite samples are:

- Collected when average waste concentrations are of interest.

- Always associated with average flow data (where appropriate).

o Composite sampling is used when:

- The water or wastewater stream is continuous.
- It is necessary to calculate mass/unit time loadings.
- Analytical capabilities are limited.

- o A timed composite shall be collected as follows:
  - Continuously
  - Constant sample volume with a constant time interval between samples.
- o A flow proportional composite shall be collected as follows:
  - Continuously and proportional to stream flow.
  - With constant sample volume and the time between samples proportional to stream flow.
  - With a constant time interval between samples and the sample volume proportional to flow at time of sampling.

5.3.2.4 Areal Composite

A sample composited from individual grab samples collected on an areal or cross-sectional basis. Areal composites shall be made up of equal volumes of grab samples; each grab sample shall be collected in an identical manner. Examples include sediment composites made up of quarter-point grab samples from a stream, soil samples from grid points on a grid system, water samples collected at various depths at the same point or from quarter points in a stream, etc.

5.3.3 Split Samples

A sample which has been portioned into two or more containers from a single sample container. Portioning assumes adequate mixing to assure the "split samples" are, for all practical purposes, identical.

5.3.4 Duplicate Samples

Samples collected simultaneously from the same source under identical conditions into separate containers.

5.3.5 Reference or Control Sample

A sample collected upstream or upgradient from a source or site to isolate the effects of the source or site on the particular ambient medium being sampled.

5.3.6 Background Sample

A sample collected from an area, water body, or site similar to the one being studied, but located in an area known or thought to be free from pollutants of concern.

5.3.7 Sample Aliquot

A portion of a sample that is representative of the entire sample.

5.4 SPECIFIC SAMPLE COLLECTION QUALITY CONTROL PROCEDURES

5.4.1 General

This subsection provides guidelines for establishing quality control procedures for sampling activities. Specific guidelines for sample site selection, selection of sampling equipment, types of samples to be collected, standard sample collection procedures, specific maintenance and calibration procedures for sampling equipment, and other considerations are presented for each medium later in this section. Specific requirements for all sample activities are presented in Section 5.2. Strict adherence to all of the standard operating procedures outlined in this chapter form the basis for the sample quality assurance program.

5.4.2 Experience Requirements

There is no substitute for field experience. Therefore, all professional and paraprofessional sampling employees shall have the equivalent of six months field experience before they are permitted to select sampling sites on their own initiative. This field experience shall be gained by on-the-job training using the "buddy" system. Each new field employee shall accompany an experienced employee on as many different types of field studies as possible. During this training period, the new employee will be permitted to perform all facets of field investigations, including sample collection, under the direction and supervision of senior technical staff.

5.4.3 Traceability Requirements

All sample collection activities shall be traceable through field records to the person collecting the sample and to the specific piece of sampling equipment (where appropriate) used to collect that sample. All maintenance and calibration records for sampling equipment (where appropriate) shall be kept so that they are similarly traceable.

5.4.4 Measurement of Relative Sampling Precision

The following duplicate sampling procedures shall be used during the collection of samples as a relative measure of the precision of the sample collection process. Duplicate grab and composite samples shall be collected during all major investigations and studies conducted. No more than ten percent of all samples shall be collected in duplicate. These samples shall be collected at the same time, using the same procedures, the same equipment, and in the same types of containers as the required samples. They shall also be preserved in the same manner and submitted for the same analyses as the required samples. The collection of duplicate composite samples shall require the installation of duplicate automatic sampler setups if automatic samplers are used for sample collection. Duplicate sample data shall be reported to the Quality Assurance Officer or his designee.

This data will be periodically examined to determine if any problems are evident with specific types of media samples or with the procedures used by specific personnel. The Quality Assurance Officer responsible for the field samplers will advise the sampling management staff of any problems encountered so that corrective action can be taken.

5.4.5 Measurement of Sample Handling Effectiveness

The effectiveness of personnel sample handling techniques will be monitored by utilizing preserved and unpreserved field blank samples. These blank samples will be prepared by personnel in the following manner:

- Water Sample Organic Trip Blank -- Two sealed preserved (or unpreserved if appropriate) VOA vials and one sealed container each for other organic compounds will be transported to the filed. These samples will be handled and treated by sampling personnel in the same manner as the other samples collected for organic compounds on that particular study. These samples will be clearly identified on sample tags and COCs as trip blanks. These water sample trip blanks will also be used to monitor the effectiveness of sample handling techniques where samples other than water, i.e., sludge, soil, sediment, etc. are collected. At least one set of trip blanks will be used on every study where samples for organic compounds analyses will be conducted.

- Metals and General Inorganic Preservative Blanks -- Metals and general inorganics sample containers filled with blank water will be transported to the field and treated in the same manner as other like samples. These blank samples

will be preserved and submitted for the same analyses as the other samples collected. These samples will be clearly identified as preservative blanks on sample tags and in the COCs. At least one preservative blank for each type of sample should be collected on non-routine field investigations. A minimum of one preservative blank should be prepared at the beginning and at the end of all major field investigations (20 samples or more). At least one preservative blank for each type of sample should be prepared once per quarter for routine inspections.

- Automatic Sampler Blank -- The procedure for collecting automatic sampler blanks is given in Section 5.5.4. In general, cleaning procedures outlined in Appendix A should be adequate to insure sample integrity. However, it is the standard practice to submit automatic sampler blanks for analysis when automatic samplers are used to collect samples for organic compounds analyses.

5.4.6 Measurement of Sample Container, Sample Equipment, and Cleaning Procedure Integrity

Specific quality control procedures are outlined in Apendix A.

5.4.7 Special Quality Control Procedures for Water Samples for Extractable, Pesticide, or Herbicide Organic Compounds Analyses

Sampling personnel shall submit duplicate water samples for extractable organic, pesticide, and/or herbicide organic compounds analyses from one sampling location per project. This sample should be collected from a location expected to be relatively free from contamination, since this sample will be use for laboratory quality control purposes. The duplicate sample should be clearly identified as "Duplicate Sample for Matrix Spike" on the sample tag, COC, and in the field logbook. This procedure shall be followed for all projects where water samples are collected for the indicated organic compounds analyses.

5.5 WASTEWATER SAMPLING

5.5.1 General Considerations

The wide variety of conditions existing at different sampling locations require that some judgment be made regarding the methodology and procedure for collection of a representative sample of wastewater. Each sampling point warrants attention commensurate

with its complexity. There are, however, basic rules and precautions generally applicable to sample collection. The procedures used are generally those outlined in the NPDES Compliance Inspection Manual (REF. 2). Additional guidance is given in the agency's handbook, Monitoring Industrial Wastewater (REF. 3). Some important considerations for obtaining a representative wastewater sample include:

- The sample should be collected where the wastewater is well mixed. Therefore, the sample should be collected near the center of the flow channel, at a depth between 0.4 - 0.6 percent of the total depth, where the turbulence is at a maximum and the possibility of solids settling is minimized. Skimming the water surface or dragging the channel bottom should be avoided; however, allowances should be made for fluctuations in water depth due to flow variations.

- In sampling from wide conduits, cross-sectional sampling should be considered. Dye may be used as an aid in determining the most representative sampling points.

- If manual compositing is employed, the individual sample bottles must be thoroughly mixed before pouring the individual aliquots into the composite container.

5.5.2 Sample Site Selection

Where applicable, wastewater samples should be collected at the location specified in the NPDES permit (if the source has such a permit). In some instances the sampling location specified in the permit, or the location chosen by the permittee, may not be adequate for the collection of a representative wastewater sample. In such instances, the project leader of filed investigator is not precluded by permit specifications from collecting a sample at a more representative location. Where a conflict exists between the permittee and the regulatory agency regarding the most representative sampling location, both sites should be sampled, and the reason for the conflict should be noted in the inspection or study report. Recommendations for a change in sampling location should be given to the appropriate permitting authority.

- Influent -- wastewaters are preferably sampled at points of highly turbulent flow in order to ensure good mixing; however, in many instances the most desirable location is not accessible. Preferable influent wastewater sampling points include:

  - The up-flow siphon following a comminutor (in absence of grit chamber).

- The up-flow distribution box following pumping from main plant wet well.

- Aerated grit chamber

- Flume throat

- Pump Wet Well when the pump is operating.

In all cases, samples should be collected upstream from recirculated plant supernatant and sludges, and the sample collected should be completely untreated.

o Effluent -- samples should be collected at the site specified in the permit, or if no site is specified in the permit, at the most representative site downstream from all entering wastewater streams prior to discharge into the receiving waters. If a conflict exists between the permittee and inspector regarding the source being sampled or the location of the most representative site, follow the procedure outlined in Section 5.5.2 above.

o Pond and Lagoon Sampling -- Generally, composite wastewater samples should be collected from ponds and lagoons. Even if the ponds or lagoons have long retention times, composite sampling is necessary because of the tendency of ponds and lagoons to short circuit. However, if dye studies or facility data indicate a homogeneous discharge, a grab sample may be taken as representative of the waste stream.

5.5.3 Sampling Techniques

Sampling and flow measuring are integrally related. The investigator must know the wastewater flow variability before a sampling program can be initiated.

Whether to use a flow proportional or time composite sampling scheme depends on the variability of the wastewater flow. If an investigator knows or suspects that there is significant variability in the wastewater flow or if the investigator knows nothing about the facility, a flow proportional sample should be collected. Otherwise a time composite sample would be acceptable.

Prior to sampling, the flow measuring system (primary flow device, totalizer, recorder) should be examined. If the flow measuring system is unacceptable, the investigator may have to install a flow measuring device. If the flow measuring system is acceptable, samples can be collected by the appropriate method.

Time composite samples are based on a constant time interval between samples. A time composite sample can be collected either manually or with an automatic sampler.

Flow proportional samples can be collected automatically with an automatic sampler and a compatible pacing flow measuring device, semi-automatically with a flow chart and an automatic sampler capable of collecting discrete samples, or manually.

5.5.4 Use of Automatic Samplers

5.5.4.1 General

Automatic samplers may be used when several points are to be sampled at frequent intervals or when a continuous sample is required. Automatic samplers used must meet the following requirements:

- Sampling equipment must be properly cleaned to avoid cross-contamination which could result from prior use (see Appendix A for cleaning procedures).
- No plastic or metal parts of the sampler will come in contact with the water or wastewater stream when parameters to be analyzed could be affected by these materials.
- The sampler must be able to provide adequate refrigeration during the sampling period. This can be accomplished in the field by using ice.
- The sampler must be able to collect a large enough sample for all parameter analyses (see Table 1.3 for required sample volumes).
- A minimum of 100 mL should be collected each time the sampler is activated if a peristaltic pump is used.
- The sampler should provide a lift of at least 20 feet and the sampler should be adjustable so that the volume is not a function of the pumping head.
- Pumping velocity must be adequate to transport solids and not allow solids to settle.
- The intake line leading to the pump must be purged before each sample is collected.
- The minimum intake line inside diameter should be 1/4 inch.

- An adequate power source should be available to operate the sampler for 48 hours at a 30 minute sampling interval.

5.5.4.2 Equipment Installation

Conventional Sampling

The automatic samplers may be used to collect time composite or flow proportional samples. In the flow proportional mode, the samplers are activated by a compatible flow meter. Flow proportional samples can also be collected using a discrete sampler and a flow recorder and manually compositing the individual aliquots in flow proportional amounts (REF. 2).

All new tubing (Dow Corning Medical Grade Silastic, or equal, in the pump and either Teflon or Tygon, or equal, in the sample train) will be used for each sampler installation.

Installation procedures include cutting the proper length of Teflon or Tygon cubing, Milli-Q water rinsing and/or blank collection, positioning collection tubing in wastewater stream, and sampler programming.

For a time composite sample, the sampler should be programmed to collect 200 mL at 30 minute intervals or 100 mL at 15 minute intervals into a refrigerated 3 gallon glass jug. For a 5 gallon compositing jug, the volume should be increased accordingly.

For a flow proportional sample, the sampler should be programmed to collect a minimum of 100 mL for each sample interval, with the interval predetermined based on the flow of the waste stream.

At the end of each 24 hours sampling period, the contents of the glass compositing jug with the sample should be stirred and siphoned (poured if there are no visible solids) into the respective containers, followed by immediate preservation, if required.

Automatic Sampler Maintenance, Calibration, and Quality Control

To insure proper operation of automatic samplers, and thus the collection of representative samples, the procedures outlined in this section shall be used to maintain and calibrate automatic samplers. Each automatic sampler shall be numbered and a log shall be kept describing the sampler with company serial number.

Logs shall be used to record repair information including specific repairs and the name of the person performing the repairs.

The following maintenance and calibration procedures shall be used; any differences from those prescribed procedures will be documented.

Prior to each field trip, the sampler operation will be checked. This includes operation (forward, reverse, automatic) through three cycles of purge-pump-purge; checking desiccant and replacing if necessary; checking 12-volt batteries to be used with the sampler; and repairing any item if necessary.

During each field trip, prior to initiating sampling, the purge-pump-purge cycle shall be checked at least once. The constant pumping volume using a graduated cylinder or other calibrated container will be checked at least twice, and the flow pacer that activates the sampler shall be checked to be sure it operates properly.

Upon return from a field trip, the sampler shall be examined for holes, dents, etc., and repaired, if necessary. The desiccant will be checked and replaced if appropriate. The operation (forward, reverse, automatic, etc) will be checked and any required repairs will be made and documented. The sampler should then be cleaned as outlined in Appendix A.

The automatic sampler's pumping rate at multiple heads, the timing mechanisms, the multiplexer, or the flow pacer will be checked against the manufacturer's specs and documented whenever one or more of these functions appears to be operating improperly.

5.5.5 Manual Sampling

Manual sampling is usually used for collecting grab samples and/or for immediate in-situ field analyses. However, it can also be used in lieu of automatic equipment over extended periods of time for composite sampling, especially when it is necessary to observe and/or for unusual waste stream conditions.

The best method to manually collect a sample is to use the actual sample container which will be used to transport the sample to the laboratory. This eliminates the possibility of contaminating the sample with an intermediate collection container. The actual sample container must always be used for collecting samples for oil and grease and bacterial analyses.

A separate collection container can be used to collect the sample, from which the sample can be redistributed to other containers. If this is done, however, the container used to collect the sample must be properly cleaned (Appendix A) and must be made of material that meets the requirements of the parameters

being investigated. Also, a separate container will be used at each sampling stations. This will avoid cross contamination between sampling station.

If the water or wastewater stream cannot be physically reached by the sampling personnel, an intermediate collection container may be used. The sample is collected by lowering a properly cleaned Teflon, plastic, glass, or stainless steel collection vessel (type of collection vessel used depends on the parameter being investigated) into the material to be sampled. The collection vessel may be lowered by hand or attached to a pole or rope and then lowered into the stream.

In some cases it may be best to use a pump, either power or hand operated, to withdraw a sample from the water or wastewater stream. If a pump is used, it is imperative that all components of the pump that come in contact with the liquid are properly cleaned (Appendix A) to insure the integrity of the sample.

Samples are manually collected by tipping the collection container in the water or wastewater stream so the mouth of the container faces upstream. The container should be rinsed with this procedure at least twice before the sample is collected (exceptions to this rinsing procedure exist if preservatives are present in the sampling container and for certain analyses such as oil and grease and bacteria).

5.5.6 Special Sample Collection Procedures

5.5.6.1 Trace Organic Compounds and Metals

Trace organic compounds and metals detection limits are usually in the parts per billion range, so extreme care must be exercised to insure sample integrity.

All containers, composite bottles, tubing, etc., used in sample collection for trace organic compounds and metals analyses should be prepared as described in Appendix A.

When possible, the sample should be collected directly into the appropriate sample container. If the material to be sampled cannot be physically reached, an intermediate collection device may be used. This should be a Teflon, glass, or stainless steel vessel on a pole or rope or Teflon tubing via a peristaltic type pump and a Teflon vacuum container attachment which converts a sample container into a vacuum container. The device which is used should be cleaned as described in Appendix A.

Personnel handling the sample should always wear a new pair of disposable surgical gloves with each set of samples collected.

This is necessary to prevent cross-contamination as well as for personal safety. A more detailed discussion is given in Section 5.2.10 under special precautions for trace contaminant sampling.

When an automatic sampler is used for collecting samples for trace organic compounds and metals analyses, the procedures described in the previous section on collecting organic compounds and metals analyses with automatic samplers should be use.

5.5.6.2 Bacterial

Samples for bacterial analysis will always be collected directly into the prepared glass or plastic sample bottle. The sample bottle should be kept unopened until it is to be filled. When the stopper is removed, care should be taken not to contaminate the stopper or the inside of the bottle. The bottle should be held near the base and filled to within about one inch of the top without rinsing and recapped immediately. The bottle should be plunged, neck downward, below the surface and turned until the neck points slightly upward. The mouth should be directed toward the current (REF. 4, 5). Table 1.3 presents preservation procedures and holding times.

When the samples bottle must be lowered into the waste stream, either because of safety or impracticality (manhole, slippery effluent area, etc.), care must be taken to avoid contamination.

5.5.6.3 Immiscible Liquids/Oil and Grease

Oil and grease may be present in wastewater as a surface film, an emulsion, a solution, or as a combination of these forms. Since it is very difficult to collect a representative sample for oil and grease analysis, the inspector must carefully evaluate the location of the sampling point. The most desirable sampling location is the point where greatest mixing is occurring. Quiescent areas should be avoided if possible. Because losses of oil and grease will occur on sampling equipment, the collection of a composite sample is impractical. Individual portions collected at prescribed time intervals must be analyzed separately to obtain the average concentrations over an extended period.

5.5.6.4 Purgeable Organic Compounds Analyses (VOA)

Samples to be analyzed for purgeable organic compounds should be stored in 40 ml septum vials with screw caps with a Teflon lined silicone disk in the cap to prevent contamination of the sample by the cap. This disks should be placed in the caps (Teflon side to be in contact with the sample) in the laboratory prior to the beginning of the sampling program.

When sampling for purgeable organic compounds, duplicate samples should always be collected from each location. The investigator should determine if the water to be sampled contains chlorine. If the water contains no chlorine, two 40 mL vials containing four drops of concentrated HCl should be filled with the sample and labeled PA (preserved acid). If the sample contains no chlorine and only if it will be analyzed within 24 hours, the HCl preservation is not necessary. If the water contains chlorine, the following sampling and preservation procedure should be followed:

- Fill a 4 ounce (120 mL) soil VOA sampling container containing 0.008 percent sodium thiosulfate with the water sample. Cap and mix thoroughly but gently by swirling to eliminate residual chlorine. Transfer the sample to two 40 mL VOA vials con-taining four drops of concentrated HCl*. Label 40 mL vial PTA (preserved/sodium thiosulfate/ acid).

The purgeable organics vials (40 mL) should be completely filled to prevent volatilization, and extreme caution should be exercised when filling a vial to avoid any turbulence which could also produce volatilization. The sample should be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to gently pour the last few drops into the vial so that surface tension holds the water in a "convex meniscus." The cap is then applied and some overflow is lost, but air space in the bottle is eliminated. After capping, turn the bottle over and tap it to check for bubbles; if any are present, repeat the procedure.

Sampling and preservation containers should be prelabeled (i.e., PA, Pt, or PTA) prior to any filed activities. This will reduce the chances of confusion during sampling activities by the investigation team.

5.5.7 Auxiliary Data Collection

While conducting waste-water sampling, the following information will also be obtained (if applicable):

- Field measurements - pH, DO, conductivity, and temperature.

- Flows associated with the samples collected -- continuous flows with composite samples and instantaneous flows with grab samples.

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*The sodium thiosulfate and acid preservatives must be added in this order and in two separate steps because HCl reacts with sodium thiosulfate.

- Diagrams and/or written descriptions of the wastewater treatment systems (if available).

- Photographs of pertinent wastewater associated equipment, such as flow measuring devices, treatment units, etc.

- O&M information on the wastewater treatment process (if applicable).

All observations, measurements, diagrams, etc., will be entered in bound field logbooks or attached thereto (where applicable).

5.6 Surface Water Sampling

5.6.1 General Considerations

Selection of a surface water sampling location for water quality studies is based on many factors, including:

- study objective
- water use
- point source discharges
- nonpoint source discharges
- tributaries
- changes in stream characteristics
- types of stream bed
- stream depth
- turbulence
- presence of structures (weirs, dams, etc.)
- accessibility
- personnel available

When sampling in estuarine systems, tidal effects must be considered in citing sampling locations.

If the study objective is to investigate a specific location as a source of water supply, recreation or other discrete use, then considerations such as accessibility, flow, velocity, physical characteristics, etc. are not as critical from a water quality investigation standpoint.

If the objective of a water quality study is to determine patterns of pollution, provide data for mathematical modeling purposes, conduct assimilative capacity studies, etc. where more than a single sampling location is to be investigated, then several factors become interrelated and need to be considered in sampling location selection. An excellent guide to conducting surface water stream studies is F. W. Kittrells, "A Practical Guide to Water Quality Studies" (REF. 6).

5.6.2 Sample Site Selection

Before any sampling is conducted, an initial reconnaissance should be made to locate suitable sampling locations. Bridges and piers are normally good choices as sites since they provide ready access and permit water sampling at any point across the width of the water body. However, these structures may alter the nature of water flow and thus cause sediment deposition or scouring. Additionally, bridges and piers are not always located in desirable locations with reference to waste sources, tributaries, etc. Wading for water samples is not recommended in lakes, ponds, and slow-moving rivers and streams because bottom deposits are easily disturbed, thereby resulting in increased sediment in the overlying water column. On the other hand, wadeable areas may be best for sediment sampling. In slow-moving or deep water, a boat is usually required for sampling.

Sample station locations can be chosen without regard to other means of access if the stream is navigable by boat, especially in estuarine systems where boats frequently provide the only access to critical sampling locations.

Walking to collect samples may be feasible in some cases, but this method usually will be chosen for only very small streams. A field investigator usually has to carry a considerable amount of sampling equipment, field analytical kits, and water samples. When it also is necessary to wear rubber boots to walk the stream or to wade out to the main current, the physical effort involved often makes this method too difficult to be practical.

Fresh water environments are commonly separated into two types:

- rivers, streams, and creeks
- lakes, ponds, and impoundments

Since these waterways differ considerably in general characteristics, site selection must be adapted to each. Estuarine environments are a special case and are discussed separately.

Rivers, Streams, and Creeks

In the selection of a surface water sampling site on rivers, streams, and creeks, areas that exhibit the greatest degree of cross-sectional homogeneity shall be located. When available, previously collected data may indicate if potential sampling locations are well mixed or vertically or horizontally stratified. Since mixing is principally governed by turbulence and water velocity, the selection of a site immediately downstream of a riffle area will insure good vertical mixing. These locations are

also likely areas for deposition of sediment since the greatest deposition occurs where stream velocity slows down. Horizontal (cross-channel) mixing occurs in constrictions in the channel, but because of velocity increases, the stream bottom may be scoured, and therefore, a constriction is a poor sediment sample location. In the absence of turbulent areas, the selection of a site that is clear of immediate point sources, such as tributaries and industrial and municipal effluents, is preferred for the collection of water samples.

Typical sediment depositional areas are located inside of river bends, downstream of islands, and downstream of obstructions in the water. Sites that are located immediately upstream or downstream from the confluence of two streams or rivers should generally be avoided since flows from two tributaries may not immediately mix, and the sediment may be moving almost as two streams in proportion to the inflow from the tributaries. Potential sites upstream from the confluence with another stream may also be unsuitable at times due to possible back-flow which can upset the normal movement of sediment.

When several stations along a stream reach are to be sampled, they should be strategically located:

- They shall be spaced at intervals based on time-of-water-travel not distance. A general rule of thumb is about one-half day time-of-water-travel for the first three days downstream of a waste source and approximately one day through the remaining distance.

- If the study is to be compared to a previous study, the same sampling stations should be used, if possible, for comparison purposes.

- A station should be located whenever a marked physical change occurs in the stream channel. Example: A stream reach between two adjacent stations should not include both a long rapids section of swift shallow water with a rocky bottom, and a long section of deep, slow-moving water with a muddy bottom. Stations at each end of the combined reach would yield data on certain rates of change, such as re-aeration, that would be an unrealistic average of two widely different rates. Much more would be learned of the actual natural characteristics of the stream by inserting a third sampling station within the reach, between the rapids and the quiet water sections.

Dams and weirs cause changes in physical characteristics of a stream that may be similar to the above rapids-quiet water situation. They usually create quiet, deep pools in river reaches

that, by comparison, formerly were swift and shallow. Such impoundments should be bracketed. When times of water travel through them are long, stations should be established within the impoundments.

Some stream structures, such as dams, permit overflow that accomplishes significant reaeration of oxygen deficient water. In such cases, stations should be located short distances upstream and downstream from the structures to measure the rapid, artificial increase in dissolved oxygen (DO), which is not representative of natural reaeration.

A minimum of three stations located between any two points of major change in a stream is a desirable precaution, when feasible, even when the time-of-travel between the points of change is short. Major changes may consist of a waste discharge, a tributary inflow, or a significant difference in channel characteristics. The use of three stations is especially important when rates of change of unstable constituents are being determined. If results from one of only two stations in a subreach are in error for some unforeseen reason, it may not be possible to judge which of the two sets of results indicate the actual rate of change. Results from at least two of three stations, on the other hand, will probably support each other and indicate the true pattern of water quality in the subreach.

If there is interest in the effects of certain discharges or tributary streams on ambient waster quality, sites should be located both upstream and downstream from the tributaries or dischargers.

Unless a stream is extremely turbulent, it is nearly impossible to fix the effect of a waste discharge or tributary immediately downstream from the point source. Inflow frequently hugs the stream bank with very little lateral mixing for some distance. This is a major consideration in estuarine environments. Samples from quarter points may miss the wastes altogether and reflect only the quality of water above the waste source. Samples taken directly in the portion of the cross section containing the waste would indicate excessive effects of the waste with respect to the river as a whole.

The station on a tributary should be as near the mouth as is feasible. This may be a bridge some distance upstream from the mouth. Frequently, the mouths of tributaries may be entered from the main stream for sampling when collection in the main stream is by boat. Care should be exercised to avoid collecting water from the main stream that may flow into the mouth of the tributary on either the surface or bottom because of differences in density resulting from temperature, dissolved salts, or turbidity.

Actual sampling locations will vary with the size of the water body and the amount of turbulence in the stream or river. Generally, with small streams less than 10 feet wide, 1 sampling site can be found where the water is well mixed. In such cases, a single grab sample taken at mid-depth at the center of the channel is adequate to represent the entire cross-section. A sediment sample can also be collected at the center of the channel. For slightly larger streams, at least one vertical composite should be taken from mid-stream, with samples taken just below the surface, at mid-depth, and just above the bottom. Of course, the measurement of DO, pH, temperature, conductivity, etc., should be on each aliquot of the vertical composite. The measurement of such parameters on the vertical composite is not generally useful and is not to be conducted. For rivers, several verticals should be sampled. These vertical composites should be closer together toward mid-channel, where most of the flow travels, than toward the banks, where the proportion of total flow is smaller. The number of vertical composite required and the number of depths sampled for each are usually determined in the field by the sampling crew. This determination is based on a reasonable balance between two considerations:

- The larger the number of subsamples, the more nearly the composite sample will represent the water body.

- Taking any subsample is time-consuming, expensive, and increases the chance of contamination.

In most circumstances, a number of sediment samples should be collected along a cross-section of a river or stream in order to adequately characterize the bed material. A common procedure is to sample at quarter points along the cross-section of the site selected. When the sampling technique or equipment requires that the samples be extruded or transferred at the site, they can be combined into a single composite sample. However, samples of dissimilar composition should not be combined but should be stored for separate analysis in the laboratory.

Lakes, Ponds, and Impoundments

Lakes, ponds, and impoundments have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more samples be obtained. Occasionally,an extreme turbidity difference may occur vertically where a highly turbid inflowing river enters a lake, and each layer of the stratified water column needs to be considered. Since the stratification is caused by water temperature differences, the cooler, heavier river water is beneath the warmer lake water. A temperature profile of the water column as well as visual observation can detect the different layers and they can be sampled separately.

The number of water sampling sites on a lake, pond, or impoundment will vary with the size and shape of the basin. In ponds and small impoundments, a single vertical composite at the deepest point may be sufficient. Similarly, the measurement of DO, pH, temperature, etc., is to be conducted on each vertical composite aliquot. In naturally-formed ponds, the deepest point is usually near the center; in impoundments, the deepest point is usually near the dam.

In lakes and larger impoundments, several vertical subsamples should be composited to form a single sample. These verticals are often taken along a transactor grid. Again, the number of vertical subsamples and the depths at which subsamples are taken are usually at the discretion of the sampling crew. In some cases, it may be of interest to form separate composites of epilimnetic and hypolimnetic zones, but normally a composite shall consist of several vertical subsampels collected at various depths.

In lakes with irregular shape and with several bays and coves that are protected from the wind, additional separate composite samples may be needed to adequately represent water quality. Similarly, additional samples should be taken where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

When collecting sediment samples in lakes, pond, and reservoirs, the site selected should be approximately at the center of water mass. This is particularly true for reservoirs that are formed by the impoundment of rivers or streams. Generally, the coarser grained sediments are deposited near the headwaters of the reservoir, and the bed sediments near the center of the water mass will be composed of fine-grained materials. The shape, inflow pattern, bathymetry, and circulation must be considered when selecting sediment sampling sites in lakes or reservoirs.

Estuarine Waters

Estuarine areas are zones where inland freshwaters (both surface and ground) mix with oceanic saline waters. Estuaries are generally categorized into three types, dependent upon freshwater inflow and mixing properties (REF. 7, 8, 9, 10):

- Mixed estuary -- is characterized by an absence of vertical halocline - (gradual or no marked increase in salinity in the water column) and a gradual increase in salinity seaward. Typically this type of estuary is found in major freshwater sheetflow areas featuring shallow depths.

- Salt wedge estuary -- is characterized by a sharp vertical increase in salinity and channelized freshwater inflow into a deep estuary. In these estuaries, the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally, back and forth, with the tidal phase.

- Oceanic estuary -- is characterized by salinities approaching full strength oceanic waters. Seasonally, freshwater inflow is small with the preponderance of the fresh saline water mixing occurring near or at the vegetated shore line.

A reconnaissance investigation should be conducted for each estuarine study unless prior knowledge of the estuarine type is available. The reconnaissance should focus upon the freshwater and oceanic water dynamics with respect to the study objective. In this regard, National Oceanic Atmospheric Administration tide tables and USGS freshwater surface water flow records provide perspective to the estuary dynamics. The basic in-situ measurement tools for reconnaissance are:

- boat
- recording fathometer
- salinometer
- dissolved oxygen meter

These instruments coupled with the study objective or pollution source location, whether it is a point or nonpoint source problem, provide the focus for setting sampling locations. More often than not, preplanned sampling locations in estuarine areas are changed during the actual study period. Due to the dynamics of estuaries, initial sampling often reveals that the study objective could be better served by relocating, adding, or deleting sampling locations.

Sampling in estuarine areas is normally based upon the tidal phases, with samples collected on successive slack tides (REF. 11).

All estuarine sampling programs conducted by branch personnel shall include vertical salinity measurements at one to five-foot increments coupled with vertical DO and temperature profiles. A variety of water sampling devices are used, but in general, the Van Dorn (or similar type) horizontal sampler is employed.

Samples are normally collected at mid-depth in areas where the depths are less than 10 feet, unless the salinity profile indicates the presence of a halocline (salinity stratification). In that

case, samples are collected from each stratum. Depending upon the study objective, when depths are greater than 10 feet, water samples may be collected at the one foot depth, mid-depth, and one foot from the bottom.

In general, estuarine investigations are two phased, with study investigations conducted during wet and dry periods. Depending upon the freshwater inflow sources, estuarine water quality dynamics cannot normally be determined by a single season study.

For a complete discussion of estuarine systems, refer to References 7, 8, 9, 10.

Control Stations

In order to have a basis of comparison of water quality, the collection of samples from control stations is always necessary. A control station above the source of waste is fully as important as are stations below, and should be chosen with equal care to ensure representative results. At times it may be desirable to locate two or three stations above the waste inflow to establish the rate at which the unstable material is changing. The time of travel between the stations should be sufficient to permit accurate measurement of the change in the constituent under consideration.

5.6.3 Sampling Equipment and Techniques

General

Any equipment or sampling techniques used to collect a sample are acceptable as long as they do not cause the integrity of the sample to be violated and they provide a sample which is representative of the stream being sampled.

Water Sampling Equipment/Techniques

The physical location of the investigator when collecting a sample may dictate the equipment to be used. If surface water samples are required, direct dipping of the sample container into the stream is desirable. This is possible, however, only from a small boat, a pier, etc., or by wading in the stream. Wading, however, may cause bottom deposits to rise and bias the sample. Wading is acceptable if the stream has a noticeable current (is not impounded), and the samples are collected directly into the bottle while pointed upstream. If the stream is too deep to wade or if the sample must be collected from more than one water depth or from a bridge, etc., supplemental sampling equipment must be used.

For most samples, including those for trace organic compounds or metals analyses, a Teflon coated Nansen bottle (or equal) or DO dunker can be used. Teflon allows the container to be properly cleaned (decontaminated). The Nansen bottle allows specific depth samples to be collected.

Except when the DO dunker's air vents are valved to allow opening at a specific depth, the DO dunker allows water to slowly enter the chamber as it moves downward through the water column. This is usually useful, though, since it allows a composite of the water column to be collected rather than a grab at a single depth.

In addition to using the DO dunker for collecting samples for subsequent analyses, the DO dunker has the capability for placing two DO bottles inside for collecting water directly into the bottles with the proper overflow collection procedures. Additionally, a bacteriological or oil and grease bottle can be attached to the top of the dunker for direct sample collection. (However, these could be used only for stream surface samples.)

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon coated sampler, a standard Kemmerer or Van Dorn sampler may be used. The Kemmerer sampler is a brass cylinder with rubber stoppers that leave the ends open while being lowered in a vertical position to allow free passage of water through the cylinder. The Van Dorn sampler is plastic and is lowered in a horizontal position. In each case, a messenger is sent down the rope when the sampler is at the designated depth, to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill respective sample bottles. With a rubber tube attached to the valve, DO sample bottles can be properly filled by allowing an overflow. With multiple depth samples, care should be taken not to stir up the bottom sediment and thus bias the samples.

A plastic bucket can be used to collect samples if the parameters to be analyzed do not preclude it. However, the bucket should be rinsed twice with the sample water prior to collection of the sample. Also, an acid rinsed plastic bucket can be used to collect samples for trace metals analyses and a solvent rinsed stainless steel bucket can be used to collect samples for trace organic compounds analyses.

Sediment Sampling Equipment/Techniques

To collect a sediment sample from a stream, a variety of methods can be used. Dredging (Peterson, Eckman, Ponar), coring, and scooping (BMH-60) are available. Regardless of the method used, precautions shall be taken to insure that the sample collected is representative of the stream. These methods are discussed in the following paragraphs.

Dredging

For routine analyses, the Peterson dredge is preferable when the bottom is rocky, in very deep water, or when the stream velocity is high. The dredge should be lowered very slowly as it approaches bottom, because it can displace and miss lighter materials if allowed to drop freely.

The Eckman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high velocities. It should not be used from a bridge more than a few feet above the water, because the spring mechanism which activates the sampler can be damaged by the messenger if dropped from too great a height.

The Ponar dredge is a modification of the Peterson dredge and is similar in size and weight. It has been modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends thus reducing the "shock wave." The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates.

Corers

Core samples are used to sample vertical columns of sediment. They are particularly useful when a historical approach to sediment deposition is desired for they preserve the sequential layering of the deposit. Many types of coring devices have been developed depending on the depth of water from which the sample is to be obtained, the nature of the bottom material, and the length of core to be collected. They vary from hand push tubes to weight or gravity driven devices.

Coring devices are particularly useful in pollutant monitoring because the "shock wave" created by descent is minimal, thus the fines of the sediment-water interface are only minimally disturbed; the sample is withdrawn intact permitting the removal of only those layers of interest; core liners manufactured of glass or Teflon can be purchased, thus reducing possible sample contamination; and the samples are easily delivered to the lab for analysis in the tub in which they were collected. The disadvantage of coring devices is that a relatively small surface area and sample size is obtained often necessitating repetitive sampling in order to obtain the required amount for analysis. Because it is felt that this disadvantage is offset by the advantages, coring devices are recommended in sampling sediments for trace organic compounds or metals analyses.

In shallow, wadeable waters, the direct use of a core liner or tube manufactured of Teflon or glass is recommended for the collection of sediment samples. Their use can also be extended to deep waters when SCUBA equipment is available. Teflon is preferred to avoid glass breakage and possible sample loss. Stainless steel push tubes are also acceptable and provide a better cutting edge and higher strength than Teflon. The use of the glass or Teflon tube by itself eliminates any possible metal contamination from core barrels, cutting heads, and retainers. The tube should be approximately 12 inches if only recently deposited sediments (8 inches or less) are to be sampled. Longer tubes should be used when the depth of the substrate exceeds eight inches. Soft or semi-consolidated sediments such as mud and clays have a greater adherence to the inside of the tube and thus can be sampled with larger diameter tubes. Because coarse or unconsolidated sediments such as sands and gravel tend to fall out of the tube, a small diameter is required for them. A tube about two inches in diameter is usually the best size. The wall thickness of the tube should be about 1/3 inch for either Teflon or glass. The inside wall may be filed down at the bottom of the tube to facilitate entry of the liner into the substrate.

Caution should be exercised not to disturb the area to be sampled when the sample is obtained by wading in shallow water. The core tube is pushed into the substrate until only four inches or less of the tube is above the sediment-water interface. When sampling hard or coarse substrates, a gentle rotation of the tube while it is pushed will facilitate greater penetration and cut down on core compaction. The tube is then capped with a Teflon plug or a sheet of Teflon held in place by a rubber stopper or cork. After capping, the tube is slowly extracted, the negative pressure and adherence of the sediment keeping the sample in the tube. Before pulling the bottom part of the core above the water surface, it too is capped.

To help prevent contamination from direct contact between the sampler's hands and the upper part of the tube, a collar-type device should be constructed of wood and should have a circular recess to accept the top of the tube. The recess should have a hole in it to allow water to pass through when pushing the tube in, and should be lined with sheet Teflon. Handles should be attached to the sides of the collar. After the tube is driven in, impart a wide circular motion to help loosen the core for easy removal; take off the collar device; cap the top of the tube (as described above); pull it up out of the sediment layer; and cap the bottom of the tube before removing it from the water.

For a detailed description of several types of coring devices, refer to "Sampling Protocols for Analysis of Toxic Pollutants in Ambient Water, Bed Sediment and Fish" (REF. 12).

Scooping

If the water is wadeable, the easiest and most acceptable way to collect a sediment sample is to scoop the sediment using a stainless steel spoon or grain scoop. This reduces the potential for cross-contamination. This method is accomplished by wading into the stream, and while facing upstream (into the current), scooping the sample along the stream bottom in the upstream direction. If the stream is too deep to wade but less than eight feet deep, a stainless steel grain scoop attached to a piece of conduit can be used either from the banks if the stream is narrow or from a boat.

If the stream has a significant flow and is too deep to wade, a BMH-60 sampler may be used. It is not particularly efficient in mud or other soft substrates because its weight will cause penetration to deeper sediments, which are not desired when sampling for priority pollutants. It is also difficult to release secured samples in an undisturbed fashion that would readily permit subsampling. The BMH-60 may be used for priority pollutant sampling provided that caution is exercised by only taking subsamples that have not been in contact with the metal walls of the sampler.

Mixing

Regardless of the method of collection, sediment samples collected for chemical analysis should be thoroughly mixed before being placed in the appropriate sample containers. The sediment should be removed from the sampling device (dredge, core tube, scoop, etc.) and placed in a glass or Teflon coated stainless steel pan, then thoroughly mixed using a stainless steel or Teflon coated stainless steel spoon. The sediment in the pan should be scraped from the sides, corners, 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 container. Each quarter of the sample should be mixed individually. Each quarter is then rolled to the center of the container and the entire sample is mixed again. This procedure should be continued to ensure that all parts of the sample are mixed and that the sample is a homogeneous as possible before being placed in the sample containers.

5.6.4 Special Sample Collection Techniques

Trace Organic Compounds and Metals

Since trace organic compounds and metals are usually found in extremely low concentrations in ambient waters, the possibility of contamination is greater than with sediment or fish. Precautions must be taken with sampling equipment and preservatives to ensure that contamination does not occur.

The Teflon coated DO dunker or Nansen bottle (previously described), when properly cleaned (Appendix A) is acceptable for collecting water samples from streams for trace organic compound and metals analyses. However, instead of filling separate sample bottles with each retrieval, a sufficient volume for all sample containers should be collected in a large glass compositing jug and then, with mixing, be alternately siphoned or poured into the respective sample bottles. This is especially necessary when splitting samples for quality control purposes. Direct dipping of the sample containers is also an acceptable method of collecting surface water for priority pollutants analyses.

Most priority pollutants are partitioned more strongly in sediment than in water; thus, if these pollutants have been deposited recently and are not quickly degraded or desorbed, they are evident in the sediment analysis. Ideally, only Teflon, stainless steel, or glass should be used in sediment sampling for priority pollutant analyses. The method using glass or Teflon coring tubes, as discussed previously, is the preferred technique.

In many situations when the water is deep or the only sampling location is from a bridge, a dredge may be used. In these cases, a high grade stainless steel Ponar dredge (properly clean, Appendix A) shall be used to collect the sediment samples. Direct scooping of the stream sediment as described earlier is acceptable.

Bacterial

Samples for bacteriological examination must be collected in bottles properly sterilized and protected against contamination. The preferable method is to scoop up the water with the open bottle just below the surface. This method usually is used when sampling by boat. While the bottle is open, both bottle and stopper must be protected against contamination. A small amount of water should be poured from the bottle after filling to leave an air space for subsequent shaking in the laboratory. The bottle should be closed at once.

When sampling from a bridge, the sterilized sample bottle can be placed in a weighted frame, opened, and then lowered to the water with a string or rope. The bottle can also be lowered by attaching twine directly to it. Care should be taken not to dislodge dirt or other material from the bridge that will fall into the open bottle. The mouth of the bottle may be faced upstream by swinging the bottle downstream under the bridge and dropping it quickly but without excessive slack in the rope. The bottle is then pulled upstream and out of the water.

Special equipment of collecting sterile samples at various depths, when essential, is available. The JZ sampler, for example, includes a metal frame to hold the sample bottle, two sterile glass tubes connected by a rubber tube and inserted through the sterile bottle stopper, and a messenger. One of the glass tubes is bent so that the upper portion is horizontal. This portion is positioned next to the rope. The messenger breaks this tube, which allows the bottle to fill. The bottle, glass tube and rubber tube must be properly sterilized before use. Additional guidance for collecting samples for bacterial analyses is given in References 4, 5.

Purgeable Organic Compounds Analyses (VOA)

Water samples to be analyzed for purgeable organic compounds should be stored in 40 mL septum vials with screw cap and Teflon-silicone disk in the cap to prevent contamination of the sample by the cap. The disks should be placed in the caps (Teflon side to be in contact with the sample) in the laboratory prior to the beginning of the sampling program.

The vials (40 mL) should be completely filled to prevent volatilization, and extreme caution should be exercised when filling a vial to avoid any turbulence which could also produce volatilization. The sample should be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to gently pour the last few drops into the vial so that surface tension holds the water in a sort of "convex meniscus." The cap is then applied and some overflow is lost, but air space in the bottle is eliminated. After capping, turn the bottle over and tap it to check for bubbles; if any are present, repeat the procedure. Since the VOA vials are pre-preserved, extreme caution should be exercised when the vials are used as the collection device for surface samples in order to prevent the loss of the preservative. The best procedure is to not completely fill the vial and to use the vial cap to collect enough water to top-off the sample.

When collecting water samples for purgeable organic compounds, duplicate samples should always be collected from each location. Two 40 mL vials containing four drops of concentrated HCl should be filled with sample and labeled PA (preserved acid).

Sediment samples for purgeable organic compounds analyses should be thoroughly but gently mixed with a precleaned stainless steel spoon in a precleaned compositing container (Appendix A). The 4-ounce (120 mL) sample container should be filled completely; no head space should remain in the sample containers.

5.6.5 Auxiliary Data Collection

A bound field log book will be used to record daily activities, describe sampling locations and techniques, list photographs taken, document weather and stream conditions during the investigation, record water and tide stage, etc. Visual observations are particularly significant and may prove invaluable in interpreting water quality study results. These visual observations should also be recorded in field records.

5.6.6 Specific Sampling Equipment Quality Assurance Procedures

All water and sediment sampling equipment shall be cleaned as outlined in Appendix A after field use and before being stored. This equipment shall be inspected and tested before being issued for each field study. Any repairs necessary shall be made and recorded.

During field studies, this equipment shall be cleaned as outlined in Appendix A and all such cleaning procedures shall be documented in field records.

5.7 GROUND-WATER SAMPLING

5.7.1 General Considerations

Ground-water sampling may be required for a variety of reasons, such as examining potable or industrial water supplies, checking for and/or tracking contaminant plume movement in the vicinity of a land disposal or spill site, RCRA compliance monitoring, or examining a site where historical information is minimal or non-existent, but where it is thought ground water contamination could have occurred.

Ground water is usually sampled through an in place well, either temporarily or permanently installed. However, it can also be sampled anywhere ground water is present, as in a pit or a dug or drilled hole.

Occasionally, a well will not be in the ideal location to obtain the sample needed; for example, to track a contaminant plume. In that case, a well will have to be installed, and it may be either a temporary or permanently installed well. An experienced and knowledgeable person, preferably a hydrogeologist, will need to locate the well and supervise its installation so that the samples ultimately collected will be representative of the ground water.

Additional guidance is given in the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" (REF. 13); the ground-water sampling procedures used will meet the intent of this document.

5.7.2 Sample Site Selection

The relationship of the following factors to potential pollution sources shall be considered and evaluated when selecting ground-water sampling sites; the direction of ground-water flow; depth to ground water; thickness of the aquifer (if applicable); type of stratigraphy; presence of perched water cables; types of soils; depth of bedrock; type of vegetation; surface drainage patterns; type of topography; general land use; and surface features such as rock outcrops, seeps, springs, streams, rivers, and wet areas (REF. 14). The area of interest should be located on an aerial photograph, a USGS 7.5 minute quadrangle map, a USDA soils map, and/or any other appropriate map that shows topography and general relationships between surface features. Aerial photographs can usually be obtained at the local Agricultural Stabilization Conservation Service office or the local county tax office. USGS 7.5 minute quadrangle maps can be acquired from the State Geological Survey or from the USGS, and soils maps from the USDA-SCS. A visual inspection of the area may be sufficient to evaluate and determine the surface conditions and their relationship to the subsurface conditions (REF. 14). In some cases, surface conditions and subsurface conditions cannot be correlated by site inspection or reconnaissance. When this occurs, a more detailed study, possibly involving test drilling, will have to be conducted.

It is extremely important to sample the unconfined or surficial aquifer downgradient of potential pollution sources or spills to determine if this aquifer has been affected. Generally the direction of ground-water flow can be estimated by two vectors - one in the direction of surface water flow (i.e., downstream) and another toward the surface water stream or river, if present. The relative magnitude of these vectors will vary according to site conditions and in some instances both direction and magnitude may be changed by construction activities. If both a shallow and deep aquifer are involved in the zone of interest, a screening study will reveal whether or not the deep aquifer needs to be sampled and a more detailed study is required. To adequately assess subsurface conditions, a minimum of three wells are required, one in the upgradient portion of the area of interest, one in the middle portion, and one in the downgradient portion. In some cases, a more complex system of wells may be needed to define the subsurface conditions, especially in establishing the depth to the shallow ground-water aquifer and direction of ground-water movement. Site conditions and the scope of the project will determine the total

number of wells required. Existing wells should be used when possible. Where well installation is necessary, the wells should be installed according to the following procedures.

5.7.3 Monitoring Well Installation

Wells shall be dug, driven, drilled, or bored depending on the scope of work. Hand equipment such as augers, post hole diggers, picks, and shovels can be used to dig shall wells in soft soils. Wells can also be installed by driving a piece of casing connected to a well point into the ground with an axe, sledge hammer, or mechanical or power device. Power equipment such as drilling rigs can be used to drill or auger wells in all types of soils and to any depth (REF. 15, 16, 17).

Where feasible the following procedures shall be used for well installation:

Temporary Monitoring Wells

For very shallow wells (<15 feet) in soft material, hand augers or small portable power augers shall be used for boring. A temporary stainless steel well casing with a well screen attached shall be installed as soon as the hole is augered.

For deeper temporary wells, larger well drilling equipment should be used with a hollow stem auger where possible. The use of a hollow stem auger prevents cave-in of the hole during drilling, allows for the collection of soil samples at various depths during the drilling operation, and may serve as a temporary casing for the well. In some cases the bottom of the auger will become plugged and not allow water to flow into the casing. When this happens, the auger should be pulled and the hole allowed to fill with water. A well casing can be installed if caving occurs.

When the water table is 25 to 30 feet deep, permanent well installation procedures should be considered.

Permanent Monitoring Well

Permanent monitoring wells shall be installed using hollow stem augers or continuous flight augers in soil and by standard rock coring procedures in rock. Where site conditions do not warrant the use of augers, alternate drilling methods such as mud, or air rotary can be used. When muds are used, a sample of the mud shall be collected for appropriate analyses. Casings with well screens shall be installed in unconsolidated and semi consolidated soils to prevent soil and other foreign material from entering the well during pumping. Screens may or may not be required for wells in rock. The space surrounding the screen should be back filled

with sand and the remainder of the space surrounding the casing above the screen should be backfilled with natural clay, bentonite and/or cement bentonite grout, depending on the conditions at the site. Stainless steel well casings are preferred if samples are to be collected for organic compounds analyses. PVC casings are acceptable where organic contaminants are not a concern or under extremely corrosive conditions (REF. 18).

Monitoring Well Security

Wells should be capped and locked at the conclusion of sampling for future use, or if the well will not be used in the future, it should be properly abandoned by backfilling with suitable permanent fill materials such as concrete, bentonite, compatible soil, or a combination of these materials (REF. 15).

5.7.4 Monitoring Well Development

All permanently installed wells shall be adequately developed prior to initial sampling efforts (REF. 14). Adequate development should eliminate all fine material from the area of the well screen and allow for the collection of a sample which is free of suspended materials. Wells installed by "wet drilling" where drilling muds are used shall be developed so that residual drilling muds will not settle around the well screens or in the surrounding soil and contaminate future sampling.

Various methods may be used to develop wells. These methods consist of suction lift pumping (pitcher, centrifugal, roller, piston, peristaltic pumps), pressure ejection pumping, submersible pumping, surge blocks, and bailing (REF. 15, 16, 17).

5.7.5 Purging Equipment and Techniques

General

Wells shall be purged before taking samples in order to clear the well of stagnant water which has been standing in the well casing and may not be representative of aquifer conditions. One method of purging is to pump the well until three to five times the volume of standing water in the well has been removed. A second method is to pump the well until the specific conductance, temperature and pH of the ground water stabilizes. Normally, a combination of the two methods is employed (i.e., specific conductance, temperature, and pH are measured at intervals and a record of the volume purged is monitored). If a well is pumped dry, this constitutes an adequate purge and the well can be sampled following recovery (REF. 15, 17).

Purging Techniques (Wells Without Plumbing or In Place Pumps)
General

For permanently installed wells, the depth of water shall be determined (if possible) before purging. This can be accomplished by attaching a weight on the end of a tape and lowering it into the well until it touches the water, or by use of a mechanical or electrical water level indicator. Personnel shall exercise extreme caution during this procedure to prevent contamination of the well. This is a critical concern when samples for trace organic compounds or metals analyses are collected.

Using Pumps to Purge

When suction lift or centrifugal pumps are used, only the intake line is placed into the water column. To minimize contamination, the line placed into the water is either standard cleaned (see Appendix A) Teflon, in the case of the suction lift pumps, or standard cleaned stainless steel pipe attached to a hose, when centrigual pumps are used.

When submersible pumps (bladder, turbine, displacement, etc.) are used, the pump itself is lowered into the water column.

Using Bailers to Purge

Standard cleaned (Appendix A) closed-top Teflon bailers with new nylon rope are lowered into top of the water column, allowed to fill, removed and the water is discarded.

Field Care of Purging Equipment

Regardless of which method is used for purging, new aluminum foil or plastic sheeting shall be placed on the ground surface around the well casing to prevent contamination of the pumps, hoses, ropes, etc. in the event they need to be placed on the ground during the purging or accidentally come into contact with the ground surface.

It is preferable that hoses used in purging that come contact with the ground water be kept on a spool, both during transporting and during field use, to further minimize contamination from the transporting vehicle or ground surface.

Purging Entire Water Column

The pump/hose assembly or bailer used in purging should be lowered into the top of the standing water column and not deep into the column. This is done so that the purging will "pull" water from the formation into the screened area of the well and up

through the casing so that the entire static volume can be removed. If the pump was placed deep into the water column, the water above the pump may not be removed, and the subsequent samples collected may not be representative of the ground water.

To minimize cross contamination between wells, no more than three to five feet of hose should be lowered into the water column. If the recovery of the well is at least as fast as the pump rate, the pump may be left hanging at the initial level until an adequate volume has been purged. If the pump rate exceeds the recovery rate of the well, the pump well have to be lowered, as needed, to accommodate the drawdown.

After the pump is removed from the well, all wetted portions of the hose and the pump shall be cleaned as outlined in Appendix A.

Careful consideration shall be given to using pumps to purge wells which are excessively contaminated with oily compounds, because it may be difficult to adequately decontaminate severely contaminated pumps under field conditions. When wells such as this are encountered, alternative purging methods, such as bailers, should be considered.

Purging Techniques - Wells With In Place Plumbing

General

In place plumbing is found at water treatment plants, industrial water supply wells, private residences, etc. The objective of purging is the same as with monitoring wells without in place pumps to ultimately collect a sample representative of the ground water.

The volume to be purged depends on several factors: whether the pumps are running continuously or intermittently, how close to the source the sample can be collected, and the presence of any storage/pressure tanks between the sampling point and the pump. If storage/pressure tanks are present, an adequate volume must be purged to totally exchange the volume of water in the tank.

Continuously Running Pumps

If the pump runs continuously, and the sample can be collected prior to a storage/pressure tank, no purge, other than opening a valve and allowing it to flush for a few minutes, is necessary.

If the pump runs continuously, and a storage/pressure tank is located ahead of the sample location, the purge must include the entire storage volume to be sure that a sample representative of the ground water will be collected.

Intermittently Running Pumps

If the pump runs intermittently, it is necessary to determine the volume to be purged, including storage/pressure tanks that are located ahead of the sampling location.

The pump should then be run continuously until the required volume has been purged.

5.7.6 Sampling Techniques

Sampling Techniques - Wells With In Place Plumbing

Samples should be collected following purging from a valve or cold water tap as near to the well as possible. Samples should be collected directly into the appropriate containers.

Sampling Techniques - Wells Without Plumbing

Following purging, samples should be collected using a peristaltic pump/vacuum jug procedure, if possible, or with a closed top Teflon bailer. The pump used for purging generally should not be used for sampling. When the peristaltic pump is used, samples for purgeable organic compounds should be collected using a bailer or by allowing the Teflon tube to fill and then allowing the water to drain into the sample vials. All equipment shall be cleaned using the procedures described in Appendix A. Also, refer to the Potable Water Supply discussion, Section 5.8, for additional information.

When bailing, new foil or plastic sheeting should be placed on the ground around each well to prevent contamination of sampling equipment in the event any equipment is dropped or otherwise comes in contact with the ground. Braided nylon cord may be used to haul the bailer if the nylon cord is used only one time and discarded. Teflon coated wire, singe strand stainless steel wire, or monofilament are acceptable for hauling bailers and may be decontaminated for reuse.

5.7.7 Special Sample Collection Procedures

Trace Organic Compounds and Metals

Special sample handling procedures shall be instituted when trace contaminant samples are being collected. All sampling equipment, including pumps, bailers, drilling equipment, water level measurement equipment, etc., which come into contact with the water in the well must be cleaned in accordance with the cleaning procedures described in Appendix A. Synthetic drilling mud (i.e., Revert) should not be used when constructing wells which will be

used for trace contaminant sampling. Pumps shall not be used for sampling, unless the interior and exterior portions of the pump and discharge hoses can be thoroughly cleaned. Blanks should be collected to determine the adequacy of cleaning prior to collection of any sample using a pump. Peristaltic pumps using Teflon tubing and a Teflon insert can be used to collect samples without the sample coming into contact with the pump. This is accomplished by placing the Teflon insert into the opening at a standard cleaned gallon glass container (Appendix A). The Teflon tubing connects the container to the pump and sample source. The pump creates a vacuum in the container, thereby drawing the sample into the container without coming into contact with the pump tubing. Procedures for collecting samples for purgeable organic compounds analyses (VOA) are also given in the Wastewater Sampling Section 5.5. Samples for purgeable organic compounds analyses shall be collected with well bailers or by allowing the Teflon tube to fill and ten allowing the water to drain into sample collection vials. The procedures given in the General Considerations, Special Precautions for Trace Contaminant Sampling (Section 5.2.11) shall be followed.

Filtering

As a standard policy, ground-water samples should not be filtered in the field. However, if required by RCRA regulations, then both filtered and non-filtered samples will be submitted for analyses. Proper well installation and development as well as proper well purging technique should minimize the turbidity of samples. Whenever extremely high concentrations of sediment are present in a well sample, the aliquot of the sample for metals analyses should not be preserved without first being filtered. Whenever samples for dissolved metals analyses are collected, an additional sample, unfiltered and acid preserved will also be collected for total metals analyses. Samples for analyses of organic compounds shall never be filtered. When samples are being filtered in the field, the filter apparatus must be cleaned (Appendix A) and samples must be filtered.

Bacterial Sampling

Whenever wells (normally potable wells) are sampled for bacteriological parameters, care must be taken to ensure the sterility of all sampling equipment and all other equipment entering the well. Further information regarding bacteriological sampling is available in Sampling for Organic Chemicals and Microorganisms in the Subsurface (REF. 19) as well as References 4, 5. Additional information on bacterial sampling is also included in Sections 5.5, 5.6, and 5.8.

5.7.8 Special Sampling Equipment Quality Assurance Techniques

All equipment used to collect ground-water samples shall be cleaned as outlined in Appendix A. and repaired, if necessary, before being stored at the conclusion of field studies.

All equipment shall be tested before being issued for field studies.

Cleaning procedures conducted in the field (Appendix A) or field repairs shall be thoroughly documented in field records.

5.7.9 Auxiliary Data Collection

Water table measurements from the top of the well casings (references to National Geodetic Vertical Datum) in permanent wells, and ground surface elevation in temporary wells should be made to determine the general direction of ground-water flow and gradient. Tracer dyes, radioactive, and thermal detection methods can be used to determine direction and velocities of flow (REF. 14). Also, a study of the general topography and drainage patterns will generally indicate direction of ground-water flow.

Water table measurements shall not be taken until the water table has stabilized, preferably 24 hours after well installation for permanent wells (REF. 20). The ground surface elevation at the wells should be determined by standard engineering survey practices.

In addition to water level measurements, the pumping rate used to purge a well, the volume of water in wells, and drillers logs are examples of auxiliary data that should be collected during ground-water sampling activities. This information should be documented in field records. Methodology for obtaining these data are given in the following sections.

Temperature, specific conductance, and pH shall be measured each time a well is sampled. This information is generally obtained during the purging process to evaluate the adequacy of the purging procedure. In this situation, the final measurements for these parameters prior to sampling shall be considered the measurement of record for the well. If these parameters were not evaluated during purging, they shall be obtained prior to sampling.

Well Pumping Rate - Bucket/Stop Watch Method

The pumping rate of a pump can be determined by collecting the flow of water from the pump in a bucket of known volume and timing how long it takes to fill the bucket. The results should be flow in gallons per minute. This method shall be used only with

pumps with a constant pump rate, such as gasoline powered or electric submersible pumps. It should not be used with battery powered pumps. As the batteries lose their charge, the pump rate decreases so that pumping time calculations using initial, high pump rates are erroneously short.

Volume of Water In Wells

In order to purge wells, the volume of water in the well should be known. To determine the volume, the following method should be used; measure the distance from the bottom of the well to the static water level, then measure the inside diameter of the well or casing. Obtain the volume of the well by the formula.

$$V = 0.041\ d^2h$$

Where

h = depth of water in feet
d = diameter of well in inches
V = Volume of water in gallons

If preferred, a quick reference nomograph or table may be used.

Driller's Log

It is imperative that drilling logs be concise, complete, and described in a manner that is easily understood to all who read them. The following items shall be included in the logging data:

- hole number and location
- description of soils and subsurface conditions (if applicable)
- type of drilling equipment, drilling company (if applicable)
- method of drilling
- type and size of casing
- type and size of well screen
- depth to well screen
- type of pump and pumping rate
- drilling and sampling times

- depth to water table, and data and time measured
- type of samples taken and depths taken
- volume of water purged
- type of well (permanent or temporary)
- type of sampling equipment and/or cleaning procedure
- depth of sampling and description (if applicable)

Additional ground-water related data can be obtained from most local, statE, and federal agencies dealing with water resources. Some states require well drillers to be licensed, and all work performed on wells must be reported to the state on prescribed forms. These forms are available to the public, so a study of wells installed in the area of interest will provide background information as to the subsurface conditions. State geological surveys, as well as the USGS, have various types of water related papers and reports on all phases of ground-water studies in each state. City and county governments usually have departments that deal with water related projects that may provide data for the local area. Federal agencies such as the SCS, U. S. Army Corps of Engineers, the Bureau of Reclamation, U. S. Forest Service, Science and Education Administration, and the U. S. Public Health Service have water programs and may provide data. Other sources include the Bureau of Mines, colleges, universities, and technical societies such as American Association of Petroleum Geologists, American Institute of Mining and Metallurgical Engineers, American Water Well Association, Association of Engineering Geologists, and Geological Society of American (REF. 14, 21).

5.8 SAMPLING OF POTABLE WATER SUPPLIES

5.8.1 General Considerations

When sampling potable water supplies, utmost care must be taken to insure that samples are representative of the water supply being sampled. This is important not only from a technical and public health perspective, but also from a public relations standpoint. Poor sampling techniques may result in incorrect results (either not detecting a compound which is present or by contaminating the sample and falsely indicating a compound which is not present). If incorrect results are disclosed to the public, it may be impossible to change public opinion when correct results are reported.

5.8.2 Sampling Site Selection/Sampling Techniques

Even though the same care and techniques used in wastewater, ground-water, etc., sampling (including thorough documentation of location, data, time, etc.) are used by personnel in potable water supply sampling, there are certain additional special procedures which shall be used.

When water samples are collected from wells, either by mechanical or hand pumping, the wells must be purged before the sample is collected (see Section 2.6.7 for ground-water sampling methods). This procedure insures that water in the well field is sampled, not the standing water in the pump or holding tank. As a rule of thumb, at least one volume of water in the well casing and storage tank should be evacuated (a 15 minute period is usually sufficient for residential wells). This also insures that any contaminants that might have entered the area of the tap from external sources are flushed away (REF. 19).

Potable water samples shall be representative of the water quality within a given segment of the distribution network. Taps selected for sample collection should be supplied with water from a service pipe connected directly to a water main in the segment of interest and should not be separated from the segment interest by a staorge tank. The sampling tap must be protected from exterior contamination associated with being too close to the sink bottom or to the ground. Contaminated water or soil from the faucet exterior may enter the bottle during the collecting procedure since it is difficult to place a bottle under a low tap without grazing the neck interior against the outside faucet surface. Leaking taps that allow water to flow out from around the stem of the valve handle and down the outside of the faucet, or taps in which water tends to run up on the outside of the lip, are to be avoided as sampling locations. Aerator, strainer, and hose attachments on the tap must be removed before sampling. These devices can harbor a bacterial population if they are not cleaned routinely or replaced when worn or cracked. Whenever a steady stream of water cannot be obtained from taps, after such devices are removed, a more suitable tap shall be sought. Taps where the water flow is not steady should be avoided because temporary fluctuation in line pressure may cause sheets of microbial growth that are lodged in some pipe section or faucet connection to break loose. The cold water tap should be opened for two or three minutes or for sufficient time to permit clearing the service line; a smooth-flowing water stream at moderate pressure without splashing should be obtained. Then, without changing the water flow which could dislodge some particles in the faucet, the samples can be collected (REF. 19).

Regardless of the type of sample bottle being used, the bottle cap should not be placed on the ground or in a pocket. Instead, hold the bottle in one hand and the cap in the other, keeping the bottle cap right side up (threads down) and using care not to touch the inside of the cap. Exercise care not to lose the Teflon liner in certain bottle caps. Avoid contaminating the sample bottle with fingers or permitting the faucet to touch the inside of the bottle. When sampling for bacterial content, the bottle should not be rinsed before use. This may not only contaminate the bottle but also remove the thiosulfate dechlorinating agent (if used). When filling any container, care should be taken so splashing drops of water from the ground or sink do not enter into either the bottle or cap. In order to avoid dislodging particles in the pipe or valve, do not adjust the stream flow while sampling.

When sampling at a water treatment plant, samples should be collected both from the raw water supply and after chlorination.

Duplicate samples will always be collected for VOA and bacterial analyses. Single samples may be collected for extractable organic compounds, metals, phenol, cyanide, and conventional parameter analyses. The procedures given in Section 5.2.10 (Special Precautions for Trace Contamination Sampling) and in Section 5.5.6 (Purgeable Organic Compounds Sample Collection) shall always be followed when potable water supplies are sampled.

Personnel shall always obtain the name(s) of the resident or water supply owner/operator and the resident's exact mailing address, as well as the resident's home and work telephone numbers. The information is required so that the residents or water supply owner/operators can be informed of the results of the sampling program.

5.8.3 Sampling Equipment/Specific Sampling Equipment Quality Assurance Techniques

Sampling equipment and specific equipment quality assurance techniques are contained in Sections 5.6 (Surface Water Sampling) and Section 5.7 (Ground-water Sampling).

5.9 SOIL SAMPLING

5.9.1 General Considerations

The objective of this section is to give general guidance for the collection of soil samples during field investigations. Guidance for preparing soil sampling protocols, including statistical sampling methodology are included in the EPA publication "Preparation of Soil Sampling Protocol, Techniques and Strategies" (REF. 22).

5.9.2 Sampling Location/Site Selection

Areas selected for soil sampling shall be strategically located in order to collect a representative fraction of the soils with the minimum number of samples and effort. A surface inspection of the subject area shall be made to locate pertinent features (e.g., rock outcrops, drainage patterns, surface runoff, ponds, lakes, wet areas, seeps, springs, permanent structures, fill areas, erosional areas, depositional areas, etc.) and to evaluate the relationship between these features and potential sources of pollution. The location of sediment depositional areas are good indicators of surface runoff direction. If the direction of surface runoff or drainage is difficult to detect, observation of new deposition or sediment movement following a rain may prove helpful in establishing this direction. The spreading or fanning out of the sediment body will indicate direction flow.

In most instances, the first investigation of a site will be a reconnaissance type survey. Soil sampling in these instances will generally be confined to surface or near-surface soils and/or sediments with hand equipment. For screening purposes, sampling of this type should be conducted in depositional areas on the periphery of the study area, primarily at the downstream or downgradient portion(s) of the area of interest; however, an upgradient location should also be selected for obtaining background and/or control samples. Investigators should be aware that sampling in depositional areas tends to bias the sampling toward elevated concentrations which is useful as a screening tool, but should not be construed as representative of the area conditions.

More in-depth investigations are usually conducted after a preliminary study or reconnaissance survey has been completed. Review of previous investigations will aid in selection of suitable sampling locations and these studies should be examined when the study plan for the more detailed study is prepared. The number of samples and the number of test pits and/or borings and the specific depth that samples are collected will vary according to the site conditions and the scope of the investigation.

5.9.3 Sampling Techniques

General

Sampling is often conducted in areas where a vegetative turf has been established. In these cases a clean stainless steel shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. When the soil sample is obtained, it should be deposited into a glass pan for mixing (or compositing, if applicable) prior to filling the sample containers. Mixing of the soil sample for chemical analysis should be performed

in accordance with the procedures outlined in Section 5.6.3. If an undisturbed sample is needed, the Shelby tube sampler may be used. If practical, and at the project leader's discretion, all trenches or holes that were excavated for sampling should be filled in and the turf replaced.

Surface Soil Sampling

Prior to samples, leaves, grass, and surface debris should be removed from the area to be sampled using a clean stainless steel spoon or shovel. Surface soil samples shall then be collected using a precleaned, stainless steel scoop or spoon.

Shallow Subsurface Soil Sampling

Shallow subsurface soil samples may be collected by digging a hole or trench with a stainless steel shovel, then removing all of the loose soil and collecting a sample at the desired depth using a stainless steel spoon a stainless steel hand auger, or a Shelby tube.

The stainless steel hand auger consists of three basic parts:

- bucket
- extension
- handle

At the bottom end of the bucket are two cutting edges. The extensions are three feel long. When sampling deeper subsurface soil a number of extensions may be joined end to end to increase the depth from which soil may be sampled.

The Shelby tube is a stainless steel tube approximately 12 inches long and 2 inches in diameter. One end of the tube has the edges beveled into a cutting edge. The other end can be mounted on an adapter which allows attachment to the end of the hand auger. The Shelby tube is pushed into the soil to be sampled and then removed. The tube can then be removed from the adapter and the soil pushed out using a decontaminated piece of equipment such as the handle of a stainless steel spoon. If an undisturbed sample is required, the Shelby tube with its sample intact may be shipped directly to the laboratory for analyses.

Deeper Subsurface Soil Sampling

For deeper sampling using hand equipment, a stainless steel auger is used to bore a sampling hole until the desired depth is reached. Another clean auger bucket or a Shelby tube is then used

to collect the sample which is placed in a glass pan. Surface debris should be removed from the location of the sampling hole using a clean, stainless steel shovel or spoon before augering operations are initiated.

Often the depth which can be reached using a hand auger is limited due to the soil having low cohesion which leads to the hole collapsing or to the soil being very tightly packed which can make turning and removing the auger difficult. In cases such as these, a portable power auger Little Beaver may be used to reach the desired depth. The sample can then be collected as described in the previous paragraph. The portable power auger consists of an powered drive unit (hand-held) used by sampling personnel to drive crew-like auger flights. The auger flights should be cleaned using the same procedures as for the other soil sampling equipment (Appendix A). For Safety reasons, the Little Beaver portable power auger should never be used with less than two sampling personnel present.

The split spoon sampler may be used for sampling at greater depths. Because of its weight, the split spoon sampler is generally used with power equipment, i.e., drilling rig. A hollow stem auger is used to advance the hole to the desired depth. The split spoon is added to the correct length of drill rod and forced into the undisturbed soil by means of a 140 pound weight or hammer. The split spoon is retrieved from the hole and opened to reveal the sample. The top two or three inches of the sample normally will be disturbed and should be discarded. The undisturbed portion should be placed in a glass pan by means of a clean stainless steel spoon or spatula. The procedure is repeated until the desired amount of sample is collected. The sample should then be thoroughly mixed.

5.9.4 Special Precautions for Trace Contaminant Soil Sampling

The procedures outlined in Section 5.2.11 shall be followed. All soil sampling equipment used for sampling for trace contaminants should be constructed of stainless steel where possible. In no case will chromium, cadmium, or galvanized plated or coated equipment be used for soil sampling operations. Similarly, no painted equipment shall be used. All paint and primer must be removed from soil sampling equipment by sandblasting or other means, before such equipment can be used for collecting soil samples.

5.9.5 Soil Samples Collected for Purgeable Organic Compounds Analyses (VOA)

Soil samples collected from purgeable organic compounds analyses should be thoroughly mixed and containerized as soon as

possible after sampling. The sample should be placed in the sample container so that no head space is left in the container after the container is closed.

5.9.6 Specific Sampling Equipment Quality Assurance Techniques

Drilling rigs and other major equipment used to collect soil samples shall be identified so that this equipment can be traced through field records. A log book shall be established for this equipment so that all cleaning, maintenance and repair procedures can be traced to the person performing these procedures and to the specific repairs made. Sampling spoons, hand augers; Shelby tubes, and other minor disposable type equipment are exempted from this equipment identification requirement.

All equipment used to collect soil samples shall be cleaned as outlined in Appendix A and repaired, if necessary, before being stored at the conclusion of field studies.

Any cleaning conducted in the field (Appendix A) or field repairs should be thoroughly documented in field records.

5.9.7 Auxiliary Data Collection

In addition to information pertaining to an area or specific site/location that may be available in EPA files from previous investigations (i.e., site screening, water quality, well monitoring studies, etc.) information and data may be obtained from various city, county, state, and other federal agencies.

A system of logging all pertinent data collected during drilling and sampling operations should be maintained. The test hole locations should be recorded and referenced to the site map and/or datum base so that each location can be permanently established. Samples should be accurately tagged and labeled with all labeling and field recording procedures. Also, refer to the section on drilling logs in the Groundwater Sample Section (Section 5.7.9). The latitude and longitude shall be obtained for each site for any future data entry.

5.10 LANDFILLS AND HAZARDOUS WASTE SITE SAMPLING

5.10.1 General Considerations

Sampling at sanitary landfills is generally considered a routine operation. Sampling at known or suspected hazardous waste sites, on the other hand, could involve sampling operations that are inherently dangerous to the personnel involved. Therefore, the procedures outlined in the EPA Region IV Field Health and Safety Manual should be observed during all sampling operations at known

or suspected hazardous waste sites (REF. 23). The draft EPA Safety Manual for Hazardous Waste Site Investigations (REF. 24) should also be used as a guide during sampling activities at these sites.

Sampling operations conducted at landfills and hazardous waste sites include the collection of on-site samples from open and closed containers, waste piles, pits, ponds, lagoons, leachate streams, spillage of materials, contaminated soil, as well as sampling of ground water and soil. Samples collected off-site (soil, surface water, sediment, ground water, tissue) shall be considered environmental samples unless site observations or other evidence indicate otherwise. All samples collected on known or potential hazardous waste sites shall be considered to be "hot" or "concentrated" samples unless field personnel have valid reasons to believe otherwise. These samples shall be handled as hazardous materials as outlined in the draft EPA Safety Manual for Hazardous Waste Site Investigations (REF. 24).

Additional information concerning field operations at hazardous waste sites are included in the EPA publication Characterization of Hazardous Waste Sites - A Methods Manual, Volume 1 - Site Investigations (REF. 25) and Volume II - Available Sampling Methods (REF. 26).

Sampling procedures for collecting soil, sediment, water, and ground-water samples at hazardous waste sites and landfills are identical to those given in the previous section (Wastewater Sampling - 5.5, Surface Water Sampling - 5.6, Ground-water Sampling - 5.7, Soil Sampling 5.8, etc.). The only difference is the degree of caution and safety precautions and procedures utilized for on-site samples collected from hazardous waste sites. Waste sampling procedures are included in the Waste Sampling Section (2.6.11). Some general guidance is also given for selecting sampling locations for on-site investigations. Guidance given in previous sections shall be used when selecting sampling locations for environmental assessments of these sites. Where possible, disposable sampling equipment shall be used to collect on-site samples from hazardous waste sites. All "hot" or "concentrated" samples shall be clearly labeled as such when they are submitted for laboratory analyses. Any observations (odor, appearance, container labeling, etc.) made by the field team which might alert the laboratory to potential dangers or provide laboratory personnel with information on possible constituents in the samples (high concentration, etc.) shall be explained on the sample tag and explained verbally to the sample custodian or other laboratory personnel, as necessary.

5.10.2 Sampling Location Selection

When selecting a sampling location at a landfill or hazardous waste site, the following should be determined (REF. 15):

- o surface water flow (drainage pattern)
- o discharge and recharge areas
- o direction of ground-water flow
- o topography
- o leachate flow
- o location of streams in relation to the subject area
- o vegetation
- o wells in the area
- o seeps
- o springs
- o wet areas
- o soil conditions
- o general geology

All of these items are important in evaluating a site for sampling both soils and water, and have been discussed at length in the sections on water and soil sampling.

When a site is being screened for sampling, the most productive method of determining sampling locations is to walk the boundary of the site (after if has been located and defined) focusing attention on areas where surface runoff leaves and site. The site shall be checked for leachate flow or surface spills. Springs, seeps, ponds, and wet areas shall be examined to see if they display signs of leachate. Obvious signs of leachate in the water are discoloration and/or odor. The soil shall be inspected to see if it is discolored. Areas of excessive dead vegetation and/or dead animals are good indicators of a potential hazard. Nearby water bodies and wells downgradient from the site shall be located for sampling to check for off-site migration of contaminants. Where necessary, test holes can be bored with hand or power equipment to define the general direction of ground-water movement and subsurface stratigraphic conditions.

5.10.3 Specific Quality Control Procedures for Sampling Equipment

All major sampling and safety equipment used during investigations at hazardous waste sites including barrel openers, safety equipment (other than disposable gear), Geiger counters, explosion meters, cameras, etc. shall be numbered so that this equipment can be traced through field records. A log book shall be established for this equipment, so that all cleaning, maintenance, and repair procedures can be traced to the person performing such procedures

and to specific repairs made. Quality control procedures for certain pieces of equipment, such as automatic samplers, pumps, soil sampling equipment, etc., are contained elsewhere in this manual.

All equipment utilized to collect samples at hazardous waste sites shall be cleaned as outlined in Appendix A and repaired, if necessary, before being stored at the conclusion of a field study. In some instances, special decontamination procedures in excess of the cleaning procedures outlined in Appendix A will be necessary. These procedures will be developed on a case-by-case basis according to the specific material encountered (REF. 24, 27). Provisions should also be made for disposal (preferably burial at the sampling site) of contaminated disposable equipment.

All equipment shall be tested before being issued for field studies.

Any cleaning procedures conducted in the field (Appendix A) or field repairs, shall be thoroughly documented in field records.

5.11 WASTE SAMPLING

5.11.1 General Considerations

Waste sampling as discussed in this section includes the collection of sludge samples from municipal and industrial wastewater treatment facilities; samples of liquid waste and sludge from pits, ponds and lagoons; the collection of concentrated waste samples from open and closed containers such as drums, barrels, tank trucks, and storage tanks; and waste piles.

Generally the collection of sludge samples from municipal and industrial wastewater treatment plants is a low risk operation. However, the collection of liquid waste and sludge samples from open containers and liquid waste from pits, ponds, or lagoons and solid waste from waste piles may involve sampling operations that are inherently dangerous to the personnel involved. Sampling of closed containers (barrels, drums, etc.) shall be considered a high hazard operation by all personnel. The procedures outlined in the Region IV Field Health and Safety Manual (REF. 23) should be strictly observed during all potentially hazardous sampling operations. Additional safety guidance is included in the draft EPA Safety Manual for Hazardous Waste Site Investigations (REF. 24).

5.11.2 Collection of Municipal Wastewater, Industrial Wastewater, and Municipal Water Treatment Plant Sludge Samples

Sampling Locations

Sampling locations must be carefully selected to insure that the samples are truly representative of the material being sampled. the following are suggested locations for different sampling conditions.

Municipal sludge Being Drawn to a Drying Bed

Collect samples from the pipe flowing to the bed or at the discharge point into the bed. Take three or more aliquots of samples during the draw period to insure that variations in the sludge concentrations and consistency are accounted for.

Sludge From An Aerobic Digester

It is difficult to insure that the contents in these units are well mixed. Samples can be taken from sample ports in the recirculation lines if so equipped. Otherwise, samples can be taken from "thief holes" in the floating top of the digester.

Sludge From an Aerobic Digester

It is much easier to sample these units because of the clear view of the contents. Samples should be taken while the contents are being mixed and from the 1/3 - 2/3-depth zone.

Sludge From a Quiescent Holding Basin (Water or Wastewater)

One sample cannot be collected which will be representative of the total contents of the basin since the material is generally stratified. Samples can be collected from the upper relatively clear liquid layer as one would collect any water sample. Sludge samples should be collected from the basin from a boat or a platform. Sediment sampling devices are required to collect these samples.

Sludge From Drying Beds

After sludge is partially dried and cracked, samples can be collected with a stainless steel spoon, shovel or similar device. Samples should be collected from three or four locations in the bed to insure a representative sample. The sample should be collected of the full depth of sludge on the bed.

Sampling Technique

If the sampling technique involves multiple aliquots or if the final sample will consist of aliquots from several locations, all aliquots should be placed into a Pyrex dish, or other suitable container, and mixed thoroughly before containerization.

If the sludge layer is shallow or if only the surface is to be sampled, samples can be collected directly into the sample container.

If depth samples are required, the methods described in Section 5.11.3 (Sampling Technique) may be used.

Regardless of the method used, special care must be taken when collecting the sludge sample to ensure that excess water flowing out of the sampling device does not wash out much of the fine material, thus biasing the sample.

Special Precautions for Trace Contaminant Sampling

For complete information refer to Section 5.9.

Sludge Samples Collected for Purgeable Organic Compounds Analysis

For complete information refer to Section 5.9.

5.11.3 Pits, Ponds, and Lagoons

General

For the purposes of this subsection, pits, ponds, and lagoons refer to any basin, pit or open tank, lined or unlined, which contain or are suspected of containing unknown concentrated liquid chemical waste. This discussion does not include municipal and industrial wastewater treatment ponds or natural or man made surface water impoundments.

Sampling Locations

Sampling locations within pits, ponds, and lagoons should yield samples which are representative of that section, or of the entire pit, pond, or lagoon being sampled. All phases in the pit, pond, or lagoon (floating solids, all liquid phases, and sludge) should be sampled. the only exception to this policy will be situations where representative samples cannot be safely collected or where the investigative team is attempting to determine worst case conditions.

Because of the inherent dangers with sampling known or unknown concentrated waste, sampling personnel should never attempt to sample pits, ponds and lagoons by using a boat. All sampling should be accomplished from banks of pits, ponds, and lagoons or from piers.

Liquid Waste Sampling Techniques

If the sampling technique utilized requires multiple aliquots, or if the final sample will consist of aliquots from several different locations in the pit, poind, or lagoon, all aliquots should be placed into a pyrex dish or large glass sample container, or other suitable compositing container, and mixed thoroughly before containerization.

Floating solids can be sampled directly or with a stainless steel scoop or spoon attached to a piece of conduit pipe.

The presence of individual liquid phases can be determined by using a profile tube. The top liquid phase can be sampled by direct dipping with the sample container; dipping with the sample container attached to a conduit pipe, either directly or by way of a fishing pole type arrangement, or dipping the sample with a stainless steel scoop attached directly to conduit pipe. Other liquid phases can be sampled with a peristaltic pump/vacuum jug arrangement with the end of the Teflon tube intake attached to a conduit pipe and held at the desired depth or with Bacon-Bomb sampler opened at the desired depth. The Bacon-Bomb sampler can be operated directly from the banks of pits, ponds, and lagoons or from piers or operated by way of a fishing pole type arrangement using a piece of conduit pipe.

Sludge Sampling

Sampling Technique

If the sampling technique involves multiple aliquots, or if the final sample will consist of aliquots from several different locations in the pit, pond or lagoon, all aliquots should be placed into a Pyrex dish or other suitable container and mixed thoroughly before containerization.

Sludge samples can be collected by pushing a stainless steel push tube into the sludge and emptying the tube contents into a Pyrex dish or other suitable container. "Emptying" can include shaking to remove sludge or extrusion of thick or gummy sludges with a new wooden dowel. a disadvantage of this technique is the need for multiple insertions of the tube into the sludge to collect sufficient sample volume.

Sludge samples can also be collected with a stainless steel ponar dredge. An advantage of this technique is that one operation of the dredge usually yields sufficient sample volume for most sampling efforts.

One of the easiest methods of collecting a sludge sample consists of attaching a stainless steel scoop to a piece of conduit pipe with either strapping tape or a scoop bracket, and dipping the scoop into the sludge. An advantage of strapping tape is that it generates less equipment to decontaminate. However, glue on the tape may dissolve rapidly in oily or solvent type wastes. The scoop bracket has a decided advantage in that it allows sampling personnel to adjust the angle between the scoop and the conduit pipe.

5.11.4 Open and Closed Container Sampling

General

Sampling of closed containers (drums, barrels, tanks) should only be conducted when absolutely necessary. Whenever container sampling is necessary, the first priority should be the collection of samples from open containers since open containers generally present less hazard to the samplers than closed containers (i.e., volatile components have already evaporated, extreme acute toxicity would probably be evident from dead animal life or vegetation around the sit). Closed containers must be considered as extremely hazardous from either the toxicity, explosion or fire standpoints, Chronic toxicity may be a danger in both open or closed containers. Because of the dangers involved with container sampling, the sampling or drums, barrels, or other containers containing either unknown material or known hazardous material shall be considered a hazardous duty assignment. Additional information regarding container sampling is available in the draft EPA Safety Manual for Hazardous Waste Site Inspections (REF. 24).

A problem which often arises in container sampling is stratification and/or phase separation of the container contents. When this condition occurs or is suspected, care must be taken to insure that the sample collected is representative of the container contents. If only one layer or phase is sampled, this should be noted and taken into account when interpreting analytical results. For example, if a large tank is being sampled for PCB's and the only valve or access port available for sampling is at the bottom of the tank, it should be noted that the concentration of PCB's might be biased toward high concentrations, since PCB's are heavy and tend to collect near the bottom of a container.

Where possible, samples should be composited with depth (i.e., collected throughout the entire depth of the container or at several different depths) to provide a representative sample. When a drum or cylindrical container is standing vertically, depth compositing provides a good quantitative estimate of the container content. In other cases where such containers are tipped, horizontal, deformed, etc., depth compositing will provide representative sample at least on a qualitative basis. (Note: A quantitatively representative sample could be collected, but would require sophisticated sampling methodology involving multilayer sampling and volume measurements; this is not recommended unless initial screening indicates it is absolutely necessary.)

Sampling Techniques

Closed drums, barrels, or other containers (including storage tanks) containing unknown materials or known hazardous materials shall be opened only using spark proof opening devices. A remotely controlled device may be used when deemed necessary. Such a device involves the use of a remotely operated pneumatic wrench along with a brass pressure fitted bung socket.

Samples from drums or barrels can be collected using a four-foot length of glass tube. In most instances, glass tubes with a one-half inch or less inside diameter work best. The tube is inserted into the opening of the drum or barrel as far as possible. The open end is then sealed either with the thumb or a rubber stopper to hold the sample in the tube while removing the tube from the container. The sample is then placed in the appropriate container and the procedure is repeated until an adequate amount of sample is collected. Sample volume shall be held to the absolute minimum required for analysis. An optional method involves the use of a piercer valve which is inserted into the drum or barrel using a remotely operated hydraulic jack (27); however, this method should be used only as a last resort (24). Several valves may be required at different depths on the drum or barrel if stratification has occurred. The sample is collected directly from the valve.

Other sampling procedures that include the use of automatic samplers, pumps, siphons, multiple valves and ports, etc. may be used depending on the specific container involved. These procedures should not be used unless it can be established that their use will not constitute a fire or explosion hazard. This determination shall be made only after field reconnaissance, collection of appropriate field data (explosion meter, photoionizer, etc.) and consideration of available file information on this site.

Tank trucks and storage tanks containing liquid wastes are a special case. Samples may be collected from access ports on top of these tanks or trucks using the techniques outlined above. Tank trucks are often compartmentalized and the investigator should insure that all compartments of the tank truck are sampled. Sampling from discharge valves usually found on tank trucks is not recommended due to potential stratification of tank contents. However, if the investigator has to sample from a tank tuck discharge valve, the valving arrangement of the particular tank truck being sampled must be clearly understood to insure that the contents of all compartments are sampled. The same precautions apply to sampling from storage tank valves. In either case, the investigator must realize that samples obtained from valves (particularly those at or near the bottom of tank truck and storage tanks) may not yield representative samples.

5.11.5 Waste Piles

General

Waste piles may consist of sludges and other solid waste, liquid waste mixed with soil, or any type of waste mixed with construction debris, household garbage, etc. Each situation presents a unique challenge to the sampler in the selection of an appropriate sampling location and technique.

Sampling Locations

Sampling locations should be selected which will yield a sample which is representative of the waste pile being investigated. The only exception to this policy will be situations in which representative samples cannot be collected safely or where the investigative team is attempting to determine worst case conditions. A representative sample from a small waste pile can often be obtained by collecting a single sample. The collection of a representative sample(s) from large waste piles, however, presents problems with both the number and locations of samples. For a sample(s) to be truly representative, a statistical approach should be used in selecting both the number of samples and the location where they are to be collected. A discussion of statistical methods which can be utilized is given in the Test Methods for Evaluating Solid Waste (SW-846) issued by the EPA Office of Solid Waste and Emergency Response (REF. 28).

Sampling Techniques

All samples collected should be placed into a Pyrex dish and mixed thoroughly before containerization. Stainless steel shovels, spoons, or scoops should be used to clear away surface material before samples are collected. Near surface samples can then be

collected with a clean stainless steel spoon. Depth samples can be collected from the cleared location by forcing a stainless steel push tube into the pile or by augering to the desired depth with a stainless steel hand auger. When the desired depth is reached with a hand auger, a clean auger head should be used for collecting the sample. An alternate method for collecting depth samples is to dig to the desired depth with a stainless steel shovel or scoop and collecting the sample with a stainless steel spoon.

5.11.6 Specific Quality Control Procedures for Sampling Equipment

All major sampling and safety equipment used during investigations at hazardous waste sites including barrel openers, safety equipment (other than disposable gear), Geiger counters, explosion meters, cameras, etc. shall be identified so that this equipment can be traced through field records. A logbook shall be established for this equipment, so that all cleaning, maintenance, and repair procedures can be traced to the person performing such procedures and to specific repairs made. Quality control procedures for certain pieces of equipment, such as automatic samplers, pumps, soil sampling equipment, etc. are contained elsewhere in this manual.

All equipment used to collect waste samples shall be cleaned as outlined in Appendix A and repaired, if necessary, before being stored at the conclusion of a field study. In some instances, special decontamination procedures in excess of the cleaning procedures outlined in Appendix A will be necessary. These procedures will be developed on a case-be-case basis according to the specific material encountered (REF. 27). Provisions should also be made for disposal of contaminated disposable equipment.

All equipment shall be tested before being issued for field studies.

Any cleaning procedures conducted in the field (Appendix A) or field repairs, shall be thoroughly documented in the field logbooks.

5.11.7 Collection of Auxiliary Information and Data

The collection of auxiliary information and data is particularly important when collecting waste samples. Any field analyses, including those conducted with safety equipment such as photoionizers, explosion meters or approximate analyses such as those obtained with pH indicator paper shall be recorded in field logbooks. Sketches of sampling locations, valving arrangements of tank trucks and storage tanks, markings on barrels, drums tanks, etc. should be thoroughly documented and in the logbooks.

Photographs are particularly useful for recording this information and they should be used extensively during waste sampling operations.

5.12 REFERENCES

1. Memorandum re: "National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Environmental Laboratory Samples." U.S. Environmental Protection Agency, Office of Planning and Management, March 6, 1981.

2. NPDES Compliance Inspection Manual, United States Environmental Protection Agency, Enforcement Division, Office of Water Enforcement and Permits, EN-338, 1984.

3. Handbook for Monitoring Industrial Wastewater, United States Environmental Protection Agency, Technology Transfer, 1973.

4. Handbook for Evaluating Water Bacteriological Laboratories, United States Environmental Protection Agency, ORD, Municipal Environmental research Laboratory, Cincinnati, Ohio, 1975.

5. Microbiological Methods for Monitoring the Environment, Water and Wastes, United States Environmental Protection Agency, ORD, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 1978.

6. Kittrell, F. W., "A Practical Guide to Water Quality Studies of Streams," United States Department of Interior, Federal Water Pollution Control Administration: Cincinnati, Ohio 1969.

7. Lauff, G. H., ed., Estuaries, American Association for the Advancement of Science: Washington, D.C., Publication No. 83, 1967.

8. Fischer, H. B., E. J. List, R. C. Koh, J. Inberger, and N. H. Brooks, Mixing in Inland and Coastal Waters, Academic Press: New York, 1979.

9. Ippen, A. T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, Inc.: New York, 1966.

10. Reid, G. K. and R. D. Wood, Ecology of Inland Waters and Estuaries, 2nd Edition, D. Van Nostrand Company: New York, 1976.

11. Kaplovsky, A. J., "Estuarine Pollution Investigation Employing " Same-Slack" Technique," Journal of the Water Pollution Control Federation, Volume 29, No. 9, pg. 1042, 1957.

12. Freed, J. R., P. R. Abell, D. A. Dixon, R. E. Huddleston, M. W. Slimak, and J. Pawlow, "Sampling Protocols for Analysis of Toxic Pollutants in Ambient Water, Bed Sediment, and Fish," Interim Final Report, 3 February 1980, for Office of Water Planning and Standards, United States Environmental Protection Agency, 1980.

13. "RCRA Ground-Water Monitoring Enforcement Guidance: RCRA Ground-Water Monitoring Compliance Order Guidance (Final) and RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (Draft),: US-EPA, Office of Waste Programs Enforcement and Office of Solid Waste and Emergency Response, August 1985.

14. "Groundwater," Section 18, USDA-SCS National Engineering Handbook, United States Department of Agriculture, Soil Conservation Service, 1978.

15. Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities, United States Environmental Protection Agency, Office of Water and Waste Management, SW-611, 1977.

16. Water Quality Monitoring at Solid Waste Disposal Sites in Minnesota, Minnesota Pollution Control Agency, Solid Waste Division, 1979.

17. Manual of Ground-Water Sampling Procedures, United States Environmental Protection Agency, Robert S. Kerr Environmental Research Laboratory, 1981 and Waste Management, SW-611, December 1980.

18. Barcelona, Michael J., et.al., A Guide to the Selection of Materials for Monitoring Well Construction and Groundwater Sampling, Illinois State Water Survey, Department of Energy and Natural Resources, Champaign, Illinois, SWS Contract Report 327, August 1983.

19. Sampling for Organic Chemicals and Microorganisms in the Subsurface, United States Environmental Protection Agency, EPA-600/2-77-176, 1977.

20. "Engineering Geology," Section 8, National Engineering Handbook, United States Department of Agriculture, Soil Conservation Service, 1978.

21. Geologic Site Exploration, United States Department of Agriculture, Soil Conservation Service, EWP Technical Guide No. 4, 1969.

22. Preparation of Soil Sampling Protocol: Techniques and Strategies, US-EPA-600/4-83-020, EMSL, Las Vegas, August, 1984.

23. Field Health and Safety Manual, United States Environmental Protection Agency, Region IV, August, 1984.

24. Safety Manual for Hazardous Waste Site Investigations, United States Environmental Protection Agency, Draft, 1979.

25. Characterization of Hazardous Waste Sites - A Methods Manual: Volume 1 - Site Investigations, US-EPA, EMSL Las Vegas, EPA-600/4-84-075, April 1985.

26. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II - Available Sampling Methods, 2nd Edition, US-EPA, EMSL, Las Vegas, EPA-600/4-84-076, December 1984.

27. Enforcement Considerations for Evaluation of Uncontrolled Hazardous Waste Disposal Sites by Contractors, US-EPA, NEIC, 1980.

28. Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (SW-846), US-EPA, Office of Solid Waste and Emergency Response, Washington, D.C., July 1982.

6.0 SAMPLE CUSTODY

A critical aspect of sound sample collecting and analysis protocols is the maintenance of strict COC procedures. COC procedures include inventorying and documentation during sample collection, shipment and laboratory processing. A sample is considered to be in an individual's custody if the samples is: 1) in the physical possession or view of the responsible party, 2) secured to prevent tampering, or 3) placed in a restricted area by the responsible party.

6.1 FIELD SAMPLING OPERATIONS

Sample tracking is accomplished in the field by assigning each sample a unique number as it is collected. This number should be traceable back to the date, time, site and depth (where appropriate) of collection. This is recorded on the sample label and the COC as well as in the field logbook. All containers are labeled prior to actual sampling.

6.1.1 Field Logbook

The field logbook is a bound field notebook of water-resistant paper. All entries are made in indelible ink, signed and dated. Information that is recorded in the field logbook includes:

- purpose of sampling (Contract/Project number)
- sampling methodology
- site location
- sample location and depth
- date and time of collection
- sample number and volume
- preservatives (volume added and type)
- QC samples or activities
- Data from any field analyses or physical testing.
- Any pertinent information or observation concerning the site or samples.
- signatures of sampler and witness
- method of shipment

6.1.2 Sample Label

A sample label is attached to all sample containers at the time of collection. The label is written in indelible ink and contains the following information:

- project number
- sample number
- sample location and depth
- date and time collected
- preservative used (if any)
- name of sampler and witness

A typical sample label is illustrated in Figure 1.5.

6.1.3 Sample Custody

Sample custody is initiated with the detailed record keeping by the field sampling personnel. COC establishes the documentation

and control necessary to identify and trace a sample from sample collection through sample analysis. It includes field sample labeling to prevent sample mix-up, custody seals to prevent sample tampering, secure custody and provide the recorded support information for potential litigation.

6.1.4 Chain-of-Custody Records (COC)

The COCs are used to document the integrity of all samples. To maintain a record of sample collection, transfer between personnel, shipment and receipt by the laboratory, a COC will be filled out for each sample set at each sampling location. The COC will contain the following information:

- project name
- project location
- project contact and phone number
- project number
- sample number
- date and time collected
- preservative used (if any)
- number of containers
- description of the sample
- analysis desired
- name of sampler and signature
- Signature of people in possession of the sample and when samples were transferred.
- Any remarks concerning discrepancies between the sample, sample label, and the COC.

6.1.5 Field Sample Shipment

The individual in charge of shipping samples to the laboratory is responsible for ensuring the completion of the COC. This individual will also inspect the form for completeness and accuracy. Any changes made to the COC will be initialed by the person making the change. An example of a COC is presented in Figure 1.6.

Samples are to be accompanied by an approved COC. When the possession of the samples is transferred, the individual relinquishing the samples signs and records the date and time on the document. The individual receiving the samples also signs and records the date and time of transfer. This record represents the official documentation for all transference of the sample custody until the samples have arrived at the laboratory.

If samples are to be split with another laboratory facility or government agency, a separate COC is prepared for those samples. This COC indicates with whom the samples have been split and is appropriately signed and dated with the time of transfer of the splits.

The following is a description of the procedure when transporting environmental samples from the sampling site to the laboratory:

- The outer surface of all sample containers is cleaned with bottled water and paper towels.
- Log book entries, sample tags, COCs are all completed.
- Samples and trip blanks are placed into a sample cooler along with the ice packs. After the cooler is filled, the appropriate COC is placed inside the cooler and the outer surface of the cooler is cleaned.
- Glass sample containers are wrapped with insulating material to prevent contact with other sample containers or the inner walls of the cooler.
- Once all packaging is completed, each cooler is sealed with identifying labels or custody seals which are initialed by the field samplers for COC.
- Samples are classified according to the Department of Transportation (DOT) regulations pursuant to Title 49 CFR.
- The laboratory is then notified prior to shipment that samples are being sent to the laboratory for analysis. This notice should be given at least 24 hours in advance of the expected sample arrival data.

Samples are packaged in thermally insulated, rigid coolers according to DOT specifications 173.510, 172 Subparts B C and D, and Subparts A and B of Part 173. Sample containers are placed in the cooler that contains blue ice and absorbent packing for liquids or styrofoam packing for solids. The completed COC is placed inside the shipping container unless otherwise noted.

The cooler is marked as follows:

- o proper shipping name; hazardous substance, liquid or solid
- o hazardous class; To be determined (label placed in upper left corner of outer container)
- o labels; "This Side Up" or arrows placed on the opposite side of the outer container if a liquid is to be shipped

A hazardous material shippers certification is filled out and will accompany the shipment. The container is secured with strapping tape to prevent leakage. It is recommended that an overnight express service (i.e., Federal Express) be used for the sample transport.

6.2 LABORATORY OPERATIONS

Delivery of the samples to the laboratory will be accomplished by direct transfer, overnight courier or common carrier as dictated by the specific project. Sample delivery by either special courier or common carrier will require a custody seal on the sample chest. Should the samples arrive with the seal broken, it should be written on the COC and the samples will not be processed until a thorough investigation has been completed. Upon arrival at the laboratory all sample containers are opened and inspected. Field sampling personnel or the project manager are notified on the same day of any problems concerning the samples or documents associated with the shipment. If samples arrive on Saturday and the field personnel are unavailable notification will be made on the next working day.

6.2.1 Sample Receipt

All samples will be received by the Sample Custodian or in his/her absence by any member of the laboratory staff. All samples received will be considered to be hazardous samples, thus all shipping containers should be opened in the sample receipt area of the warehouse by the walk-in exhaust hood. All personnel associated with sample receipt are required to become familiar with any and all safety procedures for the handling of hazardous samples.

The objective of the sample receipt procedure is to ensure that all pertinent information about the condition of the sample is recorded. The Sample Custodian will examine the shipping container and shall record the following information on the COC:

- o The condition of the shipping container, noting any damage.
- o The presence/absence of COC seals and their condition.

- The labeling on the shipping container.

The shipping containers should not be opened except under or in an approved hood or in an approved, well ventilated area. Approved hood space and/or approved, well ventilated areas should be determined by the Laboratory's Health and Safety Officer or the Corporate Health and Safety Officer. Prior to the removal of samples, plastic backed absorbent pads should be laid out to receive the sample bottles. The Sample Custodian will note on the sample COC (or the Project Problem Sheet, Figure 1.7, if the COC is missing) the following information:

- presence/absence of the chain-of-custody form/record,
- presence/absence of airbills and/or bills of lading documenting shipment of samples,
- any necessary project and/or sample information enclosed with the shipment.

Upon removal of the samples the following information must be recorded:

- The condition of the samples (intact, broken, leaking, cold or ambient, headspace in the VOA vials, etc.).
- The presence/absence of sample tags.

If the sample tags are present:

- Record sample tag document control numbers.
- Compare sample tags with the COCs and document whether these numbers agree.
- If the sample tag numbers are not listed on the COC, record this fact.

If an odor is noticed after opening the shipping container prior to sample removal it must be noted on the COC record. Once the COC, sample labels and sample tags have been compared, the Sample Custodian shall document agreement among the forms and shall note any discrepancies found on the Project Problem Sheet.

- If all samples that are recorded on the COC are received and no problems are observed, the Sample Custodian will sign the COC in the "TRANSFER ACCEPTED BY" box.

PROJECT PROBLEM SHEET

DATE: _____

TIME: _____

TO: _____

FROM: _____

PROBLEM: _____

_____

_____

_____

_____

_____

_____

_____

_____

PROBLEM CONTACT NAME: _____

ACTION TO BE TAKEN: _____

_____

_____

_____

_____

_____

_____

FIGURE 1.7 - PROJECT PROBLEM SHEET

- If problems are noted, the Sample Custodian will sign the COC and note the problems in the "REMARKS" box and note the problems on the Project Problem Sheet.

- If discrepancies have been discovered, they shall be reported to the appropriate Client Services personnel for clarification.

Following the inspection of the shipping containers, sample bottles and accompanying documentation the Sample Custodian will place the samples in the walk-in cooler and deliver the written documentation, including the COC, the Project Problem Sheet, etc., to the client services personnel. The client services personnel will review all of the sample documentation and compare it with any documentation previously supplied by the client. If necessary the client services personnel will make the necessary contacts to verify any discrepancies and carry out the client directives. All communications by the client services personnel will by documented in logbooks assigned to each person. The information recorded will consist of at least the following items:

- date of the communication
- person contacted
- detailed account of all directives given by the client

Once all of the sample information has been verified and checked against other project documentation the client services personnel will proceed to log-in the sample.

6.2.2 Sample Splitting

When clients supply their own containers or when bulk samples are received the Sample Custodian shall split the sample to provide sufficient aliquots for each analytical procedure that is to be performed. The following guidelines should be used to determine the manner in which samples will be split.

Water Samples - Inorganic Parameters Only

The Sample Custodian with the appropriate laboratory section supervisors will determine the minimum sample quantities required for the analysis. If insufficient sample exists to produce the aliquots needed the Sample Custodian shall contact the client services personnel for a priority list of parameters. Based upon the client services information the sample Custodian will split the sample into the proper containers so the laboratory may proceed with the analysis.

Water Samples - Organic and Inorganic Parameters

When bulk samples arrive for both inorganic and organic analyses the Sample Custodian or the personnel completing the volatile analysis will split out a portion for any required volatile analyses and transfer the sample to the instrumentation room volatile refrigerators. The remainder of the sample will be split for other organic or inorganic parameters as necessary.

Sediment/Soil Samples

Every effort will be made to acquire duplicate aliquots of these matrices. The sample will be made homogeneous after any portion required for the volatile organic analysis has been removed by one or all of the following procedures:

- stirring
- air drying and grinding
- particle separation
- quartering

The Sample Custodian or personnel completing the semi-volatile organic analysis shall obtain the aliquot for the organic analysis and the remainder will be given to the inorganic laboratory for further splitting if necessary. If insufficient material exists to provide the minimum quantities for analysis, the client shall be notified to either schedule a resampling event or to provide a list of priority parameters.

6.2.3 Sample Storage

All samples are kept in either the walk-in cooler or the volatile analysis refrigerator located in the organic instrumentation laboratory. Once the sample has been accepted and placed within these storage areas any laboratory personnel has access in order to complete the analysis. The Sample Custodian is responsible for the following items:

- Samples are to be removed from the shipping container and stored in their original container unless the container has been damaged. If the container has been damaged the Sample Custodian is responsible for transferring the sample to an appropriate container for further storage.

- The Sample Custodian will remove any samples from the storage areas for shipment off site when necessary.

- Ensure that the volatile samples are stored separately from the other samples.

- Ensure that standards are not stored with any samples.

6.2.4 Long-Term Storage/Sample Disposal

Upon completion of the analysis the samples will be remain stored in either the walk-in cooler or the volatile refrigerator for an additional thirty days. After thirty days the samples will be moved to the waste disposal room where they will be stored for an additional thirty days. If during the sixty storage period arrangements have not been made to return the sample to site or to initiate any further analytical the sample is properly disposed of according to internal disposal procedures.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

The following subsections outline the calibration procedures and frequencies for both field and laboratory analytical instrumentation.

7.1 GAS CHROMATOGRAPH FOR VOLATILE ORGANIC ANALYSIS

Prepare calibration standards at a minimum of five concentration levels for each parameter. One of the external standards should be at a concentration near, but above the Minimal Detection Limit, (MDL), and the other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the detector. These standards should be prepared fresh on a routine basis. Analyze each calibration standard and tabulate area responses versus the concentration in the standard. The results can be used to prepare a calibration curve for each compound. Alternatively, if the ratio of response to concentration (calibration factor) is a constant over the working range (< 20% relative standard deviation, (RSD), linearity through the origin can be assumed and the average ratio or calibration factor can be used in place of a calibration curve. The working calibration curve or calibration factor must be verified on each working day by the measurement of one or more calibration standards. If the response for any parameter varies from the predicted response by more than +/- 10%, the test must be repeated using a fresh calibration standard. Alternatively, a new calibration curve or calibration factor must be prepared for that parameter.

7.2 GAS CHROMATOGRAPH FOR EXTRACTABLE ORGANIC ANALYSIS

Prepare calibration standards at a minimum of five concentration levels for each parameter of interest by adding volumes of one or more stock standards to a volumetric flask and diluting to volume with the appropriate solvent. One of the external standards should be at a concentration near, but above the MDL and the other

concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the detector.

Using injections of one to five micro-liters of each calibration standard, tabulate area responses against the mass injected. The results can be used to prepare a calibration curve for each compound. Alternatively, if the ratio of response to concentration (calibration factor) is constant over the working range (< 20% RSD), linearity through the origin can be assumed and the average ratio or calibration factor can be used in place of a calibration curve. The working calibration curve or calibration factor must be verified on each working day by the measurement of one or more calibration standards. If the response for any parameter varies from the predicted response by more than +/- 15%, the test must be repeated using a fresh calibration standard. Alternatively, a new calibration curve or calibration factor must be prepared for that compound.

7.3 ATOMIC ABSORPTION SEPCTROPHOTOMETER FOR TRACE METALS ANALYSIS

Calibration standards are prepared by dilution of a stock solution (~1000 ug/mL) at the time of analysis. Calibration standards are prepared fresh at least daily and are discarded after use. A blank and at least three calibration standards are prepared in graduated amounts in the appropriate concentration range. The calibration standards are prepared using the same acids as the samples. Beginning with the blank and working toward the highest standard, each solution is aspirated and the readings are rendered and processed. Each result is used to develop a calibration curve (computer generated from the system software). The working calibration curve is verified during each working day, at least one time per hour, by the measurement of one or more calibration standards. If the response varies more than +/- 15% from the predicted response, the standard is re-analyzed. If the response is still more than +/- 15% from the predicted response, all analyses performed after the last calibration standard will be repeated after instrument calibration.

7.4 SPECTROPHOTOMETER FOR COLORIMETRIC DETERMINATIONS

Calibration standards are prepared by dilution of a stock solution (~1000 ug/mL) to appropriate working standards and to calibration standards on a daily basis. Concentrations of stock and working standards will be dependent on the specific methods of analysis. A blank and at least five calibration standards are prepared in graduated amounts in the appropriate concentration range. Calibration standards will be prepared exactly as the samples unless specified differently in the method.

A standard curve is prepared by plotting absorbance versus concentration for the calibration standards. The working calibration curve is verified by analysis of a standard. If the response varies more than +/- 10% from the predicted response, the standard is re-analyzed. Should the response still vary more than +/- 10%, a new standard curve will be prepared.

7.5 SPECIFIC ION METER

This calibration procedure is specific for the Orion 901 specific ion meter and associated specific ion electrodes. Typical electrode response curves are given in each specific electrode instruction manual. The standard calibration method that follows is valid over the entire range of response. The necessary solutions consist of the following:

- Adjustors - Ionic strength adjustors, (ISA), pH adjustors, decomplexing agents are added in equal proportions to all samples, standards and blanks. Necessary adjustors are described in specific electrode manuals.
- Standards - Two standards are prepared that bracket the expected concentration range of the samples.
- Blank laboratory grade water with adjustors added.

The specific calibration procedures is as follows:

1. The instrument is set up with electrode(s) as described in the electrode instruction manual.
2. Preset slope from electrode instruction manual.
3. Set standard thumbwheels to display concentration of first standard.
4. Set mode switch to "CONCN".
5. Place electrode(s) in first standard and add adjustors.
6. Press "Clear/Read MV", all reading to stabilize.
7. Press "Set CONCN".
8. Remove electrode(s), rinse with lab grade water, shake off excess water.
9. Place electrode(s) in lab grade water - add adjustors - allow reading to stabilize, press "Set Blank".

10. Repeat Step #8.

11. Place electrode(s) in second standard and add adjustors allow - readings to stabilize.

12. Adjust slope thumbwheel so exact concentration of standard two is shown on display.

13. Analyze samples by adding adjustors and allowing readings to stabilize.

14. Recalibrate every two hours or as necessary as indicated by analysis of a middle standard.

7.6 PH METER

Equipment

A pH meter - Orion 901 Ionalyzer equipped with a temperature compensating electrode.

Solution

The pH buffers that bracket the expected pH range (usually pH 4 and pH 10); a third median value pH (usually pH 7).

Procedure

1. Instrument set up as described in electrode manual.

2. Preset slope from temperature compensation table.

3. Set "Standard" thumbwheel to display pH value of higher buffer.

4. Set mode switch to "pH".

5. Place electrode in pH buffer of higher value.

6. Press "Clear/Read MV" - allow reading to stabilize.

7. Press "Set CONCN".

8. Remove electrode(s) and rinse with lab grade water - shake off excess water.

9. Place electrode(s) in pH buffer of lowest value - allow reading to stabilize.

10. Adjust slope thumbwheels so display reads.

11. Repeat step #8.

12. Immerse electrode(s) in middle pH buffer and allow for stabilization; value should be +/- 0.1 pH unit - if not, check electrode as described in the manual.

13. Determine pH values of samples by immersing electrode in sample - allow reading to stabilize.

14. Analyze middle pH buffer after each ten samples.

7.7 ANALYTICAL BALANCE

For preparing standards from concentrated or pure material, a Mettler analytical balance capable of weighing to 0.1 mg is used. This balance incorporates a built-in calibration weight. Calibration procedure is as follows:

1. Allow balance to stabilize by being left on power supply for one hour.

2. Remove objects from the pan and close doors.

3. Press control bar until "CAL" is displayed.

4. Release control bar, "CAL ---" appears on display.

5. Slide calibration lever slowly towards the rear when "CAL 100" is displayed.

6. "CAL--" will be displayed, then "100,000"; at this time, the balance has been calibrated to 100.000 g +/- 0.00001g.

7. "CAL 0" will next appear - slide calibration lever back to original position - "---" will be displayed, then "0.00000"; at this time the balance has been zeroed to 0.0000 g +/- 0.00001g.

8. At least monthly, the calibration of each analytical balance will be checked using Class S1 weights. At least yearly, the balance will be serviced and calibrated by a certified technician.

7.8 CALIBRATION STANDARDS AND TRACEABILITY

Standards for analysis of metals will be purchased stock standards each at a concentration of approximately 1000 ppm. These standards where possible are traceable to National Bureau of Standards reference materials. Dilutions of the standards will be made to prepare working standards on a daily basis. Standards for

organic, extractable and volatile organic analyses will be prepared, when available, from neat materials. These materials will be obtained from Chem Service, Inc., or an appropriate vendor and will be "Standard Grade" material. These materials are normally greater than 95% pure, pre-analyzed, purity certified, expiration dated and lot numbered. Primary standards are usually either not available in sufficient quantities or are too expensive to be used on a routine basis. Therefore, secondary standards must be prepared in-house (or, in some cases, purchased) and compared to primary standards. If all steps in the comparison are documented, the secondary standard is said to be traceable. Secondary standards prepared at a later date can then be compared to the first secondary standard. This process is called "maintaining the traceability of standards." Standard preparation is recorded in a bound standard log book. The details are recorded in the standard log book on the pre-printed pages. Identity numbers from each standard are assigned for each sequential log and listed in the standard log book. Primary standards will not be used for routine analytical purposes. Because of the limited availability of such standards, they will be used to standardize secondary (stock and working standards). The QA supervisor will maintain data to ensure the traceability of all standards. If traceability is broken, the re-analysis of the secondary standard must be performed in parallel with the primary standard.

8.0 ANALYTICAL PROCEDURES

Refer to Table 1.2 for the EPA approved analytical procedures that will be used.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

The following section outlines the data reduction plan for the collected data, criteria used to validate the data and the decision flow from raw data to the validated concentrations.

9.1 DATA REDUCTION

Data reduction includes the identifications and calculations necessary to convert the raw instrument readings to the final reported compounds and their respective concentrations.

9.1.1 Conventional Parameters

Data calculation and reduction will be performed as described in the individual EPA approved methods.

9.1.2 Trace Metal Parameters

Atomic absorption spectrophotometry is based upon the principle in which the amount of light of a particular wavelength absorbed by a specific metal will enable the percent absorption to be determined and then used to ultimately calculate the absorbance. Since absorbance is directly related to concentration, a plot of the two parameters is linear in certain operable ranges and allows for the determination of unknown concentrations in solutions (direct samples or extracts) after measurement of absorbance. The computer system controlling the instrument actually completes the calculations and reports the concentration in mg/L. The following equations show how the final sample concentration is calculated using the instrument calculated concentration.

$$\text{mg/L metal} = \frac{A\ (Vi)\ (D)}{(Vf)}$$

Where:

A = concentration from instrument in mg/L
Vi = initial volume (before digestion) mL
Vf = final volume (after digestion) mL
D = dilution factor if necessary

$$\text{mg/kg metal} = \frac{A\ (Vf)\ (D)}{W\ (P)}$$

where:

A = concentration from instrument in mg/L

Vf = final volume of sample in mL

D = dilution factor if necessary

W = sample weight in grams

P = percent solids in decimal (if results in dry weight are needed)

9.1.3 Organics

Gas Chromatograph Results

Calculations are performed for each analyte after its identification is determined. Identification is based upon the retention time of the suspect peak compared to the retention time of the external standard. The concentration of the analyte is determined by using the calibration curve and the peak area of the analyte. A calibration factor is determined from the calibration curve and used to calculate the concentration.

Gas Chromatograph/Mass Spectrometry Results

Qualitative identification of an analyte is determined by obtaining the extracted ion current profiles (EICPs) for the three identifying mass ions and following the criteria listed below:

- The intensity of the three characteristic masses of each analyte must maximize within one scan of one another.
- The relative peak height ratios of the three characteristic masses must be within ±20% when compared to the mass spectrum of the reference standard analyte.
- The relative retention time of the suspect peak must be within ± 0.06 of the standard reference peak.

In order to list structural isomers as separate analytes they must have acceptable resolution. Acceptable resolution is achieved if the baseline to valley height between the isomers is less than 25 percent of the sum of the two peaks. Otherwise structural isomers must be identified as unresolved isomeric pairs.

The following equations demonstrate how the actual sample calculations are carried out.

GC Volatiles

$$\text{ug/L (ug/kg)} = \frac{As\ (D)}{CF\ (Vf)\ (P)}$$

where:

As = area response of targeted analyte
D = dilution factor if necessary
Vf = volume purged in ml or g
CF = calibration factor from standard analysis
P = percent solids in decimal (if results in dry weight are needed)

$$CF = \frac{As}{AMT}$$

where:

As = area response of targeted analyte
AMT = amount of targeted analyte in ng

GC/MS Volatiles

$$ug/L\ (ug/kg) = \frac{As\ (AMT)\ (D)}{Ais\ (RF)\ (Vf)\ (P)}$$

where:

As = area response for targeted analyte

AMT = amount of internal standard in ng

D = dilution factor if necessary

Ais = Area of internal standard

Vf = volume purged in mL or g

P = percent solids in decimal (if results in dry weight are needed)

RF = response factor from standard analysis calculated as

$$RF = \frac{As\ (AMTis)}{Ais\ (AMTs)}$$

where:

As = area response for targeted analyte
AMTis = amount of internal standard in ng
Ais = area response of the internal standard
AMTs = amount of the targeted analyte in ng

GC Extractable

$$ug/L\ (ug/kg) = \frac{As\ (Vf)}{(CF)\ (Vi)\ (P)}$$

where:

As = area response for targeted analyte

CF = calibration factor as explained above

Vf = final extract volume in uL

Vi = initial volume in ml or weight in g

P = percent solids in decimal (if results in dry weight are needed)

To quantitate multicomponent mixtures (i.e., PCBs, chlordane) area summations are used. For PCBs at least five peaks where possible are included in the area summation for quantitation. The same relative peaks (based on pattern and retention times) are used to calculate the calibration factor from the standard. For toxaphene and chlordane total area summations are used for quantitation.

GC/MS Extractable

$$ug/l\ (ug/kg) = \frac{As\ (AMTis)\ (Vf)\ (D)}{Ais\ (RF)\ (Vi)\ (P)}$$

where:

As = area response for targeted analyte

AMTis = amount of internal standard in ng

Vf = final extract volume in uL

D = dilution factor if necessary

Ais = area of internal standard

RF = Response factor as listed above

Vi = initial volume in ml or weight in g

P = percent solids in decimal (if results in dry weight are needed)

9.2 DATA VALIDATION

Data validation is performed by the analyst, the section supervisor, department manager and the QA Officer. Validation is accomplished through routine audits of the data collection and work flow procedures and by monitoring the QC sample results. The minimum requirements for each analytical sequence are as follows:

- At least a three point calibration and one calibration check standard. The calibration check standard must be made up from a different source from that of the initial calibration standards.
- One reagent blank per analytical batch (i.e., one per twenty samples).
- Laboratory control samples on a per batch basis.
- Matrix spike and matrix spike duplicate analysis per sample batch.

In addition to the requirements listed above, the GC/MS instruments must also complete the items listed below:

- The decafluorotriphenylphosphine (DFTPP) or bromofluorobenzene (BFB) required tuning criteria must be met.
- Percent recovery calculated from the surrogates added to every sample analyzed by GCMS must fall within control limits or be reanalyzed.
- Area counts of the internal standards are monitored (-50% to + 100%)

The data collection and procedures used within the laboratory are audited as follows:

- Review of the sample documents for completeness by the analyst at each step of the analysis.
- Daily review of instrument logs, performance test results and analyst performance by the section supervisor.
- Daily review of performance indicators such as blanks, surrogate recoveries, matrix spike and matrix spike duplicate results.

- Random calculation checks.
- Review of all reports prior to and subsequent to data entry.
- Review and approval of the final report by the lab manager and/or the QC Officer.

The review of data quality involves several levels of evaluation. Each of the section supervisors, department managers an the QA Officer are responsible for ensuring that the data is validated at various stages throughout the analytical scheme. Any problems with the validity of the data must be corrected as soon as possible for obvious reasons. It is also imperative that the actions taken to correct the problem be documented completely.

In general, the analysts and the laboratory section supervisors are responsible for reviewing the data relative to instrument calibration, standard preparations, method blanks, raw data, calculations and transcriptions. The analyst normally reviews 100% of the raw analytical data generated, including the calibration data and all calculations. Upon completion of the analyst review, a second level of the raw data review is performed by either the section supervisor or the department manager where data quality indicators such as method blanks, replicate analyses and spike recoveries are reviewed for acceptance. At the next level of data quality review the QA Officer is generally responsible for a complete review of about 15% of the data generated. The emphasis is on the data acceptability relative to the laboratory, program or project data quality objectives. All analytical problems encountered during sample analysis must be properly addressed to provide explanations to the data users.

9.3 DATA REPORTING

Once the data has been validated it is ready for report production. A cover page is prepared which includes the following information:

- client name
- number of analyzed samples contained within the report
- types of analyses completed
- date of sample receipt
- date when the analytical results for the entire project

- were available for reporting
- notice of confidentiality
- signature by the laboratory manager authorizing the release release of the hardcopy report

An example of a typical cover page is shown in Figure 1.8. Immediately following the cover page, is a listing of the methods used by the laboratory to complete the work. These method summaries appropriately describe the analytical method or list the reference from which the analytical method was derived. Typical method summaries are included in Figure 1.9. After the method references the analytical data is reported. An example of a typical report page is shown in Table 1.10. A copy of the original COC is also included in the final report for reference purposes.

10.0 FIELD AND LABORATORY QUALITY CONTROL CHECKS

This section outlines the typical procedures followed by both the field sampling personnel and the laboratory personnel ensuring that the appropriate quality control requirements have been met. Obviously the specific QC procedures may change according to the requirements of a particular job site, however, the following should be considered as minimum requirements.

10.1 FIELD OPERATIONS

Collection and analysis of field quality control samples are intended as checks on the integrity of sample collection and handling procedures and equipment decontamination procedures. The specific quality control checks required for the field may be found in Section 5.4 entitled Specific Sample Collection Quality Control Procedures. Listed below are items which may be found in that section.

- Experienced sampling personnel
- Traceability of the sample through the sampling and sample receipt by the laboratory.
- Necessity of replicate/duplicate field samples as a measure of the sampling precision.
- Trip blanks (REF. 1) - The trip blank is to be used when sampling for volatile organics. The purpose is to determine if contamination has occurred as a result of improper sample container cleaning, contaminated blank source water,

OHM Corporation

Environmental Testing
and Certification Corp.

ANALYTICAL REPORT

CLIENT: John Doe Corp.
Railroad Borough, PA

ATTN: Mr. John Doe

PROJECT NUMBER: 0.00 SAMPLE TYPE: Solids

ANALYSIS PERFORMED:

Volatiles

(Samples: 001 and 002)

DATE COMPLETED: 3/01/90 DATE RECEIVED: 2/26/90

This report is PROPRIETARY AND CONFIDENTIAL and delivered to and intended for the exclusive use of the above named client only. Environmental Testing and Certification Corp. assumes no responsibility or liability for the reliance hereon or use hereof by anyone other than the above named client.

The analyses and data interpretation that form the basis of this report was prepared under the direct supervision and control of the undersigned who is solely responsible for the contents and conclusions herein.

Reviewed and
Approved By _____ Date _____
R. J. Schock, Mgr., ETC-Findlay Laboratory

16406 U.S. Route 224 East ■ P.O. Box 1404 ■ Findlay, Ohio 45839-1404 ■ 419-423-5526

FIGURE 1.8 - FINAL REPORT COVER PAGE

PROJECT 7819

SUMMARY REPORT OF ANALYTICAL SERVICES

1. INTRODUCTION

ETC-Findlay Laboratory received 8 samples from OHM Corporation (OHMC). These samples were acquired by their technical personnel and transferred to the laboratory complete with Chain-of-Custody Record(s), a copy of which is attached for reference. These samples were analyzed for the following:

TCLP Leachate Preparation

TCLP leachates were prepared according to Federal Register, Vol. 51 No. 216, Friday, November 7, 1986, Appendix I to Part 268-Toxicity Characteristic Leaching Procedure.

Volatiles

Samples are prepared and analyzed according to USEPA Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, SW-846, 3rd edition, September 1986; Method 8240, GC/MS Methods for Volatile Organics.

2. ANALYTICAL RESULTS

The following tables detail the analytical results for samples received by the laboratory on February 3, 1990.

FIGURE 1.9 - REPORT METHOD SUMMARIES

TABLE 1: QUANTITATIVE RESULTS

TCLP METALS ANALYSIS (JR30)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No	Company	Facility	Sample Point	Date	Time Hours
ID6488		300350	32090	900124	0

Compound	Results				
	Sample Concen. mg/l	MDL mg/l	Blank Data mg/l	Batch #	
Cadmium (Leachate)	185	005	ND	Q985	
Chromium (Leachate)	019	010	ND	Q985	
Lead (Leachate)	6 52	075	ND	Q985	
Nickel (Leachate)	6 99	020	ND	Q985	
Silver (Leachate)	ND	010	ND	Q985	

FIGURE 1.10 - TYPICAL REPORT PAGE

sample contamination during storage and transportation due to exposure to volatile (eg. gasoline fumes) and other environmental conditions during the sampling event. Trip blanks are prepared prior to the field sampling by collecting reagent water which is free from volatile contaminants, adding preservatives as appro-priate, sealing the container, labeling the container and trans-porting the blank to the field. The trip blanks are not to be opened in the field and are returned to the laboratory with the collected samples from the field site.

- Field blanks (REF. 1) - field blanks are used to evaluate the effects of the on-site environmental contaminants, the purity of the reagents used as preservatives or additives and the general sample containers filling or collection. Field blanks are prepared on-site by filling the sample containers with reagent grade water, adding the appropriate preservatives or additives, 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. The frequency of the field blanks should be 5% of the samples in the parameter group per day or one field blank per parameter group per day, whichever is greater.

- Equipment blanks (REF. 1) - equipment blanks are required if sampling equipment must be cleaned in the field and reused for subsequent sample collection. These blanks are used to determine the effectiveness of the field cleaning procedures as well as the source of any contamination which may be found in the trip blanks.The final rinse water (reagent grade) shall be rinsed on or through the sampling equipment, collected in an appropriate sample containers and preserved. These blanks must be included in the same storage and transport containers as the samples. At least one equipment blank per piece of equipment used in the sampling process that must be field cleaned. If a piece of equipment is cleaned more than 20 times in one sampling event, equipment blanks must be submitted at a rate of 5% for each equipment type. For each equipment blank collected, aliquots must be taken and properly preserved for each method group.

10.2 LABORATORY OPERATIONS

Responsibility for internal QC checks rests with the Laboratory Group Supervisor and with the analyst. The QC Supervisor will monitor the performance of the analyst and the laboratory group supervisor for implementation of proper QC checks and will approve all data.

- o Initial Calibration and Calibration Verification a minimum of 5 standards and a blank for the standard curve;
  - Analysis of the mid-range standard to verify calibration.
- o Continuing Calibration Verification;
  - Analysis of mid-range standard at a minimum frequency of 10% (check standards).
- o Procedural Blank Analysis;
  - A procedural blank (Method blank) will be prepared and analyzed with each batch of samples or with every 20 samples prepared, whichever is more frequent.
- o Matrix Spike Analysis;
  - At least 1 spiked sample will be prepared and analyzed for each batch of samples prepared or for each 20 samples analyzed, whichever is more frequent.

10.2.1 Quality Control Samples

QC samples obtained from NBS or EMSL Cincinnati are analyzed on a routine basis as an internal audit of methodologies and control limits. In addition, the laboratory maintains several state certifications that require analysis of USEPA-EMSL Water Supply and/or Water Pollution Study PE samples or PE samples as supplied by the appropriate state agencies.

10.2.2 References

1. Field QC Blanks, DER QAS Guidance #89-02, Florida Department of Environmental Regulation, April 28, 1989.

11.0 PERFORMANCE AND SYSTEM AUDITS

Audit is defined as systematic check to determine the quality of operation of field and laboratory activities. It is comprised of the following: 1) performance audit and 2) system audits.

11.1 FIELD AUDITS

11.1.1 Field Performance Audits

Field performance audits are performed on an ongoing basis during the project as field data are generated, reduced, and analyzed. All numerical analyses, including manual calculations,

are documented. All records of numerical analyses are legible, of reproduction-quality, and supporting complete to permit logical reconstruction by a qualified individual other than the originator.

Other indicators of the level of field performance are the analytical results of the blank, duplicate and replicate samples. Each blank analysis if an indirect audit of effectiveness of measures taken in the field to ensure sample integrity (e.g., field decontamination procedures). The results of the field duplicate and replicate analyses is an indirect audit of the ability of each field team to collect representative sample portions of each matrix type.

11.1.2 Field System Audits

System audits of site activities are accomplished by an inspection of all field audit activities by a technical audit team. This audit is composed of comparison, by the audit team, of current field practices with standard procedures. The following is a listing of the criteria to be used in the evaluation of field activities:

- Overall level of organization and professionalism
- All activities conducted in accordance with the work plan
- All procedures and analyses conducted according to procedures outlined in the QAPP
- Sample collection techniques versus QAPP
- Level of activity and sample documentation
- Working order of instruments and equipment
- Level of QA conducted per each field team
- Contingency plans in case of equipment failure or other event preventing the planned activity from proceeding
- Decontamination procedures
- Level of efficiency with which each team conducts planned activities at one site and proceeds to the next
- Sample packaging and shipment

After the audit, any deficiencies are discussed with the field staff, and corrections are identified. If any of these deficiencies might affect the integrity of the samples being collected,

the audit team informs the field staff immediately, so that any corrections might be made. The audit team consists of the project QA Officer and field-supervisory level management staff.

11.2 LABORATORY AUDITS

11.2.1 Laboratory Performance Audit

Procedures used to assess the effectiveness of the quality control system are noted in the following subsections.

Internal Performance Audits

These are accomplished by the laboratory through the use of control samples, replicate measurements and use of reference materials in conjunction with control charts.

Sample analysis system audits are conducted by the QA Officer and include the following:

- Verification of written procedures and analyst(s) understanding
- Verification and documentation of procedures and documents
- Review of analytical data and calculations

External Performance Audits

These are accomplished by the laboratory through interlaboratory checks such as:

- Participation in laboratory evaluation programs (see Table 1.4)
- Participation in performance evaluation samples available from EPA (see Table 1.5)
- Analysis of split samles and comparing results with the other laboratory

11.2.2 Laboratory System Audit

An on-site inspection is done by an audit team or laboratory certification personnel to review the laboratory quality control system which covers sample handling, sample analysis, records control, preventive maintenance, and proficiency testing. When EPA or laboratory certification personnel initiates a system audit of

TABLE 1.4 - LABORATORY EVALUATION PROGRAMS

CERTIFYING/ACCREDITING AGENCY	CERTIFICATION NUMBER/DATE	DESCRIPTION
State of California Dept. of Health Services	#309	Approved for various inorganic and organic analyses of hazardous waste.
State of New Jersey Dept. of Environmental Protection	#74603	Approved for various inorganic and organic analyses of drinking water and water pollution samples.
State of New York Dept. of Health	#10712	Approved for various inorganic and organic analyses of non-potable water.
State of Ohio Ohio EPA	4/4/88 - 4/4/91	Analysis of pH, Alkalinity, Nitrate, Fluoride, and Chloride.
State of Wisconsin Dept. of Natural Resources	#999037160	Analysis of various inorganic and organic analysis of environmental samples.

TABLE 1.5 - LABORATORY PE SAMPLE PROGAMS

AGENCY	PARAMETERS
Chemical Waste Management	PCBs, metals, conventionals
State of New York Dept. of Health	Non-potable water analysis for various inorganic and organic parameters
USEPA WP Study	Various conventionals, trace metals, and organic parameters
USEPA WP Study	Various conventionals, trace metals, and organic parameters

the laboratory, any recommendations made or deficiencies identified will be considered for implementation and corrective actions taken to correct deficiencies.

12.0 PREVENTATIVE MAINTENANCE

Critical to the performance and minimization of downtime of all equipment whether it be measurement or support, is proper maintenance. Preventative maintenance will be performed as recommended by the manufacturer of the respective equipment. This maintenance will consist of, but not be limited to, the following minimum procedures at the specified time intervals.

All of the routine maintenance and problem troubleshooting for each piece of equipment must be documented in the instrument maintenance logbook. This information which is recorded includes a description of the problem or maintenance procedure, steps followed throughout the procedure, parts replaced, initials of the person completing the procedure, the amount of downtime and the dates through which the instrument was unavailable for production. When personnel from outside the laboratory work on the equipment they must also record their activities in the maintenance logbook. It is the responsibility of the section supervisors to ensure that the documentation is completed as required.

12.1 PH METERS AND COMBINATION PH ELECTRODES

Preventive maintenance for the pH meter and electrodes primarily involves the proper care of the electrode. Proper electrode care involves storage of the probe in a 1:1 solution of pH = 7 buffer and deionized water. Also the port for the addition of internal filling solution must be plugged at all times to prevent evaporation of the solution when the electrode is not in use. When the internal filling solution has dried out, the chamber will be rinsed with deionized water before replacement of the filling solution. This step prevents clogging of the probe and poor (<100 percent) slope adjustments when calibration the electrode. Whenever slope readings are deteriorating or a low ionic strength sample gives erroneous readings, treatment of the electrode with 1N KOH and 1N HCl should be performed. Spare parts such as a replacement probe and fresh buffer solutions will be available for the system at all times.

12.2 ANALYTICAL BALANCES

Analytical balances will be cleaned and calibrated on a yearly basis by a manufacturer's representative. Monthly, the accuracy of analytical balances will be compared to standard weights.

12.3 Atomic Absorption Spectrophotometers and Inductively Coupled Argon Plasma Spectrophotometers

Routine maintenance of the AA's includes inspection of all hoses and O-rings for wear and replacement as necessary. The spray chamber is removed, totally disassembled at regular intervals, and each component is thoroughly cleaned. The furnace graphite shield, chimney, rinse chamber, rinse bottle, and syringe are regularly cleaned. The spray chamber and nebulizer is cleaned daily by aspirating at least 50ml of H_2O. The liquid in the trap is flushed and changed. The burner is cleaned with hot water. The lamp window and quartz windows of the furnace assembly are cleaned daily.

12.4 GAS CHROMATOGRAPHS

Routine maintenance of the GC's includes daily checks of gas inventory, changes of septum, changes of glass wool for packed columns. Detectors are inspected and cleaned according to manufacturer's specifications.

12.5 SPECTROPHOTOMETERS

Routine maintenance of the spectrophotometer includes daily check of the sample compartment for spills, inspection of external stray light filters, and electrical connection inspections. The instrument is disassembled and cleaned as required according to the instrument manual.

12.6 DISSOLVED OXYGEN, CONDUCTIVITY, AND TURBIDITY METERS

These meters will be checked daily for spills and inspected for proper connections. The instruments will be disassembled and cleaned according to the instrument's manual.

Probes associated with the D.O. and conductivity meter will be inspected daily and expendable parts replaced as necessary.

12.7 GAS CHROMATOGRAPH/MASS SEPCTROMETERS

Routine maintenance of the GC/MS systems includes daily checks of the system operating parameters, gas supplies, septum changes, changes of injection ports or glass wool when required and inspection of the vacuum system. All systems are operated on a standard twelve (12) hour clock to ensure correct system operation. Additional routine maintenance will be according to manufacturers specifications.

12.8 CONTINGENCY PLANS FOR MINIMIZATION OF UNSCHEDULED DOWNTIME

Essential in the minimization of downtime is an inventory of user-replaceable spare components. Each measurement system will be equipped with spare components such as fuses, printed circuit boards, and cables for replacement in the event of a downtime situation. This will reduce downtime and allow for more effective troubleshooting in the event of equipment failure. OHM also has an Electronics Department that is able to help troubleshoot the affected instrument and make needed repairs.

13.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

13.1 FIELD DATA

13.1.1 Precision

Duplicate and replicate samples analyzed by the laboratory assess the precision of the sampling effort. Control limits for duplicate/replicate RPDs is set at 0-20% to provide interim guidelines. Once a sufficient amount of replicate data becomes available, field precision control charts are constructed similar to the laboratory precision charts. For any given concentration, the mean and the standard deviation(s) of the replicates are calculated. The mean is the centerline of the control chart. Data from each sample set are pooled with the previous sample sets to generate control and warning limits for the next set. Warning and control limits for water samples are set at $\pm$ 2s and $\pm$ 3s, respectively. Control limits for solid samples are more liberally established due to matrix heterogeneity. Data outside any control limit are subject to QA review.

13.1.2 Accuracy

Field instruments are calibrated daily or more frequent, if needed, to ensure accuracy of the measurement of field parameters. Specifically, the pH measurement must be accurate to $\pm$ 0.1 unit, temperature must be to $\pm$ 0.5°C, and specific conductance must be $\pm$ 10 umhos/cm. Each well be purged until the above parameters are stable within the specified limits.

All blanks associated with each sample set are to be analyzed and evaluated for cross-contamination. Blank contamination and the resulting corrective action are assessed on an individual basis.

13.1.3 Completeness

The field supervisor is responsible for ensuring that all field instrumentation and equipment are functioning properly and calibrated according to set procedures, and that all data are recorded accurately and legibly. In addition, the field supervisor must ensure all sites are sampled for all the specified analyses, that sufficient sample volume has been provided to complete those analyses, and that all of the QA samples have been included with each sample set. The goal for completeness for each sample set shipped to the laboratory is 100 percent. The minimum acceptable completeness limit is 95 percent.

13.2 LABORATORY DATA

13.2.1 Accuracy Control

Data accuracy is a reflection of the efficiency of the analytical procedure. It is determined by use of spiked samples and standard reference materials or laboratory control samples performed at the rate of one set every 20 samples. A control chart is generated using historical laboratory data where warning and control limits are established to assess data accuracy.

The accuracy (check standards) samples will have concentration values of the mid-standard. During analysis, a minimum of ten percent (10%) of samples must be accuracy samples. The accuracy samples must be staggered throughout the analysis, not placed one after another. After a minimum of seven (7) accuracy samples are analyzed, the percent recovery is calculated for each sample by the following equation:

$$\% \text{ Recovery} = \frac{\text{Observed Value} \times 100}{\text{True Value}}$$

The accuracy criteria is determined by calculating the standard deviation of seven (7) or more percent recovery values and setting the upper and lower control limits using the following equations:

$$\text{Upper control limit} = p + 3Sp$$

$$\text{Lower control limit} = p - 3Sp$$

Where:

p = average percent recovery
Sp = standard deviation

After the standard deviation, for the seven (7) or more samples has been calculated, the accuracy control limits will be used to determine if the analysis is out of control. This is done by checking the results against the control limits. If any values are above the upper control limit or below the lower control limit, all sample results after the last qualifying accuracy sample must be repeated or discarded. If seven (7) consecutive values fall below the lower control limit, new limits must be calculated using the new accuracy check values. If the values fall between the upper and lower limits, then conditions are reported as "within limits."

13.2.2 Precision Control

Precision is based upon the results of the relative percent differences as calculated from the percent recoveries of the matrix spike and duplicate samples. The control limits for precision is based on historical laboratory data.

Present practice is to include MS and MSD samples on a per batch basis or a minimum frequency of 5%. Duplicate results are compared and the relative percent difference (RPD) is then determined according to the following formula:

$$RPD = \frac{(D1 - D2)}{(D1 + D2)/2} \times 100$$

Where:

D1 = Determination #1
D2 = Determination #2

The RPD will be entered into the lab's data system and will be used to define the Precision of the analysis. This value should be less than 20%.

13.2.3 Recovery Control

Recovery control is necessary to determine if the sample matrix is interfering with the constituent being analyzed. A minimum five percent (5%) of samples will be recovery check samples (matrix spikes). Samples involving different types of matrices

must have at least one recovery check for each type. The percent recovery of the matrix spike is determined by the following equation:

$$\% \text{ Recovery} = \frac{(SSR - SR)}{SA} \times 100$$

Where:

SRR = Spiked sample result
SR = Sample result
SA = Spike added

Control limits will be determined for each matrix, determining the deviation for seven (7) or more percent recovery values.

13.2.4 Completeness Control

Completeness is expressed as the percentage of the amount of valid data obtained to the amount of data expected. For a set of data to be considered complete, it must include all QC data verifying its accuracy and precision.

If samples analyzed do not meet all Quality Control requirements in terms of accuracy and precision for any specific parameter, the sample preparation and analysis will be repeated pending adequate volume.

$$\% \text{ Complete} = \frac{\text{Acceptable results}}{\text{Total analyses}} \times 100$$

14.0 CORRECTIVE ACTIONS

The results from the following Quality Assurance activities may initiate a corrective action:

- Performance audits
- System audits
- Inter-laboratory comparison study
- Calibration data out of specified limits
- Failure to adhere to Quality Assurance plan

- Failure to adhere to standard operating procedures
- Data completeness below required limits
- Problems detected by the field personnel
- Problems outlined by the DER QA Officer
- Any and all problems detected which effect or potentially effect the quality of the work effort devoted to the project.

Upon notification of a problem, or when a potential problem is identified, the Project Manager notifies the QA Officer. At this time, a thorough investigation of the reported problem is immediately performed to determine if corrective action should be initiated.

Corrective actions may be initiated by any laboratory individual, as well as the laboratory QA Officer. The laboratory manager will be responsible for approving the corrective action and the Quality Assurance Officer insures the corrective action is carried out. Follow-up procedures for either case will not be considered complete until the problem has been effectively and permanently solved. These procedures will consist of, but not be limited to, the following:

- Determining when the problem occurred and the systems affected by the problem.
- Assign responsibility and time schedule to implement the corrective action.
- Determine the desired effectiveness and implement the corrective action.
- Verification and documentation that the corrective action has eliminated the problem.

The Laboratory Manager has the authority to require that all measurements that may be in doubt due to the problem be stopped or limited until the corrective action is complete. The QA Officer also has the authority to order new samples be obtained and reanalyzed after the corrective action is complete. Formal notification to ETC management and incorporation into the project file will be the ultimate disposition of any corrective action.

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance reports will be prepared on a quarterly basis by the Manager of Analytical Services and the QA Officer. They will be submitted to the ETC Network QA Manager and appropriate agencies as applicable. The report will consist of: an assessment of data accuracy, precision and completeness, results of performance audits, results of system audits, and documentation of any corrective actions that were initiated during the reporting period.

16.0 PERSONNEL QUALIFICATIONS

Table 1.6 list the current ETC Findlay laboratory personnel, their education and their respective work experience.

TABLE 1.6 - ETC FINDLAY LABORATORY PERSONNEL

NAME	DEGREE	YEARS OF EXP	ADMIN	GC/VOA	GC/SVA	GC/ME VOA	GC/ME SVA	AA/ICP	HPLC/IC	COMM/SMPL PREP	COMPUTER SYSTEM
A. ALORAILI	MS +	3								X	
C. BEGIN	MS	3								X	
T. BOBBY	MS	15		X	X						X
S. BOWER	AD +	27	X								
C. BREITIGAN	MS +	< 1								X	
R. BURCHETT	BS	2									X
P. CHARTRAVERE	BS	2								X	
S. CLARK	MS +	4								X	
C. CLAMBON	MS	< 1								X	
P. COHLON	BS, MBA	10	X	X	X	X	X	X	X		
M. CONRY	PH.D.	< 1		X	X						
P. CRABTREE	BS	1								X	
S. DEAN	MS	1								X	
M. DELONG	BS	< 1								X	
B. DONAIRE	BS	9		X	X	X	X	X	X	X	
B. DILLON	MS	< 1								X	
S. EARL	BA	8		X	X					X	
D. FREUND	BS	1			X				X	X	
R. FIRESTONE	MS +	2.5								X	
B. GALLANT	BS	5				X	X			X	
G. GERRY	BA	18	X	X	X	X	X	X	X	X	
A. GRAM	MS +	3								X	
T. GRAM	PH.D.	13	X	X	X	X	X	X	X	X	
J. [illegible]	BS	6	X	X	X	X	X		X	X	
E. HOUSEHOLDER	MS	2								X	
D. JENSEN	MS +	2								X	
J. JOHNSON	MS +	5								X	
J. KELLY	BS	< 1								X	
G. KNIERIEM	BA	7	X	X	X					X	
C. KOEHLER	MS	7	X							X	
L. KOLOPAJLO	PH.D.	5			X			X	X	X	
L. LAUCK	MS +	3	X								
D. LEARE	BS	1		X	X						
J. MARTIN	BS	12		X	X	X	X		X	X	
D. MENDRALA	BS	7		X	X	X	X				
D. MUSGRAVE	BS	14		X				X	X	X	
J. POWELL	MS	< 1								X	
JAB POWELL	MS	1								X	
M. RADABAUGH	BS	5						X		X	
W. REMMER	MS +	6	X								
S. SCHOCK	MS	12	X	X	X	X	X	X	X	X	
T. SHEPHERD	AD	5									X
R. SLOAN	BS +	14						X	X	X	
L. STEWART	BS	12		X	X					X	
S. SWAN	MS	5								X	
D. TEPE	BS	5		X	X			X	X	X	
A. WALL	BS	2			X						
J. WARREN	MS	5								X	
M. WEST	MS	3				X	X				
L. WHITAKER	AD	2	X								

A P P E N D I X

A

Figure 2.5.1

ENVIRONMENTAL TESTING and CERTIFICATION

Seal No. _____ ETC Job # _____

CHAIN OF CUSTODY FORM (CC1)

ORIGINAL

Date Sealed _____ By: _____

Company: _____ Attn.: _____

Facility/Site: _____ Phone: _____

Address: _____

SAMPLE IDENTIFICATION

Facility: _____ (Facility/Site Code) _____ (Optional Sample Point Descriptions)

Sample Point: ___-_____ (Source Code (from below)) (Your Sample Point ID (left justify)) _____ (Start Date YY/MM/DD) _____ (Start Time (2400 hr. clock)) _____ (Elapsed Hours (composite))

Source Codes:

Well	(W)	Outfall	(O)	Bottom Sediment	(B)	Surface Impoundment	(I)	Leachate Collection Sys	(C)	Other	(X)
Soil	(S)	River/Stream	(R)	Generation Point	(G)	Treatment Facility	(T)	Lake/Ocean	(L)	Specify _____	

SHUTTLE CONTENTS

BOTTLE				ANALYSIS	SAMPLER		LAB
No	Type	Size	Preserv.		Filt. (Y/N)	Observations	Observations

CHAIN OF CUSTODY CHRONICLE

1. Shuttle Opened By: (print) _____ Date: _____ Time: _____
   Signature: _____ Seal #: _____ Intact: _____

2. I have received these materials in good condition from the above person.
   Name: _____ Signature: _____
   Date: _____ Time: _____ Remarks: _____

3. I have received these materials in good condition from the above person.
   Name: _____ Signature: _____
   Date: _____ Time: _____ Remarks: _____

4. Shuttle Sealed By: (print) _____ Date: _____ Time: _____
   Signature: _____ Seal #: _____ Intact: _____

Figure 2.5.3

ETC

CHAIN OF CUSTODY

Company: _____ Job # _____

Address: _____

_____

Attention: _____

Sample Description:

CUSTOMER ID	DESCRIPTION	ETC #

Sample(s) Relinquished by: _____

Time: _____ Date: _____

Sample(s) Received by: _____

Time: _____ Date: _____

Page ____ of ____

Client Rep: _____
Due In: _____

ORDER FORM

CONTACT (PM): _____ PHONE: _____

ACCT #: _____ PO #: _____

FACILITY CODE: _____ SITE: _____ TAT: DA____

# of Jobs	Sampling Date	A-TYPE	PRICE	SAMPLE Numbers

COMMENTS: _____

JC_____ JC_____ JOBLINK #_____ ORDERED _____

REC DATE:_____ ORIG. REC'D DATE:_____ LOGGED IN _____ LABELS_____

EDIT: _____

COPIES: _____ REPORT TYPE: _____

SITE PHONE: _____ SITE FAX: _____

O/A _____COMPLETE DATE _____REVIEWER_____ TYPED_____BILLED_____

PROPOSED PROJECT SHEET

ALL stypes, SUB contaminant(s) Date last updated: 89/06/19 at 01:00
ETC - FINNLAT LABORATORY **LAB SAMPLE CONTROL REPORT (CS05AD)**
Sorted by: DUEDATE, ACCOUNT, JOBNUMBER

Job No <Sub/Job> Facility	Lab/Ext Xrfnd Job/Ext Tcode Sub/Ext	Due Date Rec Date Prior	Hold Date	Sre/Serv Locations	Atype	Subcode	SP	MS	GC	AA	CV	PR	CH
Acctid: CHNSEFL CHN CORPORATION FLORIDA DIVISION													
JC3312-00	600067	0A21	89/06/26	89/06/11	FINL/LARM	ZASB/PLR					S0606	NEED	
	600066 /	(89/06/05)											
007326	61	50.00											
/FOR SAMPLES1 IN COMPOSITE SEE COC AND LETTER IN FILE1/**/													
JC3313-00	600067	0A21	89/06/26	89/06/11	FINL/LARM	ZASB/PLR					S0606	NEED	
	600066 /	(89/06/05)											
007326	62	50.00											
/FOR SAMPLES1 IN COMPOSITE SEE COC AND LETTER IN FILE1/**/													
JC3317-01	600070	0A21	89/06/26	89/06/11	FINL/TNA	ZASB/PLR					S0606	NEED	
	600066 /	(89/06/05)											
007326	60	50.00											
---------- 007326 Facility Total: 3 150.00 ----------													
Account Daily Total: 3 150.00													
Daily Totals for 89/06/26 Jobnumber: 3 150.00							0	0	0	0	3	3	0
Acctid: CHNSMW CHN CORPORATION MIDWEST REGIONAL OFF													
JC3618-00	600120	0A21	89/06/28	89/06/20	FINL/WINN	18TXE					S0613		NEED
	600079 /	(89/06/07)	89/06/13		FINL/FLOR	1TOC						00614	NEED
006995	117	135.00											
JC3619-00	600120	0A21	89/06/28	89/06/20	FINL/WINN	18TXE					S0613		NEED
	600079 /	(89/06/07)	89/06/13		FINL/FLOR	1TOC						00614	NEED
006995	119	135.00											
JC3620-00	600120	0A21	89/06/28	89/06/20	FINL/WINN	18TXE					S0613		NEED
	600079 /	(89/06/07)	89/06/13		FINL/FLOR	1TOC						00614	NEED
006995	121	135.00											
JC3621-00	600120	0A21	89/06/28	89/06/20	FINL/WINN	18TXE					S0613		NEED
	600079 /	(89/06/07)	89/06/13		FINL/FLOR	1TOC						00614	NEED
006995	122	135.00											
JC3622-00	600120	0A21	89/06/28	89/06/20	FINL/WINN	18TXE					S0613		NEED
	600079 /	(89/06/07)	89/06/13		FINL/FLOR	1TOC						00614	NEED
006995	123	135.00											
JC3623-00	600120	0A21	89/06/28	89/06/20	FINL/WINN	18TXE					S0613		NEED
	600079 /	(89/06/07)	89/06/13		FINL/FLOR	1TOC						00614	NEED
006995	124	135.00											
JC3624-00	600120	0A21	89/06/28	89/06/20	FINL/WINN	18TXE					S0613		NEED
	600079 /	(89/06/07)	89/06/13		FINL/FLOR	1TOC						00614	NEED
006995	125	135.00											
JC3625-00	600120	0A21	89/06/28	89/06/20	FINL/WINN	18TXE					S0613		NEED
	600079 /	(89/06/07)	89/06/13		FINL/FLOR	1TOC						00614	NEED
006995	126	135.00											
JC3626-00	600120	0A21	89/06/28	89/06/20	FINL/WINN	18TXE					S0613		NEED
	600079 /	(89/06/07)	89/06/13		FINL/FLOR	1TOC						00614	NEED
006995	127	135.00											
JC3627-00	600120	0A21	89/06/28	89/06/20	FINL/WINN	18TXE					S0613		NEED

DAILY SAMPLE STATUS SHEET

INORGANIC ANALYSIS DATA SHEET

Date: _____
Project #: _____ ETC ID #: _____
Sample ID #: _____ QC Report #: _____

Elements Identified and Measured

Matrix: Water _____ Soil _____ Sludge _____ Other _____

Circle One: ug/L or mg/Kg

	Results (BDL)		Results (BDL)
Aluminum		Magnesium	
Antimony		Manganese	
Arsenic		Mercury	
Barium		Nickel	
Beryllium		Potassium	
Cadmium		Selenium	
Calcium		Silver	
Chromium		Sodium	
Cobalt		Thallium	
Copper		Vanadium	
Iron		Zinc	
Lead		Percent Solids (%)	

Comments: _____

Inorganics Lab Manager: _____

INITIAL AND CONTINUING CALIBRATION VERIFICATION

BATCH: _____
DATE: _____
UNITS: mg/L

PROJECT: _____
INSTRUMENT #: _____

Compound	Initial Calibration[1]			Continuing Calibration[2]					Method[4]
	True Value	Found	%R	True Value	Found	%R	Found	%R	
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									
Other:									

[1] Initial Calibration Source _____

[2] Continuing Calibration Source _____

[4] Indicate Analytical Method Used:

P = ICP

A = Flame AA

F = Furnance AA

INORGANIC RECORD-FORM 2

INITIAL AND CONTINUING CALIBRATION VERIFICATION

BATCH: _____
DATE: _____
UNITS: ___mg/L_____mg/Kg_____

PROJECT: _____
INSTRUMENT #: _____

Compound	Initial Calibration Blank Value	Continuing Calibration Blank Value 1	2	3	4	Preparation Blank Matrix 1	Matrix 2
Aluminum							
Antimony							
Arsenic							
Barium							
Beryllium							
Cadmium							
Calcium							
Chromium							
Cobalt							
Copper							
Iron							
Lead							
Magnesium							
Manganese							
Mercury							
Nickel							
Potassium							
Selenium							
Silver							
Sodium							
Thallium							
Vanadium							
Zinc							
Other:							

ICP INTERFERENCE CHECK SAMPLE

PROJECT #: _____ Check Sample ID: _____
DATE: _____ Check Sample Source: _____
UNITS: mg/L

Compound	Control Limits[1] Mean	Control Limits[1] Std. Dev.	True[2]	Initial Observed	Initial %R	Final Observed	Final %R
Aluminum							
Antimony							
Arsenic							
Barium							
Beryllium							
Cadmium							
Calcium							
Chromium							
Cobalt							
Copper							
Iron							
Lead							
Magnesium							
Manganese							
Mercury							
Nickel							
Potassium							
Selenium							
Silver							
Sodium							
Thallium							
Vanadium							
Zinc							
Other:							

[1]Mean value based on n = _____.
[2]True value of EPA ICP Interference Check Sample or contractor standard

SPIKE SAMPLE RECOVERY

PROJECT: _____ INSTRUMENT #: _____

DATE: _____ LAB SAMPLE ID #: _____

UNITS: __mg/L_____mg/Kg_____ug/L____ MATRIX: _____

	Sample Result(s)	Spiked Sample Result (SSR)	Spiked Dup. Result (SDR)	Spike Added	Percent Recovery	RPD
Aluminum						
Antimony						
Arsenic						
Barium						
Beryllium						
Cadmium						
Calcium						
Chromium						
Cobalt						
Copper						
Iron						
Lead						
Magnesium						
Manganese						
Mercury						
Nickel						
Potassium						
Selenium						
Silver						
Sodium						
Thallium						
Vanadium						
Zinc						
Other:						

%R = ((SSR - SR)/SA) x 100

"N" = Out of Control

"NR" = Not Required

RPD = ((SSR - SDR)/((SSR + SDR)/2)) x 100

INSTRUMENT DETECTION LIMITS AND LABORATORY CONTROL SAMPLE

PROJECT: _____ INSTRUMENT #: _____
DATE: _____ LCS #: _____
UNITS: mg/L or mg/Kg (Circle One)

Instrument Detection Limits (IDL)		Lab Control Sample				
Compound	Limits (BDL)	ICP/AA ID#	Furnance ID#	True	Found	%R
Aluminum						
Antimony						
Arsenic						
Barium						
Beryllium						
Cadmium						
Calcium						
Chromium						
Cobalt						
Copper						
Iron						
Lead						
Magnesium						
Manganese						
Mercury						
Nickel						
Potassium						
Selenium						
Silver						
Sodium						
Thallium						
Vanadium						
Zinc						
Other:						

%R = ((SSR - SR)/SA) x 100
"M" = Out of Control
"NR" = Not Required
RPD = ((SSR - SDR)/((SSR + SDR)/2)) x 100

INSTRUMENT DETECTION LIMITS

DATE: _____

ICP/Flame AA (Circle One) Model # _____ Furnance AA # _____

Compound	Wavelength (nm)	IDL (ug/L)
Aluminum		
Antimony		
Arsenic		
Barium		
Beryllium		
Cadmium		
Calcium		
Chromium		
Cobalt		
Copper		
Iron		
Lead		
Magnesium		
Manganese		
Mercury		
Nickel		
Potassium		
Selenium		
Silver		
Sodium		
Thallium		
Vanadium		
Zinc		

[1]Indicate the instrument for which the IDL applies with a "P" (for ICP an "A" (for Flame AA), or a "F" (for Furnance AA) behind the IDL value
[2]Indicate elements commonly run with background correction (AA) with a "B" behind the analytical wavelength.

Comments: _____

_____

Inorganics Manager _____

DATE: _____ ICP Model # _____

Compound	Wavelength (nm)	Interelement Correction Factors for:								
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Cadmium										
Calcium										
Chromium										
Cobalt										
Copper										
Iron										
Lead										
Magnesium										
Manganese										
Mercury										
Nickel										
Potassium										
Selenium										
Silver										
Sodium										
Thallium										
Vanadium										
Zinc										

Comments: _____

_____

Inorganics Manager _____

INORGANIC RECORD-FORM 9

DATE: _____ ICP Model # _____

Compound	Wavelength (nm)	Interelement Correction Factors for: Al	CA	Fe	Mg				
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									

Comments: _____

Inorganics Manager _____

INORGANIC RECORD-FORM 9a

ORGANIC EXTRACTION AND ANALYSIS DATA FORM

Project #/Sample #	Fraction	QC Type	Vi, Vf ml or g	Percent Solids	Vi (g) Dry Weight	Vf ml	Surrogate Spike Amount	Spike Number	Spike Amount

COMMENTS:

(c:\WP\FORMS\EXTRACT.FRM)

ORGANIC EXTRACTION AND ANALYSIS DATA FORM

DAILY INSTRUMENT WORK LOG

Date: _____

Instrument No: _____ Analyst(s): _____

Detector Type: _____ Start Time: _____

Method Number: _____ Stop Time: _____

Column: Length _____
Body: Glass _____ Silica _____ Other _____
I.D. _____ Packing/Phase _____

Temp. Program:
T-int. _____°C H-int. _____min. $\Delta T/\Delta m$ _____°C/min.
T-fin. _____°C H-fin. _____min. Total Run Time _____min.
Area System Standard: _____ Inj. Quant. (ul) _____

Run Number	Sample Description	Dilution

ROUTINE MAINTENANCE: _____

DAILY INSTRUMENT WORK LOG

Organic Extraction and Analysis Data Form

Sample #	Fraction	VI Units	% Solids	VI Dry Wt.	VF Units	Dilution	Amount of Spike	QC #	Inst. Run #	Extract Conc.	Reported Conc.	Spike Rec. %

ORGANIC EXTRACTION AND ANALYSIS DATA FORM

GC DATA PACKET CHECKLIST

Analysis _____ Batch # _____
Project # _____ Samples _____
_____
_____

Copies _____
Originals _____
Original Batch Data Filed with Project _____

Initial	Item
_____	Calibration Summary
_____	Extraction Log
_____	Batch Chronicle
_____	QA/QC Summary
_____	Run Logs as Appropriate
_____	Calculation Sheets
_____	Report Sheets for each Sample
_____	Double check units and LOD's
_____	Copies of Chromatograms used in Calculations (Level II-Level V)

Comments: _____
_____
_____
_____

Prepared by: _____ Data: _____
Reviewed by: _____ Date: _____

GC DATA PACKET CHECKLIST

PRIMARY STANDARD PREPARATION

e: _____

Type of Standard: Acid Base/Neutral Herbicide Pesticide PCB Volatile Other _____

Balance No: _____ Mixing (Inversion, Vertex, etc.): _____

ID No: 214- _____ Source: Chemserev Supelco Aldrich Pierce Other _____

Dilution volume: _____ Solvent: _____

	Compound	Lot Number	Purity	Gross Wt (g)	Tare Wt (g)	Net Wt (g)	Adjusted Net Wt (g)	Conc. ng/ul
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

(OVER)

INTERMEDIATE STANDARD PREPARATION

INTERMEDIATE STANDARD PREPARATION

DATE: _____ CHEMIST: _____ IDENTIFICATION NO: 214- _____

COMPOUND(S): _____

Identification number of concentrated stock: 214- _____ Dilution Volume: _____

Concentration of concentrated stock: _____ ng/ul Final Concentration: _____

Aliquot of concentrated stock: _____

WORKING STANDARD PREPARATION

DATE: _____ CHEMIST: _____ IDENTIFICATION NO: 214- _____

COMPOUND(S): _____

Identification number of concentrated stock: 214- _____ Dilution Volume: _____

Concentration of concentrated stock: _____ ng/ul Final Concentration: _____

Aliquot of concentrated stock: _____

DATE: _____ CHEMIST: _____ IDENTIFICATION NO: 214- _____

COMPOUND(S): _____

Identification number of concentrated stock: 214- _____ Dilution Volume: _____

Concentration of concentrated stock: _____ ng/ul Final Concentration: _____

Aliquot of concentrated stock: _____

DATE: _____ CHEMIST: _____ IDENTIFICATION NO: 214- _____

COMPOUND(S): _____

Identification number of concentrated stock: 214- _____ Dilution Volume: _____

Concentration of concentrated stock: _____ ng/ul Final Concentration: _____

Aliquot of concentrated stock: _____

A P P E N D I X

B

2.6 CALIBRATION PROCEDURES AND FREQUENCY

ETC meets, or in most cases exceeds the calibration criteria specified in the methods. Procedures and frequencies outlined in each method's SOP are taken from the individual method reference, CLP Statement of Work protocols and New Jersey Department of Environmental Protection criteria. The analyst does not proceed with further analysis until the calibration requirements specified in their SOP's have been met.

ETC utilizes organic reference materials from various vendors including: Supelco, NBS, USEPA Repository, Aldrich, Chem Service and Pfalz and Bauer. Stock solutions and working calibration standards are prepared from the purchased material. ETC SOP's document uniform and identifiable traceability procedures back to the neat material. Percent purity traceable to NBS and EPA may be available from our sources.

Likewise, ETC's inorganic reference standards are provided by vendors which specify traceability to NBS and EPA material.

Table 2.6.1 summarizes ETC's instrument calibration procedures.

TABLE 2.6.1 INSTRUMENT CALIBRATION SUMMARY CONVENTIONAL CHEMISTRIES

INSTRUMENT	MODEL	METHODS	STANDARD RANGE	PROCEDURE	FREQUENCY
Auto Analyzer	Technicon AA II	Phenolics 420.2	0.05 - 0.30 mg/L	5 point calib.	per batch
Auto Analyzer	Technicon GTPC	Chloride 325.2	5.0 - 200 mg/L	5 point calib.	
		Cyanide 335.3	0.10 - 0.50 mg/L	5 point calib.	
		Nitrate 353.2	0.10 - 2.0 mg/L	5 point calib.	
		Nitrite 353.2	0.05 - 1.0 mg/L	5 point calib.	
		Fluoride 413E	0.10 - 2.0 mg/L	5 point calib.	
		Alkalinity 310.2	10.0 - 400 mg/L	5 point calib.	
Carbon Analyzer	Dohrmann DC80	TOC EPA 415.1	10.0 - 400 mg/L	Single point calib.	per batch
Carbon Analyzer	Dohrmann DC80			5 point verification	per batch
IR - Spectrophometer	Perkin Elmer 1310	Pet. Hydrocarbon EPA 418.1	0.5 - 40 mg/L	5 point calib. 2 point verification	quarterly per batch.
VIS - Spectrophotometer	Hach DR 3000	COD (Hach) 1979	10.0 - 150 mg/L	5 point calib.	per batch
pH meter	Orion 501	pH EPA 150.1	4 - 10 units	3 point calib.	per batch
Conductance Meter	YSI #32	Conductance EPA 120.1	0.01 MKCL @ 1413 umhos/cm	Single point calib.	per batch
Turbidity Meter	Hach X/R	Turbidity EPA 180.1	1.8 - 180 NTU	3 point calib. (Formazine) 3 point calib. (Secondary Std.)	Quarterly per batch
Turbidity Meter	Hach X/R	Sulfate EPA 375.4	5.0 - 150 mg/L	5 point calib.	per batch
Seta Flash	ERDCO	SW846 1020	27.2°C	single point (p-xylene)	per batch
Tox	Dohrmann DX20A	SW846 9020	1.0 ug CL	Cal. check STD	per batch 1/8 prolysis
Analytical Balance	Amer. Sci. Prod.	TDS @ 180°C EPA 160.1 TSS @ 105°C EPA 160.2	NA NA	3 point cal. check 3 point cal. check	per batch per batch

TABLE 2.6.1 INSTRUMENT CALIBRATION SUMMARY FOR METALS ANALYSES

INSTRUMENT	MODEL	METHODS	STANDARD RANGE	PROCEDURE	FREQUENCY
Mercury Analyzer	Fisher Hg-3	Cold Vapor			
		EPA 245.1 Hg	0.2 - 10.0 ug/L	6 point calib.	per batch
Atomic Absorption	Perkin Elmer 5100	GF-AA	ug/L		
		EPA # 202.2 As	0 - 40	4 point calib.	per batch
		EPA # 270.2 Se	0 - 40		
		EPA # 279.2 Tl	0 - 40		
		EPA # 239.2 Pb	0 - 40		
		EPA # 213.2 Cd	0 - 6		
		EPA # 218.2 Cr	0 - 12		
		EPA # 204.2 Sb	0 - 50		
		ICP - AE	mg/L	4 point calib.	per batch
ICP AE-Spectrophotometer	Jerrell Ash ICP - 9000	EPA # 200.7 Ag	0 - 0.2		
		EPA # 200.7 Al	0 - 5.00		
		EPA # 200.7 As	0 - 1.00		
		EPA # 200.7 B	0 - 1.00		
		EPA # 200.7 Ba	0 - 2.00		
		EPA # 200.7 Be	0 - 0.20		
		EPA # 200.7 Ca	0 - 20.00		
		EPA # 200.7 Cd	0 - 0.20		
		EPA # 200.7 Co	0 - 0.40		
		EPA # 200.7 Cr	0 - 0.60		
		EPA # 200.7 Cu	0 - 0.60		
		EPA # 200.7 Fe	0 - 2.00		
		EPA # 200.7 Mg	0 - 20.0		
		EPA # 200.7 Mn	0 - 0.60		
		EPA # 200.7 Mo	0 - 0.50		
		EPA # 200.7 Na	0 - 100.00		
		EPA # 200.7 Ni	0 - 0.60		
		EPA # 200.7 Pb	0 - 1.00		
		EPA # 200.7 Sb	0 - 1.00		
		EPA # 200.7 Se	0 - 2.00		
		EPA # 200.7 SN	0 - 2.00		
		EPA # 200.7 Sr	0 - 1.00		
		EPA # 200.7 Ti	0 - 1.00		
		EPA # 200.7 V	0 - 0.60		
		EPA # 200.7 Zn	0 - 1.00		
Atomic Absorption Spectrophotometer	Perkin Elmer 5100	Flame - AA	mg/L	4 point calib.	per batch
		EPA # 258.1 K	0 - 10.00		

TABLE 2.6.1 INSTRUMENT CALIBRATION SUMMARY FOR ORGANICS ANALYSES

INSTRUMENT	MODEL	METHODS	STANDARD RANGE	PROCEDURE	FREQUENCY
Tracor (1)	540	Purgeable Halocarbons 601/8010 (GC)	1.0 - 100 ug/ml	5 point calib.; calibration check	Initial; After 10 injections
		Purgeable Aromatics 602/8010 (GC)	1.0 - 100 ug/ml	5 point calib.; calibration check	Initial; After 10 injections
Hewlett Packard (15)	5890A 5880A+	Purgeable Aromatics 602/8010 (GC)	1.0 - 100 ug/ml	5 point calib.; calibration check	Initial; After 10 injections
		Organochloride Pesticides and PCBs 608/8080 (GC)	Compound Dependent ug/ml 0.005 - 0.200 0.010 - 0.400 0.050 - 2.00 0.10 - 4.0 0.20 - 8.0	5 point calib.; calibration check	Initial; After 10 injections
		Herbicide 8150 (GC)	Compound Dependent ug/ml 0.50 - 10.0 0.10 - 2.0	5 point calib.; calibration check	Initial; After 10 injections
Hewlett Packard (17)	5995 5995A 5988 5970B* 5890A	Volatiles 624/8240 (GC/MS)	20 - 200 ug/L	5 point calib.;	Initial; Every 12
		Semi-Volatiles 625/8270 (GC/MS)	40 - 320 ug/ml	5 point calib.; calibration check	Initial; Every 12 hours
		TCDD 2,3,7,8 8280 (GC/MS)	0.2 - 5.0 ng/ul	5 point calib.; calibration check	Initial; Every 12 hours

+ Not used for Purgeable Aromatics Analysis

* Not used for Volatile Analysis

2.7 ANALYTICAL METHOD SUMMARY

ETC utilizes a wide variety of methods. Routinely performed methods may be referenced in Table 2.6.1. Analytical results and Quality Assurance protocols are based on the following guidelines:

- "Methods of Organic Chemical Analysis of Municipal and Industrial Wastewater", Federal Register Vol. 49, No. 209, October 26, 1984;
- "Test Methods for Evaluating Solid Waste", SW-846 Third Edition, September 1986, USEPA;
- "Standard Methods for the Examination of Water and Wastewater" 1985, 14th, 15th and 16th Edition;
- "Methods for Chemical Analysis of Water and Wastes" March 1983, EMSL, EPA;
- "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples", EPA 600/8-80-038, June 1980;
- Organic Analysis: Multi-media, Multi-Concentration-IFB-CLP, SOW July 1987 and February 1988;
- Inorganic Analysis: Multi-media, Multi-Concentration IFB-CLP, SOW July 1987;
- Dioxin Analysis: Soil/Sediment/Water Matrix; Multi-Concentration, Selected Ion Monitoring with Jar Extraction Procedure; IFB WA86-K357.
- "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;
- National Enforcement Investigation Center Policies and Procedures Manual, EPA-330/9/78/001-R, Revised May 1986

In addition to performing these standard methods and procedures, ETC has the capability of modifying external methods and/or performing client or project specific methods. Within normal laboratory operations, ETC can also design experiments and/or method improvements to offer clients improved performance for a specified parameter.

Method references specific to a project may be referenced in the Appendix.

2.8 DATA REDUCTION, EVALUATION AND REPORTING

All organic or inorganic data generated by the analytical laboratories are reviewed by designated trained individuals. This data review includes: data interpretation and quantitation, inspection of quality control data against criteria and to ensure that the data package includes analytical and QC results, all raw data, laboratory chronicles, and chromatograms. After review, results are entered into ETC's computerized data base from which data summary tables are generated. Upon completion, the package is transferred to a designated reviewer who performs a QC audit for the following:

- o use of proper methodology and detection limits;
- o compliance to QC protocol and criteria;
- o presence and completeness of laboratory chronicle(s), (signatures and dates);
- o accuracy of calculations and data quantitation.

Data packages are then transferred to the production service personnel, who review each data package to ensure compliance with client orders by reviewing on-line input in the ETC computer tracking system. All laboratory data is then assembled in the client's technical report(s). Reports are reviewed for completion prior to reproduction in the copy/bind department.

The original documentation is maintained and archived as follows:

- o Technical Report, Chain of Custody and Field Documentation - original documentation is filed numerically according to ETC loglink. The loglink number is traceable to the date of sample receipt.

- o Batch Data Package - any data which substantiates the final reported results, but are not report deliverables, are maintained by assigned batch number.

These files are cataloged and maintained in a limited access area within ETC for approximately three months. They are then hand delivered to an offsite business archive facility where they are limited to ETC personnel access. All records are easily retrievable for ETC and/or client review.

In addition to the production of fully defensible data packets, ETC Network Laboratories also provide summary reports where rapid analytical results are required by the client. These reports by their very nature are more limited in that copies of raw data, i.e., run logs, chromatograms, tune files, etc. are not included. This information is however, kept in the project files and pertinent analytical results are supplied in the final report.

So with full data packets, strict adherance to laboratory QC requirements are maintained to ensure data validity and method criteria are met.

2.9 QUALITY CONTROL CHECKS AND FREQUENCY

2.9.1 External Quality Control Check Samples

In addition to the stringent quality control requirements of the analytical methodologies, ETC maintains a separate Quality Assurance group to review procedures, policies and methodologies used at ETC. This QA group is also responsible for submitting periodic blind quality assurance check samples to help ensure quality of data, adherence to protocols, and identification of potential systematic errors.

In each analytical laboratory, external reference samples (EPA, NBS, NIOSH, etc.) are analyzed several times a year. In some lab areas they may be analyzed daily with each parameter. The results of these QC check samples are used to assess the accuracy of determinations and help to ensure the quality of data generated. These data are also used by the QA department to assess trends in performance and for statistical evaluations of precision and accuracy.

2.9.2 Internal Quality Control Check Samples

The table below presents a cross-section of QC samples which are used routinely for ETC projects. These data are compiled and are used both by our QA department and project staff.

Table 2.9.1

Quality Control Check Samples

SAMPLES	COMMENTS
Trip Blank	Volatile organic free water prepared by the laboratory, to be used when sampling for volatile organics. Analyzed to detect accidental or incidental contaminations. Used at the discretion of QA department, unless required by specific project plan. One trip blank per sample container.
Field Blank	Blank water, provided by the laboratory per client request, which is transferred on-site to an additional clean sample container. Analyzed at the request of client or project directors, field blanks are used to evaluate environmental and procedural effects of the sampling event.
Equipment Blank	Blank water, provided by the laboratory per client request, passed through equipment to determine the effectiveness of field cleaning procedures. Analyzed at the request of client or project directors.

Method Blank	A blank used to check "reagent" or "process" introduced contamination. Analyzed with each batch of samples (up to a maximum of 20 samples/batch).
Calibration Check Std.	A standard spiked into reagent water (QC Spiked Blank) and carried through the entire process, used to verify method performance. These are analyzed with each batch of samples (up to a maximum of 20 samples/batch).
Spiked Sample	A client sample spiked to check for sample and extract matrix effects on recovery of known added analyte(s) accuracy. Analyzed at a 5-10% frequency with actual samples in a batch. (Matrix Spike and/or MS/MSD)
Lab Duplicate	A client sample is split and then processed as separate samples to check sample reproducibility, (precision). These samples are analyzed at a 5-10% frequency within a sample batch.
Internal Standards	An analyte which mimics the behavior of target analytes, and is added to sample/extract prior to analysis to check on instrument performance. Used as specified in methodology.
Surrogate	An analyte which mimics the behavior of target analytes and is added to each sample or lab extract to check for sample/extract or extract matrix effects on recovery of known added analyte. IFB CLP/SW-846 recommended surrogates and recovery limits are used and reported for organic analyses.

Should additional QC requirements be requested for a specific project, they may be referenced in the Appendix.

12/3/87

SECTION I - POLICY AND ORGANIZATION

A. SAFETY AND HEALTH POLICY

Environmental Testing and Certification Corp. is committed to safety. It will strive to provide a safe and healthy work environment for all employees.

This commitment is based on the philosophy of:

> Safety and Health of all employees is of the greatest importance, ranking FIRST above Quality, Production or Cost.

Swep T. Davis
President

2.10 MANAGEMENT, DATA QUALITY AND PERFORMANCE AUDITS

ETC's QA/QC is administered by a separate Quality Assurance department which answers directly to the senior management of the Corporation. It is the responsibility of this department to review the procedures, policies and methodologies used by ETC. The QA/QC policies utilized by ETC are some of the strictest in the industry and were developed using EPA, NIOSH, USATHAMA and GLP recommendations.

2.10.1 Data Quality

The QA department at ETC maintains files of the QC data generated by the labs. These data include method blanks, spiked blank recovery, spiked sample recovery, duplicate data, and other method/project specific data. ETC's computer system is utilized for storage of these data. The QA department uses these data to determine precision, accuracy, method validity and statistical process control criteria.

The QA department administers and maintains a program used to document all internal and external data challenges, called the Quality Action Report process. Using this system all data challenges are documented and assigned as to error/non-error, with determination made as to the responsible lab area and systematic "type" error made. A computer data base is maintained with these data which allows ETC to develop strategies and/or policies to reduce systematic errors.

2.10.2 Internal Performance Audits

The QA department administers an internal blind sample program. Under this program blind samples may be prepared by our standards laboratory and submitted to each lab area at minimum once per month. The results of these samples are submitted to QA, who evaluate the data for: identification, quantitation and percent recovery, proper documentation.

If problems are identified through this program, additional blind check samples may be initiated, as well as a corrective action session held with the appropriate manager to resolve problems.

2.10.3 Internal System Audits

The QA department conducts scheduled audits of each laboratory and facility departments. The program is designed to aid in the fulfillment of QA objectives within the facility. Good laboratory practices, safety, and conformance to standard operating procedures are reviewed with the area manager, documented and reported to the Lab Director. The report is then reviewed with the respective area manager who provides a written response which must include corrective actions to be taken and time frames for implementation. Occasionally, unscheduled audits are conducted to confirm that critical concerns have been addressed as indicated. Internal audit reports are confidential to ETC employees.

2.10.4 External System and Performance Audits

In addition to the self-imposed audits at ETC, several projects require submission to on-site external systems audits. Clients, federal, and state regulatory agencies audit our facility. These audits may consist of performance evaluation samples submitted blindly for analysis and/or system audits performed through on-site laboratory inspections. ETC is routinely audited by several state agencies for compliance to certification regulations (NJDEP, NYS' DOH,& DEC for example) as well as the EPA under the Contract Lab Program (CLP).

2.10.5 Laboratory Certification

ETC's laboratory certification program is maintained by the QA department. It is ETC's policy to obtain all appropriate certifications for every active project. ETC currently participates in approximately 20 different state certification programs, as well as participating in the EPA's CLP program.

2.11 PREVENTATIVE MAINTENANCE PROCEDURES

ETC, being a highly computerized and instrument oriented laboratory, maintains maintenance contracts with all instrument manufacturers with 24-hour, 7 days/week emergency call service. In the event of an instrument breakdown, there are several options which may be considered:

- o Schedule the work on another instrument while service is being performed;
- o Request that the vender provide an instrument to use for the interim;
- o "Subcontract" the work to an ETC Network laboratory, providing client consent and certification requirements have been identified and approved by Quality Assurance.

Regularly scheduled in-house maintenance includes, but is not limited to, the following items for the GC/MS systems:

- o Injection port liner (capillary) replacement before starting a new sequence;
- o Removal of 2-3 inches of the front part of the capillary column before starting a new sequence;
- o Septum replacement before starting a new sequence;
- o Manual tune of each Mass Spectrometer before starting a new sequence;
- o Ion source cleaning as needed (indicated through daily tuning and DFTPP/BFB criteria);
- o Check water levels in cooling water circulators weekly;
- o Check helium tanks daily;
- o Purgeable column resolution checked as a result of a problem, for example, high % RSD;
- o Purge and trap units and automatic samplers returned to the Tekmar service department on a continuing basis for repair and reconditioning;
- o A column test mix acquired and evaluated by the data system automatically every 12 hours (for extractables). GC column performance and mass axis drift is checked. If mass axis is out of specifications, recalibration is performed. If column performance is unsatisfactory, a new column is installed.

Routine preventative maintenance on the GC systems include:

- o Septum replacement before starting new sequence;
- o Check carrier gas tanks daily;
- o Inject reagent hexane before starting new sequence to demonstrate system is free of interfering artifacts;

- o Check flows before starting sequence to ensure system is free of leaks;
- o Change autosampler wash bottles at beginning of each sequence;
- o Check gas filters' carrier lines leading to instruments weekly.

Routine preventative maintenance on the graphite furnace include:

- o Daily cleaning prior to instrument operation: contact rings, furnace housings and quartz windows are cleaned with a swab and isopropanol. Graphite tubes are inspected, then cleaned or replaced;
- o Clean or cut capillary injector depending on condition, realign, daily;
- o Replenish matrix modifier reservoir, daily;
- o Check lamp alignments and energies daily and realign, if necessary.
- o On a weekly basis, clean mirrors for the optical sensor, and the windows on furnace housing and instrument housing. Clean with isopropanol and Kim-wipes;
- o Refill nitric acid ($HN0_3$) rinse as necessary;
- o Recalibrate optical temperature sensor monthly;
- o Examine contact rings for excessive wear on a monthly basis and replace as necessary.

Routine preventative maintenance on the flame AA include:

- o Check Acetylene (C_2H_2) and Nitrous oxide (N_20) tanks with each use. Replace tanks when levels indicate.
- o Clean burner head with deionized water, rinsing after each use;
- o Replace capillary tube approximately every six months;
- o Empty sample overflow reservoir when full;

Routine preventative maintenance on the mercury analyzer include:

- o Remove and clean sample cell and all connecting tubing monthly.
- o Check condition of sparger and insure that it is functioning properly. Replace if cracked or defective;
- o Maintain sufficient level of mercury scrubber solution, check daily;

- o Clean optics and replace hollow cathode lamps as required (indicated by instruments overall performance);

Routine preventative maintenance on the Inductively Coupled Plasma (ICP) include:

- o Change capillary and pump tubing twice weekly at the start of each shift;
- o Replace liquid argon tank approximately every four days;
- o Reprofile via slit micrometer twice daily;
- o Replace and realign plasma torch as needed (based on instrument performance);
- o Clean nebulizer and spray chamber as needed;
- o Drain sample overflow reservoir when full;
- o Check condition of primary imaging mirror weekly and replace approximately every four months.

Routine preventative maintenance on the pH-ISE meters and electrodes include:

- o Gel-type electrodes are inspected and cleaned with Alconox soap solution to remove oily residues daily.
- o Meter is calibrated daily. If the calibration or the slope has deteriorated, the electrode is cleaned as above and treated with 1N hydrochloric acid (HCl), then recalibrated.
- o pH electrodes are stored in fresh pH 7.0 buffer solution when not in use.
- o ISE electrodes and meter functional checks are maintained per the manufacture's instructions.
- o Spare electrodes, filling solutions and buffers are available for the system at all times.

Routine preventative maintenance on the analytical balance, top loading balance include:

- o All balance surfaces are cleaned daily and covered when not in use.
- o The analytical balance will be calibrated and cleaned by the manufacturer's representatives annually. Labels are attached to each balance indicating the date of last calibration.
- o The accuracy of each balance is checked against NBS traceable Class "S" weights prior to use.

Routine preventative maintenance on the carbon analyzers include:

- o Instrument surfaces will be cleaned daily prior to operation.

2.13 CORRECTIVE ACTION

Corrective actions can be initiated at several operational levels; however, they always involve QA personnel. In each case, after an assessment of the situation, appropriate steps are taken to correct the problem. Depending on the severity of the problem, corrective actions may be taken at the analyst level, department level or within the entire laboratory. ETC recognizes the importance of corrective action to maintain a high quality program. In this light, all data are reviewed for completeness, accuracy, and compliance with QC criteria.

In general, there are three major types of corrective actions which may be initiated at ETC:

2.13.1 Sample problems - individual samples or matrix problems are usually handled within the analytical laboratory. Corrective actions may include complete re-extraction, repreparation, analysis, clean-up, dilutions or matrix modifications. All actions taken are documented with the analytical results.

2.13.2 QC Batch problems - An entire batch of samples may require corrective action if QC criteria are not met. Laboratory managers and QA staff are involved in the decisions for actions which include re-analysis, re-extraction, etc. The QA department personnel review both sets of data where applicable to determine if the problems have been resolved.

2.13.3 Systematic problems - Those problems of a procedural nature are handled by the laboratory managers and QA manager. For major operational changes, initiation of such are made only after approval of the QA manager and Vice President of Operations.

When a situation is identified that requires corrective action, that situation is investigated using processes that address the non-conformance to requirement, or lack of existing requirements that may be applied. The corrective action is identified and documented through one of several internal report forms and/or communicated through electronic mail via computer terminal, to be filed electronically by the user as needed.

D.2.6

MacDermid
INCORPORATED

245 FREIGHT STREET - WATERBURY, CT 06702 - TELEPHONE (203) 575-5700 - TELEX 4436011 - INTL. FAX 203-575-7900 - DOM. FAX 203-575-5630

December 21, 1992

Mr. Richard Traub, Chief
Michigan Section
U.S. Environmental Protection Agency
Region 5 - 77 West Jackson Blvd.
Chicago, IL 60604

RE: Quality Assurance Project Plan
Notice of Defiency MID005338371

Dear Mr. Traub:

As per my November 19, 1992 letter, enclosed is the revised QAjP as per OHM, our consultant. If you have any questions, please do not hesitate to contact me.

Sincerely,

Cherrie D. Gillis
Manager, Regulatory Affairs

/enc.

RECEIVED
DEC 22 1992
OFFICE OF RCRA
Waste Management Division
U.S. EPA, REGION V

371-15

MacDermid
INCORPORATED

245 FREIGHT STREET - WATERBURY, CT 06702 - TELEPHONE (203) 575-5700 - TELEX 4436011 - INTL. FAX 203-575-7900 - DOM. FAX 203-575-5630

RECEIVED
NOV 24 1992
OFFICE OF RCRA
Waste Management Division
U.S. EPA, REGION V

November 19, 1992

Mr. Richard Traub, Chief
Michigan Section
U.S. Environmental Protection Agency
Region 5 - 77 West Jackson Blvd.
Chicago, IL 60604

Re: Quality Assurance Project Plan
Notice of Defiency MID005 338 371

Dear Mr. Traub:

This is to advise you that MacDermid through its consultant, OHM is revising the QAjP and within the 60 day limitation will have this document to your attention.

If you have any questions, please do not hesitate to contact me at (203) 575-7947.

Sincerely,

Cherrie D. Gillis
Manager/Regulatory Affairs

CDG:mat

cc: Ed Kania, James Batozynski
Anne Rogers - Nutter, McClellan & Fish

#371-14

OCT 20 1992

HRP-8J

CERTIFIED MAIL P 664 395 434
RETURN RECEIPT REQUESTED

Mr. James Batozynski
MacDermid Incorporated
1221 Farrow Avenue
Ferndale, MI 48220

Re: Quality Assurance Project Plan
Notice of Deficiency
MID 005 338 371

Dear Mr. Batozynski:

The United States Environmental Protection Agency (U.S. EPA) has completed a review of the Quality Assurance Project Plan (QAPjP) dated February 26, 1991. This plan was submitted as part of the Draft Resource Conservation and Recovery Act Facility Investigation (RFI) Task III Work Plan in accordance with the MacDermid Federal Hazardous and Solid Waste Amendments permit.

Based on the review, the U.S. EPA has determined that the QAPjP is deficient as submitted. As discussed in the enclosed Notice of Deficiency (NOD), the QAPjP does not follow the required format of the U.S. EPA guidance document entitled "Content Requirements for RFI QAPjPs" dated October 1990. In addition, the QAPjP lacks site-specific details and contains excessive references to other supporting documents. Please be aware that the citing of supporting documents through incorporation by reference should be kept to a practical minimum. Other deficiencies expressed in the NOD address specific issues that require further clarification.

The U.S. EPA will conduct a review of the RFI Task I and II reports and the Draft RFI Task III Work Plan. Comments on these documents will be sent separately. As you know, these reports were submitted in conjunction with the QAPjP.

Please submit a revised QAPjP within 60 days of receipt of this letter. It is highly recommended that the various sections of the QAPjP and the RFI Work Plan be condensed into a single QAPjP that is specific to the project work proposed for the MacDermid facility.

377-12

SENDER:

- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can turn this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt Fee will provide you the signature of the person delivered to and the date of delivery.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Mr. James Batozynski
MacDermid Inc.
1221 Farrow Avenue
Ferndale, MI 48220

4a. Article Number

P 664 395 434

4b. Service Type

☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery

5. Signature (Addressee)

6. Signature (Agent)

Bill Berlin

8. Addressee's Address (Only if requested and fee is paid)

PS Form 3811, November 1990 ★U.S. GPO: 1991—287-066 **DOMESTIC RETURN RECEIPT**

If you have any questions regarding this NOD, please contact Shari Kolak, of my staff at (312) 886-6151.

Sincerely,

ORIGINAL SIGNED BY
RICHARD T. TRAUB

Richard Traub, Chief
Michigan Section

Enclosure

cc: Kimberly Bee (MNDR)

WMD/OR/RPB/MI/nl-slk/SLK/10-15-92/Shari's disk/b:macderm.nod

NL 10/15

SIGNATURE/INITIAL CONCURRENCE REQUESTED - RCRA PERMITTING BRANCH (RPB)										
TYPIS	AUTH.	ILS CHIEF	INS CHIEF	MIS CHIEF	MN/WI CHIEF	OHS CHIEF	SWS CHIEF	RPB CHIEF	RCRA ASOC.DR	WASTE MGMT. DIV.DIRECTOR
SK 10-15-92	SK 10-15-92			RJ 10/19/92						

P 664 395 434

Certified Mail Receipt
No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

UNITED STATES POSTAL SERVICE

Sent to: Mr. James Batozynski	
Street & No.: 1221 Farrow Avenue	
P.O., State & ZIP Code: Ferndale MI 48220	
Postage	$ .98
Certified Fee	1.00
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	1.00
Return Receipt Showing to Whom, Date, & Address of Delivery	
TOTAL Postage & Fees	$ 2.98
Postmark or Date	OCT 20 1992 CHICAGO, IL LOOP STA USPS

PS Form 3800, June 1990

HRP-8J / MI-RPB / Kolak

HRP-8J / RPB-MI / Kolak

NOTICE OF DEFICIENCY
QUALITY ASSURANCE PROJECT PLAN (QAPjP)
for MACDERMID INCORPORATED,
FERNDALE, MICHIGAN
MID000724724

GENERAL COMMENTS/DEFICIENCIES

The materials submitted, a Quality Assurance Program Plan (QAPP) for the laboratory, and an RFI Work Plan which included a Task III document which contains some project specific information pertaining to quality assurance and field sampling, do not currently fulfill the Region V requirements for a Quality Assurance Project Plan (QAPjP). However, a review was performed by matching, to the extent possible, the contents of these documents to the following sixteen (16) elements of a Region V QAPjP (as defined by Region V Model QAPjP, and Content Requirements for RFI QAPjPs). The (submitted) QAPP follows this format, but lacks the site-specific details of a QAPjP. This review provides general guidance in developing a site-specific QAPjP through reorganization of the submitted materials and additional information.

The majority of the deficiency comments deal with the inclusion and/or submittal of information and procedures specific to the proposed project. Detailed information/procedures must be included in the QAPjP in lieu of stating that "standard" procedures will be followed. The 16 elements of a QAPjP are usually outlined as shown below:

I. Title Page and QAPjP Approval
II. Table Of Contents
III. Project Description
IV. Project Organization and Responsibility
V. Quality Assurance Objectives for Measurement Data
VI. Sampling Procedures
VII. Sample Custody
VIII. Calibration Procedures and Frequency
IX. Analytical Procedures
X. Internal Quality Control Checks
XI. Data Reduction, Validation and Reporting
XII. Performance and System Audits
XIII. Preventative Maintenance
XIV. Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness
XV. Corrective Action
XVI. Quality Assurance Reports to Management

A site-specific QAPjP should, to the fullest extent possible, be a "stand alone" document. If references to other documents cannot be avoided, they should contain the title of the

reference, section, and page number. The information in these references should be included within the QAPjP or as an Attachment or Appendix, if possible. However, attachment of manuals or voluminous references is discouraged.

I. TITLE PAGE AND QAPjP APPROVAL

The QAPjP is required to have an approval page with space for the signatures of the individuals filling the following (at a minimum) positions:

- U.S. EPA Region V Project Coordinator
- U.S. EPA Regional Quality Assurance Manager
- Contractor Project Manager
- Contractor QA Officer
- Any subcontractors as appropriate
- Project Manager
- Project QA Officer

It is not necessary to include the names of the individuals in these positions, thus preventing the need for a revision to the document should that individual no longer occupy that position.

II. TABLE OF CONTENTS

Individuals receiving official copies of the QAPjP and any subsequent revisions must be indicated. Provide this listing after the Table of Contents.

The document control format header must include the following information: the project name; document section number; document revision number; date; and section page number. Provide this format at the top of each page in the QAPjP and number the pages by section number.

III. PROJECT DESCRIPTION

A suitable Project Description, was not provided in the QAPP. The fact that a project description was not included indicates that the submitted QAPP was not tailored for the MacDermid project. This is the central problem which must be overcome. Sections in the Introduction, which presently focuses on certain aspects such as the History of ETC are not pertinent to this project, and should be deleted. However, some of the required information is present in the RFI Workplan. Pertinent information, derived from the RFI Workplan or other sources, must be incorporated into the QAPjP . It would be best to directly insert portions of these documents into the QAPP, which has already been submitted for review, and delete nonpertinent sections.

Alternatively, specific referencing to portions of supporting documents (document, section, and page number) accompanied by deletion of nonessential sections of the already submitted QAPP may suffice. When the revised QAPjP is submitted, it should be comprised of the following items. Some of these have already been included in either the laboratory QAPP, or more likely in the Task I and III reports. However, the Permittee bears responsibility for integrating the documents such that the organization outlined below is followed, in order to fully address the issue of 'Project Description'.

- Introduction - A description of the project and a brief statement addressing the different phases of the work, the general objectives and investigative plan.

- Site Description - A description of the site-specific features including location, size, borders, physical features, geologic and hydrogeologic information. These items should be addressed in separate paragraph/ sections within the QAPjP. Presumably, some of the information that was included in Task I of the RFI Workplan could either be directly incorporated into the QAPjP, or specifically referenced in pertinent sections of the reorganized QAPjP. (See comment below concerning Project Objectives.)

- Site History or Background - A chronological history of the site including any information on the environmental history (i.e., sampling, spills, available data). Data should be summarized in a table which includes the analytical methods, results, and method detection limits if available. It may be possible to specifically reference sections of the RFI Workplan.

- Target Compounds - Brief discussion of the relevant (important) site contaminants or target compounds, including required detection limits for RFI/CMS. Table 1.2 of the QAPP should be revised to reflect only those constituents that actually will be analyzed in order to address the scope of MacDermid's project. Therefore, the list must be developed to reflect relevant project objectives. For instance, according to the RCRA Facility Assessment, (administrative Log # 538-4) for MacDermid, several volatile organic compounds were identified in soil. These included chlorobenzene, chromium, lead, nickel, thallium, methyl chloride, and other hazardous constituents. The target compound list that is presented in the QAPjP, should, at a minimum, include all the constituents listed in the RFA, and all other constituents which shall be analyzed and reported. (Apparently not all the target analytes indicated in Tables 5.7, 5.8 and 5.9 of the Task I report shall be analyzed in samples taken under the

scope of this project.) In Table 3.1 of Task III, several constituents are listed which, collectively, are intended to be the target compound list. This list should be consistent with conclusions based on previously accepted data that is presented in Task I. The RCRA project officer and assigned State of Michigan personnel must concur on which sections of the historical data base that is summarized in Task I can be considered valid information on which to found a basis for further project phases. At a minimum, all the hazardous constituents for which SW-846 methodology has been cited in Table 3.1 of Task III and for which SW-846 methodology has been validated, should be analyzed. and reported.

- Project Objectives - This should include an expanded description of the following items: Specific objectives; intended data usages; and data quality objective (DQO) summaries. This is a key section of the QAPjP, because the specific need for any data quality objectives (e.g. in terms of analytical accuracy, precision, etc...), or analytical sensitivities, which is reflected in selection of analytical methods, will be entirely dependent on what the intended goals or overall purpose of the project happen to be. (Please note that U.S. EPA's 40 CFR Part 264, Subpart S action level criteria are proposed levels only.) Some discussion of how the levels specified in Tables 5.5 and 5.10 of the Task I report should become incorporated into the QAPjP. If it is intended to compare investigative results to data thought to be representative of soil background conditions, then the rationale for selection of suitable background locations should be stated in the QAPjP. Because the Permittee intends to later demonstrate that the 'no action' alternative provision of its RCRA permit will be appropriate, (see executive summary) then the project objectives should be consistent with rationale that would potentially allow MacDermid to make such a presentation.

- Sampling Network and Rationale - A detailed description of the sampling network and the rationale for the selection of the locations, methods, parameters, etc., must be presented in the reorganized QAPjP. This may be achieved by referencing pertinent sections of the RFI Workplan, (Tasks I and III) and/or sampling plan and indicating where in these documents the salient items of the plan can be found. Alternatively, a wholesale revision Because the rationale for proposed soil borings is dependent on the outcome of previous sampling efforts, there must be concurrence between the

the RCRA project officer and MDNR representatives concerning which of the historical data may be considered acceptable, (see Task III report, p.2-3). In the RCRA permit, it is specified that 'Corrective action shall, at a minimum, be addressed at the following solid waste management units. - Two closed surface impoundment areas; closed incinerator; railroad spur; and units that emit air contaminants.' So, the QAPjP must reflect how sampling shall be done to address the permit requirements. It is recommended that much ofthis pertinent information be submitted in a tabular format, indicating each of the analytes to be analyzed at each respective SWMU for each type of media to be encountered at each SWMU. Also numbers of investigational and quality assurance samples to be taken should be indicated in this table. Then, this table should be referred to, wherever appropriate, in the field and sampling section of the QAPjP.

- Project Schedule - A description of the anticipated start date, any milestone dates, and the anticipated completion date of the project or monitoring/sampling activities. An appropriate method for this requirement is a bar chart with project tasks and time lines

IV. PROJECT ORGANIZATION AND RESPONSIBILITY

This section must contain additional information regarding the project management, organization, responsibility and authority. At present, information in the QAPP only addresses this section for laboratory personnel. Provide this information for all personnel involved in the project, including EPA Region V personnel, contractor team personnel and any subcontractor personnel. Identify their responsibilities on the project, management hierarchy, and key personnel for different tasks. This information can be found, in part, in the Task III RFI workplan, sections 1.1 and 2.4 and incorporated with the QAPP information. An organization chart is required for this section.

Additionally, clarify which individuals from the laboratory will be involved in the project. Page 2-8 of the Task III RFI Workplan indicates that Bob Schock will be the laboratory manager for the project while the laboratory QAPP does not list this individual in any capacity at the lab.

V. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

Laboratory-specific information was found in the laboratory QAPP in section 4.3, but site-specific details required in a QAPjP were absent. This information must be tailored to fit the specific needs of the project, and must reflect the actual circumstances that will most likely be encountered. Specific Quality Assurance Objectives (e.g., Method Detection Limit, Precision, Accuracy, Completeness Representativeness and Comparability) for your project and detail the procedures and means (e.g., blanks, spikes, etc.) must be provided. This information must be provided on a matrix specific basis for each constituent that shall be analyzed and reported. A tabular presentation showing analytes, respective media, and acceptance criteria should be presented. Even if the acceptance criteria are to be largely founded on that published in the SW-846 methods chapters, the laboratory must state whether these levels can actually be achieved. Also, data quality objective information cannot be referenced; this must be included directly within the QAPjP. Method detection limits that are thought to be achievable for each analyte should be presented in the QAPjP. Preconceived contract required detection limits should not be reported either in the QAPjP or in the final data package. Practical quantitation limits should not be considered by the Permittee to be the final detection limits that will be reported as method detection limits. However, if the laboratory can achieve levels comparable to the practical quantitation limits, then this should be stated in the QAPjP.

Please note that in Region V, duplicates and blanks should be collected at the following frequencies:

- Trip Blanks must be collected at a frequency of one per cooler in which aqueous matrix VOC samples are shipped.

- Field Blanks (equipment, field) must be collected for all aqueous matrix parameters at a rate of one sample for every 10 or fewer investigative samples.

- Duplicates must be collected for all matrices and parameters at a rate of one sample for every 10 or fewer investigative samples.

These blanks and duplicate samples must be treated as regular investigative samples, with regards to sample volumes, containers, preservation and shipping.

VI. SAMPLING PROCEDURES

The information supplied in the Task III RFI Workplan pages 3-2 to 3-21 addresses the subject of sampling procedures. In addition, information in the laboratory QAPP provides general sampling procedures for every possible sampling situation. Reorganization of these sections into single cohesive sampling and analysis document is highly recommended. The revised document should address each of the points outlined below to take into account site-specific factors. Procedures found in the QAPP that do not relate to the type of sampling that will be conducted at the facility should not be included in the QAPjP. The following information is required in detailing sampling procedures for a QAPjP:

- Detailed procedures, criteria, or guidelines used for sampling point selection.

- Detailed procedures, criteria, or guidelines used for collecting background samples, if any. Compositing of samples should not be conducted.

- Detailed procedures for the collection of samples for each sample matrix and parameter(s).

- Detailed procedures for sample packaging, handling and shipment, including time considerations, and field filtration requirements and procedures.

- Sample containers, reagents, preservation and holding time requirements (a table is appropriate/recommended).

- Any special conditions for the preparation of sampling containers and time requirements, (a table is appropriate). The holding time for volatile organics should be 7 days unpreserved or 14 days with acid preservation from the time of sample collection to analysis. This may result in modifications to Table 3.1.
- Chain-of-custody procedures, including an acceptable and logical numbering system.

- Detailed procedures for preparing/collecting trip blank samples, field blank samples, and field duplicate samples.

- Adequate documentation of the sampling activities, including forms, notebooks, bound logbooks and detailed procedures for recording sample history, site and sample conditions, and analysis to be taken, etc.

- A detailed summary of the sampling and analysis performed, using a table is appropriate.

- Details of any field filtering and/or sample compositing that may have occurred during sampling activities.

VII. SAMPLE CUSTODY

Provide discussion of the three (3) distinct/separate issues for sample custody (chain-of-custody (COC)) on the following areas related to this project:

- COC procedures for all field activities, including sampling, field measurement, and screening.

- COC procedures for laboratory activities, including sample receiving, log-in, storage, tracking of custody transfer during sample preparation and analysis, etc.

- Final evidence file, including the description of file contents and specifying a file custodian.

Provide this information in detail in the QAPjP, as information provided in section 3.8 of Task III of the RFI Workplan does not adequately cover the required elements and formatting.

VIII. CALIBRATION PROCEDURES AND FREQUENCY

Provide specific procedures and frequencies for the calibration of all field instruments to be used during the investigation/field activities. Identify all field instruments which may be used and discuss the procedures for the initial calibration, and follow-up calibration checks during a particular field activity. In addition, list any conditions which may trigger or warrant a calibration check or recalibration during the course of the field activity.

The calibration of the laboratory equipment is detailed in section 7.0, pages 103 to 108 of the laboratory QAPP. These sections should somehow effectively and specifically relate to the MacDermid QAPjP. If sections of the laboratory QAPP are to be incorporated by reference, then detailed references (document, section, and page number) from the laboratory QAPjP must be provided. However, the difficulty with the sections in the laboratory QAPP remains one of detail. The best manner in which to address this element would be to look at each analytical method to be used under the scope of the MacDermid investigation. Then, for each respective method, the specific details concerning calibration should be summarized. Methods in SW-846 do give

guidance and options on how calibration should be performed. SW-846 is not a 'cookbook', and the actual details concerning how calibration will be conducted must be added by the Permittee to the QAPjP.

IX. ANALYTICAL PROCEDURES

In addition to instrumental methods of analysis, all sample cleanup, preparatory, or digestion methods to be used in conjunction with the instrumental methods must also be listed. Individual methods must be selected for each hazardous constituent. Wherever possible, only methods from SW-846 should be selected. However, for groundwater analyses, it may be permissible to use the analogous water method, (e.g. 602). For analyses of mercury in groundwater, method 7470 is preferred over method 7471. Method 8020 can also be used to identify benzene, if present. Why wasn't benzene added to the list of analytical parameters included in Table 3.1? The detection limit for total chromium in soil seems rather high. Please explain why this could be the case. The actual method detection limits achieved for each constituent should be reported with the analytical data package. The Permittee is referred to Table 6 of method 8270, as found in SW-846 for the list of analytes for which this method has been validated. Methylene chloride is not included on this list. Rationale explaining why methylene chloride will be analyzed using method 8270 instead of method 8240 should be presented. Furthermore, if method 8240 shall be used to analyze samples, then results for each of the constituents listed in Table 2 of method 8240 should be delivered to U.S. EPA and the MDNR. Table 3.1 and any relevant discussions within the Task III document should be revised to clarify or reflect these points. Methods that will not be performed should not be mentioned in the QAPjP. All field methods that will be conducted during the project should be fully described in the QAPjP, (e.g. pH, temperature, and specific conductance measurements of groundwater samples, or soil headspace analyses using the PID - see page 3-10 of the Task III report). Both filtered and unfiltered aliquots of all groundwater samples should be analyzed, (see page 3-10 of the Task III report). Procedures for field filtering should be described in the QAPjP. In section 3.9.1 of the Task III report, procedures for use of methods alternative to those published in SW-846 is discussed. Only those methods which are to be used during the project should be included or mentioned in the QAPjP. If indeed other methods are proposed, then these should be reflected in Table 3.1. Furthermore, a complete set of standard operating procedures should be submitted for methods that are not considered to be U.S. EPA procedures. The actual laboratory addresses to which the various kinds

of samples shall be shipped should be mentioned in the QAPjP. (In Table 2.6.1 of the laboratory QAPP, there is some additional information that is insufficient in detail. For instance, more details concerning calibration standards, source of standards, and frequency of calibration, for only those instruments to be used in conjunction with methods that will be performed under scope of the MacDermid project, is required.)

X. INTERNAL QUALITY CONTROL CHECKS

Provide information on the following (many of the following are addressed elsewhere but must be reiterated to aid in assessing effectiveness of quality control procedures) issues for both the field activities and laboratory analysis:

Field Activities (measurements and screening)

- Continuing calibration checks
- Replicate analysis
- Spike sample analysis
- Blanks (trip, field, duplicate)
- Quality Control samples
- Zero and Span gases (i.e., air monitoring)
- Calibration standards and devices

Laboratory Analysis

- Method Blanks
- Reagent/Preparation Blanks
- Matrix Spike and Matrix Spike Duplicates
- Calibration Standards
- Internal Standards
- Surrogate Standards
- Continuing Calibration Check
- Calibration Check Standard
- Laboratory duplicate/replicate analysis, etc.

Provide this information for each of the specific sampling and analytical methods used. In addition, indicate at what stage in the analysis each of these checks will/do occur and at what frequency. Provide a table (if possible) to outline these steps.

XI. DATA REDUCTION, VALIDATION AND REPORTING

In completing this section more detail is needed and the field activities must be addressed. The information in

section 3.10 of Task III of the RFI Workplan provides for a general overview of the required procedures. Additional details must be provided in the QAPjP either through direct insertion or specific reference citation.

Specifically, the following need to be addressed:

- Discussion that assures the resulting data package will comply with Functional Guidelines for Evaluating Organic/Inorganic Analysis - U.S.E.P.A.

- Summary of data reduction procedures

- Statistical approach summary and details of how (and which) the statistical functions relate to data reduction, validation and reporting.

- Detail the methods to be used for the reduction of both field and laboratory data.

- Describe the criteria/guidelines/procedures to be used (by an individual independent of the laboratory) for data validation.

- Describe the data reporting format which will be followed, including all reporting forms and units. Include in this listing all contents of the lab data package.

Provide this information, realizing that these procedures must be developed/performed independently of the laboratory. The information found in section 9.0 of the laboratory QAPP does not adequately address this requirement either.

XII. PERFORMANCE AND SYSTEM AUDITS

The requirements of this section cannot be addressed by the laboratory QAPP and must be clearly defined within the site-specific QAPjP. These requirements deal with the performance of the sampling and measurement activities related to the field program. The following subjects must be somehow incorporated into the reorganized QAPjP revision, noting that external audits remain the responsibility of U.S. EPA.

Elements to be addressed for both field and laboratory internal audits must include:

- Identification of the <u>responsible party</u> for these audits;

- Specification of the frequency of these audits to be conducted; and

- Description of the methods/procedures to be used for conducting these audits. This should include:

  - independence of audit; and

  - examination of sample handling and other records.

XIII. PREVENTATIVE MAINTENANCE

This requirement was not specifically addressed in the RFI Workplan. Provide procedures in the QAPjP for the preventative maintenance of the field equipment that will be used as part of the investigative field program.

Information regarding preventative maintenance of laboratory equipment may be incorporated by reference from the laboratory QAPP, but only if these procedures allow for the maintenance of the equipment in a manner that assures the quality of the analytical results. Alternatively information regarding preventative maintenance of laboratory equipment may reference SW 846 or other standardized methods.

XIV. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

Details of the procedures to address this requirement were not found within the RFI Workplan (except sparsely and only gerenrally in sections 3.10, and 3.11). Some pertinent information was also found in section 13.0 of the laboratory QAPP, which should be incorporated by reference into the reorganized QAPjP. It should be explained how these sections relate specifically to the MacDermid project. This information must be supplied in the QAPjP or may reference a Data Management Plan (DMP) which contains all of this information. However, the supplied DMP (with the RFI Workplan) does not adequately address these issues.

XV. CORRECTIVE ACTION

In general this section must provide adequate detail to addressing corrective actions for field and/or laboratory activities. Incorporate sections 14.0 of the laboratory QAPP and section 4.4 of the Task III RFI Workplan into the QAPjP while ensuring that the following elements are included:

- The pre-specified conditions that automatically trigger corrective action.
- Personnel who initiate, approve, implement, evaluate, and report corrective action (by title).
- Procedures to initiate, develop, approve and implement corrective actions.
- Alternative corrective actions to be taken.

XIV. QUALITY ASSURANCE REPORTS TO MANAGEMENT

The requirements of this section may be adequately addressed by combining the information found in section 15.0 of the laboratory QAPP with that of sections 2.5, 4.5, and 4.6 (including subsections) found in Task III of the RFI Workplan. Quality assurance reports are required to be submitted to management on a periodic basis to ensure that any problems are investigated and proper corrective actions are taken.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V

DATE: AUG 17 1992

SUBJECT: Completion of QAPjP Review for MacDermid

FROM: Charles B. Slaustas, Chief
Minnesota/Wisconsin Permitting Section

Charles B. Slaustas

TO: Rich Traub, Chief
Michigan Section

Ms. Shari Kolak of your staff agreed to have Mr. Allen Debus of my staff review and amend comments prepared originally last year by A. T. Kearney for the MacDermid Facility of Fernadale, Michigan. This memornadum officially transmits Mr. Debus' comments, and draft QAPjP deficiency letter to you. Ms. Kolak has already been supplied with a cassette copy of these materials for use. If you have any further questions on this matter please contact Mr. Allen A Debus of my staff at 6-6186.

Attachments

37-11

NOTICE OF DEFICIENCY
QUALITY ASSURANCE PROJECT PLAN (QAPjP)
for MACDERMID INCORPORATED,
FERNDALE, MICHIGAN
MID000724724

GENERAL COMMENTS/DEFICIENCIES

The materials submitted, a Quality Assurance Program Plan (QAPP) for the laboratory, and an RFI Work Plan which included a Task III document which contains some project specific information pertaining to quality assurance and field sampling, do not currently fulfill the Region V requirements for a Quality Assurance Project Plan (QAPjP). However, a review was performed by matching, to the extent possible, the contents of these documents to the following sixteen (16) elements of a Region V QAPjP (as defined by Region V Model QAPjP, and Content Requirements for RFI QAPjPs). The (submitted) QAPP follows this format, but lacks the site-specific details of a QAPjP. This review provides general guidance in developing a site-specific QAPjP through reorganization of the submitted materials and additional information.

The majority of the deficiency comments deal with the inclusion and/or submittal of information and procedures specific to the proposed project. Detailed information/procedures must be included in the QAPjP in lieu of stating that "standard" procedures will be followed. The 16 elements of a QAPjP are usually outlined as shown below:

I. Title Page and QAPjP Approval
II. Table Of Contents
III. Project Description
IV. Project Organization and Responsibility
V. Quality Assurance Objectives for Measurement Data
VI. Sampling Procedures
VII. Sample Custody
VIII. Calibration Procedures and Frequency
IX. Analytical Procedures
X. Internal Quality Control Checks
XI. Data Reduction, Validation and Reporting
XII. Performance and System Audits
XIII. Preventative Maintenance
XIV. Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness
XV. Corrective Action
XVI. Quality Assurance Reports to Management

A site-specific QAPjP should, to the fullest extent possible, be a "stand alone" document. If references to other documents cannot be avoided, they should contain the title of the

reference, section, and page number. The information in these references should be included within the QAPjP or as an Attachment or Appendix, if possible. However, attachment of manuals or voluminous references is discouraged.

I. TITLE PAGE AND QAPjP APPROVAL

The QAPjP is required to have an approval page with space for the signatures of the individuals filling the following (at a minimum) positions:

- U.S. EPA Region V Project Coordinator
- U.S. EPA Regional Quality Assurance Manager
- Contractor Project Manager
- Contractor QA Officer
- Any subcontractors as appropriate
- Project Manager
- Project QA Officer

It is not necessary to include the names of the individuals in these positions, thus preventing the need for a revision to the document should that individual no longer occupy that position.

II. TABLE OF CONTENTS

Individuals receiving official copies of the QAPjP and any subsequent revisions must be indicated. Provide this listing after the Table of Contents.

The document control format header must include the following information: the project name; document section number; document revision number; date; and section page number. Provide this format at the top of each page in the QAPjP and number the pages by section number.

III. PROJECT DESCRIPTION

A suitable Project Description, was not provided in the QAPP. The fact that a project description was not included indicates that the submitted QAPP was not tailored for the MacDermid project. This is the central problem which must be overcome. Sections in the Introduction, which presently focuses on certain aspects such as the History of ETC are not pertinent to this project, and should be deleted. However, some of the required information is present in the RFI Workplan. Pertinent information, derived from the RFI Workplan or other sources, must be incorporated into the QAPjP . It would be best to directly insert portions of these documents into the QAPP, which has already been submitted for review, and delete nonpertinent sections.

Alternatively, specific referencing to portions of supporting documents (document, section, and page number) accompanied by deletion of nonessential sections of the already submitted QAPP may suffice. When the revised QAPjP is submitted, it should be comprised of the following items. Some of these have already been included in either the laboratory QAPP, or more likely in the Task I and III reports. However, the Permittee bears responsibility for integrating the documents such that the organization outlined below is followed, in order to fully address the issue of 'Project Description'.

- Introduction - A description of the project and a brief statement addressing the different phases of the work, the general objectives and investigative plan.

- Site Description - A description of the site-specific features including location, size, borders, physical features, geologic and hydrogeologic information. These items should be addressed in separate paragraph/ sections within the QAPjP. Presumably, some of the information that was included in Task I of the RFI Workplan could either be directly incorporated into the QAPjP, or specifically referenced in pertinent sections of the reorganized QAPjP. (See comment below concerning Project Objectives.)

- Site History or Background - A chronological history of the site including any information on the environmental history (i.e., sampling, spills, available data). Data should be summarized in a table which includes the analytical methods, results, and method detection limits if available. It may be possible to specifically reference sections of the RFI Workplan.

- Target Compounds - Brief discussion of the relevant (important) site contaminants or target compounds, including required detection limits for RFI/CMS. Table 1.2 of the QAPP should be revised to reflect only those constituents that actually will be analyzed in order to address the scope of MacDermid's project. Therefore, the list must be developed to reflect relevant project objectives. For instance, according to the RCRA Facility Assessment, (administrative Log # 538-4) for MacDermid, several volatile organic compounds were identified in soil. These included chlorobenzene, chromium, lead, nickel, thallium, methyl chloride, and other hazardous constituents. The target compound list that is presented in the QAPjP, should, at a minimum, include all the constituents listed in the RFA, and all other constituents which shall be analyzed and reported. (Apparently not all the target analytes indicated in Tables 5.7, 5.8 and 5.9 of the Task I report shall be analyzed in samples taken under the

scope of this project.) In Table 3.1 of Task III, several constituents are listed which, collectively, are intended to be the target compound list. This list should be consistent with conclusions based on previously accepted data that is presented in Task I. The RCRA project officer and assigned State of Michigan personnel must concur on which sections of the historical data base that is summarized in Task I can be considered valid information on which to found a basis for further project phases. At a minimum, all the hazardous constituents for which SW-846 methodology has been cited in Table 3.1 of Task III and for which SW-846 methodology has been validated, should be analyzed. and reported.

- Project Objectives - This should include an expanded description of the following items: Specific objectives; intended data usages; and data quality objective (DQO) summaries. This is a key section of the QAPjP, because the specific need for any data quality objectives (e.g. in terms of analytical accuracy, precision, etc...), or analytical sensitivities, which is reflected in selection of analytical methods, will be entirely dependent on what the intended goals or overall purpose of the project happen to be. (Please note that U.S. EPA's 40 CFR Part 264, Subpart S action level criteria are proposed levels only.) Some discussion of how the levels specified in Tables 5.5 and 5.10 of the Task I report should become incorporated into the QAPjP. If it is intended to compare investigative results to data thought to be representative of soil background conditions, then the rationale for selection of suitable background locations should be stated in the QAPjP. Because the Permittee intends to later demonstrate that the 'no action' alternative provision of its RCRA permit will be appropriate, (see executive summary) then the project objectives should be consistent with rationale that would potentially allow MacDermid to make such a presentation.

- Sampling Network and Rationale - A detailed description of the sampling network and the rationale for the selection of the locations, methods, parameters, etc., must be presented in the reorganized QAPjP. This may be achieved by referencing pertinent sections of the RFI Workplan, (Tasks I and III) and/or sampling plan and indicating where in these documents the salient items of the plan can be found. Alternatively, a wholesale revision Because the rationale for proposed soil borings is dependent on the outcome of previous sampling efforts, there must be concurrence between the

the RCRA project officer and MDNR representatives concerning which of the historical data may be considered acceptable, (see Task III report, p.2-3). In the RCRA permit, it is specified that 'Corrective action shall, at a minimum, be addressed at the following solid waste management units. - Two closed surface impoundment areas; closed incinerator; railroad spur; and units that emit air contaminants.' So, the QAPjP must reflect how sampling shall be done to address the permit requirements. It is recommended that much ofthis pertinent information be submitted in a tabular format, indicating each of the analytes to be analyzed at each respective SWMU for each type of media to be encountered at each SWMU. Also numbers of investigational and quality assurance samples to be taken should be indicated in this table. Then, this table should be referred to, wherever appropriate, in the field and sampling section of the QAPjP.

- Project Schedule - A description of the anticipated start date, any milestone dates, and the anticipated completion date of the project or monitoring/sampling activities. An appropriate method for this requirement is a bar chart with project tasks and time lines

IV. PROJECT ORGANIZATION AND RESPONSIBILITY

This section must contain additional information regarding the project management, organization, responsibility and authority. At present, information in the QAPP only addresses this section for laboratory personnel. Provide this information for all personnel involved in the project, including EPA Region V personnel, contractor team personnel and any subcontractor personnel. Identify their responsibilities on the project, management hierarchy, and key personnel for different tasks. This information can be found, in part, in the Task III RFI workplan, sections 1.1 and 2.4 and incorporated with the QAPP information. An organization chart is required for this section.

Additionally, clarify which individuals from the laboratory will be involved in the project. Page 2-8 of the Task III RFI Workplan indicates that Bob Schock will be the laboratory manager for the project while the laboratory QAPP does not list this individual in any capacity at the lab.

V. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

Laboratory-specific information was found in the laboratory QAPP in section 4.3, but site-specific details required in a QAPjP were absent. This information must be tailored to fit the specific needs of the project, and must reflect the actual circumstances that will most likely be encountered. Specific Quality Assurance Objectives (e.g., Method Detection Limit, Precision, Accuracy, Completeness Representativeness and Comparability) for your project and detail the procedures and means (e.g., blanks, spikes, etc.) must be provided. This information must be provided on a matrix specific basis for each constituent that shall be analyzed and reported. A tabular presentation showing analytes, respective media, and acceptance criteria should be presented. Even if the acceptance criteria are to be largely founded on that published in the SW-846 methods chapters, the laboratory must state whether these levels can actually be achieved. Also, data quality objective information cannot be referenced; this must be included directly within the QAPjP. Method detection limits that are thought to be achievable for each analyte should be presented in the QAPjP. Preconceived contract required detection limits should not be reported either in the QAPjP or in the final data package. Practical quantitation limits should not be considered by the Permittee to be the final detection limits that will be reported as method detection limits. However, if the laboratory can achieve levels comparable to the practical quantitation limits, then this should be stated in the QAPjP.

Please note that in Region V, duplicates and blanks should be collected at the following frequencies:

- Trip Blanks must be collected at a frequency of one per cooler in which aqueous matrix VOC samples are shipped.

- Field Blanks (equipment, field) must be collected for all aqueous matrix parameters at a rate of one sample for every 10 or fewer investigative samples.

- Duplicates must be collected for all matrices and parameters at a rate of one sample for every 10 or fewer investigative samples.

These blanks and duplicate samples must be treated as regular investigative samples, with regards to sample volumes, containers, preservation and shipping.

VI. SAMPLING PROCEDURES

The information supplied in the Task III RFI Workplan pages 3-2 to 3-21 addresses the subject of sampling procedures. In addition, information in the laboratory QAPP provides general sampling procedures for every possible sampling situation. Reorganization of these sections into single cohesive sampling and analysis document is highly recommended. The revised document should address each of the points outlined below to take into account site-specific factors. Procedures found in the QAPP that do not relate to the type of sampling that will be conducted at the facility should not be included in the QAPjP. The following information is required in detailing sampling procedures for a QAPjP:

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- Matrix Spike and Matrix Spike Duplicates
- Calibration Standards
- Internal Standards
- Surrogate Standards
- Continuing Calibration Check
- Calibration Check Standard
- Laboratory duplicate/replicate analysis, etc.

Provide this information for each of the specific sampling and analytical methods used. In addition, indicate at what stage in the analysis each of these checks will/do occur and at what frequency. Provide a table (if possible) to outline these steps.

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- Summary of data reduction procedures

- Statistical approach summary and details of how (and which) the statistical functions relate to data reduction, validation and reporting.

- Detail the methods to be used for the reduction of both field and laboratory data.

- Describe the criteria/guidelines/procedures to be used (by an individual independent of the laboratory) for data validation.

- Describe the data reporting format which will be followed, including all reporting forms and units. Include in this listing all contents of the lab data package.

Provide this information, realizing that these procedures must be developed/performed independently of the laboratory. The information found in section 9.0 of the laboratory QAPP does not adequately address this requirement either.

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The requirements of this section cannot be addressed by the laboratory QAPP and must be clearly defined within the site-specific QAPjP. These requirements deal with the performance of the sampling and measurement activities related to the field program. The following subjects must be somehow incorporated into the reorganized QAPjP revision, noting that external audits remain the responsibility of U.S. EPA.

Elements to be addressed for both field and laboratory internal audits must include:

- Identification of the <u>responsible party</u> for these audits;

- Specification of the frequency of these audits to be conducted; and

- Description of the methods/procedures to be used for conducting these audits. This should include:

  - independence of audit; and

  - examination of sample handling and other records.

XIII. PREVENTATIVE MAINTENANCE

This requirement was not specifically addressed in the RFI Workplan. Provide procedures in the QAPjP for the preventative maintenance of the field equipment that will be used as part of the investigative field program.

Information regarding preventative maintenance of laboratory equipment may be incorporated by reference from the laboratory QAPP, but only if these procedures allow for the maintenance of the equipment in a manner that assures the quality of the analytical results. Alternatively information regarding preventative maintenance of laboratory equipment may reference SW 846 or other standardized methods.

XIV. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

Details of the procedures to address this requirement were not found within the RFI Workplan (except sparsely and only gerenrally in sections 3.10, and 3.11). Some pertinent information was also found in section 13.0 of the laboratory QAPP, which should be incorporated by reference into the reorganized QAPjP. It should be explained how these sections relate specifically to the MacDermid project. This information must be supplied in the QAPjP or may reference a Data Management Plan (DMP) which contains all of this information. However, the supplied DMP (with the RFI Workplan) does not adequately address these issues.

XV. CORRECTIVE ACTION

In general this section must provide adequate detail to addressing corrective actions for field and/or laboratory activities. Incorporate sections 14.0 of the laboratory QAPP and section 4.4 of the Task III RFI Workplan into the QAPjP while ensuring that the following elements are included:

- The pre-specified conditions that automatically trigger corrective action.
- Personnel who initiate, approve, implement, evaluate, and report corrective action (by title).
- Procedures to initiate, develop, approve and implement corrective actions.
- Alternative corrective actions to be taken.

XIV. QUALITY ASSURANCE REPORTS TO MANAGEMENT

The requirements of this section may be adequately addressed by combining the information found in section 15.0 of the laboratory QAPP with that of sections 2.5, 4.5, and 4.6 (including subsections) found in Task III of the RFI Workplan. Quality assurance reports are required to be submitted to management on a periodic basis to ensure that any problems are investigated and proper corrective actions are taken.

A.T. Kearney, Inc.
222 South Riverside Plaza
Chicago, Illinois 60606
312 648 0111
Facsimile 312 648 1939-2302

Management
Consultants

ATKEARNEY

August 22, 1991

Mr. Bernie Orenstein
Regional Project Officer
U.S. Environmental Protection Agency
Region V, 5HR
230 South Dearborn
Chicago, IL 60604

RECEIVED
AUG 22 1991
OFFICE OF RCRA
Waste Management Division
U.S. EPA, REGION V

Reference: EPA Contract No. 68-W9-0040; Work Assignment No. R05-18-01; Technical Review of Site-Specific Quality Assurance Project Plans for Three RCRA Facilities; Work Plan

Dear Mr. Orenstein:

Enclosed please find the original QAPjPs for the above-referenced facilities to be returned to your files. These files include: Waste Management of Illinois, Inc.; Marathon Oil; and MacDermid Incorporated.

Please feel free to call me or Dr. John Goode, the Kearney Team Work Assignment Manager (who can be reached at 415/595-4300), if you have any questions.

Sincerely,

Robert Young for A.A.

Ann L. Anderson
Technical Director

cc: A. Debus, EPA Region V
B. Fuhrer, EPA Region V
S. Kolak, EPA Region V
G. Hruska, EPA Region V
A. Glazer
L. Poe
A. Williams

371.21

A.T. Kearney, Inc.
222 South Riverside Plaza
Chicago, Illinois 60606
312 648 0111
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Management
Consultants

AT KEARNEY

August 16, 1991

Mr. Bernie Orenstein
Regional Project Officer
U.S. Environmental Protection Agency
Region V, 5HR
230 South Dearborn
Chicago, IL 60604

Reference: EPA Contract No. 68-W9-0040; Work Assignment No. R05-18-01; Technical Review of Site-Specific Quality Assurance Project Plans for Macdermid Incorporated; Final Deliverable (Task 03)

Dear Mr. Orenstein:

Enclosed please find the final deliverable for the above-referenced project.

As discussed with Ms. Kolak, the EPA WAM, the materials submitted as a Quality Assurance Project Plan (QAPjP) include a Laboratory Quality Assurance Program Plan (QAPP). The submitted QAPP follows an appropriate format but does not provide the required site-specific information. This review provides general guidance in developing a site-specific QAPjP from the submitted materials and additional information.

Please do not hesitate to call me or Dr. John Goode, the Kearney Team Work Assignment Manager (who can be reached at 415/595-4300), if you have any questions.

Sincerely,

Greg M. Terdich for

Ann L. Anderson
Technical Director

RECEIVED
AUG 16 1991
OFFICE OF RCRA
Waste Management Division
U.S. EPA, REGION V

cc: A. Debus, EPA Region V
S. Kolak, EPA Region V
G. Schupp, EPA Region V
A. Glazer
L. Poe
J. Goode
A. Williams

311-13

FINAL DELIVERABLE
(TASK 03)

TECHNICAL REVIEW OF QUALITY ASSURANCE PROJECT PLANS (QAPjPs) for MACDERMID INCORPORATED, FERNDALE, MICHIGAN

Submitted by:

A.T. Kearney, Inc.
222 S. Riverside Plaza
Chicago, Illinois 60606

Submitted to:

Mr. Bernie Orenstein
Regional Project Officer
Region V
230 South Dearborn Street
Chicago, Illinois 60604

In response to:

EPA Contract No. 68-W9-0040
Work Assignment No. R05-18-01

August 16, 1991

Quality Assurance Project Plan (QAPjP)
General Comments/Deficiencies
for
Macdermid Incorporated, Ferndale, Michigan

GENERAL COMMENTS/DEFICIENCIES

The materials submitted, a laboratory Quality Assurance Program Plan (QAPP) and an RFI Work Plan, do not fulfill the Region V requirements for a Quality Assurance Project Plan (QAPjP). However, a review was performed by matching, to the extent possible, the contents of these documents to the following sixteen (16) required elements of a Region V QAPjP (as defined by Region V Model QAPjP, and Content Requirements for RFI QAPjPs). The (submitted) QAPP follows this format, but lacks the required site-specific details of a QAPjP. This review provides general guidance in developing a site-specific QAPjP from the submitted materials and additional information.

The majority of the deficiency comments deal with the inclusion and/or submittal of information and procedures specific to the proposed project. Detailed information/procedures must be included in the QAPjP in lieu of stating that "standard" procedures will be followed.

I. Title Page and QAPjP Approval
II. Table Of Contents
III. Project Description
IV. Project Organization and Responsibility
V. Quality Assurance Objectives for Measurement Data
VI. Sampling Procedures
VII. Sample Custody
VIII. Calibration Procedures and Frequency
IX. Analytical Procedures
X. Internal Quality Control Checks
XI. Data Reduction, Validation and Reporting
XII. Performance and System Audits
XIII. Preventative Maintenance
XIV. Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness
XV. Corrective Action
XVI. Quality Assurance Reports to Management

A site-specific QAPjP is to be a "stand alone" document. If references to other documents cannot be avoided, they should contain the title of the reference, section, and page number. The information in these references should be included within the QAPjP or as an Attachment or Appendix, if possible. However, attachment of manuals or voluminous references is discouraged.

I. TITLE PAGE AND QAPjP APPROVAL

The QAPjP is required to have an approval page with space for the signatures of the individuals filling the following (at a minimum) positions:

- EPA Region V Project Coordinator
- EPA Regional Quality Assurance Manager
- Contractor Project Manager
- Contractor QA Officer
- Any subcontractors as appropriate
- Project Manager
- Project QA Officer

It is not necessary to include the names of the individuals in these positions, thus preventing the need for a revision to the document should that individual no longer occupy that position.

II. TABLE OF CONTENTS

It is a Region V requirement for a QAPjP to list individuals receiving official copies of the QAPjP and any subsequent revisions. Provide this listing after the Table of Contents.

The document control format header must include the following information: the project name; document section number; document revision number; date; and section page number. Provide this format at the top of each page in the QAPjP and number the pages by section number.

III. PROJECT DESCRIPTION

This section, the Project Description, is not provided in the QAPP. However, some of the required information is present in the RFI work plan. Provide this information, preferably in the QAPjP, or include references (document, section, and page number) in the QAPjP for the location of this information. Provide a project description which includes the following:

- <u>Introduction</u> - A description of the project and a brief statement addressing the different phases of the work, the general objectives and investigative plan.

- <u>Site Description</u> - A description of the site-specific features including location, size, borders, physical features, geologic and hydrogeologic information. These items should be addressed in separate paragraph/ sections within the QAPjP.

- Site History or Background - A chronological history of the site including any information on the environmental history (i.e., sampling, spills, available data). Data should be summarized in a table which includes the analytical methods, results, and method detection limits if available.

- Target Compounds - Brief discussion of the relevant (important) site contaminants or target compounds, including required detection limits for RFI/CMS.

- Project Objectives - This should include an expanded description of the following elements: Specific objectives; intended data usages; and data quality objective (DQO) summaries.

- Sampling Network and Rationale - A detailed description of the sampling network and the rationale for the selection of the locations, methods, parameters, etc. This may be achieved by referencing a readily available work plan (RFI) and/or sampling plan and indicating where in these documents the salient items of the plan can be found.

- Project Schedule - A description of the anticipated start date, any milestone dates, and the anticipated completion date of the project or monitoring/sampling activities. An appropriate method for this requirement is a bar chart with project tasks and time lines

IV. PROJECT ORGANIZATION AND RESPONSIBILITY

This section must contain additional information regarding the project management, organization, responsibility and authority. At present, information in the QAPP only addresses this section for laboratory personnel. Provide this information for all personnel involved in the project, including EPA Region V personnel, contractor team personnel and any subcontractor personnel. Identify their responsibilities on the project, management hierarchy, and key personnel for different tasks. This information can be found, in part, in the Task III RFI workplan, sections 1.1 and 2.4 and incorporated with the QAPP information. An organization chart is required for this section.

Additionally, clarify which individuals from the laboratory will be involved in the project. Page 2-8 of the Task III RFI Workplan indicates that Bob Schock will be the laboratory manager for the project while the laboratory QAPP does not list this individual in any capacity at the lab.

V. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

Laboratory-specific information was found in the QAPP in section 4.3, but lacks the site-specific details required in a QAPjP. This information must be tailored to fit the specific needs of the project. Provide specific Quality Assurance Objectives (e.g., Method Detection Limit, Precision, Accuracy, Completeness Representativeness and Comparability) for your project and detail the procedures and means (e.g., blanks, spikes, etc.) of achieving these objectives.

Note: Region V requires duplicates and blanks to be collected at the following frequencies:

- Trip Blanks must be collected at a frequency of one per cooler in which aqueous matrix VOC samples are shipped.

- Field Blanks (equipment, field) must be collected for all aqueous matrix parameters at a rate of one sample for every 10 or fewer investigative samples.

- Duplicates must be collected for all matrices and parameters at a rate of one sample for every 10 or fewer investigative samples.

These blanks and duplicate samples must be treated as regular investigative samples, with regards to sample volumes, containers, preservation and shipping.

VI. SAMPLING PROCEDURES

Provide the detailed sampling procedures to be used at the facility. This requirement may be fulfilled by referencing (by document, section, and page number) a detailed sampling plan, the RFI Workplan and/or presenting a detailed listing in the QAPjP.

The information supplied in the Task III RFI Workplan pages 3-2 to 3-21 provides information on these requirements but needs to be addressed/included in a QAPjP. In addition, information in the laboratory QAPP provides general sampling procedures for every possible sampling situation. The information, if used, would need to be modified to include site-specific procedures for sampling. Do not include the procedures found in the QAPP that do not relate to the type of sampling to occur at the facility. The following information is required in detailing sampling procedures for a QAPjP:

- Detailed procedures, criteria, or guidelines used for sampling point selection.

- Detailed procedures, criteria, or guidelines used for collecting background samples, if any. Detailed procedures for collecting and preparing composite samples, if composite samples are to be collected.

- Detailed procedures for the collection of samples for each sample matrix and parameter(s).

- Detailed procedures for sample packaging, handling and shipment, including time considerations, and field filtration requirements and procedures.

- Sample containers, reagents, preservation and holding time requirements (a table is appropriate/recommended).

- Any special conditions for the preparation of sampling containers and time requirements, (a table is appropriate).

- Chain-of-custody procedures, including an acceptable and logical numbering system.

- Detailed procedures for preparing/collecting trip blank samples, field blank samples, and field duplicate samples.

- Adequate documentation of the sampling activities, including forms, notebooks, bound logbooks and detailed procedures for recording sample history, site and sample conditions, and analysis to be taken, etc.

- A detailed summary of the sampling and analysis performed, using a table is appropriate.

- Details of any field filtering and/or sample compositing that may have occurred during sampling activities.

VII. SAMPLE CUSTODY

Provide discussion of the three (3) distinct/separate issues for sample custody (chain-of-custody (COC)) on the following areas related to this project:

- COC procedures for all field activities, including sampling, field measurement, and screening.

- COC procedures for laboratory activities, including sample receiving, log-in, storage, tracking of custody transfer during sample preparation and analysis, etc.

- Final evidence file, including the description of file contents and specifying a file custodian.

Provide this information in detail in the QAPjP, as information provided in section 3.8 of Task III of the RFI Workplan does not adequately cover the required elements and formatting.

VIII. CALIBRATION PROCEDURES AND FREQUENCY

Provide specific procedures and frequencies for the calibration of all field instruments to be used during the investigation/field activities. Identify all field instruments which may be used and discuss the procedures for the initial calibration, and follow-up calibration checks during a particular field activity. In addition, list any conditions which may trigger or warrant a calibration check or recalibration during the course of the field activity.

The calibration of the laboratory equipment is detailed in section 7.0, pages 103 to 108 of the laboratory QAPP. Provide direct detailed references (document, section, and page number) in the QAPjP for the applicable procedures for the types of analysis to be run and the equipment to be used.

IX. ANALYTICAL PROCEDURES

The analytical procedures and parameters listed in Table 3.1 do not adequately describe all of the analysis that will/may be performed. Include a description/listing of all analysis to be performed or provide detailed references to a document (SW-846, QAPP, etc.) by section and page number for any analysis not listed. Do not list those that will not be performed, only those that will or may be performed.

Provide in the QAPjP the analytical procedures that shall be followed by the laboratory in analyzing the project samples. Detail or reference only those procedures that will/do apply to the type of analysis run.

X. INTERNAL QUALITY CONTROL CHECKS

Provide information on the following (many of the following are addressed elsewhere but must be reiterated to aid in

assessing effectiveness of quality control procedures) issues for both the field activities and laboratory analysis:

Field Activities (measurements and screening)

- Continuing calibration checks
- Replicate analysis
- Spike sample analysis
- Blanks (trip, field, duplicate)
- Quality Control samples
- Zero and Span gases (i.e., air monitoring)
- Calibration standards and devices

Laboratory Analysis

- Method Blanks
- Reagent/Preparation Blanks
- Matrix Spike and Matrix Spike Duplicates
- Calibration Standards
- Internal Standards
- Surrogate Standards
- Continuing Calibration Check
- Calibration Check Standard
- Laboratory duplicate/replicate analysis, etc.

Provide this information for each of the specific sampling and analytical methods used. In addition, indicate at what stage in the analysis each of these checks will/do occur and at what frequency. Provide a table (if possible) to outline these steps.

XI. DATA REDUCTION, VALIDATION AND REPORTING

In completing this section more detail is needed and the field activities must be addressed. The information in section 3.10 of Task III of the RFI Workplan provides for a general overview of the required procedures. Provide additional details to this information in the QAPjP or provide detailed references to a document (section and page number) where the information can be found.

Specifically, the following need to be addressed:

- Discussion that assures the resulting data package will comply with Functional Guidelines for Evaluating Organic/Inorganic Analysis - U.S.E.P.A.

- Summary of data reduction procedures

- Statistical approach summary and details of how (and which) the statistical functions relate to data reduction, validation and reporting.

- Detail the methods to be used for the reduction of both field and laboratory data.

- Describe the criteria/guidelines/procedures to be used (by an individual independent of the laboratory) for data validation.

- Describe the data reporting format which will be followed, including all reporting forms and units. Include in this listing all contents of the lab data package.

Provide this information, realizing that these procedures must be developed/performed independently of the laboratory. The information found in section 9.0 of the QAPP does not adequately address this requirement.

XII. PERFORMANCE AND SYSTEM AUDITS

The requirements of this section cannot be addressed by the laboratory QAPP and must be clearly defined within the site-specific QAPjP. These requirements deal with the performance of the sampling and measurement activities related to the field program. Provide, within the QAPjP, the following elements, noting that external audits are the responsibility of EPA.

Elements to be addressed for both field and laboratory internal audits:

- Identify the <u>responsible party</u> for these audits;

- Specify the <u>frequency</u> of these audits to be conducted; and

- Describe the <u>methods/procedures</u> to be used for conducting these audits. This should include:

  - independence of audit; and

  - examination of sample handling and other records.

XIII. PREVENTATIVE MAINTENANCE

This requirement is not specifically addressed in the RFI Workplan. Provide procedures in the QAPjP for the

preventative maintenance of the field equipment that will be used as part of the investigative field program.

Information regarding preventative maintenance of laboratory equipment may be incorporated from the QAPP, but only if these procedures allow for the maintenance of the equipment in a manner that assures the quality of the analytical results. Alternatively information regarding preventative maintenance of laboratory equipment may reference SW 846 or other standardized methods.

XIV. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

Details of the procedures to address this requirement were not found within the RFI Workplan (except sparsely and only verbally in sections 3.10, and 3.11). Information was found in section 13.0 of the laboratory QAPP. Incorporate this information into the QAPjP and include greater detail and example equations for percent recovery, relative percent difference (RPD), relative standard deviation (RSD), Method detection limits (MDL), and percent valid data. This information must be supplied in the QAPjP or may reference a Data Management Plan (DMP) which contains all of this information. However, the supplied DMP (with the RFI Workplan) does not adequately address these issues. Provide detailed procedures for assessing data precision, accuracy and completeness.

XV. CORRECTIVE ACTION

In general this section must provide adequate detail to addressing corrective actions for field and/or laboratory activities. Incorporate sections 14.0 of the QAPP and section 4.4 of the Task III RFI Workplan into the QAPjP and ensure that the following elements are included:

- The pre-specified conditions that automatically trigger corrective action.
- Personnel who initiate, approve, implement, evaluate, and report corrective action (by title).
- Procedures to initiate, develop, approve and implement corrective actions.
- Alternative corrective actions to be taken.

XIV. QUALITY ASSURANCE REPORTS TO MANAGEMENT

The requirements of this section may be fulfilled by combining the information found in section 15.0 of the QAPP with that of sections 2.5, 4.5, and 4.6 (including subsections) found in Task III of the RFI Workplan. Quality assurance reports are required to be submitted to management on a periodic basis to ensure that any problems are investigated and proper corrective actions are taken.

OHM Corporation

RECEIVED
JUL 1 1991
OFFICE OF RCRA
Waste Management Division
U.S. EPA, REGION V

June 26, 1991

Ms. Sherry Kolak
U.S. Environmental Protection Agency
Region V
Michigan Section
Office Of RCRA - (5HR-13)
230 South Dearborn Street
Chicago, Illinois 60604

RE: MacDermid Incorporated, Ferndale, Michigan; Site Assessment:

Dear Ms. Kolak:

Pursuant to our conversation this date, please find enclosed the ETC-Findlay Laboratory - Quality Assurance Program Plan (QAPP).

If I may be of further assistance, do not hesitate to contact me at your convenience.

Sincerely,

James W. Voorhees, Jr., CPG.
Manager Geosciences
Midwest Region

Encl:

371-16

16406 U.S. Route 224 East ■ P.O. Box 551 ■ Findlay, Ohio 45839-0551 ■ 419-423-3526

report in file room

OHM Corporation

November 19, 1990

RECEIVED
NOV 20 1990
OFFICE OF RCRA
Waste Management Division
U.S. EPA, REGION V

Ms. Mardi Klevs (5 HR-13)
Michigan Section
RCRA
USEPA Region V
230 South Dearborn
Chicago, IL 60604

RE: MacDermid Ferndale Facility RFI
MID 005 338 371

Dear Ms. Klevs:

Enclosed you will find a summary of the proposed approach to initiate work at the MacDermid Ferndale facility. We are sending this to you at the request of Frank Cruice in preparation for our meeting on Monday, November 26, 1990.

We look forward to meeting with you then and discussing these and other pertinent issues.

Sincerely,

Richard A. Veen
Michigan Division Manager

RAV:vld

cc: Frank Cruice/MacDermid
James Batozynski/MacDermid

enclosure

538-29

2615 Taylor Street ■ Lansing, Michigan 48906 ■ 517-484-7715

MEETING WITH USEPA TO DISCUSS RCRA FACILITY INVESTIGATION MACDERMID FERNDALE FACILITY

The purpose of the meeting will be to review and discuss a modified approach to the RCRA facility investigation required under the conditions of Permit MID 005 338 371.

The intent of the modified approach is to produce statistically valid, properly documented data to sufficiently characterize the nature and extent of any environmental impairment which may exist at the following SWMU's so that corrective measures may be expediently selected.

- Air quality
- Railroad spur
- Former incinerator
- Former lagoons

The basic scope of the modified approach is outlined below.

<u>Task 1, Description of Current Conditions</u>

- File and document research
- Maps and charts of site, localized description
- Nature and extent of contamination
- Implementation of interim measures
- Report

<u>Task 2, Pre-Investigation Evaluation of Corrective Measure Technologies</u>

- On-site criteria
- Off-site criteria
- Report

<u>Task 3, Exploratory Site Evaluation</u>

- Ground-water samples
- Shallow boreholes--lagoon closures
- Soil analyses
- Air quality
- Report

The work of Tasks 1 and 2 will conform to the scope specified in the permit guidelines for the RFI. The work of Task 3 will involve collection of supplemental data to further characterize the land based SWMU's. An approach to assessing air quality will be developed after review of historical data on the facility. We anticipate this data can be collected without the necessity of preparing the extensive planning documents identified in the permit as Task 3 RFI work plan. We envision a work plan of considerably less

magnitude which will nonetheless yield technically qualified data. Our expectation is that this data when coupled with the data from previous investigations of the site may produce a characterization and quantification of the site adequate to select an appropriate remedy for each unit addressed, if needed, at the completion of Task 3.

Advantages to this approach are it is considerably less expensive and time consuming for MacDermid and USEPA and it would avoid redundancy of data in some of the SWMU areas.

We feel this approach warrants consideration for two reasons. First, the site history does not suggest the presence of an extensive or complex contamination. Second, the site itself appears to be stratigraphically straight forward thus lending support to an uncomplicated investigation. A summary of these points follows.

Site Specific--Operational History

- Incinerator--The incinerator was used until its removal from the site in 1976 for destruction of fiber barrels, paper, and general housekeeping burnables. Metal rings and non-parishables were collected and transported to a solid waste landfill for disposal.

- Railroad Spur--According to interviews and documentation, nonhazardous material such as fiber barrels and diatomaceous earth were transported onto the site via this line.

- Lagoons--Based on existing data, concentrations in these structures are moderate to low levels and the extent of residuals may be more precisely determined with some additional exploratory boreholes, sample analyses, and the installation of perimeter ground-water monitoring wells.

  Historically, sludges were collected in the lagoons along with the aqueous residuals and treated in the on-site wastewater-treatment system. The presence of remaining lagoon residuals will be evaluated in Tasks 2 and 3.

- Releases and Spills--Historically, incidents have been limited on this facility. The primary subsurface evaluation will be in the area of the lagoon residuals under the OHM Tasks 2 and 3.

- Air Quality--Ambient quality will be addressed upon evaluation of historical data.

Site Specific--Characterization

- Surface Water Collection--The topographic low of the facility collects surface water run off in the center of the site. The water and transported materials are collected in the drainage system and treated at the wastewater-treatment facility. Under these conditions, limited ponding or standing water collects.

- Near-Surface Ground Water--According to the data from the boring logs and the local hydrogeology of the area, the water table is a perched structure and not a recharging system to the deeper ground-water aquifer.

- Subsurface Geology--According to boring log information and the local geologic and soil studies available from this area, approximately 13 feet below the ground surface elevation, a 60-foot-thick clay stratum is located, thus limiting down-section percolation of materials deposited on or near the surface soils.

In summation, it is our view that the modified task approach to determining the extent of the environmental impact and potential mitigation at this facility, considering the size and operational background, is justified. Further, to utilize the requirements in the USEPA RFI guidelines (e.g., Performance Audit and System Audit procedures in the Data Collection Quality Assurance Plan, graphical display requirements in the Data Management Plan, Community Relations Plan etc.), would be overly expensive, repetitive, and time consuming for this size of project.