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COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVAL ORDNANCE STATION INDIAN HEAD, MARYLAND

FINAL WORK PLAN SITE INSPECTION: PHASE I OLSON ROAD LANDFILL

Prepared for:

DEPARTMENT OF THE NAVY
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D. C.

SOUTHDIV CONTRACT NUMBER:
N62467-89-D-0318

Prepared by:

ENSAFE/ALLEN & HOSHALL
MEMPHIS, TENNESSEE

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Release of this document requires the prior notification of the Commanding Officer of the Naval Ordnance Station, Indian Head, Maryland.

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FOREWORD

PROJECT TITLE: CONTRACT N62467-89-D-0318, COST PLUS AWARD FEE CONTRACT FOR COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION, NAVY (C.L.E.A.N.) DISTRICT II; SITE INVESTIGATION, NAVAL ORDNANCE STATION (NOS), INDIAN HEAD, MARYLAND.

This Work Plan outlines Phase I of the Site Inspection (SI) to be completed at the Naval Ordinance Station Indian Head, Maryland. Phase I of this Site Inspection involves the assessment of the Olson Road Landfill (Site 42) to determine if contamination is present as a result of past disposal practices at the site. Site 42 is an Installation Restoration Site scheduled for a Site Inspection by EnSafe/Allen & Hoshall through a SOUTHDIV CLEAN contract. However, due to the scheduling for building construction on the landfill site (MILCON Project, P-059), completion of the Site Inspection of Site 42 has been expedited and defined as Phase I of the NOS Indian Head Site Inspection. The remaining suspect sites will be subject to a investigation during Phase II of the Site Inspection.

The Site Inspection of Site 42 will be accomplished by the installation of a series of shallow soil borings and monitoring wells with the collection and analysis of soil, groundwater, sediment and surface water samples for laboratory analysis.

This Work Plan includes support documents which outline the Phase I Site Inspection. This Work Plan comprises three sections which include: Section I-Sampling and Analysis Plan (SAP), Section II-Quality Assurance Plan (QAP), and Section III-Health and Safety Plan (HSP). Each of these documents contain the information prescribed in Navy contract N62467-89-D-0318, and the Plan of Action prepared by EnSafe/Allen & Hoshall (August, 1991).

SAMPLING AND ANALYSIS PLAN

FOR

SITE INSPECTION

PHASE I
OLSON ROAD LANDFILL

NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

SECTION I. SAMPLING AND ANALYSIS PLAN

1.0 INTRODUCTION

The following is a Sampling and Analysis Plan (SAP) for Phase I of the Site Inspection (SI) to be completed at the Olson Road Landfill (Site 42) located at the Naval Ordnance Station (NOS) Indian Head, Maryland. This plan is submitted in accordance with the provisions of Navy Contract N62467-89-D-0318. This plan consists of two (2) sections, the Field Sampling Plan and the Project Management Plan.

1.1 Project Objective

The objective of this project is to determine if contamination exists, at the Olson Road Landfill site, as a result of past disposal practices. This will be accomplished by the completion of a surface and subsurface investigation. This investigation involves the completion of a geophysical survey and the installation of a series of soil borings and groundwater monitoring wells. Samples will be collected from the soil borings, groundwater monitoring wells, two ponds local to the site and a swale adjacent to the site. Select samples will be submitted for laboratory analysis.

1.2 Site Description

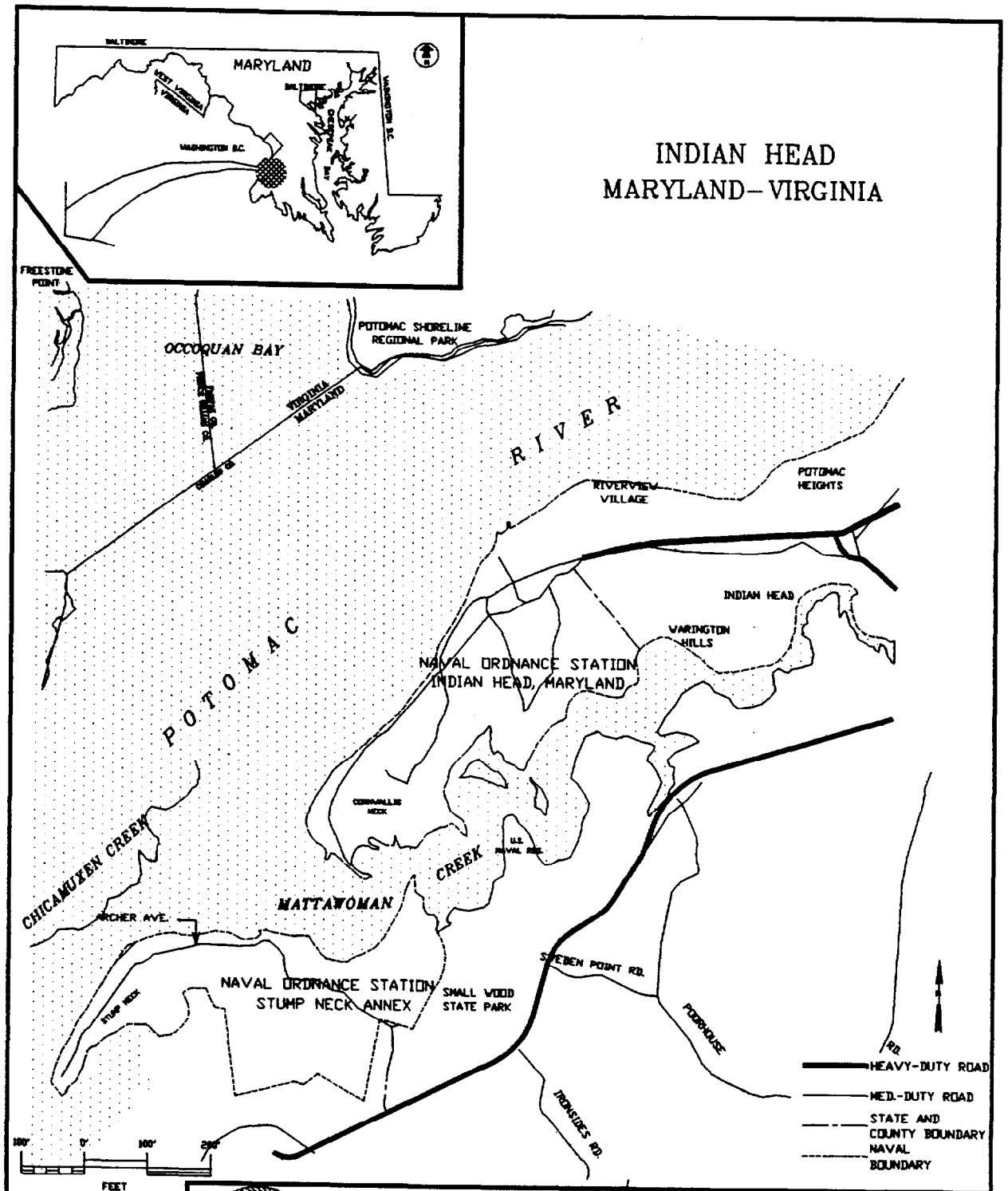
The Olson Road Landfill is part of NOS Indian Head. Figure 1.1 is a vicinity map of the naval facility. The site comprises approximately 2 acres. Figure 1.2 is a site plan of the Olson Road Landfill. Refuse was deposited in the landfill over a 5 year period ending in 1987. Hazardous material content was not confirmed or denied. The area is bulldozed over but visible debris includes scattered cans, drums pallets, and branches. In addition, the area does not conform to topographic maps which may indicate filling.

1.3 Previous Investigations

An environmental impact assessment was completed for the MILCON project to determine the potential from impact to the ecosystems at P059 as a result of new construction. The assessment indicated no major impacts were suspected.

A limited visual inspection was completed at the Olson Landfill as part of the NOS Preliminary Assessment (NEESA 13-021A). Basic information and conclusions resulting from that assessment are as follows:

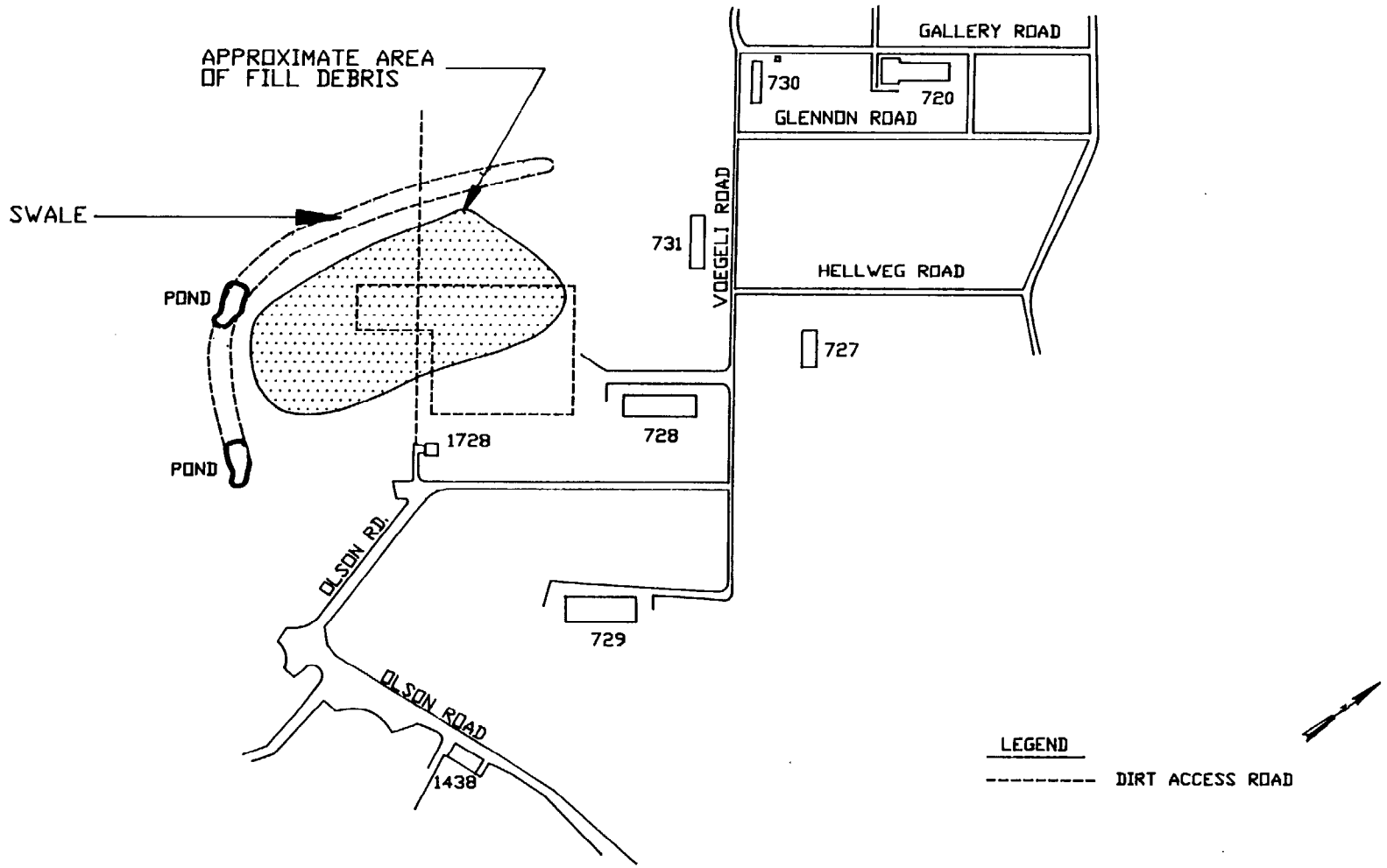
- Disposal apparently occurred over a five year period in the early and mid 1980's;



SITE INVESTIGATION
PHASE I
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
(REDRAW FROM: PRELIMINARY ASSESSMENT REPORT)

VICINITY MAP
FIGURE 1.1

DATE: 9/17/91 | DWG NAME: MDVICA



NOT TO SCALE

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
(MODIFIED FROM: PRELIMINARY
ASSESSMENT REPORT)

OLSON ROAD LANDFILL
FIGURE 1-2

DATE: 10/29/91

DWG NAME: MOOLSRLF

- Disposal of hazardous waste is not recorded nor recalled by site personnel;
- Debris currently visible includes branches, pallets, and a few scattered cans and drums; and,
- Disposal in this area was not authorized.

1.4 Geology and Hydrology

A description of the geology and hydrology of the NOS Indian Head area is not within the Scope of Work for Phase I of the SI. A description of the local geology and hydrology will be provided in the Work Plan for Phase II of the SI to be prepared under separate cover.

2.0 FIELD SAMPLING PLAN.

This section describes the sampling rational, sampling procedures and decontamination procedures. The SI is designed to produce data of technical quality to assess the current site conditions and includes those tasks necessary to determine if contamination is present at Site 42. Data management (Quality Assurance, data reduction, etc.) is discussed in the Quality Assurance Plan, Section II of this Work Plan.

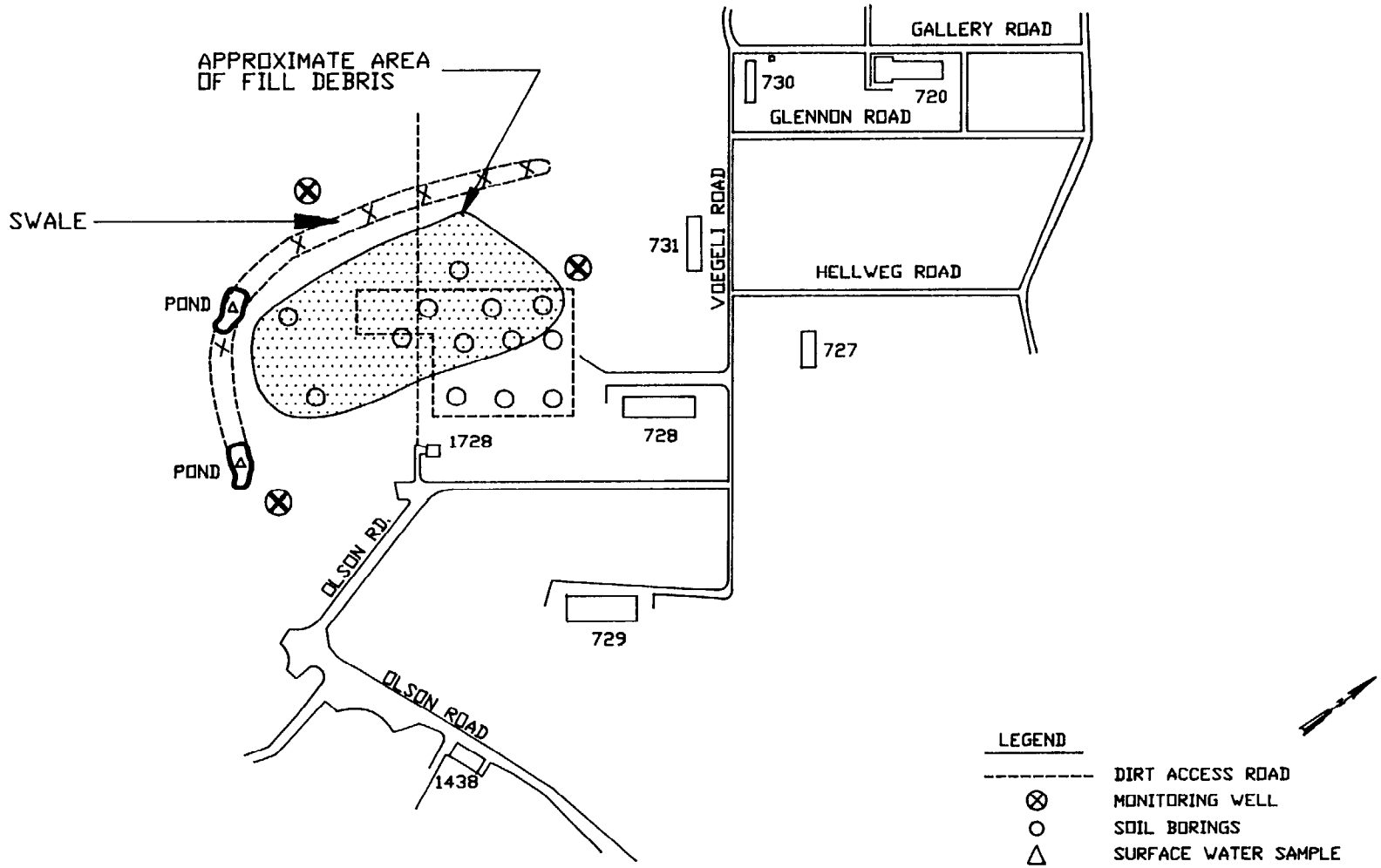
2.1 Sampling Rationale

The Field Sampling Plan (FSP) is divided into three stages which include: 1) a geophysical survey, 2) shallow subsurface survey and 3) surface water and drainage swale analysis. Stage 1, the geophysical survey, will utilize a magnetometer study and a ground penetrating radar to scan the subsurface for potential hazards. Stage 2 will involve the installation of shallow soil borings and groundwater monitoring wells. Stage 3 will involve the collection of surface water samples and sediment samples. Details of each stage are described in detail below.

The area of investigation includes three zones, these zones are A) the proposed construction area, B) the fill area (outside the construction area), and C) the area outside the fill area. Figure 2.1 indicates the proposed location of soil borings, monitoring wells and samples locations for the ponds and drainage swales. Samples will be collected from each zone and submitted for laboratory analysis. Distribution and frequencies of soil, groundwater, surface water and sediment samples are described Table 2.1.

2.2 Geophysical Survey

A limited shallow geophysical survey will be completed utilizing the techniques of a magnetometer and ground penetrating radar



NOT TO SCALE

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
(MODIFIED FROM PRELIMINARY
ASSESSMENT REPORT)

PROPOSED SAMPLING PLAN
OLSON ROAD LANDFILL
FIGURE 2-1

DATE: 10/29/91

DWG NAME: MDOLSRLF

TABLE 2-1 SAMPLE DISTRIBUTION			
Zone	Sample locations	Sample Matrix	Number of Lab Samples
A	10-borings	Soil	3 from 5 borings
		Soil	4 from 5 borings
	1-boring*	Soil	2 (top & depth)
B	2-borings	Soil	3 from each
C	3-borings (wells)	Soil	3 per boring
		Water	1 per well
	6-swales**	Sediment	6
	2-ponds	Water	1 per pond

* One boring will be completed in zone C for background. This boring may be complected as the upgradient monitoring well.

** One of the six swale sediment samples will be collected for background.

(GPR). The purpose of the survey is to locate any buried obstructions (such as; buried tanks, drums, etc.) that may impede drilling operations and to aid in profiling the shallow subsurface. This will be accomplished by completing a series of traverses across the site, concentrating on the proposed construction site.

These two techniques will be applied in tandem. The magnetometer will provide data over the complete investigation area. Ground penetrating radar will be used to collect detailed data at anomalous areas indicated by the magnetometer data.

LGI, Inc. a Division of Laney Geosciences, Inc. will be retained by EnSafe/Allen & Hoshall to complete the survey. Field operations will be directed and supervised by the EnSafe/Allen & Hoshall Project Geologist.

2.2.1 Magnetic Study

The rational of the magnetic survey of the Olson Road Landfill involves station measurements techniques. A grid will be superimposed on the investigation area with 20 foot nodal points. Magnetometer readings will be completed at each nodal point and at the midpoint between each nodal (i.e. ten foot centers). An isogamic map[1] will be produced from the data collected during the magnetic study. Anomalous areas indicated on the isogamic map will be marked on the survey area. Those areas will be the subject of the more detailed ground penetrating radar survey.

A magnetometer measures the intensity of the magnetic field of the earth. Magnetometers are sensitive to metal (ferrous) objects and are commonly used at hazardous/solid waste sites to locate buried pipes, drums, scrap metal, etc.

Buried metal objects will produce a significant variation (anomalies) in the measured magnetic field. The measured response is non-unique and is proportional to the target mass and depth of burial. The response of the gradiometer will decrease by a factor of 16 if the distance to the target object is doubled.

The type of magnetometer to be utilized at the Olson Road Landfill is a dual fluxgate magnetometer or gradiometer. The basic configuration of a gradiometer is two fluxgate magnetometers mounted at know distance apart and in a consistent orientation. A gradiometer measures the gradient of a directional component of the magnetic field of the earth. This gradient may be measured in any direction, however, the standard measurement is the vertical component.

2.2.2 Ground Penetrating Radar

Ground penetrating radar (GPR) uses high frequency radio waves to provide a continuous vertical profile of the shallow subsurface along a traverse. This technique uses a small antenna which is slowly moved across the ground surface. Energy is radiated downward from the antenna into the subsurface and then reflected back to the receiving antenna. The wave reflections are a response to a relative change in electrical properties in subsurface conditions indicating such features as a variation in soil or rock types, interface between soil and rock, presence of groundwater, buried objects, voids areas and so on. The result is a cross-sectional profile along the traverse. GPR is typically capable of penetrating to depths of 10 to 20 feet, however, penetration and data quality vary with site conditions.

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[1] An isogamic map is a contoured map of magnetic intensities.

This technique utilizes a compact system and is adaptable to a range of surface conditions.

Initial in-field review of data is possible; however, this data must be reviewed by experience personnel. All raw data collected will be reviewed and scrutinized in the field by the subcontracting field engineer and by the EnSafe/Allen & Hoshall Project Geologist for quality and completeness. The location of all soil borings in the landfill area is contingent on the raw data from the geophysical survey.

2.2.3 Geophysical Survey Report

A formal report will be prepared by the subcontractor and submitted to EnSafe/Allen & Hoshall within two weeks of the completion of the survey. The results of the survey will be formerly presented in the Site Inspection Report (SIR) prepared by EnSafe/Allen & Hoshall.

2.3 Subsurface Survey

A shallow subsurface survey will be conducted including the installation of sixteen proposed shallow soil borings (three completed as groundwater monitoring wells) and the collection of soil and groundwater samples for laboratory analysis. Figure 2.1 indicates the proposed boring and monitoring well locations. Soil boring samples submitted for laboratory analysis will be selected on the bases of head space analysis of split soil samples completed in the field or as directed by the Project Geologist. The procedures for the installations of soil borings and monitoring wells along with the sampling procedures for collecting soil samples (soil borings) and groundwater samples are described in detail in the this section.

2.3.1 Soil Boring Installation and Soil Sampling Procedures

A series of soil borings will be installed and soil samples collected to facilitate the scope of the SI. The data collected from borings and soil sample analysis will aid in determining if contamination is present in the landfill. Proposed boring locations are presented in Figure 2.1. The procedures for the installation of soil borings and the collection of soil samples are as follows:

- Borings will be completed to a maximum depth of 25 feet or to groundwater using standard 4.25 inch internal diameter (I.D.) augers. Standard penetration test and split spoon soil samples will be collected at five foot intervals to depth, or as directed by the site geologist.

- If the groundwater is encountered during the completion of the soil borings, grab water samples (in-situ samples) may

be collected from select locations. These grab sample locations will be chosen on a biased random basis and will be dependent on the presence of a sufficient quantity of groundwater for sample collection. These grab water samples will be collected from the annuls of the auger using a standard teflon coated bailer.

- The soil sampler will be a standard 24 inch, two inch outside diameter (O.D.) split spoon. The augers will be advanced to the desired sampling depth. The split spoon sampler will be attached to the end of drilling rods and inserted into the annuls of the augers to the sampling depth. The sampler will be driven 24 inches through the use of a 140 pound hammer dropped through a 30 inch fall, in accordance to NEESA 20.2-031A.

- Once the split spoon sampler is retrieved, the sampler will be opened and a portion of the soil sample will be immediately collected for the volatile constituents. The soil will be placed in the appropriate container and labelled. The filled sample container will be placed in a cooler on ice to maintain the sample temperature at four degrees celsius (± two degrees).

- The remaining portion of the soil sample will be classified in the field by an experienced geologist. Following classification the sample will be placed in a stainless steel bowl and mixed to form a homogenized sample. The soil will then be placed in the appropriate container, labelled and place in a cooler to maintain the sample temperature at four degrees celsius (± two degrees).

- All soil samples will be submitted to PACE, Inc. of Novato, CA., (NEESA approved) under strict chain-of-custody, for analysis.

- If notable organic refuse is encountered during the drilling process, an explosive meter will be utilized to measure flammable gas (i.e. methane) concentrations. If flammable gas concentrations exceed 10% of the Lower Explosive Limits (LEL), a careful investigation and mapping of the area must be made. If the concentration of flammable gases exceeds 20% of the LEL, all operations must be terminated immediately and the area evacuated. Operations will continue only after concentrations retard to below 10% of the LEL and the area is surveyed to determine future risks.

- Boring cuttings will not be replaced into the borings in accordance with Well Construction Regulation for the State of Maryland. The cuttings may be separated and stored onsite in drums in a designated area(s), until analytical results are reviewed. At that time, the fate of the

cuttings will be properly determined (i.e. properly disposed or used as fill).

- All borings will be abandoned by pressure grouting to the surface. This will prevent the infiltration of surface runoff from entering the boring.

- All drilling equipment will be decontaminated between borings to prevent cross contamination. Decontamination will consists of high pressure hot water wash followed by a potable water rinse. Decontamination will be completed before, between, and after each boring is drilled for this project. Split spoon samplers will be decontaminated

  before, between and after each use by an Alconox wash followed by a potable water rinse.

2.3.2 Monitoring Well Installation Procedures

Groundwater monitoring wells will be constructed to comply with the State of Maryland Well Construction Regulations, COMAR 26.04.04[2]. Figures 2.2 and 2.3 are typical well construction configuration consistent with the COMAR 26.04.04. All well drilling and installations will be logged and supervised by a qualified geologist. The procedures are as follows:

- Shallow monitoring wells will be initiated with 4.25 inch I.D. augers. Standard penetration test and split spoon samples will be performed at five foot intervals, or as directed by the site geologist throughout the drilling process.

- Soil samples will be collected by the procedure outlined in section 2.3.1.

- If apparent contamination (refuse, staining, odorous, etc. soils) is encountered in the upper stratum, the boring will be over-drilled and a protective casing installed[3]. Over-drilling will be completed with a 8.5 inch I.D. hollow stem auger to a minimum depth of five feet below the suspect strata and above the water table. A 10 inch PVC protective casing will be installed and secured with a portland cement

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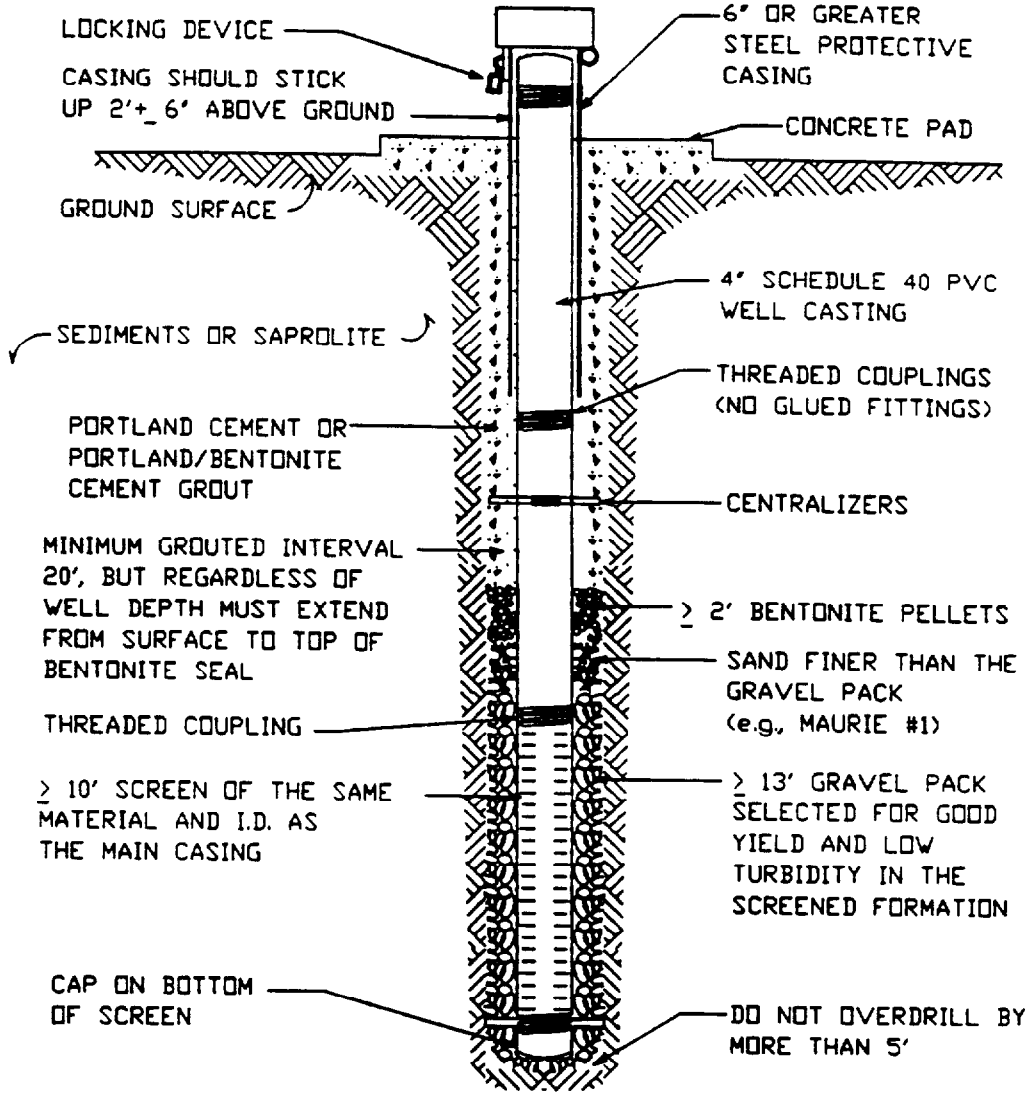
[2] Other criteria for well installation in or near solid waste disposal sites is presented in a MDE publication entitled, "Specifications for the Design and Installation of Groundwater Monitoring Wells at Solid Waste Disposal Facilities", 5/3/89.

[3] If no apparent contamination is encountered, the boring will be completed to approximately seven feet below the water table with 8.25 inch I.D. augers.

STATE OF MARYLAND
DEPARTMENT OF THE ENVIRONMENT
HAZARDOUS AND SOLID WASTE MANAGEMENT ADMINSTRATION

TYPICAL ILLUSTRATION OF MINIMUM SPECIFICATIONS FOR MONITORING WELL CONSTRUCTION



"≥" MEANS "GREATER THAN OR EQUAL TO"
WELL REGULATIONS, MINIMUM SPECIFICATIONS, AND SPECIFIC INSTRUCTIONS BY HSWMA SUPERCEDE THESE GENERAL REQUIREMENTS.

SOURCE: STATE OF MARYLAND, DEPARTMENT OF THE ENVIRONMENT
HAZARDOUS AND SOLID WASTE MANAGEMENT AMMINISTRATION

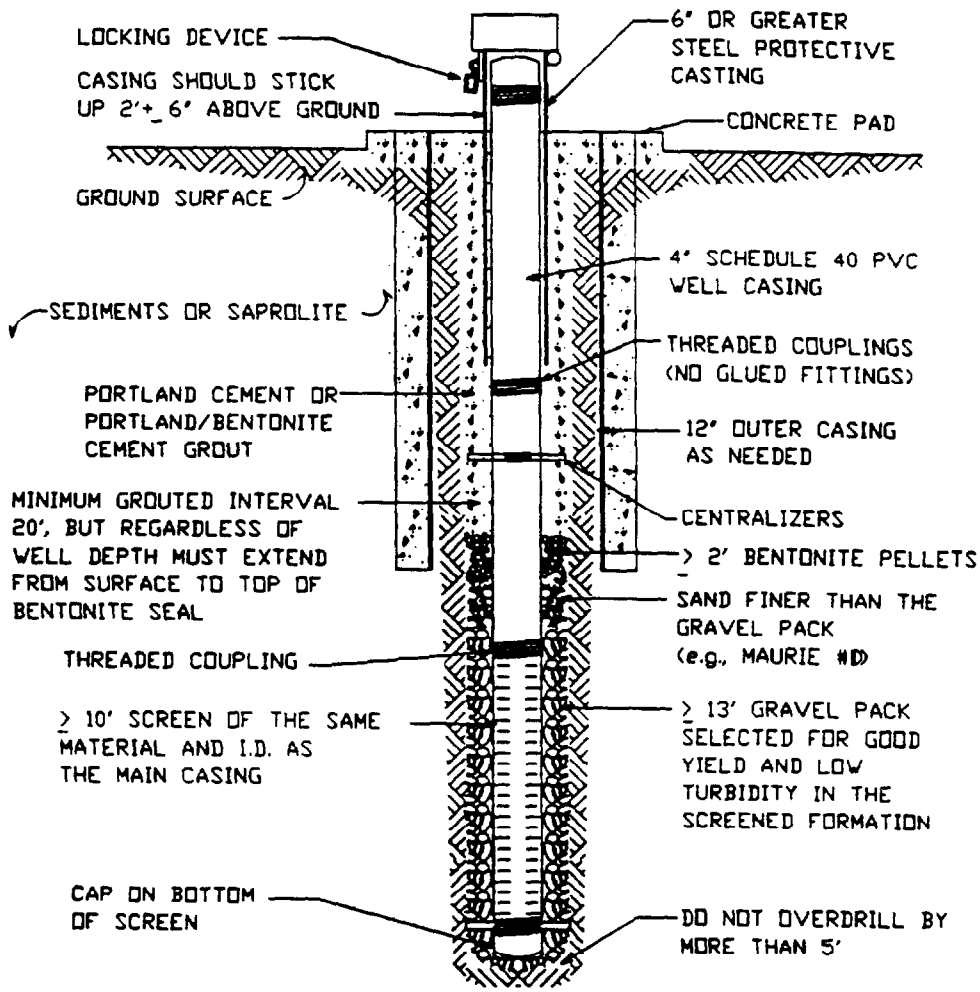
SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

MONITORING WELL DESIGN
FIGURE 2.2

DATE: 9/17/91 | DWG NAME: MDWELL9

STATE OF MARYLAND
DEPARTMENT OF THE ENVIRONMENT
HAZARDOUS AND SOLID WASTE MANAGEMENT ADMINISTRATION

TYPICAL ILLUSTRATION OF MINIMUN SPECIFICATIONS
FOR MONITORING WELL CONSTRUCTION



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SOURCE: STATE OF MARYLAND, DEPARTMENT OF THE ENVIRONMENT, HAZARDOUS AND SOLID WASTE MANAGEMENT ADMINISTRATION

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

MONITORING WELL DESIGN WITH PROTECTIVE CASING
FIGURE 2.3

DATE: 9/17/91 | DWG NAME: MDWELIOC

grout. Grout will be place in the annular space around the outside of the protective casing through a tremie pipe inserted to the depth of the protective casing. The grout will be allowed to set for a minimum period of 24 hours before the borehole will be continued. The installation of this protective casing will guard against contamination of subordinate soil units by surface and upper strata contamination.

- Once the protective outer casing is secured the boring will be continued with 6.25 inch I.D. augers to approximately seven feet below the potentiometric surface, or as directed by the site geologist.

- After the drilling is advanced to the target depth, a section of four inch, schedule 40 PVC riser equipped with a 10 foot section of 0.010 slot, four inch, schedule 40 PVC well screen will be installed with a minimum of 2.5 feet above grade stick-up. The well casing sections will be flush threaded. A minimum of three centralizers will be installed to center the well casing in the annular space. One will be placed in the screen section and the other two spaced evenly along the remaining casing.

- The annular space will be packed with a 20-40 silica sand (U.S.C.S. Standard) as a filter pack to prevent clogging of the slots. The filter pack will be tremied to a minimum depth of three feet above the slotted screen. A layer of finer sand (a minimum of two feet thick) will be placed above the filter pack to prevent the infiltration of grout and bentonite into the filter pack.

- A bentonite seal, with a minimum thickness of two feet, will be placed on top of the sand backfill. The bentonite will be allowed to hydrate a minimum of eight hours to allow complete swelling of the seal. The remaining annulus of the borehole will then be filled with a Type I portland cement with a five percent bentonite slurry to the surface.

- An outwardly sloping 3' X 3' X 6" concrete platform will be constructed at the ground surface around each well casing. A security casing with a locking cap will be installed around the well casing to preserve the integrity of the well.

- A permanent measuring point will be established at the top of each "true" well casing. This point will be marked and surveyed to establish the elevation relative to a permanent USGS NAD '27 bench mark or a permanent bench mark to the nearest 0.01 foot. This will facilitate the preparation of an accurate potentiometric map of the study area.

2.3.2.1 Monitoring Well Development

Following the completed installation of the monitoring wells, each well will be properly developed. This will ensure that the well is functioning properly.

Well developing may be completed by bailing or pumping. Bailing is done with a Teflon-coated single check valve bailer. It is manually lowered into the well and fills with water and is then retrieved. Pumping may be completed with a hand pump or an electrical submersible pump.

2.3.2.2 Monitoring Well Abandonment

All monitoring installed during this SI will be abandoned in compliance with the State of Maryland Regulation for Monitoring Well Installation, COMAR 26.04.04. The decision to abandon the will be made by the EIC and/or the activity.

There are two basic approved methods for monitoring well abandonment in the State of Maryland. One requires grouting the well inplace to the surface with a Type I/II portland cement with a five percent bentonite slurry. The second requires over drilling the monitoring well and removing the well. The remaining hole is grouted to the surface with a Type I/II portland cement with a five percent bentonite slurry.

2.3.3 Monitoring Well Sampling Procedures

Sampling of the monitoring wells will involve reading the static water level to calculate well casing volume, purging the well casing of stagnate water and retrieving the sample and placing it into properly labelled sample container(s). These procedures are described below.

2.3.3.1 Static Water Level Measurement

Static water level measurements will be performed on all monitoring wells prior to purging and in accordance with NEESA 20.2-031A, and the Southern Division "Specifications for Groundwater Monitoring Well Installation and Sampling". The procedure is as follows:

- The water level meter will be tested prior to use to insure proper operation.
- The probe will be decontaminated prior to each measurement with deionized water rinse.
- The probe will be lowered into the annulus of the monitoring well until the buzzer indicates the probe has intersected the groundwater surface.

- The depth to water will be measured to the nearest 0.01 foot relative to the permanent mark established at the well head. The depth to water will be recorded in a bound field notebook and the date and time will be noted.

2.3.3.2 Monitoring Well Purging

Each well will be purged of stagnant water. The purging process ensures that the well is functioning properly and that representative groundwater samples are obtained. During well purging, select field analytical procedures will be performed, including; pH, temperature, and specific conductivity. These procedures are outlined in Section 2.7.1 below.

Well purging procedures will be in accordance with NEESA 20.2-031A. These procedures are outlined below:

- A minimum of three (3) casing volumes will be purged from each well. The water volume in the well casing will be calculated prior to purging by subtracting the depth to water from the total depth of the casing and multiplying by the appropriate factor (0.661 gallons per foot for a standard four inch well casing).

- Well purging may be completed by bailing or pumping. Bailing is done with a Teflon-coated single check valve bailer. It is manually lowered into the well and fills with water and is then retrieved. Pumping may be completed with a hand pump or an electrical submersible pump.

- In the event that a well bails to dryness before three (3) casing volumes are removed, the purged volume will be noted and an explanation will be given. A minimum of 24 hours will be allowed to pass between well purging and well sampling on wells that bail dry.

2.3.3.3 Groundwater Sampling Procedures

All groundwater samples will be collected in accordance with NEESA 20.2-031A, Chapter 7- Ground-Water Sampling and Southern Division "Specifications for Groundwater Monitoring Well Installation and Sampling". Groundwater samples will be collected using a Teflon-coated single check valve bailer and nylon bailing rope. The procedures for sampling are as follows:

- A sheet of clean visquine will be placed on the concrete platform and around the security casing to prevent possible contact between the bailer, bailer rope and the ground surface.

- The bailer will be slowly lowered into the water column to minimize water column disturbance and possible loss of volatile parameters.

- Once the bailer has filled with water, it will be manually retrieved and the samples will be immediately transferred to appropriate sample containers. Sample containers for volatile analysis will be filled first.

- While in the field and during transport to the laboratory, all samples will be retained in a field cooler with ice packs to maintain sample temperature at approximately four degrees C (± two degrees C).

2.3.3.4 Groundwater Sampling Equipment Decontamination

All equipment used in measuring and sampling groundwater monitoring wells will be decontaminated in accordance with NEESA 20.2-031A. Decontamination will consists of a potable water/detergent wash followed by a potable water rinse. This will be completed prior to initial use and between samples. This procedure will minimize the potential for cross-contamination between sampling locations. Disposable gloves will be worn during all measurements and sampling activities. A new pair of disposable gloves will be donned for each water sample and/or measurement.

2.4 Surface Water and Drainage Swale Analysis

Sediment samples will be collected at six locations along the swale adjacent to the northwest portion of the landfill. The sampling rational will be based on a biased random criteria. A zone in and around the swale will be inspected for areas of stressed vegetation and/or visible staining. Sample will be collected in these areas, if present, otherwise sample locations will be selected on a biased random basis. One sample will be collected for background (control). Each sample will be placed into a stainless steel bowl or cleaned pan.

Sediment samples will be collected by means of a disposable scoop. The appropriate container will be filled immediately for the volatile fraction analysis. The remaining soil will be mixed to homogenize the sample. The sample will then be placed into the appropriate, pre-cleaned sample container. A label will be placed on each sample container and given a unique identification number. Each sample will be placed in a cooler on ice.

Collection of surface water samples from two ponds in the immediate vicinity (northwest and west) of the landfill is proposed. The sampling rationale for collecting surface water samples is biased random; however, the number of viable sampling points may be reduced due to accessibility. Surface water

samples will be collected directly from the surface with the sample container. A label will be placed on each sample container and given a unique identification number. Each sample will be placed in a cooler on ice.

2.5 Field and Laboratory Quality Control Checks

Internal laboratory control checks will be conducted in the laboratory by the in-house staff. EnSafe/Allen & Hoshall will conduct internal quality control checks of sampling procedures and laboratory analyses. These checks will comprise preparation and submittal of sampler rinsate blanks, trip blanks, field blanks, and field duplicates for analysis and an evaluation of the laboratory analytical package.

The types and frequency of blanks and other control check samples are dictated by NEESA level C QC criteria selected for this project by the NEESA Contract Representative (NCR). The required control check sample frequencies are outlined in NEESA 20.2-047B. Level C QC measures for sampling and analysis are discussed below.

2.5.1 Field Data Quality

All field work will be conducted and/or supervised by the EnSafe/Allen & Hoshall Project Geologist to ensure proper procedures are followed. Field records will be kept of all activities during the investigation. These records will be maintained at the EnSafe/Allen & Hoshall office in Memphis, Tennessee. Such records will include any obstacles encountered during the investigation.

Field samples will be collected per the procedures outlined in Sections 2.3.1, 2.3.3.3, and 2.4. Precision will be assessed by evaluating the results of duplicate samples, and accuracy will be assessed by evaluating the analyses of field blanks, trip blanks, and laboratory matrix and surrogate spikes. The collection frequencies for quality control sample collection are summarized in Table 2-2.

A duplicate is an identical sample collected from the same location (i.e. well) at the same time under identical conditions. Duplicate samples are analyzed along with the original sample to obtain sample procedure precision and inherent sample source variability. Duplicate samples will be collected from 10% of all soil boring samples, and one per monitoring well sample set.

A field blank consists of the source water used in decontamination and pressure washing. The sample container is filled with the source water in the field and is prepared, preserved and stored in the same manner as the other field samples. The field blanks are analyzed along with the field

TABLE 2-2
Quality Control Sample Collection Frequencies

Quality Control Sample	Frequency of Collection
Trip Blank (volatiles only)	One per sample shipping cooler
Rinseate Blank	One per week (for duration of field investigation)
Field Blank	One per groundwater sampling event
Duplicates	One per 10 water samples

samples for the constituents of interest to check for contamination imparted to the samples by the sample containers or other exogenous sources. One field blank per sampling event will be prepared.

Rinseate (or equipment) blanks are collected by retaining rinseate from sampling equipment. The equipment is rinsed with deionized water after full decontamination procedures have been performed. Rinseate samples are collected in the same type of sample containers as the field samples. Rinseate samples will be collected daily. Initially, samples from every other day will be submitted for analysis. If analytes pertinent to the project are detected, the remaining rinsate sample must be submitted for analysis. The results of the rinsate blanks will be used to flag or assess the levels of the analytes in the samples. This comparison is made during data validation. The rinseate blanks are analyzed along with the field samples for the constituents of interest.

A trip blank is a sample container prepared by the laboratory and filled with organic-free water that is transported unopened with the sample bottles. It is opened in the laboratory and analyzed along with the field samples for water matrix volatile organic analysis - analytes only. Trip blanks will be submitted to the laboratory in all sample shipping containers holding field

samples for volatile analyses at a frequency of one (1) per sample shipping cooler.

2.6 Sample Documentation and Chain-of-Custody

EnSafe/Allen & Hoshall personnel will use bound logbooks for the maintenance of all field records pertaining to the groundwater monitoring program. These records will document all visual observations, calculations, equipment calibrations, water levels, and sample identification, time and date. Every entry will be dated and the time for each entry noted.

Each sample will be identified by a sample label and standard sample tag as indicated in Figures 2.4 and 2.5. Each sample bottle will be sealed with a tamper resistant security seal. Samples will be sealed in the shipping containers and sent to the laboratory via over-night courier.

EnSafe/Allen & Hoshall will follow strict chain-of-custody procedures in accordance with NEESA 20.2-047B. Figure 2.6 is an example of the chain-of-custody form. The sample identification number, date and time of collection and requested analysis will be entered on the chain-of-custody form.

Upon transfer of custody, the chain-of-custody form will be signed by the EnSafe/Allen & Hoshall field sampling team leader, including the date and time the samples were relinquished. The chain-of-custody records will be sealed within each shipping container. All chain-of-custody forms received by the laboratory must be signed and dated by the laboratory sample custodian and returned to EnSafe/Allen & Hoshall following receipt, or as part of the data reporting package.

2.7 Analytical Procedures

All groundwater, sediment, surface water and soil sample analyses will be performed in accordance with NEESA 20.2-047B. The NCR has established that all samples be analyzed under NEESA Level C Quality Assurance utilizing EPA Contract Laboratory Procedures for Total Compound Lists/Total Analyte Lists (TCL/TAL) methodologies. Field measurements will be collected including; pH, temperature, and specific conductance. These parameters will be measured in the field during the well purging process. One set of readings will be completed after each casing volume is evacuated. These procedures are summarized in Table 2-3.

2.7.1 Field Analytical Procedures

The pH (EPA 150.1), temperature (EPA 170.1), and specific conductance (EPA 120.1) will be measured during the well purging process. These field measurements will be completed by filling the instrument sample chamber with water from the particular well

SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE
SAMPLE IDENTIFICATION	
PROJECT NUMBER	

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

FIGURE 2.4
SAMPLE BOTTLE LABEL

DATE: 04/29/91 | DWG NAME: CLENSMPL

PROJECT CODE	SAMPLE NO.	MONTH/DAY/YEAR	TIME	COMP	GRAB	WELL

TAG NO.	SAMPLE LOCATION	SAMPLERS (SIGNATURES)
LAB SAMPLE NO.	REMARKS:	ANALYSES

PRESERVATIVE:
YES ☐ NO ☐
TYPE:_____

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

FIGURE 2.5
SAMPLE TAG

DATE: 04/29/91 | DWG NAME: CLENTAG

FIGURE 2.6
CHAIN OF CUSTODY RECORD

LABORATORY: _____

ATTENTION: _____

PROJECT NO.: _____

PAGE___ of____

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

CLIENT NAME

COLLECTED BY

SAMPLE ID	DATE	TIME	comp	grab	well	SAMPLE LOCATION	#of containers	MEDIA (X)				SAMPLE ANALYSIS (X)									REMARKS
								SOIL	WATER	SEDIMENT	GROUNDWATER										

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:

RELINQUISHED BY:	DATE	TIME	RECEIVED AT LAB BY:	DATE	TIME	REMARKS

CLENCUS1

being purged. After a minimum period of one (1) minute the instrument should stabilize and the pH, Temperature, Specific Conductance, time, and date will be entered in the field log book.

TABLE 2-3
Analytical Measurements

Field Measurements	
Parameter	Method
pH	EPA 150.1[1]
Temperature	EPA 170.1[1]
Conductivity	EPA 120.1[1]
Static Water Level	Corporate SOP[2]
Photoionization Detector	Corporate SOP[2]

[1] Methods for Chemical Analysis of Water and Waste, EPA-600/4/79-020, Revised March, 1983.
[2] EnSafe/Allen & Hoshall SOP or Manufacturer's SOP for instrument operation.
[3] SW-846.

3.0 PROJECT MANAGEMENT PLAN

The following is a Project Management Plan for Phase I of the Site Inspection to be completed at the NOS Indian Head, Maryland by EnSafe/Allen & Hoshall. The Project management structure for EnSafe/Allen & Hoshall is discussed, the points of contact are listed, the requirements to be fulfilled by NEESA and the project schedule are discussed.

3.1 EnSafe/Allen & Hoshall

Project Management structure for contract N62467-89-D-0318, Cost Plus Award includes the Task Order Manager, Project-Geologist, Project-Health and Safety Officer and Site Health and Safety Officer. Complete Resumés are presented in Appendix A of this plan. The responsibilities of each are as follows:

Task Order Manager

Paul V. Stoddard, Manager of Geological Services

Responsibilities

The Task Order Manager is responsible for the proper maintenance of project budgets, schedules and deliverables, and is designated as the EnSafe/Allen & Hoshall point of contact.

Project-Geologist

Joseph R. Matthews, Professional Geologist

Responsibilities

The Project-Geologist will direct all field operations and is responsible for proper sample collection, identification,

preservation and documentation, and documentation of all field activities as outlined in this Work Plan. The Project-Geologist will prepare all draft and final reports.

Project-Health and Safety Officer(s)

Richard C. Barlow, Chemical Engineer
John Borowski, Certified Industrial Hygienist

Responsibilities

The Project-Health and Safety Officer has the primary responsibility for:

Assuring that all personnel are aware of:

Names of personnel and alternates responsible for site safety and health;

Safety, health and other hazards present on the site;

Use of personal protection equipment;

Work practices by which the employee can minimize risks from hazards;

Safe use of engineering controls and equipment on the site;

Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards; and

Site control measures, decontamination procedures, site standard operating procedures and the contingency plan and responses to emergencies including the necessary PPE.

Assuring that all employees have received a minimum of 40 hours of health and safety instruction, off the site, and actual field experience under the direct supervision of a trained experienced supervisor. Workers who may be exposed to unique or special hazards shall be provided additional training.

Monitoring the performance of personnel to ensure that mandatory health and safety procedures are being performed and correcting any performances that do not comply with the Health and Safety Plan. (Copies of health and safety training certificates must be available for review by the Project-Site Safety Officer.)

Ensuring that all field personnel employed on the site are covered by a medical surveillance program as required by 29 CFR 1910.120(f)

Consulting with the Project-Site Health and Safety Officer and/or other personnel.

Preparation and submittal of any and all project reports - includes progress, accident, incident, contractual, etc.

Project-Site Health and Safety Officer

Joseph R. Matthews

Responsibilities

The Project-Site Health and Safety Officer has the primary responsibility of: assuring that a copy of the Health and Safety Plan is maintained on site during all field activities; advising field personnel on all health and safety related matters involved at the site; directing and ensuring that the safety program is being correctly followed in the field, including the proper use of personal protective and site monitoring equipment; ensuring that the field personnel observe the appropriate work zones and decontamination procedures; reporting any safety violations to the Senior-Health and Safety Officer; and, conducting safety briefings during field activities.

3.2 Navy Energy and Environmental Support Activity

Overall responsibility for projects conducted in accordance with NEESA guidelines will be vested in NEESA (or its approved representatives). Therefore, project coordination responsibilities lie with CHESDIV, Naval Facilities Engineering Command (NAVFAC), Engineering Field Division (EFD). The following describes the components of the project chain-of-command as established in NEESA 20.2-047B.

3.2.1 Oversight

NEESA is responsible for ensuring that the quality of laboratory analyses performed during the various phases of the IR Program is acceptable. NEESA is also responsible for managing the NCR.

3.2.2 Engineering Field Division

The Engineer in Charge (EIC) at the EFD provides the site information and history, provides logistical assistance, specifies the sites requiring investigation and reviews results

and recommendations. Mr. Paul Berkman, CHESDIV, Naval Facilities Engineering Command, Washington, D.C. serves as the EIC for this project.

3.2.3 Engineer in Charge

The EIC is responsible for coordinating procurement, finance, and reporting; for ensuring that all documents are reviewed by the NCR; for communicating comments from the NCR and other technical reviewers to the subcontractors; and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

3.2.4 NEESA Contract Representative

The NCR is responsible for ensuring that each project has appropriate overall QA. The NCR reviews laboratory QA plans, work plans, submits performance sample data, provides field and laboratory audits, and reviews data from the site. The questions from subcontractors and the EIC regarding specific field and laboratory QC practices are directed to the NCR. The NCR also provides evaluation of referee samples. The NCR for this project is Martin Marietta Energy Systems, Inc.

3.2.5 Activity Oversight

Shawn Jorgensen, Environmental Engineer, will serve in an oversight capacity for this investigation.

3.3 Investigation Performance

3.3.1 Engineering Subcontractor

EnSafe/Allen & Hoshall will serve as the Engineering Subcontractor for this project. The subcontractor is responsible for designing and implementing the SI as outlined in this Work Plan.

3.3.2 Analytical Laboratory

The analytical laboratory employed by EnSafe/Allen & Hoshall for this project is PACE, Inc. Novato, CA. They will adhere to the laboratory requirements in NEESA 20.2-047B (or other QA and method requirements as specified). The laboratory is required to prepare and submit a laboratory QA plan, to analyze and submit the results of proficiency testing, submit to an on-site inspection, and to correct any deficiencies cited during the inspection by the NCR. The laboratories are required to identify a Laboratory QA Coordinator (LQAC) responsible for overall QA. The LQAC must not be responsible for schedule, costs, or personnel other than QA assistants. It is preferred that the

LQAC report to the laboratory director. The LQAC must have the authority to stop work on projects if QC problems arise which affect the quality of the data produced.

In addition to conforming to all NEESA regulations, all work shall be performed in a manner consistent with: the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended; the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 Code of Federal Regulations (CFR), Part 300, as amended; and other appropriate federal, state, and local guidelines, rules, regulations, and criteria (where applicable).

3.4 Points of Contact

The following list will be contact points for the various agencies and contractors involved in this project.

3.4.1 Chesapeake Bay Division

Engineer-in-Charge

Commanding Officer, Chesapeake Division
Naval Facilities Engineering Command
Washington Navy Yard, Bldg. 212
Washington, D.C. 20374-2121

POC: Mr. Paul Berkman
(202) 433-3760

3.4.2 Site Contact

Code: 0965C
Building D-28
Naval Ordinance Station
Indian Head, Maryland 20640-5000

POC: Mr. Shawn Jorgensen
(301) 743-6745

3.4.3 EnSafe/Allen & Hoshall Contact

Task Order Manager

EnSafe/Allen & Hoshall
5724 Summer Trees Road
Memphis, TN. 38134

POC: Mr. Paul V. Stoddard
(901) 372-7962

3.5 Deliverables

The following are project deliverables to be submitted to the EIC and the activity point of contact as indicated in Section 3.4.

3.5.1 Draft & Final Phase I Site Inspection Report

A Phase I SI Report (SIR) shall be prepared after the completion of all field work, review of analytical and data validation. This report may also include, but is not limited to:

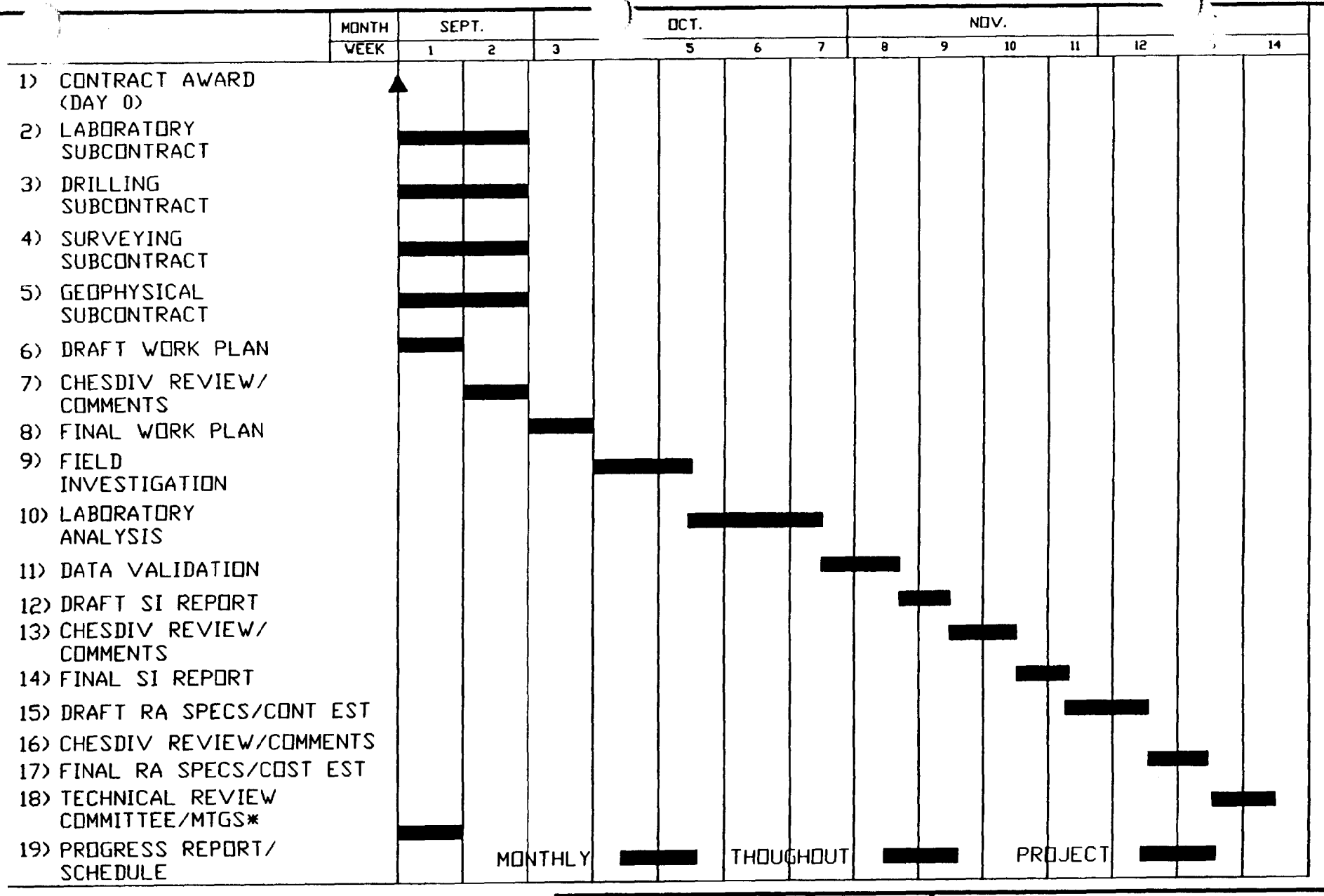
- Presentation and interpretation of analytical, geophysical, hydrologic and geologic data collected during the field operations.
- Groundwater gradient maps as well as tables of the groundwater level measurements and field analytical data.

3.5.2 Draft & Final Reports for Specifications of Proposed Action/Cost Estimates

This report will detail the specification for any and all feasible and cost-effective proposed action if the presence of contamination is confirmed. Cost estimates will be included for all viable options.

3.6 Project Schedule

This Project Schedule is prepared with the assumption analytical data will be received within 14 days of receipt by the laboratory, data validation will be completed within 21 days of the termination of field operations and draft report review will be completed within 7 days of submittal to the EIC. A time-line is presented on the following page that outlines key events in the project scope.



* TRC MEETINGS WILL BE AS SCHEDULED

NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

ACTIVITY SCHEDULE

DATE: 09/18/91

DWG NAME: 9CLNCHS5

APPENDIX A
ENSAFE PERSONNEL RESUMES

PAUL V. STODDARD, P.G.
MANAGER, GEOLOGICAL SERVICES

EDUCATION: M.S., Geology, Memphis State University/1983
B.S., Geology, Memphis State University/1982
B.S., Biology, Memphis State University/1980

CERTIFICATION: Professional Geologist, TN, AR
Pending Certification, IN

EXPERIENCE:

- Generated stratigraphic correlations of upper Cretaceous and Tertiary trends of South Texas with concentration in the Wilcox and Frio formations. Responsible for regional correlations of E-logs, preparation of stratigraphic cross sections, development and updating of structure maps, and well spotting and digitizing.

- Conducted remedial site investigations at facilities for sites with potential soil and/or groundwater contamination involving chlorinated hydrocarbons and petroleum products. Field assessments included in-situ monitoring of organic vapors utilizing an organic vapor detector and/or a scanning infrared spectrophotometer.

- Responsible for the design and implementation of "preconveyance" investigations to determine potential soil contamination at various sites being considered for commercial development.

- Field supervision and implementation of closure plans for hazardous waste facilities at Charleston, SC Naval Shipyard. Tasks included removal of hazardous waste inventories, decontamination of tanks, confirmation sampling of decontamination solutions and soil sampling at container storage compounds operated by the Shipyard and Defense Reutilization and Marketing Office.

- Sampled groundwater monitoring wells for hazardous substance contamination and supervised well drillers at Shelby County, TN state Superfund site.

- Conducted a study of pesticide contamination in groundwater at an industrial facility in Missouri. Field Investigation included soil boring, monitoring well installation, determination of hydraulic gradients, data reduction and analyses, and report generation.

- Implemented groundwater investigation for photosensitive hazardous substance contamination at NPL site.

- Field supervision and implementation of closure plans for removal of underground waste oil storage tanks and investigation of potential contamination in soils and groundwater from tank releases.

- Field supervision and implementation of sampling plan for hazardous waste facilities at NAS Memphis. Task included Level B inspection of former waste plating treatment storm sewer, and the sampling of soils associated with defective joints. The task also included the sampling of a former salvage yard for petroleum hydrocarbons and lead.

- Field supervision and implementation of underground storage tank removal investigations. Field assessments include soil sampling and/or monitoring well installation with groundwater sampling and assessment of hydrogeologic conditions.

- Project geologist for interior survey of 120 acre underground room and pillar mine. Additional tasks included surface investigation of karst features, monitoring well installation, interpretation of borehole geophysics, and subsequent groundwater sampling and data reduction.

- Project geologist for hydrogeologic assessment of RCRA facilities. Tasks include site selection and installation of groundwater monitoring networks, slug tests, and subsequent data evaluation.

- Project geologist for MCAS Cherry Point, RFI. Tasks included design and implementation of Field Sampling Plan, including soil borings, monitoring well installation, groundwater sampling, slug tests, hydrogeologic characterization -- including diurnal and tidal influences on the shallow aquifer and subsequent data reduction and report generation.

- Project geologist for hydrogeologic assessment of a proposed TN state Superfund site. Investigation included step drawdown and constant rate aquifer pump test for design and installation of a groundwater treatment system.

- Project manager for CERCLA Remedial Investigation/Feasibility Study for a former pesticide manufacturing facility. Tasks included the design and implementation of geologic/hydrogeologic assessment for volatile organic and pesticide contamination, subsequent data reduction, and report generation. Project management included cost tracking, scheduling, and continued regulatory compliance (i.e. Administrative Order).

- Project manager for CERCLA RI/FS for an industrial manufacturing facility. Related tasks included the design and implementation of geologic/hydrogeologic assessments for chlorinated solvent contamination in soils and groundwater. Investigation included monitor well installations, soil vapor extraction, borehole and surface geophysics, and a constant rate aquifer pump test, with subsequent data reduction and interpretation and RI report generation. Project management duties included community relations, maintaining data quality objectives, scheduling, waste disposal, and meeting Administrative Order Requirements.

- Supervised and directed remedial investigations (RI) per CERCLA requirements at multiple NPL sites, Region 3, Region 4, Region 5 and Region 6. Investigations included, but were not limited to, soil analyses, monitor and recovery well installation, sampling and analyses of groundwater, aquifer tests, borehole geophysics, surface geophysics and data interpretation, including preparation and presentation of assessment reports.

JOSEPH R. MATTHEWS,
GEOLOGIST

EDUCATION: M.S., Geology, Memphis State University/1989
B.S., Geology, University of Tennessee at Chattanooga/1985

CERTIFICATION: Registered Professional Geologist TN1112

EXPERIENCE:

- **Project Coordinator** overseeing the remedial response action at a PCB spill site in Akron, Ohio. Activities included removal of PCB-contaminated soils, removal of oil-cooled capacitors containing PCB dielectric fluids and removal and decontamination of PCB contaminated concrete floors and walls.

- **Project Manager/Geologist** developed RCRA Facility Investigations and directed field operations at Naval facilities. Investigated shallow subsurface and shallow aquifer systems to define contaminant migratory pathways and evaluate health risks. Data used to determine the proper worker protection for the demolition of a pesticide-contaminated storage facility.

- **Project Manager** developed and implemented UST closures in compliance with local, state and federal (RCRA) laws and regulations. Conducted assessments of leaking UST sites and completed corrective actions for petroleum hydrocarbon contaminated soil and groundwater systems. Completed UST-related projects in Tennessee, Mississippi, Missouri, Alabama, Indiana, and Kentucky.

- **Field Coordinator** on hazardous materials abatement sites: monitoring health and safety compliance, consulting, and assuring regulatory (OSHA) compliance.

- **Geologist** conducted and designed state and private industry site investigations: assessing geohydrologic conditions, determined nature and extent of site contamination, dealt with organo-pesticides, chlorinated hydrocarbons, non-halogenated

hydrocarbons, chlorides, cyanides and polychlorinated biphenyls.

- **Geologist** supervised drilling operations, installed monitoring wells, monitored health and safety compliance, and collected soil and groundwater samples following CLP protocol for a Remedial Investigation at a NPL site.

- **Geologist** investigating a proposed hazardous waste incinerator site: characterized stratigraphy, geologic structure and geohydrologic conditions.

- **Assistant Geologist** for a long-term groundwater monitoring program at a Tennessee State Superfund site: quarterly sampling of over 40 wells under CLP protocol, collected and reduced groundwater and prepared piezometric maps and geologic cross-section delineating the distribution of a chlorinated hydrocarbon plume in a multiple aquifer system.

- **Investigator** conducting Phase I environmental site assessments and environmental compliance audits consistent with the "due diligence" clause of CERCLA. Reviewed facility operation for compliance with local, state and federal environmental laws and regulations. Identified potential environmental compliance problems and estimated cost for corrective action. Conducted audits in close cooperation with investors, legal counsel, and lending institutions and their attorneys. Designed and conducted Phase II audit investigations where subsurface and groundwater contamination was indicated.

- **Project Assistant** prepared revisions of a Part B permit for the treatment of a "K" listed waste at a Open Burning/Open Detonation facility.

RICHARD C. BARLOW,
CHEMICAL ENGINEER/INDUSTRIAL HYGIENIST

EDUCATION: M.S. Chemical Engineering, University of Maryland/1979
B.S. Engineering, U.S. Coast Guard Academy/1969

EXPERIENCE:

- Developed a health and safety plan, as prescribed by 29 CFR 1910.120, for an EPA National Priorities Listed underground storage area's emergency remedial action plan, remediation investigation, and feasibility study .

- Developed a health and safety plan, as prescribed by 29 CFR 1910.120, for an EPA National Priorities Listed pesticide facility's remediation investigation and feasibility study.

- Developed a health and safety plan, as prescribed by 29 CFR 1910.120, for an EPA National Priorities Listed landfill's remediation investigation and feasibility study.

- Developed numerous additional health and safety plans for underground tank removals, pesticide facility investigations, landfill studies, and plating shop remedial actions for both private industry and the U.S. Navy.

- Developed a respiratory protection program for a small company that meets the requirements of 29 CFR 1910.134.

- Experienced in developing personal protection programs for all phases of hazardous waste cleanup activities.

- Developed Oil and Hazardous Substance Spill Contingency plans for the Navy.

- Experienced in confined space entry techniques. Has received training as a "Competent Person" for gathering and evaluating data for confined space entry.

- Trained personnel in confined space entry techniques and exposure hazard recognition.

- Administered an inspection program which involved evaluation of exposure personnel to atmospheres that were toxic, oxygen deficient and/or flammable.

JOHN H. BOROWSKI, C.I.H.
INDUSTRIAL HYGIENIST

EDUCATION:

B.S. Biochemistry, Northern Michigan University/1984

CERTIFICATIONS:

Certified Industrial Hygienist, American Board of Industrial Hygiene, Certification # 5098.
EPA/California Certified Asbestos Building Inspector/Management Planner,1991
EPA/California Certified Asbestos Practices and Procedures, 1991

EXPERIENCE:

- Assisted in the development of health and safety plans prescribed in 29 CFR 1910.120 for both the Navy and private industry cleanup projects.

- Developed procedures for the sampling, handling, and disposal of PCB contaminated dielectric fluid from non-operating capacitors and transformers for military and private concerns.

- Developed and enforced respiratory protection programs for clients and contractors performing asbestos and lead remediation to ensure compliance with the requirements of 29 CFR 1910.134.

- Assisted in development of personal protection programs for all phases of hazardous waste cleanup activities.

- Performed perimeter high volume air monitoring for VOC, PM10, Metals, and PBB emissions generated by installation of a slurry wall and capping of a hazardous waste landfill.

- Performed personal and area industrial hygiene sampling to determine worker exposure to toxins including; asbestos, lead, metal dusts, CO, CO_2, PBB, PCB, formaldehyde, bioaerosols, and various organic and inorganic acids.

- Performed source sampling of power plant and paint spray booth air emissions.

QUALITY ASSURANCE PLAN

FOR

SITE INSPECTION

PHASE I
OLSON ROAD LANDFILL

NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

SECTION II-QUALITY ASSURANCE PLAN

1.0 INTRODUCTION

This document presents the Quality Assurance/Quality Control measures for Phase I of the Site Inspection (SI) to be completed at the Olson Road Landfill (Site 42). This SI will be conducted by EnSafe/Allen & Hoshall at the Naval Ordnance Station, Indian Head, Maryland. Measures outlined in this plan include policies, project organization and objectives, functional activities, and quality assurance and quality control measures intended to achieve data quality goals. The SI is being conducted as part of the SOUTHDIV CLEAN Contract (N62477-91-D-0043) for the Chesapeake Division. Site 42 is the proposed building site for the P-059 MILCON project.

This document is intended to fulfill requirements for ensuring that all work is conducted in accordance with quality assurance/quality control protocols and field procedural protocols for environmental monitoring and data measurement as established in:

- "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program, NEESA 20.2-047B," Naval Energy and Environmental Support Activity, Port Hueneme, Calif., June 1988 (NEESA 20.2-047B)
- "Ground-Water Monitoring Guide, NEESA 20.2-031A", Naval Energy and Environmental Support Activity, Port Hueneme, Calif., February 1985 (NEESA 20.2-031A)

Where specific NEESA guidelines do not exist, applicable EPA and/or Maryland Department of the Environment (MDE) methods will be applied. These regulations are referenced in specific sections of this document (where applicable).

2.0 PROJECT DESCRIPTION

During the investigation, 16 soil borings will be installed. Three of the soil borings are to be completed as groundwater monitoring wells with associated well purging, development and sampling as required. Descriptions of boring/well installations and associated field work are provided in the Sampling and Analysis Plan (SAP).

The assessment will provide data needed to assess the extent of contamination, if present, at this site, and to determine if follow-up action (i.e. Remedial Investigation\Feasibility Study) is required to maintain compliance with environmental regulations.

The investigation will focus on determining if hazardous or regulated materials are or were landfilled at the site as the site was apparently used for disposal of a variety of solid waste including branches, pallets, and scattered cans and drums. There are no records to confirm or deny whether the landfill recieved hazardous waste or regulated materials. There have been no previous environmental assessments completed at this site; however, results of the Preliminary Assessments have indicated the need for additional study.

3.0 PROJECT QUALITY ASSURANCE OBJECTIVES

In general, the quality assurance goals of EnSafe/Allen & Hoshall projects are to assess and document all sampling and analysis according to the following criteria: (1) accuracy, (2) precision, (3) completeness, (4) representiveness and (5) comparability. Quality criteria are set herein to assure suitability for intended use of data obtained during projects, and to meet goals established by NEESA. The NEESA Contract Representative (NCR) has stipulated that Level C QC criteria are to be applied to all laboratory analyses required for this investigation as outlined in NEESA 20.2-047B.

The following section discusses project specific level of effort for Quality Assurance (QA), and data quality criteria.

3.1 Field Measurements

QA objectives for parameters to be measured in the field by EnSafe/Allen & Hoshall personnel are presented in Table 3-1. Field measurements will include pH, temperature, specific conductance,

static groundwater level, and headspace analysis on split-soil samples, boring cuttings, and well heads.

3.2 Sampling and Analysis for Contamination Level

Project QA objectives of analytical parameters for soil and groundwater will be as stipulated in EPA Contract Laboratory Program (CLP) Target Compound\Target Analyte List(TCL\TAL), and as determined by the analytical laboratories historical data quality evaluation for these methods. The NEESA laboratory approval process will ensure that laboratory method QA/QC standards are appropriate to meet goals for intended data uses. Anticipated QA goals for these methods are presented in Tables 3-2 and 3-3.

3.3 Precision and Accuracy

Methods of assessing precision and accuracy of investigations are discussed in Section 13.2 of this document.

TABLE 3-1
Field Measurements

Measurements Parameter	Reference	Matrix	Precision (%)	Accuracy % Recovery	Completeness
pH	EPA 150.1[1]	Water	± 0.05 pH	± 0.2 pH	100
Temperature	EPA 170.1[1]	Water	± 0.1° C	± 0.2° C	100
Static Water Level	SOP[2]	Water	± 0.01 in.	± 0.005 in.	100
Photoionization Detector	SOP[3]	Air	± 10 ppm	± 20 ppm	100
Well Survey Points	SOP[4]	Spatial	± 5%	± 0.1 feet	100
	SOP[4]	Vertical	± 0.05 feet	± 0.01 feet	100

[1] - Methods for Chemical Analysis of Water and Wastes, EPA-600/4/79-020, Revised March 1983.
[2] - Manufacturer's SOP for static water level measurement.
[3] - Manufacturer's SOP for operation of Photovac TIP II or HNu.
[4] - Standard Land Surveying Methods as employed by Registered Land Surveyors.

3.4 Representativeness

The goal of this investigation is to determine if soil and groundwater contamination is present. By properly collecting soil and groundwater monitoring well samples, and measuring well parameters according to NEESA (and others by reference) protocol and EPA SOP/QAM. Samples collected during investigations will be representative of areas of concern.

3.5 Completeness

Completeness goals for field measurements reflect the ability to re-sample all existing and planned wells, as well as subsequent sample collection for groundwater quality criteria defined in the QA Plan (QAP).

3.6 Comparability

Comparability is assured through established sampling and analysis methods (as specified in NEESA 20.2-031A and NEESA 20.2-047B), as well as other accepted methods or EPA SOP/QAM as approved. These methods are discussed in the project SAP.

TABLE 3-2 CLP TCL QUALITY OBJECTIVES
Matrix Spikes/Matrix Spike Duplicates/Surrogate Spikes

Fraction	Compound	Soil Precision (%RPD)	Soil Accuracy (%Recovery)	Water Precision (%RPD)	Water Accuracy (%Recovery)
VOA	Matrix Spikes				
	1,1-Dichloroethene	22	59-172	14	61-145
	Trichloroethene	24	62-137	14	71-120
	Chlorobenzene	21	60-133	13	75-130
	Toluene	21	59-139	13	76-125
	Benzene	21	66-142	11	76-127
VOA	Surrogate Spikes				
	Toluene-d_8	---	50-160	---	86-119
	4-Bromofluorobenzene	---	50-160	---	85-121
	1,2-Dichloroethane-d_4	---	50-160	---	77-120
BNA	Matrix Spikes				
BN	1,2,4-Trichlorobenzene	23	38-107	28	39-98
	Acenaphthene	19	31-137	31	46-118
	2,4-Dinitrotoluene	47	28-89	38	24-96
	Di-n-butyl Phthalate	47	29-135	40	11-117
	Pyrene	36	35-142	31	26-127
	N-Nitroso-Di-n-Propylamine	36	41-126	38	41-116
	1,4-Dichlorobenzene	27	26-104	26	36-97
A	Pentachlorophenol	47	17-109	50	9-103
	Phenol	35	26-90	42	12-89
	2-Chlorophenol	50	25-102	40	27-123

TABLE 3-2 CLP TCL QUALITY OBJECTIVES (Continued)
Matrix Spikes/Matrix Spike Duplicates/Surrogate Spikes

Fraction	Compound	Soil Precision (%RPD)	Soil Accuracy (%Recovery)	Water Precision (%RPD)	Water Accuracy (%Recovery)
	4-Chloro-3-Methylphenol	33	26-103	42	23-97
	4-Nitrophenol	50	11-114	50	10-80
BNA	Surrogate Spikes				
	Nitrobenzene-d_5	---	20-140	---	41-120
	2-Fluorobiphenyl	---	20-140	---	44-119
	p-Terphenyl-d_{14}	---	20-140	---	33-128
	Phenol-d_5	---	20-140	---	15-103
	2-Fluorophenol	---	20-140	---	23-121
	2,4,6-Tribromophenol	---	10-140	---	10-130
Pesticides	Matrix Spikes				
	Lindane	50	46-127	15	56-123
	Heptachlor	31	35-130	20	40-131
	Aldrin	43	34-132	22	40-120
	Dieldrin	38	31-134	18	52-126
	Endrin	45	42-139	21	56-121
	4,4'-DDT	50	23-134	27	38-127
Pesticides	Surrogate Spikes				
	Dibutylchlorendate	---	48-136*	---	20-150*

VOA= Volatile Organics BN= Base/Neutral Extractable A= Acid Extractable *-Advisory Limits

NOTE:QA/QC Requirements excerpted from 2/88 CLP SOW.

TABLE 3-3 CLP TAL QA OBJECTIVES
Matrix Spikes/Duplicate Analyses

Compound (Metal)	Medium/High Sample Precision[A] (%RPD)	Low Sample Precision[B] (%RPD)	Accuracy (% Spike Recovery)
Aluminum	± 20	± CRDL[C]	75-125
Antimony	± 20	± CRDL	75-125
Arsenic	± 20	± CRDL	75-125
Barium	± 20	± CRDL	75-125
Beryllium	± 20	± CRDL	75-125
Cadmium	± 20	± CRDL	75-125
Calcium	± 20	± CRDL	75-125
Chromium	± 20	± CRDL	75-125
Cobalt	± 20	± CRDL	75-125
Copper	± 20	± CRDL	75-125
Iron	± 20	± CRDL	75-125
Lead	± 20	± CRDL	75-125
Magnesium	± 20	± CRDL	75-125
Manganese	± 20	± CRDL	75-125
Mercury	± 20	± CRDL	75-125
Nickel	± 20	± CRDL	75-125
Potassium	± 20	± CRDL	75-125
Selenium	± 20	± CRDL	75-125
Silver	± 20	± CRDL	75-125
Sodium	± 20	± CRDL	75-125
Thallium	± 20	± CRDL	75-125
Tin	± 20	± CRDL	75-125
Vanadium	± 20	± CRDL	75-125
Zinc	± 20	± CRDL	75-125
Cyanide	± 20	± CRDL	75-125

[A]- Medium/High Samples = compound or metal present at 5 times (or more) the Contract Required Detection Limit (CRDL)[C]
[B]- Low Samples = compound or metal present at less than 5 times the CRDL
NOTE: QA/QC Requirements excerpted from 2/88 CLP SOW

4.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Overall responsibility for projects conducted in accordance with NEESA regulations will be vested in NEESA (or its approved representatives). Therefore, project coordination responsibilities lie with the NEESA, Engineering Field Division (EFD). The following section describes the components of the project chain-of-command as established in NEESA 20.2-047B.

4.1 Oversight

4.1.1 Navy Energy and Environmental Support Activity

NEESA is responsible for ensuring that the quality of laboratory analysis performed during the various phases of CLEAN is acceptable. NEESA is also responsible for managing the NEESA Contract Representative (NCR).

4.1.2 Engineering Field Division

The Engineer-in-Charge (EIC) at the EFD provides the site information and history, logistical assistance, specifies the sites requiring investigation, and reviews results and recommendations. Mr. Paul Berkman, CHESDIV, Naval Facilities Engineering Command, Washington, D.C., serves as the EIC for this project.

4.1.3 Engineer in Charge

The EIC is responsible for coordinating procurement, finance, and reporting; for ensuring that all documents are reviewed by the NCR; for communicating comments from the NCR and other technical reviewers to the subcontractors and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

4.1.4 NEESA Contract Representative

The NCR is responsible for ensuring that each project has appropriate overall QA. The NCR reviews laboratory QA plans and work plans, submits performance sample data, provides field and laboratory audits, and reviews data from the site. The questions from subcontractors and the EIC regarding specific field and laboratory QC practices are directed to the NCR. The NCR also evaluates referee samples. The NCR for this project is Martin Marietta Energy Systems, Inc.

4.1.5 State or Local Oversight

In accordance with verbal agreement, the Task Order Manager will coordinate all field activities with the EIC, Paul Berkman. All correspondence will carbon copy the activity file. Currently, no

correspondence with MDE is anticipated. However, all well installations and field sampling protocol will be in accordance with Maryland Well Construction Regulations, COMAR 26.04.04.

4.2 Investigation Performance

4.2.1 Engineering Subcontractor

EnSafe/Allen & Hoshall will serve as the Engineering Subcontractor for this project. As the engineering subcontractor, EnSafe/Allen & Hoshall will design and implement the field investigation activities.

4.2.2 Analytical Laboratory

The analytical laboratory will be employed by EnSafe/Allen & Hoshall and must adhere to the laboratory requirements in NEESA 20.2-047B (or other QA and method requirements as specified). The laboratory is required to: (1) prepare and submit a laboratory QA plan, (2) analyze and submit the results of proficiency testing, (3) submit to an on-site inspection, and (4) correct any deficiencies cited during the inspection by the NCR. The laboratories are required to identify a Laboratory QA Coordinator (LQAC) responsible for overall QA. The LQAC must not be responsible for schedule, costs, or personnel other than QA assistants. It is preferred that the LQAC report to the laboratory director. The LQAC must have the authority to stop work on projects if QC problems arise which affect the quality of the data produced.

In addition to conforming to all NEESA regulations, all work shall be performed in a manner consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended; the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 Code of Federal Regulations (CFR), Part 300, as amended; and other appropriate federal, state, and local guidelines, rules, regulations, and criteria (where applicable).

5.0 SOIL BORINGS AND SAMPLING

5.1 Soil Sampling Procedures

All soil samples will be collected in accordance with NEESA 20.2-031A, Chapter 4- Monitor Well Drilling. The specific sampling method is discussed in Section 4.2.3.3- Split Spoon Samples.

Soil borings will be installed using 4.25-inch internal diameter (I.D.) hollow stem auger flights. Borings will be advanced to a maximum depth of 25 feet. If groundwater is encountered, in-situ groundwater samples may be collected from select locations for

analysis. Soil samples will be collected using a 24-inch split spoon sampler, inserted through the annulus of the augers at five foot intervals to the depth of 25 feet. The last soil sample to be collected for analysis will be at the top of the saturated zone or at a depth of 25 feet, whichever comes first. Soil boring logs will be prepared for each boring advanced onsite (see Figure 6-1).

Split spoon samples will be collected at five foot intervals throughout the profile. The split spoon sampler will be a standard 2-inch outside diameter split-spoon sampling tool. The sampler will be driven into the soil through the use of a 140-pound hammer dropped through a 30-inch fall according to NEESA 20.2-031A, Chapter 4- Monitor Well Drilling specifications.

Each soil sample (from each interval) will be split into two (2) samples. The first sub-sample will be placed in the appropriate containers for subsequent laboratory analysis for full TCL\TAL constituents. The second sub-sample will be placed in a clean jar with sufficient headspace to allow for contaminant volatilization. After allowing a sufficient time for volatilization of headspace samples, readings will be made with a Photoionization Detector (PID). Sample selection criteria is outlined specifically in the SAP. The selected samples will then be preserved in a cool ice chest and shipped under strict chain-of-custody via overnight courier to the laboratory of PACE, Inc., Novata, CA. for analysis, (as discussed below). The sampling process is discussed in further detail in the project SAP, as outlined in EPA guidance documents.

5.2 Soil Sample Analyses

All soil sample analyses will be performed according to with NEESA 20.2-047B, Chapter 7- Analytical Methods. The NCR has established that all soil samples will be analyzed by EPA CLP TCL\TAL methods.

5.3 Soil Sample Documentation

All soil samples will be documented in accordance with NEESA 202.-031A, Chapter 6- Monitoring Well Data Record Requirements, and Section 8.0., Sample Identification, Containers, and Labelling. EnSafe/Allen & Hoshall personnel will use bound logbooks to maintain all field records pertaining to the investigation. These records will document visual observations, calculations, and equipment calibrations. Every entry will be dated and the time for each entry noted. The logbooks are accountable documents that will be properly maintained and retained as part of the project files. In addition, soil boring logs will be produced for all soil borings advance onsite. Information to be included on boring logs includes (but is not limited to): (1) total depth of boring, (2) lithologic

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
	DRILLING METHOD:		BORING NO.
			SHEET
	SAMPLING METHOD:		OF
			DRILLING
			START / FINISH
	WATER LEVEL		TIME / TIME
	TIME		
	DATE		DATE / DATE
	CASING DEPTH		

DATUM ELEVATION

DRILLING CONTR _____

BY _____ CHK BY _____

DATE _____

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
(MODIFIED FROM: PRELIMINARY ASSESSMENT REPORT)

FIGURE 6.1
BORING LOG

DATE:10/24/91 | DWG NAME: BORINLOG

descriptions of each geologic formation encountered, (3) blow counts for split spoon sampler penetration, (4) water bearing zones, and (5) any subsurface obstructions encountered during boring advancement (with explanations if available).

5.4 Soil Sampling Equipment Decontamination

All equipment used in collection of soil sampling (i.e. split spoon samplers, sampling rods, augers, etc.) will be cleaned with a high pressure, hot water wash prior to initiation of on-site activities. Decontamination of all augers and downhole equipment (i.e. auger, sampling rods, etc.) will be performed between each boring by high pressure hot water wash and potable water rinse. Split spoon samplers will be decontaminated between samples using a detergent wash, and a final potable water rinse. This procedure will be followed to minimize the potential for cross-contamination of soil samples. Disposable gloves will be worn during all sampling phases which require handling of samples. A new pair of latex gloves will be donned prior to handling each sample.

6.0 MONITORING WELL INSTALLATION

Figure 6-2 shows the proposed locations for three monitoring wells. Each of the three wells will be logged by a field geologist during soil sampling. As previously outlined, wells will be installed pursuant to Maryland Well Construction Regulations, COMAR 26.04.04.

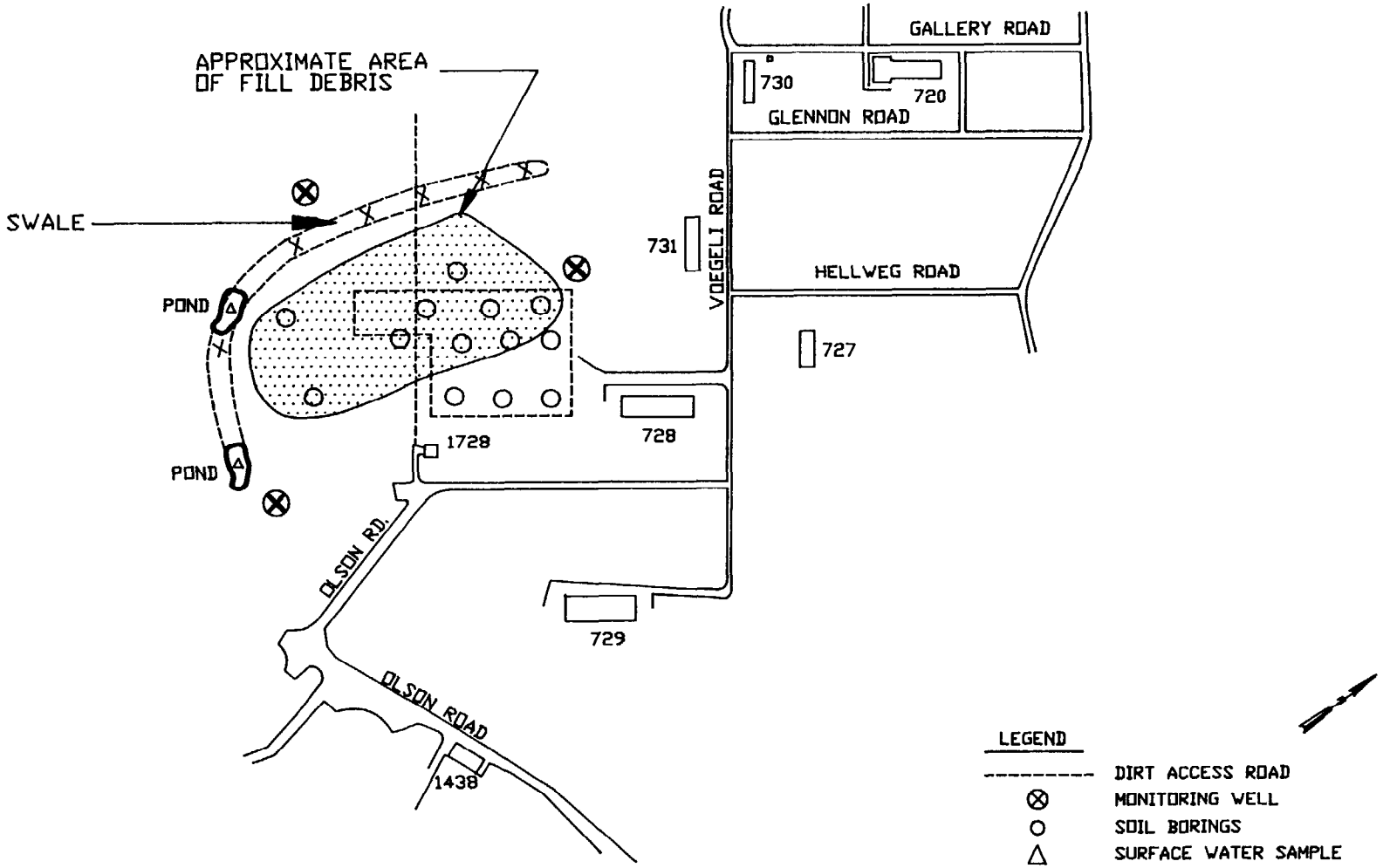
7.0 GROUNDWATER SAMPLING

7.1 Static Water Level Measurement

Static water level measurements will be performed on all monitoring wells, according to NEESA 20.2-031A, Chapter 6.1.5.6 as discussed in the SAP, and EPA SOP/QAM. Static water level measurements will be used to determine groundwater flow direction, and to construct a potentiometric surface diagram of the area of investigation for inclusion in the CAR.

7.2 Groundwater Sampling Procedures

Groundwater samples collected from monitoring wells will be collected according to NEESA 20.2-031A, Chapter 7- Ground-Water Sampling. Groundwater samples will be collected using a Teflon-coated single-check valve bailer and nylon-coated bailing rope. The bailer will be slowly lowered into the water column to minimize water column disturbance and possible loss of volatile parameters. The bailer will be manually retrieved and the samples will be immediately transferred to appropriate sample containers. The sampling process is discussed in further detail in the project SAP, and outlined in EPA SOP/QAM.



NOT TO SCALE

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
(MODIFIED FROM PRELIMINARY
ASSESSMENT REPORT)

PROPOSED SAMPLING PLAN
OLSON ROAD LANDFILL
FIGURE 6-2

DATE: 10/29/91

DWG NAME: MOOLSRLF

If groundwater is encountered during soil boring activities, an in-situ sample may be collected from selected locations. Grab (in-situ) groundwater samples will be collected randomly at locations where flow is sufficient from acquiring the full sample quantity or where directed by the Project Geologist.

7.3 Groundwater Sample Analyses

All groundwater sample analyses will be performed according to NEESA 20.2-047B, Chapter 7- Analytical Methods. The EIC has established that all groundwater samples will be analyzed under NEESA Level C using EPA CLP TCL\TAL methods. In addition, pH and temperature for each sample collected will be measured in the field.

7.4 Groundwater Sample Documentation

All groundwater samples will be documented according to NEESA 20.2-047B, Chapter 3- Site-Specific QC Requirements, and NEESA 20.2-031A, Chapter 6- Monitoring Well Data Record Requirements, and as discussed in Section 6.0. EnSafe/Allen & Hoshall personnel will use bound logbooks to maintain all field records pertaining to the investigation. These records will document all visual observations, calculations, and equipment calibrations. Every entry will be dated and the time for each entry noted. The logbooks are accountable documents that will be properly maintained and retained as part of the project files.

7.5 Monitoring Well Purging

Prior to sample collection, each well will be purged of standing water. A minimum of three casing volumes (as calculated from static water level) will be purged from each well. In the event that a well bails to dryness before three casing volumes are removed, the purged volume will be noted and an explanation will be given. All well purging will be performed using a Teflon-coated single check valve bailer which is manually lowered and removed from the well. If the well is bailed dry, a minimum of 24 hours will be allowed to pass between well purging and well sampling. The well purging process will be used to ensure that groundwater samples representative of the aquifer under investigation are obtained.

7.6 Groundwater Sampling Equipment Decontamination

All equipment used in measuring and sampling groundwater monitoring wells will be decontaminated in accordance with NEESA 20.2-031A, Chapter 3.3- Aquifer Protection requirements. Before site activities begin, it will be necessary to decontaminate all bailers and the water level indicator using a potable water/detergent wash, followed by a potable water rinse, and a final deionized water rinse. Sampling equipment will be

decontaminated in the same manner between samples. This procedure will be followed to minimize the potential for cross-contamination of samples between sampling locations. Disposable gloves will be worn during all measurement and sampling activities. A new pair of disposable gloves will be donned for each water sample and/or measurement.

8.0 SAMPLE IDENTIFICATION, CONTAINERS, PRESERVATION AND LABELLING

Clean sample containers will be provided by the laboratory. EnSafe/Allen & Hoshall will receive the containers from an approved laboratory that has followed NEESA 20.2-047B, Chapter 3.5- Sample Container Cleaning Procedures (and/or other applicable protocol), and the containers will remain in the custody of EnSafe/Allen & Hoshall personnel. All soil and water samples will be collected and preserved pursuant to EPA CLP TCL\TAL methods.

Sample preservation methods and holding times are summarized in Table 8-1. Sample container requirements and quantities are presented in Table 8-2.

Each sample will be identified by a sample label as shown in Figure 8-1. When sample containers are filled at a site, the forms will be completed, and the samples prepared and shipped to the laboratory.

8.1 Sample Chain-of-Custody

EnSafe/Allen & Hoshall will follow strict chain-of-custody procedures in accordance with NEESA 20.2-047B, Chapter 3.8, and corporate Standard Operating Procedures for chain-of-custody. EnSafe/Allen & Hoshall will generally use chain-of-custody forms, such as illustrated in Figure 8-2 for transferring sample shipments to the laboratory. Documentation of all samples will also be kept in a project field logbook.

Upon transfer of custody, the chain-of-custody form will be signed by the EnSafe/Allen & Hoshall field sampling team leader, including the date and time the samples were relinquished. As common carriers will not sign chain-of-custody forms, the chain-of-custody records will be sealed within each shipping container. All chain-of-custody forms received by the laboratory must be signed and dated by the laboratory sample custodian and returned to EnSafe/Allen & Hoshall following receipt, or as part of the data reporting package.

9.0 CALIBRATION PROCEDURES AND FREQUENCY

The analytical laboratory will perform analytical instrument calibration in accordance with NEESA 20.2-47B (and specific instrument methods by reference). Adherence to proper

SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE
SAMPLE IDENTIFICATION	
PROJECT NUMBER	

NAVAL ORDNANCE
STATION
INDIAN HEAD,
MARYLAND

FIGURE 8.1
SAMPLE BOTTLE LABEL

DATE: 04/29/91 | DWG NAME: CLENSMPL

FIGURE 8.2
CHAIN OF CUSTODY RECORD

LABORATORY: _____

ATTENTION: _____

PROJECT NO.: _____

PAGE___ of____

SITE INVESTIGATION
PHASE I
NAVAL ORDINANCE STATION
INDIAN HEAD, MARYLAND

CLIENT NAME

COLLECTED BY

SAMPLE ID	DATE	TIME	comp	grab	well	SAMPLE LOCATION	#of containers	MEDIA (X)				SAMPLE ANALYSIS (X)									REMARKS
								SOIL	WATER	SEDIMENT	GROUNDWATER										

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:

RELINQUISHED BY:	DATE	TIME	RECEIVED AT LAB BY:	DATE	TIME	REMARKS

CLEMCUS1

TABLE 8-1
EPA CONTRACT LABORATORY PROGRAM (CLP)
PRESERVATION AND HOLDING TIME REQUIREMENTS

Parameter	Media	Preservation	Holding Time*
Volatiles (TCL)	Water	Cool, 4° C pH<2, HCl	10 days until analysis
	Soil/Sediment	Cool, 4° C	10 days until analysis
Semi-Volatiles (TCL)	Water	Cool, 4° C	5 days until extraction, 45 days until analysis (max)
	Soil/Sediment	Cool, 4° C	10 days until extraction, 50 days until analysis (max)
Pesticides/ PCBs (TCL)	Water	Cool, 4° C	5 days until extraction, 45 days until analysis (max)
	Soil/Sediment	Cool, 4° C	10 days until analysis, 50 days until analysis (max)
TAL Metals + Mercury	Water	pH<2, HNO_3	180 days until analysis (-Hg), 26 days until analysis (Hg)
	Soil/Sediment	Cool, 4° C	180 days until analysis (- Hg), 26 days until analysis (Hg)
pH	Water	Cool, 4° C	Immediate
	Soil/Sediment (leachable)	Cool, 4° C	26 days until leaching and analysis
Chloride	Water	Cool, 4° C	28 days until analysis
	Soil/Sediment (leachable)	Cool, 4° C	28 days until analysis (after leaching)
Ammonia	Water	pH<2, H_2SO_4	28 days until analysis
	Soil/Sediment (leachable)	Cool, 4° C	28 days until analysis (after leaching)
Cyanide	Water	pH>12, NaOH	12 days until analysis
	Soil/Sediment	Cool, 4° C	12 days until analysis

* - USEPA CLP Required Holding Times

TABLE 8-2
SAMPLE QUANTITIES REQUIRED
FOR CLP-RAS TCL/TAL

GROUNDWATER		
Parameter	Quantity	Container
Pesticides/PCBs	One (1) Liter	Amber Glass Jar
Semi-Volatiles	2 x One (1) Liter	Amber Glass Jar
Cyanide	16 ounces	Plastic Container
Metals (with Mercury)	One (1) Liter	Clear Plastic Bottle
Volatiles	4 x 40 ml.	Clear Glass Vial (filled to capacity)
pH and Chlorides	Eight (8) ounces	Plastic Container
Ammonia	Four (4) ounces	Plastic Container
SOIL/SEDIMENT		
Parameter	Quantity	Container
Pesticides/PCBs (TCL) Cyanide Semi-Volatiles (TCL) Leachable Ammonia Leachable Chloride TAL Metals (-Hg) Mercury (Hg) Leachable pH	16 ounces	Wide Mouth Amber Glass Jar
Volatiles (TCL)	2 x 40 ml or; 2 x Four (4) Ounce	Glass Vial Wide Mouth Glass Jar

calibration procedures will be determined by the NCR during the onsite laboratory inspection.

EnSafe/Allen & Hoshall plans to calibrate field equipment such as pH, temperature and HNu PID according to manufacturer's standard operating procedures. Field equipment for which SOPs are not in force will be calibrated and operated in accordance with the manufacturer's recommendations.

All field instruments will be calibrated at the beginning and end of each work day. The pH meter will be calibrated after each set of measurements.

Soil sample screening will be performed as outlined in the SAP and Section 5 of this document. Static water level measurements will also be performed on all monitoring wells subsequent to well development, with adequate time allowed for well recharge.

Monitoring well casing (heads) will be surveyed (spatial and horizontal orientation) by a State of Maryland registered land surveyor. The survey measurements will be recorded relative to the USGS NAD '27.

All field measurements will be recorded in a dedicated field logbook and/or appropriate EnSafe/Allen & Hoshall field activity log (i.e. boring log, well construction log, etc.).

10.0 ANALYTICAL PROCEDURES

This SI will involve the collection of soil, sediment, and surface water samples for laboratory analysis. Groundwater samples will be collected for field and laboratory analysis. The analytical procedures selected by the NCR are discussed below.

10.1 Field Analyses

10.2 Laboratory Analyses

Selected soil and water samples collected during the course of this investigation will be analyzed by EPA CLP TCL\TAL Methods.

11.0 DATA REDUCTION, VALIDATION, AND REPORTING

Laboratory procedures for data reduction, validation, and reporting will be conducted according to standard operating procedures as dictated by the requirements of NEESA 20.2-047B, Chapters 7- Analytical Methods and 8- Maintaining Laboratory Approval. The specific procedures for data reduction, validation and reporting will be those outlined for Level C QC data in NEESA 20.2-047B, and the NCR approved laboratory QA Plan.

Required internal QC checks and data validation procedures are described in Section 12.0, Field and Laboratory Quality Control Checks.

EnSafe/Allen & Hoshall's use of the laboratory will be accomplished by a services agreement (contract). The contract will specify the scope of services to be performed by the laboratory, the specific analytical quality assurance requirements to be met, and the information to be developed and reported.

12.0 FIELD AND LABORATORY QUALITY CONTROL CHECKS

Internal laboratory control checks used by the laboratory will be conducted in the laboratory by the laboratory staff. EnSafe/Allen & Hoshall will conduct internal quality control checks of sampling procedures and laboratory analyses. These checks will consist of preparation and submission of sampler rinseate blanks, trip blanks, field blanks, and field duplicates for analysis, and an evaluation of the laboratory analytical package. The data validation checklists, included as Appendix B of this QA Plan, will be used as guides in evaluating data collection, field records, and analytical performance. These checklists will aid in identifying valid data and in classifying the data into one of three use categories: (1) unusable data, (2) Class A (qualitative) data, or (3) Class B (qualitative and quantitative) data.

The types and frequency of blank and other control check samples will be dictated by the NEESA Level C QC selected by the NCR. The required control check samples frequencies are outlined in NEESA 20.2-047B, Chapter 3- Site-Specific QC Requirements and Chapter 7- Analytical Methods. For Level C QC, quality control measures for sampling and analysis are described below.

12.1 Field Data Quality

All field work will be conducted and/or supervised by EnSafe/Allen & Hoshall personnel to ensure that proper procedures are followed. Field records will be kept of all activities that take place during the investigation and these records will be maintained at the EnSafe/Allen & Hoshall office in Memphis, Tennessee. These records will include any obstacles that may be encountered during the investigation.

Field samples will be collected per the procedures outlined in Sections 5 and 6 of this document. Precision will be assessed by evaluating the results of duplicate samples, and accuracy will be assessed by evaluating the analyses of field blanks, trip blanks, and laboratory matrix and surrogate spikes.

A duplicate is an identical sample collected from the same location (i.e. well) at the same time under identical conditions. Duplicate samples are analyzed along with the original sample to obtain sample procedure precision and inherent sample source variability. Duplicate samples will be collected from 10% of all soil boring samples, and one per monitoring well sample set.

A field blank consist of the source water used in decontamination and pressure washing. The sample container is filled with the source water in the field and is prepared, preserved and stored in the same manner as the other field samples. The field blanks are analyzed along with the field samples for the constituents of

interest to check for contamination imparted to the samples by the sample containers or other exogenous sources. One field blank per sampling event will be prepared.

Rinseate (or equipment) blanks are collected by retaining rinseate from sampling equipment. The equipment is rinsed with deionized water after full decontamination procedures have been performed. Rinseate samples are collected in the same type of sample containers as the field samples. Rinseate samples will be collected daily. Initially, samples from every other day will be submitted for analysis. If analytes pertinent to the project are detected, the remaining rinsate sample must be submitted for analysis. The results of the rinsate blanks will be used to flag or assess the levels of the analytes in the samples. This comparison is made during data validation. The rinseate blanks are analyzed along with the field samples for the constituents of interest.

A trip blank is a sample container prepared by the laboratory and filled with organic-free water that is transported unopened with the sample bottles. It is opened in the laboratory and analyzed along with the field samples for water matrix volatile organic analysis - analytes only. Trip blanks will be submitted to the laboratory in all sample shipping containers holding field samples for volatile analyses at a frequency of one (1) per sample shipping cooler.

The collection frequencies for quality control sample collection are summarized in Table 12-1.

12.2 Analytical Data Quality

Analytical data quality is assured through the use of NEESA guidelines for QA/QC as set forth in NEESA 20.2-047B. The guidelines include analysis and evaluation of matrix spikes.

Matrix spike samples that are prepared by the laboratory are useful in assessing the accuracy of the analytical method and can detect matrix effects, in which other sample components interfere with the analysis of the contaminant of concern. The method of measuring analytical accuracy is percent recovery. Analysis of matrix spike duplicates will provide a basis for determining method precision specific to the matrix under investigation. Precision is measured as relative percent difference between duplicate analyses.

Analytical matrix spikes and matrix spike duplicates will be performed at a rate of one per sample batch (20 samples maximum) per matrix in accordance with NEESA 20.2-047B.

TABLE 12-1
Quality Control Sample Collection Frequencies

Quality Control Sample	Frequency of Collection
Trip Blank (volatiles only)	One per sample shipping cooler containing field samples for volatile analysis
Rinseate Blank	Daily-every other day samples will be submitted for laboratory analysis
Field Blank	One per groundwater sampling event
Duplicates	Groundwater-One per sampling event Soil-one per 10 soil boring samples

12.3 Field Data Package

The field data package will include all field records and measurements obtained at a site by EnSafe/Allen & Hoshall personnel in accordance with NEESA 20.2-047B, Chapter 7.2-Deliverables and NEESA 20.2-031A, Chapter 6- Monitoring Well Data Record Requirements. The package, including all field records and measurements obtained at the Site by EnSafe/Allen & Hoshall sampling personnel, is validated by:

- Reviewing field data contained on water and soil sampling logs for completeness. Failure in this area may result in the data being invalidated for litigation or regulatory purposes.

- Verifying that field blanks, sampler rinseate blanks, and trip blanks were properly prepared, identified, and analyzed. Failure may compromise the analytical data package and result in some data being considered qualitative or invalid.

- Checking field analyses for equipment calibration and condition. Failure may result in the field measurements being invalidated.

- Reviewing chain-of-custody forms for proper completion, signatures of field personnel and the laboratory sample custodian, and dates. Failure may result in the data being invalidated for litigation or regulatory purposes.

The field data package will be reviewed by the project QA Officer for completeness and accuracy using the checklist in Appendix B.

12.4 Analytical Data Package

Validation of the analytical data package will be performed by the project QA Officer prior to submittal to the NCR (not before completion of field data validation). The validation steps will be performed by applying where applicable the EPA Laboratory Data Validation Functional Guidelines for Evaluating Organics and Inorganics Analyses, Technical Directive Document No. HQ-8410-01, and EPA Precision and Accuracy statements for the analytical methods employed. NEESA 20.2-047B, Chapter 7.3 guidelines will be applied to all Level C data validation procedures. An Analytical Data Validation Checklist (Appendix B) will be used for this purpose.

The analytical data package validation procedure includes, but is not limited to, review of the following:

- Comparison of the data package to the reporting level requirements designated for the project, to confirm completeness.

- Comparison of sampling dates, sample extraction dates, and analysis dates to check that samples were extracted and/or analyzed within the proper holding times. Failure in this area may render the data unusable.

- Review of analytical methods and required detection limits to verify that they agree with the QAP and the laboratory contract. Failure may render the data unusable.

- Analysis of field and laboratory blanks to evaluate possible contamination sources. The preparation techniques and frequencies, and the analytical results (if appropriate) will be considered.

- Evaluation of blanks must confirm freedom from contamination at the specified detection limit. All blank contaminants must be explained or the data applicable to those blanks labelled suspect and sufficient only for qualitative purposes.

12.5 Data Classification

The data will be classified by the Project Quality Assurance Officer based upon the level of reportables and the result of evaluating the field and analytical data packages. The three possible data classes are:

Unusable data: Data that may not be used for any purpose;

Class A data: Data that meets only the Class A screening criteria contained in Appendix B but not the Level B criteria. This class of data may be used for qualitative purposes only, i.e., to help develop or refine study plans, evaluate different sampling or analytical techniques, or identify gaps in the database. For this investigation, data will be classified Class A if all documentation identified by checklists in Appendix B and the QAPP have been properly prepared and are available.

Class B data: Data the meets both the Class A and Class B screening criteria. In addition to qualitative uses, the data submitted also may be used for quantitative purposes such as evaluating conditions such as risks or potential remedial solutions. For this investigation, data will be classified Class B if all analytical and field QC samples (rinsates, blanks, and spikes) are within acceptable control limits.

As with the laboratory data validation, the classification of data is based on specifically defined criteria. Samples are evaluated by matrix against the specific class criteria and judged as acceptable, provisional, or unacceptable. The explanation of the judging criteria is as follows:

A - Acceptable:	All criteria have been successfully met for all samples.
P-Provisional:	Some samples have not fully met the criteria but the information is obtainable.
U-Unacceptable:	Criteria has not been met with any samples and is not obtainable. This data may not be classified for use unless sufficient other data criteria have been met and scientific judgement indicate the data may be useful if classified.

N - Not Applicable.

Data will be classified using the Data Classification Summary Checklist (Appendix B). A report of the results of the Data

Validation for both previously collected and planned data will be submitted to the Project Manager (see Section 17.1).

13.0 PERFORMANCE AND SYSTEM AUDITS

Audits will be performed before and during the work to evaluate the capability and performance of the entire system of measurement and reporting, i.e. experimental design, sampling (or data collection), analysis, and attendant quality control activities.

13.1 Field System Audits

The Site Project Manager is responsible for evaluating the performance of field personnel and general field operations and progress. The Site Project Manager will observe the performance of the field operations personnel during each kind of activity such as water-level readings and sampling rounds. A formal systems audit of an field operations personnel by the corporate QA officer will be performed on a biannual basis (for all projects) and a field audit report of each sampling team members will be maintained on file by EnSafe/Allen & Hoshall. Where applicable, these audits will ensure that field operations are being conducted in accordance with NEESA 20.2-031A guidelines.

13.2 Laboratory Systems Audit

A laboratory systems audit is routinely conducted (at least annually) by EnSafe/Allen & Hoshall. These audits test methodology and assure that systems and operational capability is maintained. They also verify that quality control measures are being followed as specified in the laboratory written standard operating procedures (SOP) and Quality Assurance Plans (QAP). The Systems Audit Checklist used by the EPA CLP forms the procedural basis for conducting these audits.

Laboratory initiated audits will be conducted in accordance with guidelines set forth in NEESA 20.2-047B, and the laboratory QA Plan as approved by the NCR. Under NEESA 20.2-047B guidelines, the project NCR is also responsible for laboratory inspections to ensure compliance with NEESA laboratory requirements.

13.3 Performance Evaluation Audits

A performance evaluation (PE) audit is an audit performed to evaluate a laboratory's ability to obtain an accurate and precise answer in the analysis of known check samples by a specific analytical method. Following the analytical data validation described in Section 11.0, a performance evaluation audit of the laboratory may be conducted by EnSafe/Allen & Hoshall. This audit may be conducted if it is determined that the quality assurance data provided are outside acceptance criteria control

limits. PE audits may include a review of all raw data developed by the laboratory and not reported (laboratory non-reportables) and the submission of blind spiked check samples for the analysis of the parameters in question. These check samples may be disguised as field samples. In this case, the laboratory will not know the purpose of the samples. The samples may be obvious check samples (EPA or National Bureau of Standards traceable).

PE audits may also be conducted by reviewing the laboratory's results from "round-robin" certification testing and/or EPA Contract Laboratory Program (CLP) evaluation samples. An additional component of PE audits includes the review and evaluation of raw data generated from the analysis of PE samples and actual field samples that may be in question.

13.4 Regulatory Audits

It is understood that EnSafe/Allen & Hoshall field personnel and subcontract laboratories are also subject to quality assurance audits by the EPA, MDE, and the NCR. The NCR (under NEESA guidelines) will conduct laboratory inspections prior to approval for participation in any NEESA project, and will provide performance samples to the laboratory for approval purposes.

14.0 PREVENTIVE MAINTENANCE

The sampling equipment employed by EnSafe/Allen & Hoshall during an investigation that may require preventive maintenance will be checked for proper operation before and after each use on a daily basis. These checks will be conducted at the beginning and end of each day. Any replacements or repairs will be made as needed in accordance with manufacturer's instructions. Equipment or instruments potentially requiring preventive maintenance are listed in Table 14-1 along with the preventive maintenance requirements for each. Table 14-2 provides daily preventive maintenance procedures for field groundwater screening equipment to be used during the monitoring project.

Records of calibration and maintenance activities for each piece of equipment are contained in logbooks assigned to the equipment.

Preventive maintenance to be performed by the analytical laboratory will be performed in accordance with laboratory SOPs as established in an NCR approved QA Plan.

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

Precision is an estimate of the reproducibility of a method, and it is estimated by several statistical tests; the standard deviation of the error distribution, the coefficient of variation and the relative percent difference between replicate (duplicate)

samples. EnSafe/Allen & Hoshall will determine the precision of a method by analyzing replicate data.

TABLE 14-1
Field Testing Equipment

Item	Manufacturer	Model Number	Serial Number	Preventive Maintenance
pH Meter	Fisher	Accumet 956	3218	" "
Thermometer	---	Platinum RTD	---	" "
Conductivity/ pH/Temperature Meter	YSI	3500	---	Manufacturer's Operating Manual
Photoionization Detector	HNu Photovac	HW-101 TIP-II	--- ---	" " " "

Table 14-2

Preventive Maintenance for Field Equipment

Conductivity Meters

a. Each use: Meter probes are cleaned before and after each use with distilled/deionized water.

Before and after each use (daily) the instruments are checked with a commercial conductivity standard for proper calibration.

The battery is checked for proper charge.

b. Quarterly: The instrument is inspected on a quarterly basis, whether used during the quarter or not.

The inspection consists of a general examination of the electrical system (including batteries) and a calibration check.

Instruments not functioning properly are shipped to the manufacturer for repair and calibration.

pH Meters

a. Each use: Before each use (daily), the probe should be checked for cracks in the electrode bulb and complete filling with electrolyte solution.

(Table 14-2 cont.)

At the beginning and end of each sampling set, the pH meter must be calibrated using two standard pH buffers.

The battery is checked for proper charge.

Following each use, the probe is rinsed with deionized water. The probe cap is filled with electrolyte solution and placed on the probe tip. Excess electrolyte is rinsed off and the probe dried with a paper towel. The instrument is then placed in its carrying case.

b. Quarterly: The instrument is inspected on a quarterly basis whether or not it has been used.

The inspection consists of a general examination of the probe, wire, electrical system (battery check) and a calibration check.

Any malfunctioning equipment is returned to the manufacturer for repair and recalibration.

Thermometers

a. Each use: Before each use, thermometers are visually checked for cracks and mercury separation.

After use, thermometers are rinsed with deionized or distilled water and placed in their protective case to prevent breakage.

b. Monthly: Thermometers are visually inspected as described above, whether used or not. They are checked against an NBS certified thermometer for accuracy.

Precision is then defined by the coefficient of variation (CV), which expresses the standard deviation as a percentage of the mean. An indicator of CV, relative percent difference will serve as quality criterion for classification of data resulting from this investigation.

Specific statistical comparison of duplicate samples (field and laboratory), as a measure of precision evaluating both sample collection procedures and laboratory instrument performance, may be accomplished by first comparing the obtained duplicate results

with the published EPA criteria for method precision (relative percent difference).

The accuracy of a method is an estimate of the difference between the true value and the determined mean value. Specific statistical comparison of percent recovery values reported by the laboratory as a measure of method accuracy will be compared with the published EPA (or other appropriate regulatory entity) criteria for the accuracy of an individual method. Another technique for evaluating the accuracy of a method is to use the Students t-test. This test identifies whether or not a significant bias is present.

Data completeness will be expressed both as the percentage of total tests conducted and required in the scope of work that are deemed valid. Methods for assessing data precision, accuracy, and completeness by the laboratory will be outlined in the approved laboratory QA Plan.

16.0 CORRECTIVE ACTION

During the course of any investigation, field personnel are responsible for seeing that field instruments and equipment are functioning properly and that work progresses satisfactorily. The field personnel are also responsible for ensuring performance of routine preventive maintenance and quality control procedures, thereby ensuring collection of valid field data. If a problem is detected by the field personnel, the project manager shall be notified immediately, at which time problem correction will begin. Similarly, if a problem is identified during a routine audit by the project QA officer or the regulatory QA officer (or NCR), an immediate investigation will be undertaken and corrective action deemed necessary will be taken as early as possible.

In the event that corrective action is required by the analytical laboratory, it should be conducted in accordance with their NCR approved QA Plan following guidelines provided in NEESA 20.2 - 047B, Chapter 4.5 - Out-of-Control Events.

17.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

17.1 Internal Reports

The EnSafe/Allen & Hoshall QA Officer will provide status reports to the Project Manager. The reports address the following, as applicable during the course of the project:

- Quality assurance activities and quality of collected data
- Equipment and calibration and preventive maintenance activities

- Results of data precision and accuracy calculations
- Evaluation of data completeness
- QA problems and recommended and/or implemented corrective actions. Results of corrective action taken.
- QA performance and system audit findings

The laboratory is required to submit a monthly QC progress report to the NCR.

17.2 Reports to NEESA

EnSafe/Allen & Hoshall will provide a data quality assurance summary (QC Data Report) within the Draft Site Investigation Report (SIR) for submittal to the NCR. A Draft SIR must be submitted to the CHESDIV EIC no later than five weeks after initiation of field activities.

APPENDIX A

LABORATORY QUALITY ASSURANCE PLAN

The laboratory selected to perform all soil and groundwater analysis as part of this project is:

PACE, Inc.
11 Digital Avenue
Novata, CA 94949

This laboratory is on the NEESA-approved laboratories list provided to EnSafe/Allen & Hoshall by SOUTHDIV.

LABORATORY
QUALITY ASSURANCE
PLAN

PACE, Inc.

Submitted by:

_____

Approved by:

Roger C. Splinter, Ph.D.
Vice President

Rev. #0 - DATE: November 1, 1989
Rev. #1 - DATE: May 17, 1990

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III. INTRODUCTION, PROGRAM OBJECTIVES, AND STATEMENT OF POLICY

This Generic Quality Assurance (QA) Plan is written in compliance with the elements required in the U.S. EPA, "Guidelines and Specifications for Preparing Quality Assurance Program Plans." (QAMS-004 80, September 20, 1980). This document contains the required elements of a Quality Assurance Plan and is prepared in such a way that entire sections can be referenced in subsequent specific project plans. This Laboratory QA Manual defines the systems of quality control and quality assessment that constitute the comprehensive Quality Assurance Program at PACE, Inc. Quality Control consists of specific procedures applied to all phases of analysis from sample receipt through the final reporting of results. The purpose of quality control is to insure that quality goals are met under routine operating procedures. Quality assessment involves the continuous evaluation of data and monitoring of analytical processes for the purpose of insuring that the quality control systems are performing effectively.

PROGRAM OBJECTIVES

The major elements of the overall Quality Assurance Program are summarized below:

- Use of appropriate methodologies by technically competent, well-trained personnel with state-of-the-art instrumentation and equipment.
- Adherence to well-defined standard operating procedures with emphasis on good laboratory and measurement practices.
- Analysis and assessment of quality control samples including (but not limited to) matrix spike samples, duplicate samples, surrogate spikes, blanks, and independent laboratory control standards.
- Participation in external quality evaluation programs such as the EPA Water Pollution and Water Supply (WP & WS) Study Programs.
- Maintainance of accreditation by State, Federal, and other applicable agencies for work performed.
- Monitor internal and external compliance to procedures and to assess the performance of the analytical methods.

STATEMENT OF POLICY:

PACE, Inc. is committed to the policy of providing the highest quality product to its client. The validity and reliability of the information generated is maximized by the adherence to documented quality control procedures and quality assurance protocols. PACE emphasizes the application of sound quality assurance/quality control principles beginning with the initial planning of the project, through all the field and laboratory activities and ultimately to the generation of the final report. The principles of data quality objectives, representativeness, completeness, comparability, precision and accuracy are applied.

PACE is committed to providing the resources, including facilities, equipment and personnel, to ensure the adherence to rigorous QA/AC protocols. Individual Quality Assurance Project Plans are developed for monitoring analytical projects to conform with the established QA/QC protocols.

IV. LABORATORY ORGANIZATION AND RESPONSIBILITY

The organizational structures for PACE, Inc. are provided in Exhibits 1, 2, and 3.

Exhibit #1	Illustrates the PACE, Inc. Organizational Structure
Exhibit #2	Illustrates the PACE Corporate Structure with Regional Designation
Exhibit #3	Illustrates a Typical Regional Structure Showing the Quality Responsibilities

Job descriptions are provided within Quality Assurance Project Plans, as they are designed and developed to address specific projects.

PACE Organizational Sructure

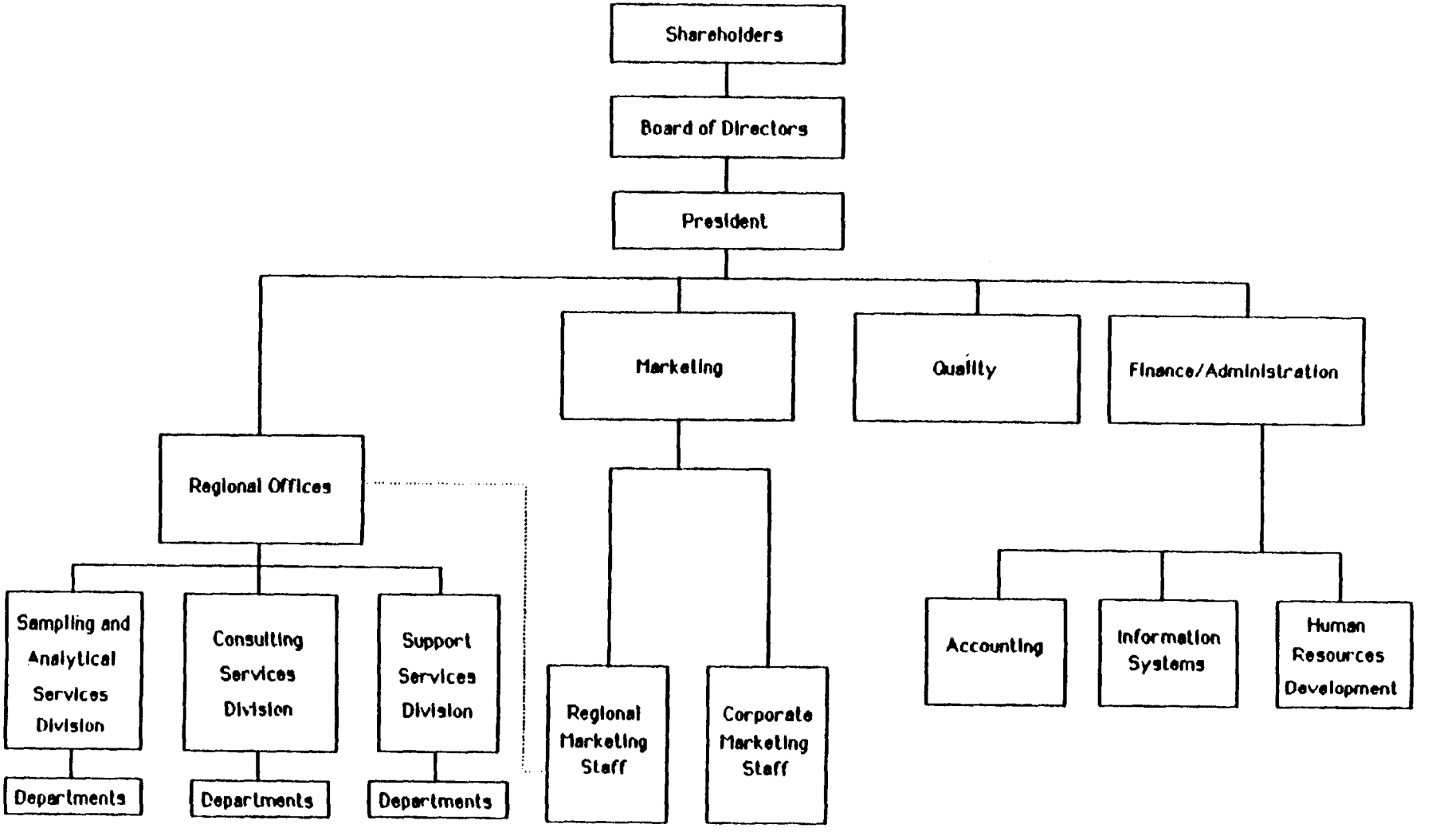

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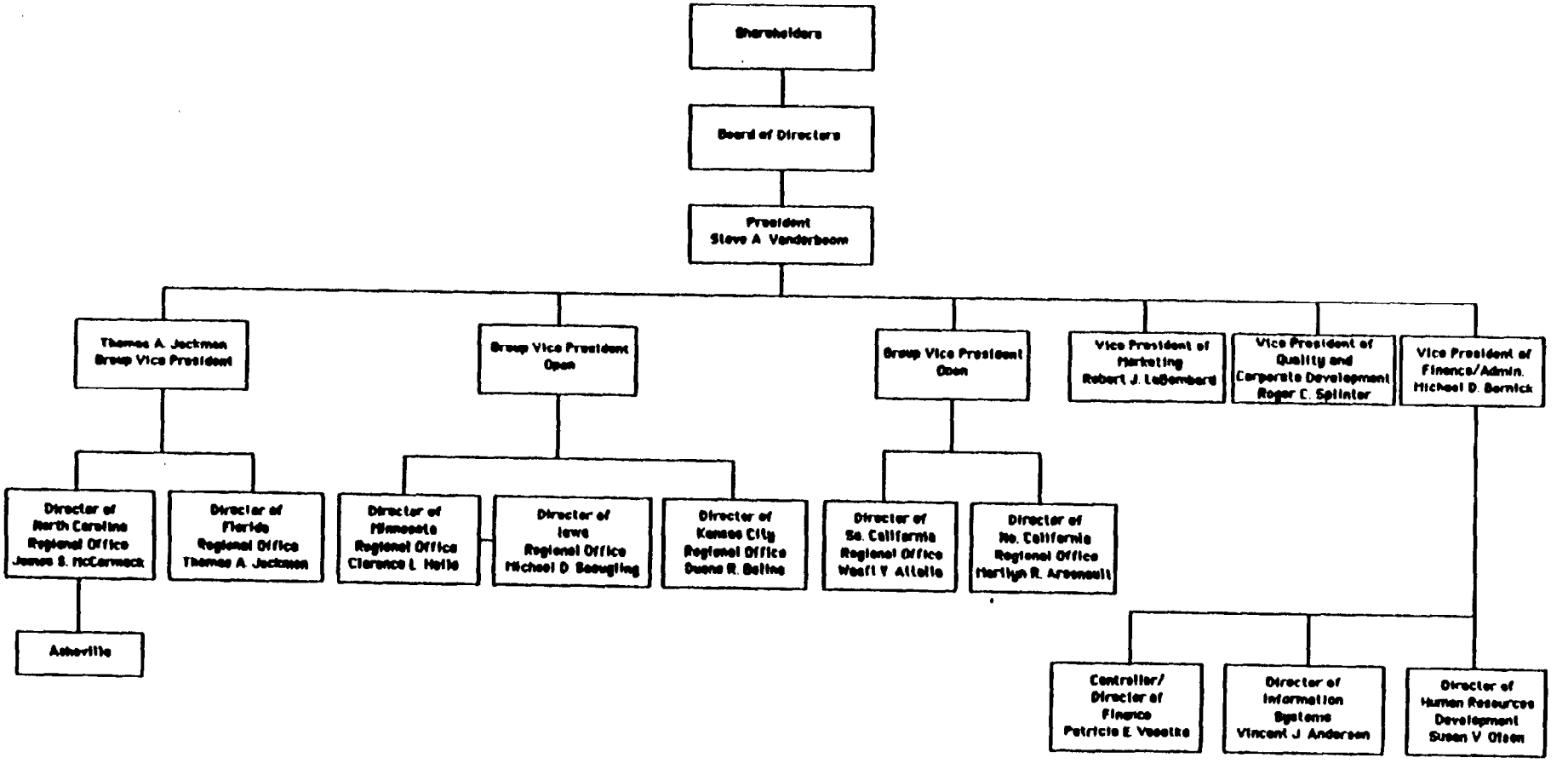
EXHIBIT 2

Corporate Management Personnel
&
Regional Directors

1.1



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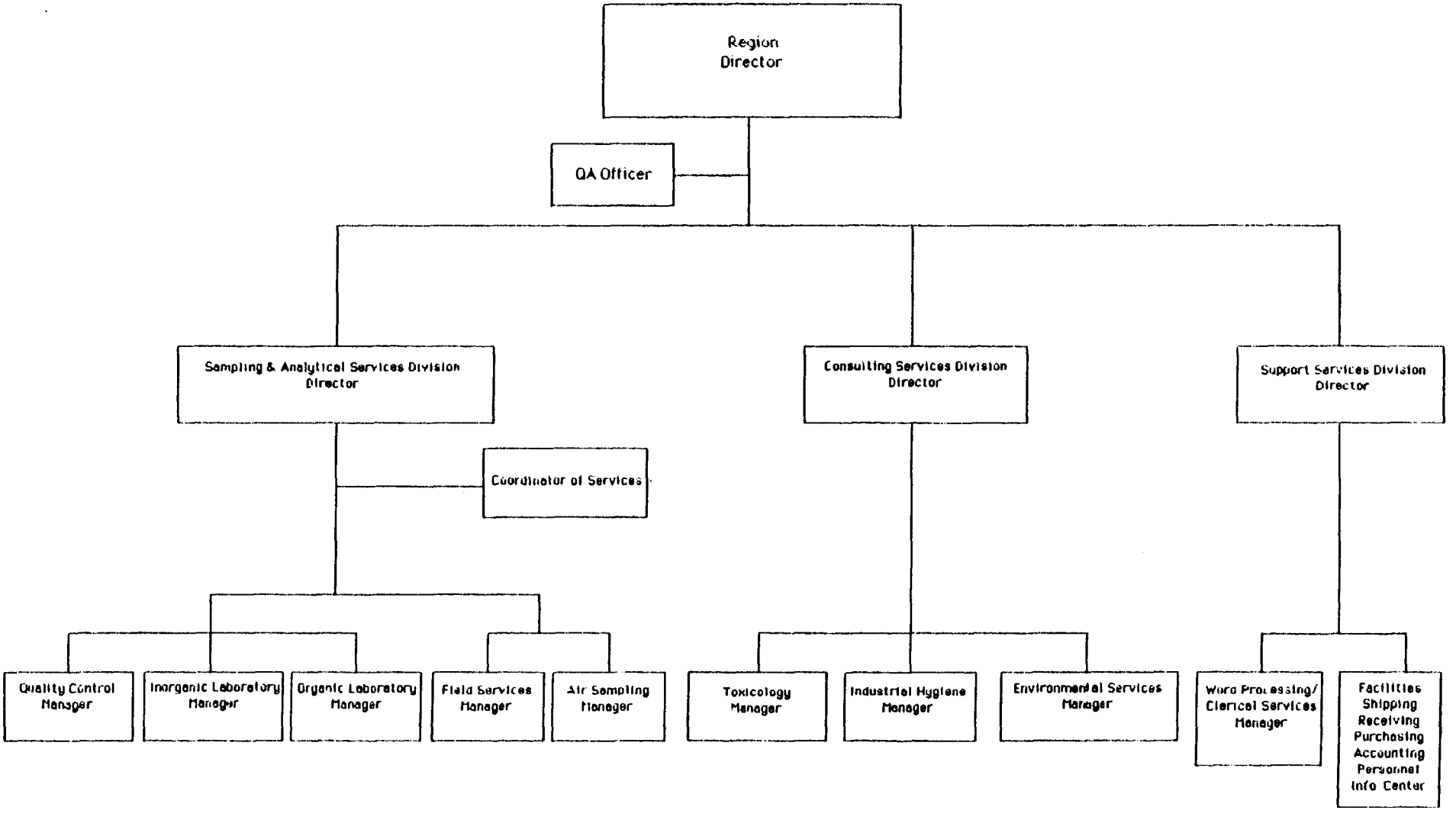
Region



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V. QUALITY ASSURANCE/OBJECTIVES

A. INTRODUCTION

The purpose of the plan is to define procedures for the documentation, evaluation, validation, and reporting of data. The objective is to provide a uniform basis for sampling, sample handling, instrument maintenance and calibration, methods control, performance evaluation and analytical data generation and reporting. Specific procedures to be used for sampling, chain of custody, calibration of field instruments (pH, conductivity meters, etc.), laboratory analysis, reporting, internal quality control, audits, preventive maintenance, and corrective actions are described in specific sections of this plan. This section addresses the objectives of accuracy, precision, completeness, representative, and comparability.

The QA objectives for precision and accuracy are to achieve the QC acceptance criteria specified in the proposed analytical procedures. For the organic and inorganic procedures, the precision and accuracy guideline requirements are specified in the individual methods.

Field Blanks and duplicates are collected and analyzed to assess field sampling activities. The results check procedural contamination and/or ambient conditions at the site.

Due to the extensive number of organic parameters and potential matrices, the development of precision and accuracy objectives and control limits for every matrix is difficult. This is typically done with (1) matrix spike and matrix spike duplicate compounds which are added to selected samples before extraction and analysis, and/or (2) surrogate spike compounds which are added to every sample, before extraction and analysis. Although the surrogate and matrix spike analyses do not provide statistically valid statements about precision and accuracy for every compound in a sample, they do give the data reviewer enough information to make judgements about precision and accuracy on a sample-by-sample basis.

Inorganic precision and accuracy data are determined by using duplicate samples (precision), matrix spike and laboratory control samples (accuracy). The following procedure is used:

For a duplicate sample analysis, at least one duplicate sample is analyzed per sample matrix type (e.g. water, soil) and concentration (e.g. low, medium) per batch of samples or for each 20 samples received, whichever is more frequent, or as specified by state/project requirements. Samples identified as field blanks can NOT be used for duplicate samples analyses. If two analytical methods are used to obtain the reported values for the same element for a batch of samples (i.e., ICP, GFAA), duplicate samples will be run by each method. The relative percent difference (RPD) for each component is calculated for later use during data assessment.

Completeness is a measure of all information necessary for a valid scientific study. For completeness, it is expected that the methodology proposed for chemical characterization of the samples collected will provide data meeting QC acceptance criteria for at least 90% of all samples collected. Completeness may also be defined as a comparison of the number of tests successfully completed (with acceptable QC) to the number of tests requested.

Representativeness is a qualitative element that is related to the ability to collect a sample that reflects the characteristics of that part of the environment that is to be assessed. Sample representativeness is dependent on the sampling techniques used and is considered individually for each project. It is specifically addressed in each work plan.

Comparability is also considered during preparation of the work plan. The objective of comparability is to ensure that results of similar activities conducted by different parties are comparable. For example, the use of EPA-approved or other methods and procedures ensures comparability with data from previous or following studies.

VI. SAMPLING PROCEDURES

PACE, Inc. receives samples collected by clients and also has the capability to perform sampling for clients. PACE prepares sample containers in accordance with EPA-issued guidelines for container and preservative requirements. Technical assistance from all supervisory and management staff is available to clients if needed.

A. BOTTLE PREPARATION PROCEDURES

The following is the procedure used for Sample Container Preparation:

1. Purpose

The purpose of this Standard Operating Procedure (SOP) is to provide clear, consistent methods for preparing containers for sample collection. Following this procedure will facilitate accurate and consistent analytical results.

2. Application

The policies and procedures contained in this SOP are applicable to the personnel in the container preparation area.

3. General Policies

a. Always use new bottles when preparing containers for sampling (exception: One gallon, amber glass bottles used for transporting deionized water can be re-used after proper cleaning). These may be commercially-obtained precleaned bottles.

b. Always wear disposable latex gloves when handling sample containers.

c. Several preparation procedures require the use of acids as a preservative or cleaning agent.

   1. Be extremely careful when working with acids.

   2. Always wear safety glasses and a laboratory coat.

d. Bottle labels will list the preservatives added and the analysis to be performed, minimizing the probability for error.

e. When shipping pre-preserved bottles containing corrosives or oxidizers, consult proper DOT regulations.

4. **Procedures: Containers for Aqueous Samples**

a. **Volatile Organic (VOA) Sample Container Preparation**

1. Vial cleaning procedures.

   a. Wash an entire package of vials in one washing session. Never store open packages of vials.

   b. Soak the vials in cleaning solution (one capful of Acationox detergent, American Scientific, per sink of hot tape water) for 5 minutes.

   c. After soaking, thrice rinse each vial thoroughly with hot tap water.

   d. Thrice rinse each vial thoroughly with carbon filtered, deionized water (CFDI).

   e. Stack rinsed vials in a drying tray (metal tray lined with aluminum foil, dull side exposed).

   f. Bake the vials at 103°C for a minimum of four hours.

   g. Cover baked vials with aluminum foil such that the dull side of the foil is in contact with the vials and set trays on a lab bench to cool.

2. Septum and cap cleaning procedures.

   a. Clean entire packages of caps and septums. Do not store open bags.

   b. Clean caps and septums separately.

   c. The same procedures used for vial cleaning are used for cap and septum cleaning. Follow B through D in Section 1.

   d. Spread evenly and thinly in drying trays to facilitate drying.

   e. Dry for one hour at 103°C. Extended periods of heat can damage caps and septums.

   f. Place clean caps and septums into a 1500 mL glass container which has been cleaned.

3. Assembling VOA vials.

   a. Place ten clean vials upright in a vial box with dividers. Recover drying trays with foil after vials have been removed.

   b. Add 4 drops of concentrated hydrochloric acid (HCL).

   c. Add (10 mg/40 ml) 0.008% sodium thiosulfate if chlorine is present (e.g. drinking water).

   d. Assemble a cap by inserting a septum in the cap such that the Teflon (white) side is exposed to the interior of the vial.

   e. Cap each vial tightly.

   f. Repeat assembly procedures until all vials are capped.

b. **Semi-Volatile Container Preparation**

1. Glass, amber jars (250, 500, and 1000 mL) with Teflon lined caps are used to hold samples for semi-volatile analysis.

2. Bottles and cap liners are rinsed with reagent grade acetone. (Acetone is a target compound for EPA 8240 and an HSL compound. If acetone interferes with the analyses, use of hexane and/or methanol may be an alternative, as specified in the method.)

   a. Acetone is highly flammable and acetone vapors are toxic.

   b. When using acetone, wear latex gloves, safety glasses and work in a vented hood.

   c. Pour a small amount of reagent grade acetone in the bottle to be rinsed.

   d. Cap the bottle with a Teflon lined cap.

   e. Shake the bottle making sure the acetone comes in contact with all sides of the bottle and the cap liner.

   f. Empty the bottle, invert it on a drying rack and allow it to air dry.

   g. Cap the bottle with a rinsed cap.

   h. Attach a blue dot to the top of the cap indicating the container has been acetone rinsed.

c. **Preparation of Containers for Metals Analysis**

1. Polyethylene bottles (125, 250, 500, and 1000 mL) with plastic caps are used to hold water samples to be analyzed for metals.

2. Add a small amount of 1:1 nitric acid to a bottle.

3. Cap the bottle and shake vigorously, being certain the acid comes in contact with all interior surfaces.

4. Empty the container.

5. Rinse the bottle and cap thrice with deionized water.

6. Add the appropriate amount of 1:1 nitric acid, cap, and place a pink or red dot on the cap to indicate the container contains nitric acid preservative.

Container Size	Quantity 1:1 Nitric Acid
125 mL	1/4 mL
250 mL	3/8 mL
500 mL	3/4 mL
1000 mL	1 1/2 mL

d. **Nutrient Container Preparation**

1. Polyethylene bottles (250, 500, and 1000 mL) with plastic caps are used to hold water samples for nutrient analysis.

2. Add the appropriate amount of sulfuric acid, diluted 1:1 from concentrate with carbon filtered deionized water, to each container.

Container Size	Quantity 1:1 Sulfuric Acid
250 mL	3/8 mL
500 mL	3/4 mL
1000 mL	1 1/2 mL

3. Attach an orange dot sticker to the cap of each prepared container.

e. **Cyanide Container Preparation**

1. Polyethylene containers (1000 mL) with plastic caps are used to hold samples for cyanide analysis.

2. Add one gram (8 to 10 pellets) or concentrated solution of sodium hydroxide and one gram of ascorbic acid to each container. If chlorine is present in the sample, use only ascorbic acid.

3. Attach a green dot sticker to the cap of each prepared container.

4. Cyanide containers have a short shelf life; do not prepare in large quantities. (See #6b)

f. **Phenol Container Preparation**

1. Clear glass, small mouth containers (1000 mL) with "poly seal" caps are used to hold samples for phenol analysis.

2. Add 1 1/2 mL of sulfuric acid, diluted 1:1 from concentrate with carbon-filtered deionized water, to each container.

3. Attach an orange dot sticker to the cap of each prepared container.

g. **Oil and Grease Container Preparation**

1. Clear glass, wide-mouth containers (1500 mL) with foil lined caps are used to hold samples for oil and grease analysis.

2. 1000 mL amber glass containers with Teflon lined caps are acceptable.

3. Add five mL of 1:1 sulfuric acid to each container.

4. Attach an orange dot sticker to the cap of each prepared container.

h. **Sulfide Container Preparation**

1. Polyethylene bottles (250 mL) with plastic caps are used to hold samples for sulfide analysis.

2. Add 0.5 mL of zinc acetate and NaOH (to pH greater than 9) to each container.

3. Attach a white dot sticker to the lid of each prepared container.

i. **Total Organic Carbon (TOC) Container Preparation**

1. Polyethylene bottles (250 mL) with plastic caps are used to hold samples for TOC analyses.

2. Add 0.25 mL of 1:1 sulfuric acid.

3. Attach an orange dot sticker to each prepared container.

j. **Radiological Containers Preparation**

1. Polyethylene bottles (one gallon) with wax coated, paper lined caps are used to hold samples for radiological analysis.

2. Add five mL of 1:1 nitric acid to each other.

3. Attach a pink dot sticker to the cap of each prepared container.

k. **CFDI Water Container Preparation**

1. One gallon, small mouth, amber glass bottles with Teflon lined caps are used to transport CFDI water.

2. These containers can be reused after appropriate cleaning.

3. Wash the bottle in hot tap water and Acationox detergent (American Scientific Products one cap of detergent per sink of water).

4. Thrice rinse the bottle with hot tap water.

5. Thrice rinse with CFDI water.

6. Bake the bottle at 103° until dry (at least four hours).

7. Remove the bottle from the oven, cover the mouth with foil, and let cool.

8. Cap the bottle with a new, Teflon lined cap.

1. **Other Container Preparation**

1. Polyethylene bottles (125, 250, 500, and 1000 mL) with plastic caps are used to hold samples for general chemistry analysis.

2. Clear glass bottles (125, 500, and 1000 mL) with foil lined caps are used to hold samples with high oil content to be analyzed for general chemistry parameters.

3. Amber glass, small neck bottles (500 mL) with Teflon-lined caps are used to hold samples for total organic halide (TOX) analysis.

5. **Procedure: Containers for Soil Samples**

a. **Volatile Organic Analysis Sample Container Preparation for Soil Samples**

1. Wide-mouth, amber glass vials (65 mL) with Teflon-lined caps are used to hold samples for volatile organic analysis.

2. The same preparations procedure is used as is used in preparation of VOA containers for aqueous samples except no preservative is added to the containers. (See #4a)

b. **Semi-Volatile Container Preparation**

1. Wide-mouth, amber glass jars (250, 500, and 1000 mL) with Teflon-lined caps are used to hold samples for semi-volatile analysis.

2. Preparation procedures are identified as those used in preparation of semi-volatile containers for aqueous samples. (See #4b)

c. **Inorganic Container Preparation**

1. Polyethylene bottles (125, 250, 500, and 1000 mL) with plastic caps are used to hold samples for inorganic analysis.

2. If the samples contain a large quantity of oil, clear glass jars (125, 500, and 1000 mL) with foil lined caps are used instead of the polyethylene bottles.

3. Container preparation procedures are identical to those used in preparation of general containers for aqueous samples.

6. **Sample Container Quality Control and Lot Assignment**

a. Bottles of a given type, prepared in one session, constitute a lot.

b. Lot sizes will vary, depending on the demand for a given bottle type.

1. A lot should be large enough to meet one week's demand for the given bottle type. Containers for samples to be analyzed for cyanide and VOA are exceptions.

2. Due to an extremely short shelf life, cyanide containers should be prepared in lot sizes required for approximately 2 days demand and prepared as necessary.

3. Due to spatial limitations, VOA vials should be prepared daily.

c. When a lot is prepared, it is assigned an eight character lot code.

1. The first two characters indicate the bottle type.

GN: General Unpreserved
MU: Metals Unfiltered
NT: Nutrients
CN: Cyanide
PH: Phenol
OG: Oil and Grease
SD: Sulfide
GV: GC VOA Water
GC: GC VOA Solid
GL: GC Q-Amber
GS: GC Sm Amber
GM: GC Misc. Refrigerated
HW: Hazardous Waste
OC: Total Organic Carbon
OX: Total Organic Halides
RA: Radiological

A complete listing of codes can be found in Section I of the LDMS User's Manual

2. The next three digits indicate the bottle size.

125: 125 mL
250: 250 mL
500: 500 mL
000: 1000 mL and one gallon

3. The last three digits are the lot number. They are assigned in sequential order.

4. When the lot code is assigned, it is listed on the Lot Log Sheet (Exhibit 4).

5. The person who prepared the containers initials the Lot Sheet next to the lot code.

One container per lot is used to hold a deionized water blank. This blank is analyzed to determine the level of contamination in the lot.

- The appropriate analyses are performed for the given container type.
- Use carbon-filtered, deionized water for all blanks.
- Fill all containers, except VOA's, up to the neck of the bottle.
- Fill VOA's such that no bubbles are trapped when the vial is capped.
- Label each blank with the following information:

  Client: PACE, QC

  Sample description: (Lot Code)
  Date Collected:
  Collected by: (Initials)
  Time Collected:
  Analysis: (As indicated for the bottle type)
  Preservative: (Check appropriate preparation)

6. Complete a Chain-of-Custody form to accompany the samples. Client, sample description, time sampled, preservative, analysis: as listed on the bottle label.

   Report to: (Name of container preparation person)

   Project Name: Container QA

   Requested Due Date: Priority 2

   Matrix: H_2O

   Route samples and Chain-of-Custody to Sample Check-in.

EXHIBIT 4

LOT LOG SHEET

LOT #	INIT.	LOCATION				LOT #	INIT.	LOCATION			
		OUT	SHELF	TIER 1	TIER 2			OUT	SHELF	TIER 1	TIER 2

7. **Sample Analysis Data Entry Form Tracking for Bottle Prep QC**

Forms will be kept in an Outstanding QC file.

a. When a Report of Laboratory Analysis is received for the project, the Sample Analysis Data Entry Form is moved to the Complete QC file.

b. A copy of the Report of Laboratory Analysis is then routed to QC Data Entry and data are entered into the appropriate data base.

c. The data are reviewed by the supervisor of the Bottle Preparation Area and signed off as being certified "clean" if the following criteria are met. After subtraction of the daily DI water blank, all laboratory contaminants shall be less than 2 times the detection limit. If this criterion is not met, the bottles are re-cleaned and another blank analyzed.

The following are guidelines for the addition of sample preservatives to containers. Check the list of analyses to be performed and determine the types and sizes of containers needed and required.

Add the appropriate preservative to its designated container under a hood. Pack the bottles into a cooler with blue ice for the client.

PREPARING ACID PRESERVATIVES

All acid preservatives are prepared using a concentration of 1:1 acid to water. Reagent grade acids are used when making the 1:1 concentrations.

COMMON ANALYSES PRESERVATIVES

Analysis	Bottle Type	Preservative	pH	Approx. Amount
Metals	1 liter plastic	1:1 HNO_3	2.0	1.5 mL
EPA 602/8020	2 XVOA vials	1:1 HCl	2.0	3 drops
Cyanide	1 liter plastic	NaOH tablets	12.0	4-5 tabs
Sulfide	500 mL plastic	Zn acetate, NaOH	9.0	2 mL Zn acetate 2 tabs NaOH
Ammonia	1 liter plastic/ glass	1:1 H_2SO_4	2.0	1.5 mL
Phenolics	1 liter amber glass	1:1 H_2SO_4	2.0	1.5 mL

Sample containers, preservatives, and holding times for representative analytical groups are listed in Table 1. Refer to 40CFR 136 for complete information and details.

pace laboratories, inc.

Inorganic Analytical Guide

TABLE 1

Common Non-Metals Analysis

Parameter	Typical Method(s)	Comparable SW-846 Method(s), If Applicable	Sample Container/ Preservative*	Preferred Volume (ml)*	EPA Holding Time*
Acidity	EPA 305.1		P, G/4°C	100	14 Days
Alkalinity	EPA 310.1/310.2		P, G/4°C	100	14 Days
Bacteria, Total Coliform	Standard Method 909A	9131/9132	WK/4°C	100	6 Hours
Bacteria, Fecal Coliform	Standard Method 909C		WK/4°C	100	6 Hours
Bacteria, Total Plate	Standard Method 907		WK/4°C	100	48 Hours
BOD, 5 Day	EPA 405.1		P, G/4°C	500	48 Hours
BOD, 5 Day Carbonaceous	EPA 405.1		P, G/4°C	500	48 Hours
Boron	EPA 212.3		HNO_3 < 2	100	6 Months
Bromide	EPA 320.1		P, G	200	28 Days
COD	EPA 410.1/410.2		P, G/4°C, H_2SO_4	250	28 Days
Color	EPA 110.3		P, G/4°C	250	48 Hours
Chloride	EPA 325.2/325.3	9251/9252	P, G	100	28 Days
Chlorine, Residual	EPA 330.1		P, G	500	Immed.
Cyanide, Total	EPA 335.2	9010	P, G/4°C, NaOH pH > 12	500	14 Days
Fluoride, Total	Standard Method 413A		P	500	28 Days
Fluoride, Electrode	EPA 340.2		P	200	28 Days
Fluoride, (SPADNS)	EPA 340.1		P	500	28 Days
Grease & Oil	EPA 413.1	9070/9071	G/4°C, H_2SO_4	1000	28 Days
Hardness, Total ($CaCO_3$)	EPA 130.2		P, G/4°C	250	6 Months
Ion Chromatography (Including common anions such as: Br^-, Cl^-, F^-, NO_2^-, NO_3^-, $PO_4^{\equiv}$, $SO_4^{=}$, SO_3^-, & others)	EPA 300		P, G/4°C	100	28 Days
Nitrogen, Ammonia	EPA 350.1/350.2		P, G/4°C, H_2SO_4	500	28 Days
Nitrogen, Kjeldahl	EPA 351.2/351.3		P, G/4°C, H_2SO_4	1000	28 Days
Nitrogen, Nitrate	EPA 353.2	9200	P, G/4°C	100	48 Hours
Nitrogen, Nitrite	EPA 353.2		P, G/4°C	100	48 Hours
Nitrogen, Nitrate & Nitrite	EPA 353.2		P, G/4°C, H_2SO_4	100	28 Days
Nitrogen, Organic	EPA 351.3		P, G/4°C, H_2SO_4	100	28 Days
Odor	EPA 140.1		G/4°C	1000	24 Hours
Oxygen, Dissolved	EPA 360.1		G - Bottle & Top	500	Immed.
pH	EPA 150.1	9040/9041/9045	P, G/4°C	100	Immed.
Phenol	EPA 420.1	9065	G/4°C, H_2SO_4	1000	28 Days
Phosphorus, Total	EPA 365.1/365.2		P, G/4°C, H_2SO_4	100	28 Days
Phosphorus, Ortho	EPA 365.1/365.2		P, G/Filter	100	48 Hours
Silica, Dissolved	EPA 370.1		P/4°C	100	28 Days
Solids, Total	EPA 160.3		P, G/4°C	100	7 Days
Solids, Total Volatile	EPA 160.4		P, G/4°C	100	7 Days
Solids, Total Dissolved	EPA 160.1		P, G/4°C	100	7 Days
Solids, Total Suspended	EPA 160.2		P, G/4°C	100	7 Days
Solids, Suspended Volatile	Standard Method 209A		P, G/4°C	100	7 Days
Solids, Settleable	EPA 160.5		P, G/4°C	1 Gal.	48 Hours
Specific Conductance	EPA 120.1	9050	P, G/4°C	100	28 Days
Sulfate	EPA 375.4	9036/9038	P, G/4°C	100	28 Days
Sulfide, Total	EPA 376.1	9030	P, G/4°C, NaOH pH > 9, Zn acetate	500	7 Days
Sulfite	EPA 377.1		P, G	500	Immed.
Surfactants	EPA 425.1		P, G/4°C	250	48 Hours
Total Organic Carbon	EPA 415.1	9060	P, G/4°C HCl pH < 2	100	28 Days
Total Organic Halogen	EPA 450.1	9020/9021	GA/4°C	500	14 Days
Turbidity	EPA 180.1		P, G/4°C	100	48 Hours

Sample Containers
P Plastic, polyethylene bottle with a polypropylene cap
G Glass
WK Whirl-Pak®
GA Glass, amber bottle with a Teflon® lined cap

Preservatives
H_2SO_4 Sulfuric Acid
HNO_3 Nitric Acid
NaOH Sodium Hydroxide

*Sample container, preferred volume and holding time are for water matrix. Consult laboratory for solid matrix sampling recommendations.

NOTE:
The methods shown are those commonly employed in performing environmental analyses. It is not intended to be inclusive of all possible EPA analytical methods or to indicate that any laboratory routinely provides the methods or parameters shown.

TABLE 1 (CONT.)

Common Metals Analysis

Solid
Sample Container: Plastic or glass
Preservative: 4°C
Preferred Volume: 100 grams
EPA Holding Time: 6 Months

Water
Sample Container: Plastic or glass
Preservative: HNO_3 pH < 2
Preferred Volume: 100 ml
EPA Holding Time: 6 Months

Parameter	FLAME** EPA or Standard Method	FLAME** SW-846 Method	FURNACE EPA or Standard Method	FURNACE SW-846 Method
Aluminum	202.1	7020	202.2	NA
Antimony	204.1	7040	204.2	7041
Arsenic	206.3**	7060	206.2	7061
Barrium	208.1	7080	208.2	NA
Beryllium	210.1	7090	210.2	7091
Cadmium	213.1	7130	213.2	7131
Calcium	215.1	7140	NA	NA
Chromium, Total	218.1	7190	218.2	7191
Chromium, Hexavalent	Standard Method 312B	7195-7198	218.5	NA
Cobalt	219.1	7200	219.2	7201
Copper	220.1	7210	220.2	NA
Gold	231.1	NA	231.2	NA
Iron, Total	236.1	7380	236.2	NA
[illegible]d	239.1	7420	239.2	7421
[illegible]nium	Standard Method 317B	NA	NA	NA
Magnesium	242.1	7450	NA	NA
Manganese	243.1	7460	243.2	NA
Mercury (Cold Vapor)	245.1	7470/7471	NA	NA
Molybdenum	246.1	7480	246.2	7481
Nickel	249.1	7520	249.2	NA
Potassium	258.1	7610	NA	NA
Selenium	270.3**	7740	270.2	7741
Silicon	Standard Method 303C	NA	NA	NA
Silver	272.1	7760	272.2	NA
Sodium	273.1	7770	NA	NA
Strontium	Standard Method 303A	NA	NA	NA
Tellurium	Standard Method 303A	NA	Standard Method 304	NA
Thallium	279.1	7840	279.2	7841
Tin	282.1	7870	282.2	NA
Titanium	283.1	NA	283.2	NA
Vanadium	286.1	7910	286.2	7911
Zinc	289.1	7950	289.2	NA

Metals by Inductively Coupled Plasma (ICP): Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Si, Ag, Na, Tl, V, Zn: EPA ICP Method 200.7 or SW-846 Method 6010

**Flame A.A. or Hydride

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Organic Analytical Guide

TABLE 1 (CONT.)

Water and Wastewater Analysis

EPA Method	Parameter	Technique	Sample Preparation	Sample Container/ Preservative	Preferred Volume (ml)	EPA Holding Time
601	Purgeable Halocarbons	GC-HALL	P&T	VOA/4°C	40	14 Days
602	Purgeable Aromatics	GC-PID	P&T	VOA/4°C	40	14 Days
603	Acrolein and Acrylonitrile	GC-FID	P&T	VOA/4°C, pH Adjusted	40	14 Days
604	Phenols	GC-FID	EXT	GA/4°C	1000	7/40 Days
605	Benzidines	HPLC-Electrochem	EXT	GA/4°C	1000	7/40 Days
606	Phthalate Esters	GC-ECD	EXT	GA/4°C	1000	7/40 Days
607	Nitrosamines	GC-NPD	EXT	GA/4°C	1000	7/40 Days
608	Organochlorine Pesticides and PCB's	GC-ECD	EXT	GA/4°C	1000	7/40 Days
609	Nitroaromatics and Isophorone	GC-FID + ECD	EXT	GA/4°C	1000	7/40 Days
610	Polynuclear Aromatic Hydrocarbons	HPLC-UV/Fluor or GC-FID	EXT	GA/4°C	1000	7/40 Days
611	Haloethers	GC-HALL	EXT	GA/4°C	1000	7/40 Days
612	Chlorinated Hydrocarbons	GC-ECD	EXT	GA/4°C	1000	7/40 Days
613	2, 3, 7, 8-Tetrachlorodibenzo-p-dioxin	GC/MS	EXT	GA/4°C	1000	7/40 Days
614	Organophosphorate Pesticides	GC-FPD or NPD	EXT	GA/4°C	1000	7/40 Days
615	Chlorinated Herbicides	GC-ECD or Hall	EXT	GA/4°C	1000	7/40 Days
624	Purgeables	GCMS	P&T	VOA/4°C	40	14 Days
625	Base/Neutrals, Acids and Pesticides	GC/MS	EXT	GA/4°C	1000	7/40 Days

Solid Waste Analysis

EPA Method	Parameter	Technique	Sample Preparation	Sample Container/ Preservative	Preferred Volume	EPA Holding Time
8010	Purgeables Halogenated Volatile Organics	GC-HALL	5030	VOA/4°C	*	14 Days
8015	Purgeables Non-Halogenated Volatile Organics	GC-FID	5030	VOA/4°C	*	14 Days
8020	Aromatic Volatile Organics	GC-PID	5030	VOA/4°C	*	14 Days
8030	Acrolein, Acrylonitrile, Acetonitrile	GC-FID	5030	VOA/4°C	*	14 Days
8040	Phenols	GC-FID	3550	GA/4°C	*	14 Days or 7/40 Days**
8060	Phthalate Esters	GC-ECD	3550	GA/4°C	*	14 Days or 7/40 Days**
8080	Organochlorine Pesticides and PCB's	GC-ECD	3550	GA/4°C	*	14 Days or 7/40 Days**
8090	Nitroaromatics and Cyclic Ketones	GC-FID or ECD	3550	GA/4°C	*	14 Days or 7/40 Days**
8100	Polynuclear Aromatic Hydrocarbons	GC-FID	3550	GA/4°C	*	14 Days or 7/40 Days**
8120	Chlorinated Hydrocarbons	GC-ECD	3550	GA/4°C	*	14 Days or 7/40 Days**
8140	Organophosphorus Pesticides	GC-FPD or NPD	3550	GA/4°C	*	14 Days or 7/40 Days**
8150	Chlorinated Herbicides	GC-ECD or HALL	3550	GA/4°C	*	14 Days or 7/40 Days**
8240	Volatile Organics	GC/MS	5030	VOA/4°C	*	14 Days
8250	Semi-Volatile Organics	GC/MS	3550	GA/4°C	*	14 Days or 7/40 Days**

Technique

Instruments:
- GC — Gas Chromatograph
- GC MS — Gas Chromatograph Mass Spectrometer
- HPLC — High Performance Liquid Chromatograph

Detectors:
- ECD — Electron Capture
- Fluor — Fluorescence
- FID — Flame Ionization
- FPD — Flame Photometric
- HALL — Electrolytic Conductivity
- NPD — Nitrogen Phosphorous
- PID — Photoionization
- UV — Ultraviolet

Sample Preparation Method Used:
- EXT — Extraction Methods that could be used include 3510, 3520, 3540 and 3550.
- P&T — Purge and Trap
- 3510 — Separatory Funnel Extraction of Liquid Samples
- 3520 — Continuous Liquid-Liquid Extraction
- 3540 — Soxhlet Extraction of Solid Samples
- 3550 — Sonication Extraction of Solid Samples
- 5030 — Purge and Trap. Direct Injection of Liquid Samples. Solid Samples Mixed then Injected.

Sample Container/Preferred Volume:
- GA — Glass Amber Bottle with Teflon Lined Cap
- VOA — Volatile Organic Analyte: 40 ml Amber Glass Vial with Teflon Septum
- * — Contact Laboratory for recommendation

EPA/Holding Time:
- 7/40 — 7 Days for Extraction and 40 Days for Analysis
- ** — Depends upon Sample Matrix

NOTE:
The methods shown are those commonly employed in performing environmental analyses. It is not intended to be inclusive of all possible EPA analytical methods or to indicate that any laboratory routinely provides the methods or parameters shown.

B. SAMPLING PROCEDURE FOR GROUNDWATER AND SURFACE WATER

Groundwater and surface water sampling techniques employed by PACE are in accordance with the EPA Regional IV Standard Operating Procedures and Quality Assurance Manual, and the PACE Field Services SOP Manual.

Trained field sampling crews are dispatched to the site for sample collection and deliver collected samples to the laboratory.

For groundwater sampling, the water level within the well is determined prior to sampling using an electronic water level meter, then recorded on the field log data sheet with all additional pertinent information (Exhibit 5). The volume of water in the casing is calculated and three to five times that volume is purged from the well. In all cases, the well is purged until the conductivity, temperature, and pH have all stabilized.

Samples from monitoring wells are taken with a precleaned Teflon or stainless steel bailer. Bailers are precleaned by washing first with detergent, then rinsed with tap water, triple rinsed with deionized water, and baked to dryness. Precleaned bailers are used between each sampling point.

All samples collected for metals analysis are preserved with nitric acid. The bailer to be used for sampling is used for purging two inch diameter wells and a gas-driven centrifugal pump is used when larger volumes of water need to be removed (static water levels of less than 25 feet). Wells with static water levels greater than 25 feet and casing diameters greater than 3 inches are purged using a submersible pump.

Quality Control Protocols:

A. All Quality Control (QC) procedures are as specifically required by the method, state, or project requirements.

B. The USEPA requires as a minimum one matrix spike, one duplicate or MSD, one blank, per set of samples of similar matrix with a maximum of 20 samples per set. This is a recommended minimum frequency for QC, unless stated otherwise by method, state or project requirements. A client may also request more frequent QC in which case it will be necessary to collect additional samples.

EXHIBIT 5

FIELD LOG DATA SHEET

PACE, Inc.

WELL SAMPLING

Client:_____ Project:_____ Project #:_____

Sample Site:_____

Well Identification and Description: (Locked_____ Not Locked_____) Key#:_____

ID inches_____PVC:_____Steel:_____Stainless Steel:_____Other:_____Labeled:_____

Total Well Depth (from top of casing)_____meters_____feet Elevation:_____feet

Static Water Level (from top of casing) Before Prepumping:_____meters_____feet

Static Water Level (from top of casing) At Time of Sampling:_____meters _____feet

Static Water Elevation:_____feet Water Column:_____feet One Casing Volume_____gal

Date Prepumped:_____Time Prepumped:_____Volume Prepumped:_____gal

Prepumping Method Used:_____ Pump Rate:_____gpm

Date Sampled:_____Time Sampled:_____Sampling Equipment Used:_____

Sample Temperature:_____°C Sample pH:_____Sample Specific Conductance:_____umho/cm2

Field Measurements Temperature Corrected: Yes___No___Metals Filtered in Field: Yes___No__

Weather Conditions:_____

Observations:_____

_____

Sample Description:_____

Name and Affiliation of Sampler(s)_____

Name and Affiliation of Inspector(s) Present:_____

STABILIZATION TEST

Time	pH	Specific Conductance (umhos/cm2)	Temp. (°C)	Cumulative Volume Removed (gallons)

C. SAMPLING PROCEDURES FOR SOILS AND SEDIMENTS

Soil and sediments are collected according to procedures in the latest edition of Test Methods for Evaluating Solid Waste, EPA-SW-846.

Soil sampling is designed to determine the depth and range of contamination from spillage or the leaching effects of rain on materials stored above ground. If borings are required, the depth and placement of the borings are planned by the project manager/subcontractor and client, using the suspected range of contamination as a guide.

VII. SAMPLE CUSTODY

A. SAMPLE RECEIPT

Sample shipments are received at the sample receiving area. Sample custodians verify the number of shipping containers received against the numbers listed on the shipping manifest/chain-of-custody. Any damage to the shipping containers or other discrepancy observed is noted on the chain-of-custody before signing it. A copy is kept for future reference.

The external chain-of-custody must be signed by the carrier for relinquishment of samples and signed by sample custodian personnel for sample receipt. The actual chain-of-custody may be supplied by PACE, (Exhibit 6), or may be the client's own form. The chain-of-custody remains in the project file at all times.

B. SAMPLE VERIFICATION

Upon arrival of a sample shipment, sample control personnel perform sample inspection. PACE's Sample I.D. and Condition Sheet (Exhibit 7) serves as a check-off list of procedures to follow and as documentation of the following:

1. Presence/absence of custody seals or tapes of the shipping containers and the condition of the seals (i.e., intact, broken).

2. Presence/absence of chain-of-custody; (if present, is it complete?)

3. Presence/absence of sample tags; (if present, are they removable?)

4. Agreement/non-agreement between the sample tags, chain-of-custody, and any client documentation.

5. Condition of the samples when received, including:

   - Cold or ambient
   - Intact, broken/leaking
   - Headspace in VOA vials
   - Sample holding time (has it been exceeded)?
   - Sample pH (less than 2 if acid preserved)

   If discrepancies are found, the PACE project manager is contacted immediately (verbally and by using the Discrepancy Report Form) (Exhibit 8). If the project manager is not available, the QC manager is contacted for further directions. A copy of a Discrepancy Report Form is attached to the project data package.

EXHIBIT 6

pace laboratories, inc.

11560

CHAIN-OF-CUSTODY RECORD
Analytical Request

Client

Address

Phone

Report To:

Bill To:

P.O. # / Billing Reference

Project Name / No.

Pace Client No.

Pace Project Manager

Pace Project No.

*Requested Due Date:

Sampled By (PRINT):

Sampler Signature

Date Sampled

ITEM NO.	SAMPLE DESCRIPTION	PH	TIME	MATRIX	PACE NO.	NO. OF CONTAINERS	PRESERVATIVES: UNPRESERVED	H_2SO_4	HNO_3	VOA			ANALYSES REQUEST	REMARKS
1														
2														
3														
4														
5														
6														
7														
8														

COOLER NOS.	BAILERS	SHIPMENT METHOD OUT / DATE	RETURNED / DATE	ITEM NUMBER	RELINQUISHED BY / AFFILIATION	ACCEPTED BY / AFFILIATION	DATE	TIME

EXHIBIT 7

SAMPLE I.D. AND CONDITION FORM

Client: _____
Project No.: _____
Date Received: _____

SAMPLE CONDITION UPON RECEIPT CHECKLIST

Complete checklist (A) during sample receipt. If any items are marked "NO," complete section (B) of this form. Otherwise, go to record samples.

			YES	NO
(A)	1.	Are there custody seals or tapes on the shipping container?	___	___
	2.	Are custody seals on the shipping container intact?	___	___
	3.	Is there a completed Chain-Of-Custody (C-O-C)?	___	___
	4.	Do the numbers of samples received and the sample matrices agree with C-O-C?	___	___
	5.	Are there tags attached to each sample?	___	___
	6.	Are sample tags, sample containers and C-O-C all in agreement?	___	___
	7.	Is the C-O-C complete with requested analyses?	___	___
	8.	Are the samples preserved correctly?	___	___
	9.	Is there enough sample to do all analyses?	___	___
	10.	Do the samples have the proper temperature?	___	___
	11.	Are the sample containers intact (e.g., not broken, leaking)?	___	___
	12.	Are VOA vials head-space free?	___	___
	13.	Are all samples within the holding times for requested analyses?	___	___
	14.	Is pH recorded for non-VOA's?	___	___

(B) Explain "NO" item here: _____

_____

_____

Send a copy of this form to Project Manager with Discrepancy Report Form. Copy of both forms remain in the QC file.

Custodian Signature: _____

EXHIBIT 8

PACE, INC.
DISCREPANCY REPORT FORM

Urgency Level: 1(_____) Requires immediate attention
2(_____) Requires attention today
3(_____) Requires attention this week

Initiator: _____ Client: _____
Date: _____
Project # _____

Sample(s) # _____ _____ _____ _____ _____

_____ _____ _____ _____ _____

_____ _____ _____ _____ _____

Discrepancy (if more space needed, use the back of this form): _____

_____

_____

To QC Manager: _____ Date: _____

Client Notified? YES ( ) NO ( ) Date & Time: _____

Project Manager Notified? YES ( ) NO ( ) Date & Time: _____

QC Response: _____

_____

_____

Project Manager Response: _____

_____

_____

Cause and Resolution (proposed or carried out): Completed by: _____

_____

_____

_____

Manager's Initials:

PM Signature: _____ Date: _____

QC Signature: _____ Date: _____

cc: Project File

C. SAMPLE LOG-IN

1. General Policies

a. Upon completing sample receipt/custody procedures, all sample and analysis data must be complete and documented on the chain-of-custody or accompanying forms for input into the Lab Data Management System (LDMS).

Sample and analysis data must include:

1. Client name and contact
2. Client number
3. PACE project number
4. PACE project manager
5. Sample descriptions
6. Due date
7. List of analyses requested

b. Sample and requested analyses data are input into the LDMS.

c. All samples received are logged into the LDMS on the day of receipt.

d. A Sample and Analysis Data Entry Form (SADEF) is generated immediately by the LDMS.

Distribution of SADEF:

- To the PACE Project Manager with a photocopy of the chain-of-custody. (Include a copy of the Discrepancy Report is applicable).
- To the QC project file with the original chain-of-custody.
- Photocopy to the Organic or Inorganic Department Manager as it applies for RUSH samples.
- To the client.

e. SADEF is to be reviewed against the chain-of-custody.

f. Sample containers are labeled with the corresponding sample number and the stamped date of receipt.

g. Samples are ready for storage.

2. **When Samples Are Received With No Paperwork**

a. If delivered by a client: Client is asked if previous arrangements were made for analysis (and with whom). The client completes a chain-of-custody and/or request for analysis, relinquishes samples to sample custodian personnel, and is given a copy of the C-O-C.

b. If received by courier or shipping:

1st: Routine Client File is checked
2nd: Anticipate Sample Alert File is checked
3rd: Sampling Kit Request File is checked
4th: PACE key client contact is consulted
5th: QC department manager is consulted to determine the designated PACE project manager
6th: Information is requested from the PACE project manager.

c. If analysis information can not be determined on the day of sample receipt, sample data entry personnel proceed to assign sample numbers and put samples on hold. Follow-up with project manager occurs until the analyses are determined and samples can be properly logged in.

3. **Responsibilities for Sample Log In**

a. Quality Control Manager/Sample Management Officer

- Has the overall responsibility for ensuring that this procedure is implemented for all samples received into the laboratory.

- Has overall responsibility for ensuring that samples are logged in correctly (given that appropriate information has been supplied).

b. Sample Custodian

- Has the primary responsibility of ensuring that sample information is input into the LDMS as described in the SOP.

- Has the responsibility to make recommendations to the QC manager for revising the SOP.

D. SAMPLE STORAGE

1. General Procedures

Samples for analysis are properly stored in the lab according to container type, preservative, and type of security required by the project.

Samples are stored immediately upon receipt to prevent sample degradation.

2. Refrigerated Storage Area Maintenance

All refrigerated storage areas are maintained at 4°C ± 2°C. The temperature is monitored and recorded daily. If the temperature fails outside the limit of 2° to 6°C, corrective action is to be taken as follows and appropriately documented.

a. Temperature is monitored at 30 minute intervals with the refrigerator door closed.

b. QC Manager is notified if the problem persists longer than one hour.

c. Samples are relocated to a proper storage environment if temperature cannot be maintained after corrective actions are implemented.

3. Routine Sample Storage

a. General Samples

Samples within each project are stored in sample number order. Waters and soils are generally stored on labeled separate shelves.

4. Specific Procedures

a. Volatiles

Samples within a project are stored in numerical order in vial containers. The holders are then stored where space permits in one of the designated volatile organic refrigerated storage areas.

b. Semi-Volatiles

Samples within a project are stored in numerical order in a designated, refrigerated storage area.

c. Hazardous Materials

Pure product or potentially heavily contaminated samples are tagged as "hazardous" and stored within a secured area, separate from other samples. This area is used only for hazardous samples and is labeled per OHSA requirements.

d. Special Projects

- Volatiles

  Samples within a project are stored in sample number order in vial containers. The holders are then stored as space permits in the Special Project VOA refrigerated storage area.

e. Asbestos

No refrigeration required. Samples are taken to asbestos lab for storage.

5. **Responsibilities for Sample Storage**

a. QC Department Manager/Sample Management Officer has direct responsibility for ensuring that the SOP is followed, samples are stored properly upon receipt, and refrigerated storage area temperatures are maintained.

b. Sample custodians are responsible for storing all samples upon receipt into the appropriate storage area, maintaining high level security for those samples under custody, and for keeping a current custody sample inventory.

c. Analytical personnel have the responsibility of daily sample storage area maintenance, disposal of old samples, and providing space for incoming samples in routine storage areas.

d. Assigned individuals are responsible for maintaining and documenting: (a) refrigerated storage area temperatures, and (b) corrective actions.

See temperature log (Exhibit 9).

Exhibit 9

TEMPERATURE LOG FORM

Storage Area No. _____

Date	Temperature	Initials	Corrective Action/Comments

Note: Temperature must be $4^{o}C \pm 2^{o}C$. If temperature is outside the limit of 2° to 6° continue to monitor at 30 minute intervals (door must remain closed). If no correction within one hour, notify the QC Manager.

F. SAMPLE/DATA ACCESS AND INTERNAL CHAIN-OF-CUSTODY

1. General Policies and Procedures

PACE has implemented standard operating procedures to assure the integrity of samples and data so that they are not degraded or disclosed to unauthorized personnel. In order to ensure that this policy is maintained, the laboratory facilities are under controlled access. Only employees are allowed into the laboratory facilities; visitors must register at the front desk.

Samples are removed from their proper location by the analyst and returned to the storage area immediately after the required sample quantity has been taken. This minimizes unnecessary time spent searching for samples and helps prevent matrix degradation from prolonged exposure to room temperature. Most samples are retained in storage in their original locations for approximately two months. Preserved metals samples and hazardous waste samples are stored up to six months. After the final report is sent and clients are allowed adequate time to review the results, the samples are properly discarded or returned to the client.

PACE normally completes the sample analysis within 15 working days after receipt. Holding times may require faster turnaround times.

Upon client request, additional and more rigorous chain-of-custody protocols for samples and data can be implemented. For samples involving a high degree of confidentiality or potential litigation, PACE, Inc. has developed extensive sample and data handling protocols to assure the scientific and legal defensibility of the report submitted. These protocols include those specified by the USEPA Contract Laboratory Program.

Analysts and technicians follow strict internal chain-of-custody procedures to further ensure the validity of all data. All samples are signed out in a sample custody log book when they are removed for analysis. The sample ID, date, time, analyst, and lab of analysis is recorded in the sample custody log (Exhibit 10). Samples are signed back in noting date, time, and storage location, upon return.

Exhibit 10

CHAIN-OF-CUSTODY
LAB CONTROL FORM

Contract/Project No.: _____
Date Received: _____
Received by: _____
Time: _____
Witness: _____
Stored in: _____

Samples No(s). _____
_____
_____
_____
_____
_____

Date & Time Removed	Sample Nos. Removed	Name	Witness	Time Returned	Name	Witness

REMINDER: Samples must be returned at the end of the shift.

2. **Responsibilities for SOP Compliance**

a. The QC manager has the overall responsibility for ensuring that the SOP is implemented and followed.

b. The sample custodian personnel have the responsibility for ensuring that the SOP is properly followed, and to notify the QC manager of problems.

c. All employees checking out samples are required to follow procedures.

G. **EXCESS SAMPLE DISPOSITION**

Samples not totally consumed during the analyses are returned to the client. It is the project manager's responsibility to ensure that proper disposal has taken place. If the sample is water or wastewater and is considered non-hazardous by the project manager, it may then (by request) be properly disposed of at PACE facilities and not returned to the client.

1. **Notification of Sample Return**

The project manager and client receive written notification at the time of project initiation in the following manner:

a. The project proposal states the following paragraph in its Conditions and Terms Statement:

PACE, Inc. Standard Operating Procedures is to return all samples of hazardous materials or wastes to the client at project completion, and PACE, Inc. reserves the right to return or dispose of all samples at our discretion.

This is a standard form used by PACE's Marketing Department.

b. The Sample and Analysis Data Entry Form states the following sentence:

- PACE, Inc. reserves the right to return all samples at our discretion.
- This form is printed out by the LDMS at sample check-in.

c. The Sample and Analysis Data Entry Form cover letter will state the following paragraph:

1. PACE, Inc. Standard Operating Procedure is to return all samples of hazardous materials or wastes to the client at project completion. PACE, Inc. reserves the right to return or dispose of all samples at our discretion. (Exhibit 11)

2. This is a pre-printed cover letter that accompanies the Sample and Analysis Data Entry Form.

d. The Sample and Analysis Data Entry Form and cover letter is sent to the project manager and to the client by the sample custodian personnel.

2. **Sample Return and Disposal**

Upon completion of laboratory analysis and/or the project, the LDMS automatically prints a report, invoice and sample disposition form. This form is part of the report package and is routed to the project manager.

a. The Sample Disposition Form (Exhibit 12) contains the following information:

1. Client name, address, and contact
2. PACE project number
3. Client project identification number
4. PACE sample identification number
5. PACE project manager name

pace® laboratories, inc.
PROFESSIONAL ANALYTICAL CHEMISTRY & ENGINEERING

Offices:
Minneapolis, Minnesota
Tampa, Florida
Coralville, Iowa
Novato, California
Leawood, Kansas
Irvine, California
Asheboro, North Carolina

1710 Douglas Drive North □ Minneapolis, MN 55422 □ Phone (612) 544-5543 □ FAX (612) 544-3974

Exhibit 11

November 1, 1989

Dear Valued Client:

A new policy has been implemented in the Sample Receiving Department of PACE Laboratories, Inc. We hope that this policy will be helpful to you.

Upon receipt of samples into the laboratory, the Sample Custodian completes a Sample and Analysis Data Entry Form. This form is designed to accommodate a short description of the samples received (sample name and/or sample reference), the type of container, and a list of the analyses requested to be performed on each sample. A copy of this form will be sent to the client (submitter).

Enclosed is a copy of the Sample and Analysis Data Entry Form relevant to the samples we recently received from you. Please compare the information on the form to assure that it is consistent with your request. If there is any inconsistency or if you have any questions on your project, please call the PACE Contact indicated on Sample and Analysis Data Entry Form. The PACE Contact has primary responsibility for monitoring the progress of your project through the laboratory.

It is also part of PACE Laboratories, Inc. Standard Operating Procedure to return all samples pertaining to the information attached that are hazardous materials or hazardous wastes to the client at project completion. PACE Laboratories, Inc. reserves the right to return or dispose of all samples at our discretion.

We have implemented this procedure to better serve our clients, and would appreciate any comments you may have.

Sincerely,

Vice President, Corporate Quality

Exhibit 12

SAMPLE DISPOSITION FORM

_____

_____

_____

_____

_____

Date removed: _____
Initials: _____

Date shipped: _____
Initials: _____

RE: Client Project ID: _____

PACE Project No.: _____

Sample ID _____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

Dear_____:

All requested analyses of the samples for the above referenced project have been completed. Enclosed are the remaining portions of the samples which are being returned to you for final disposition.

If you have any questions, please call me.

Sincerely,

_____
Project Manager

3. **Procedure for Use of the Sample Disposition Form**

a. The project manager separates the sample disposition form from the report package, signs the form, and routes it to the sample custodian. If the sample is water or wastewater and non-hazardous, the project manager may wish to properly dispose of the waste.

- If the project requires, the project manager may hold the form for an acceptable amount of time before return or disposal.

- It is important that this form be used and not discarded. It is part of the internal chain-of-custody and is filed with the project report.

- The project manager will use action codes such as:

  1 = Return to client 2 = In house disposal
  C = Clean D = Dirty

  As a general rule, soil samples will be returned and water samples will be disposed of in-house. Water samples which are highly contaminated will be returned. Preserved samples, VOA's, and extracted/tainted samples will not be returned to the client. Therefore, it is necessary to note clean or dirty to facilitate handling. If a sample has an extremely high level of contamination, note the contaminant.

  For In-House Sample Disposal

  All preserved - Clean - Neutralize/sink
  Dirty - Toxic waste

  Un-preserved water - Clean - Sink
  Dirty - Toxic waste

  Soil/Sludge - Clean - Trash
  Dirty - Toxic waste

  All VOA's - Clean - Neutralize/sink
  Dirty - Toxic waste

All Extracted/Tainted Samples

CAM Extracts - Clean - Neutralize/sink
Dirty - Acid metals waste

Other Extracts - Toxic waste

Liquid/Unknown Misc. - Project manager specify

- Project manager will complete the sample disposition form and route it back to invoicing.
- The invoicing department will put completed sample disposition form in sample control mailbox.

b. Upon receipt of the Sample Disposition Form by the sample custodian personnel, the custodian personnel will remove the samples from storage using the information provided on the form.

- If the Sample Disposition Form indicates "Dump," the sample custodian personnel will remove them from storage and place them at a sample disposal station for proper disposal. The process of disposal is performed by the sample custodian personnel or appropriate laboratory staff. The Sample Disposition Form is signed and dated by the sample custodian personnel, then routed to the file clerk for filing with other project information.
- If the samples are to be returned, the sample custodian removes the sample or samples from storage, initials and dates the Sample Disposition Form. The samples, the Sample Disposition Form, and a copy of the client's chain-of-custody are then delivered to the shipping clerk by the sample custodian for return to the client.

c. Upon receipt of the samples and Sample Disposition Form, the shipping clerk signs and dates the form.

The Sample Disposition Form is copied and the original form with the samples is returned to the client, along with a copy of the client's chain-of-custody. A copy of the Sample Disposition Form and the original chain-of-custody is routed to the file clerk for filing with other project information (QC file).

- The shipping clerk labels the box with an appropriate hazard label and ships the samples back to the client using UPS or any other requested manner for shipment. (Note: It is important for proper packaging to prevent breakage during shipment.)

- All shipping costs will be charged against the appropriate project number.

d. Upon receipt of Sample Disposition Form, the file clerk files it with other project related information.

4. **Hazardous Material/Waste Sample Disposition Option**

The preferred method for disposition of excess hazardous material/waste samples is to return the excess sample to the client. It may not be feasible to return samples in all cases or the client may require PACE to dispose of excess samples. PACE will dispose of excess hazardous samples when required and will charge a disposal fee to recover costs for management and disposal.

Procedure for Disposal Option for Excess Hazardous Material/Waste Samples:

a. The project manager informs the client that excess sample disposal will require an additional charge.

b. When analyses are complete, the project manager indicates disposal as the option on the Sample Disposition Form and completes and attaches Hazardous Material/Waste Disposal Option Form (Exhibit 13). An entry is to be made in all fields of this form as it will determine the basis for lab packing and disposal.

c. The project manager routes the Disposal Option Form to sample check-in.

d. The project manager is responsible for billing the client for disposal.

e. The sample custodian is responsible for maintaining a file of Disposal Option Forms for all samples awaiting disposal. Hazardous material/waste samples are stored in safe manner, segregated by compatibility groups as indicated by the hazardous waste disposal SOP.

EXHIBIT 13

HAZARDOUS MATERIAL/WASTE SAMPLE DISPOSAL OPTION FORM

Client _____ Client Project ID _____

Contact _____ PACE Project # _____

Address _____ Project Manager _____

_____ Report Sent Date _____

Phone # _____ Pull Sample Date _____

_____

Sample #	Matrix	Location	Disposal Method	Charge

Remarks 1=Return to Client C=Clean
2=In House Disposal D=Dirty

Removed from Refrigerator (initial/date) _____
Returned to Client (initial/date) _____
Disposed of Samples (initial/date) _____

f. The Quality Control Manager is responsible for reviewing accumulated samples awaiting disposal and initiating the disposal process when warranted. The Field Services, Inorganic, Organic, and Environmental Services Departments cooperate and participate in the disposal process. (For compatibility and compositing, see the Hazardous Waste Disposal SOP.)

VIII. CALIBRATION PROCEDURES AND FREQUENCY

Most measurements taken in the laboratory are based upon comparison to reference standards as analyzed by the standard method. The standard results are utilized to generate calibration curves or calibration factors. The results of the sample analysis are then quantified.

All instruments are calibrated using standard solutions of known concentrations. The standards are prepared from certified reference materials and are generally traceable back to NIST. Refer to Section XI for additional information.

Continuous calibration is verified by analysis of calibration standards or laboratory control samples from different sources at regular intervals. Recalibration is performed at specified time intervals or when indicated by the continuous verification procedure or as required by the method. Typical acceptance criteria for some common organic analyses are summarized in Table 2.

Forms to document initial and continuing calibration have been developed (Exhibits 14 and 15).

Refer to Section IX for additional calibration information and frequency as specified in the specific analytical methods.

TABLE 2 CALIBRATION AND QC ACCEPTANCE CRITERIA[a] FOR HALOGENATED VOLATILE ORGANICS

Parameter	Range for Q (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range P, P_s (%)
Bromodichloromethane	15.2-24.8	4.3	10.7-32.0	42-172
Bromoform	14.7-25.3	4.7	5.0-29.3	13-159
Bromomethane	11.7-28.3	7.6	3.4-24.5	D-144
Carbon tetrachloride	13.7-26.3	5.6	11.8-25.3	43-143
Chlorobenzene	14.4-25.6	5.0	10.2-27.4	38-150
Chloroethane	15.4-24.6	4.4	11.3-25.2	46-137
2-Chloroethylvinyl ether	12.0-28.0	8.3	4.5-35.5	14-186
Chloroform	15.0-25.0	4.5	12.4-24.0	49-133
Chloromethane	11.9-28.1	7.4	D-34.9	D-193
Dibromochloromethane	13.1-26.9	6.3	7.9-35.1	24-191
1,2-Dichlorobenzene	14.0-26.0	5.5	1.7-38.9	D-208
1,3-Dichlorobenzene	9.9-30.1	9.1	6.2-32.6	7-187
1,4-Dichlorobenzene	13.9-26.1	5.5	11.5-25.5	42-143
1,1-Dichloroethane	16.8-23.2	3.2	11.2-24.6	47-132
1,2-Dichloroethane	14.3-25.7	5.2	13.0-26.5	51-147
1,1-Dichloroethene	12.6-27.4	6.6	10.2-27.3	28-167
trans-1,2-Dichloroethene	12.8-27.2	6.4	11.4-27.1	38-155
1,2-Dichloropropane	14.8-25.2	5.2	10.1-29.9	44-156
cis-1,3-Dichloropropene	12.8-27.2	7.3	6.2-33.8	22-178
trans-1,3-Dichloropropene	12.8-27.2	7.3	6.2-33.8	22-178
Methylene chloride	15.5-24.5	4.0	7.0-27.6	25-162
1,1,2,2-Tetrachloroethane	9.8-30.2	9.2	6.6-31.8	8-184
Tetrachloroethene	14.0-26.0	5.4	8.1-29.6	26-162
1,1,1-Trichloroethane	14.2-25.8	4.9	10.8-24.8	41-138
1,1,2-Trichloroethane	15.7-24.3	3.9	9.6-25.4	39-136
Trichloroethene	15.4-24.6	4.2	9.2-26.6	35-146
Trichlorofluoromethane	13.3-26.7	6.0	7.4-28.1	21-156
Vinyl chloride	13.7-26.3	5.7	8.2-29.9	28-163

Q = Concentration measured in QC check sample, in ug/L.

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

P, P_s = Percent recovery measured.

D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 601 and were calculated assuming a QC check sample concentration of 20 ug/L.

TABLE 2. CALIBRATION AND QC ACCEPTANCE CRITERIA[a] FOR AROMATIC VOLATILE ORGANICS

Parameter	Range for Q (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range P, P_s (%)
Benzene	15.4-24.6	4.1	10.0-27.9	39-150
Chlorobenzene	16.1-23.9	3.5	12.7-25.4	55-135
1,2-Dichlorobenzene	13.6-26.4	5.8	10.6-27.6	37-154
1,3-Dichlorobenzene	14.5-25.5	5.0	12.8-25.5	50-141
1,4-Dichlorobenzene	13.9-26.1	5.5	11.6-25.5	42-143
Ethylbenzene	12.6-27.4	6.7	10.0-28.2	32-160
Toluene	15.5-24.5	4.0	11.2-27.7	46-148

Q = Concentration measured in QC check sample, in ug/L.

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

P, P_s = Percent recovery measured.

[a]Criteria are from 40 CFR Part 136 for Method 602 and were calculated assuming a QC check sample concentration of 20 ug/L. These criteria are based directly upon the method performance data in Table 4. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 1.

TABLE 2. QC ACCEPTANCE CRITERIA[a] FOR ORGANOCHLORINE PESTICIDES & PCB's

Parameter	Test conc. (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range P, P_s (%)
Aldrin	2.0	0.42	1.08-2.24	42-122
α-BHC	2.0	0.48	.98-2.44	37-134
β-BHC	2.0	0.64	0.78-2.60	17-147
δ-BHC	2.0	0.72	1.01-2.37	19-140
γ-BHC	2.0	0.46	0.86-2.32	32-127
Chlordane	50	10.0	27.6-54.3	45-119
4,4'-DDD	10	2.8	4.8-12.6	31-141
4,4'-DDE	2.0	0.55	1.08-2.60	30-145
4,4'-DDT	10	3.6	4.6-13.7	25-160
Dieldrin	2.0	0.76	1.15-2.49	36-146
Endosulfan I	2.0	0.49	1.14-2.82	45-153
Endosulfan II	10	6.1	2.2-17.1	D-202
Endosulfan Sulfate	10	2.7	3.8-13.2	26-144
Endrin	10	3.7	5.1-12.6	30-147
Heptachlor	2.0	0.40	0.86-2.00	34-111
Heptachlor epoxide	2.0	0.41	1.13-2.63	37-142
Toxaphene	50	12.7	27.8-55.6	41-126
PCB-1016	50	10.0	30.5-51.5	50-114
PCB-1221	50	24.4	22.1-75.2	15-178
PCB-1232	50	17.9	14.0-98.5	10-215
PCB-1242	50	12.2	24.8-69.6	39-150
PCB-1248	50	15.9	29.0-70.2	38-158
PCB-1254	50	13.8	22.2-57.9	29-131
PCB-1260	50	10.4	18.7-54.9	8-127

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

P, P_s = Percent recovery measured.

D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 608. These criteria are based directly upon the method performance data in Table 4. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 4.

TABLE 2. CALIBRATION AND QC ACCEPTANCE CRITERIA[a] FOR GC/MS VOLATILE ORGANICS

Parameter	Range for Q (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range p, p_s (%)
Benzene	12.8-27.2	6.9	15.2-26.0	37-151
Bromodichloromethane	13.1-26.9	6.4	10.1-28.0	35-155
Bromoform	14.2-25.8	5.4	11.4-31.1	45-169
Bromomethane	2.8-37.2	17.9	D-41.2	D-242
Carbon tetrachloride	14.6-25.4	5.2	17.2-23.5	70-140
Chlorobenzene	13.2-26.8	6.3	16.4-27.4	37-160
2-Chloroethylvinyl ether	D-44.8	25.9	D-50.4	D-305
Chloroform	13.5-26.5	6.1	13.7-24.2	51-138
Chloromethane	D-40.8	19.8	D-45.9	D-273
Dibromochloromethane	13.5-26.5	6.1	13.8-26.6	53-149
1,2-Dichlorobenzene	12.6-27.4	7.1	11.8-34.7	18-190
1,3-Dichlorobenzene	14.6-25.4	5.5	17.0-28.8	59-156
1,4-Dichlorobenzene	12.6-27.4	7.1	11.8-34.7	18-190
1,1-Dichloroethane	14.5-25.5	5.1	14.2-28.4	59-155
1,2-Dichloroethane	13.6-26.4	6.0	14.3-27.4	49-155
1,1-Dichloroethene	10.1-29.9	9.1	3.7-42.3	D-234
trans-1,2-Dichloroethene	13.9-26.1	5.7	13.6-28.4	54-156
1,2-Dichloropropane	6.8-33.2	13.8	3.8-36.2	D-210
cis-1,3-Dichloropropene	4.8-35.2	15.8	1.0-39.0	D-227
trans-1,3-Dichloropropene	10.0-30.0	10.4	7.6-32.4	17-183
Ethyl benzene	11.8-28.2	7.5	17.4-26.7	37-162
Methylene chloride	12.1-27.9	7.4	D-41.0	D-221
1,1,2,2-Tetrachloroethane	12.1-27.9	7.4	13.5-27.2	46-157
Tetrachloroethene	14.7-25.3	5.0	17.0-26.6	64-148
Toluene	14.9-25.1	4.8	16.6-26.7	47-150
1,1,1-Trichloroethane	15.0-25.0	4.6	13.7-30.1	52-162
1,1,2-Trichloroethane	14.2-25.8	5.5	14.3-27.1	52-150
Trichloroethene	13.3-26.7	6.6	18.5-27.6	71-157
Trichlorofluoromethane	9.6-30.4	10.0	8.9-31.5	17-181
Vinyl chloride	0.8-39.2	20.0	D-43.5	D-251

Q = Concentration measured in QC check sample, in ug/L.
s = Standard deviation of four recovery measurements, in ug/L.
$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.
p, p_s = Percent recovery measured.
D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 624 and were calculated assuming a QC check sample concentration of 20 ug/L. These criteria are based directly upon the method performance data in Table 7. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 7.

TABLE 2. QC ACCEPTANCE CRITERIA[a] FOR GC/MS SEMIVOLATILE ORGANICS

Parameter	Test conc. (ug/L)	Limit for s (ug/L)	Range for $\bar{x}$ (ug/L)	Range p, p_s (%)
Acenaphthene	100	27.6	60.1-132.3	47-145
Acenaphthylene	100	40.2	53.5-126.0	33-145
Aldrin	100	39.0	7.2-152.2	D-166
Anthracene	100	32.0	43.4-118.0	27.133
Benzo(a)anthracene	100	27.6	41.8-133.0	33-143
Benzo(b)fluoranthene	100	38.8	42.0-140.4	24-159
Benzo(k)fluoranthene	100	32.3	25.2-145.7	11-162
Benzo(a)pyrene	100	39.0	31.7-148.0	17-163
Benzo(ghi)perylene	100	58.9	D-195.0	D-219
Benzyl butyl phthalate	100	23.4	D-139.9	D-152
β-BHC	100	31.5	41.5-130.6	24-149
δ-BHC	100	21.6	D-100.0	D-110
Bis(2-chloroethyl)ether	100	55.0	42.9-126.0	12-158
Bis(2-chloroethoxy)methane	100	34.5	49.2-164.7	33-184
Bis(2-chloroisopropyl)ether	100	46.3	62.8-138.6	36-166
Bis(2-ethylhexyl)phthalate	100	41.1	28.9-136.8	8-158
4-Bromophenyl phenyl ether	100	23.0	64.9-114.4	53-127
2-Chloronaphthalene	100	13.0	64.5-113.5	60-118
4-Chlorophenyl phenyl ether	100	33.4	38.4-144.7	25-158
Chrysene	100	48.3	44.1-139.9	17-168
4,4'-DDD	100	31.0	D-134.5	D-145
4,4'-DDE	100	32.0	19.2-119.7	4-136
4,4'-DDT	100	61.6	D-170.6	D-203
Dibenzo(a,h)anthracene	100	70.0	D-199.7	D-227
Di-n-butyl phthalate	100	16.7	8.4-111.0	1-118
1,2-Dichlorobenzene	100	30.9	48.6-112.0	32-129
1,3-Dichlorobenzene	100	41.7	16.7-153.9	D-172
1,4-Dichlorobenzene	100	32.1	37.3-105.7	20-124
3,3'-Dichlorobenzidine	100	71.4	8.2-212.5	D-262
Dieldrin	100	30.7	44.3-119.3	29-136
Diethyl phthalate	100	26.5	D-100.0	D-114
Dimethyl phthalate	100	23.2	D-100.0	D-112
2,4-Dinitrotoluene	100	21.8	47.5-126.9	39-139
2,6-Dinitrotoluene	100	29.6	68.1-136.7	50-158
Di-n-octylphthalate	100	31.4	18.6-131.8	4-146
Endosulfan sulfate	100	16.7	D-103.5	D-107
Endrin aldehyde	100	32.5	D-188.8	D-209
Fluoranthene	100	32.8	42.9-121.3	26-137
Fluorene	100	20.7	71.6-108.4	59-121
Heptachlor	100	37.2	D-172.2	D-192
Heptachlor epoxide	100	54.7	70.9-109.4	26.155
Hexachlorobenzene	100	24.9	7.8-141.5	D-152
Hexachlorobutadiene	100	26.3	37.8-102.2	24-116
Hexachloroethane	100	24.5	55.2-100.0	40-113

TABLE 2. QC ACCEPTANCE CRITERIA[a] FOR GC/MS SEMIVOLATILE ORGANICS (CONT.)

Parameter	Test conc. (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range p, p_s (%)
Indeno(1,2,3-cd)pyrene	100	44.6	D-150.9	D-171
Isophorone	100	63.3	46.6-180.2	21-196
Naphthalene	100	30.1	35.6-119.6	21-133
Nitrobenzene	100	39.3	54.3-157.6	35-180
N-Nitrosodi-n-propylamine	100	55.4	13.6-197.9	D-230
PCB-1260	100	54.2	19.3-121.0	D-164
Phenanthrene	100	20.6	65.2-108.7	54-120
Pyrene	100	25.2	69.6-100.0	52-115
1,2,4-Trichlorobenzene	100	28.1	57.3-129.2	44-142
4-Chloro-3-methylphenol	100	37.2	40.8-127.9	22-147
2-Chlorophenol	100	28.7	36.2-120.4	23-134
2,4-Chlorophenol	100	26.4	52.5-121.7	39-135
2,4-Dimethylphenol	100	26.1	41.8-109.0	32-119
2,4-Dinitrophenol	100	49.8	D-172.9	D-191
2-Methyl-4,6-dinitrophenol	100	93.2	53.0-100.0	D-181
2-Nitrophenol	100	35.2	45.0-166.7	29-182
4-Nitrophenol	100	47.2	13.0-106.5	D-132
Pentachlorophenol	100	48.9	38.1-151.8	14-176
Phenol	100	22.6	16.6-100.0	5-112
2,4,6-Trichlorophenol	100	31.7	52.4-129.2	37-144

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

p, p_s = Percent recovery measured.

D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 625. These criteria are based directly on the method performance data in Table 7. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 7.

INITIAL CALIBRATION DATA
EXTRACTABLE 8080/608 COMPOUNDS
EXHIBIT 14

CALIBRATION DATE: COLUMN ID:

INSTRUMENT ID: DETECTOR ID:

MAXIMUM % RSD IS 20%

Standard ID	#	#	#		
Compound	CF 20	CF 40	CF 60	$\overline{CF}$	%RSD
Alpha-BHC					
Beta- BHC					
Lindane					
Delta- BHC					
Heptachlor					
Aldrin					
Heptachlor Epoxide					
Endosulfan I					
DDE/Dieldrin					
Endrin					
Endosulfan II					
4,4'-DDD					
Endrin Aldehyde					
4,4'-DDT					
Endosulfan Sylfate					

CF=CALIBRATION FACTOR= $\frac{\text{Total ng of Standard}}{\text{Area}}$

$\overline{CF}$ = AVERAGE CALIBRATION FACTOR = CF/n

%RSD = RELATIVE STANDARD DEVIATION = $\frac{\text{(Standard Dev.) (100)}}{\overline{CF}}$

CONTINUING CALIBRATION CHECK
Semi-Volatile Compounds
EXHIBIT 15

CASE NO: _____ CALIBRATION DATE: _____

LABORATORY NAME: PACE LABORATORIES TIME: _____

CONTRACT/PROJECT NO. _____ ANALYST: _____

INSTRUMENT I.D.: _____ INITIAL CALIBRATION DATE: ___

MAXIMUM %D FOR CCC IS 10%

COMPOUND	CF	CF	%D	CCC
Alpha-BHC				
* Beta-BHC				
Lindane				
Delta-BHC				
Heptachlor				
* Aldrin				
Heptachlor Epoxide				
* Endosulfan I				
DDF/Dieldrin				
* Endrinion				
Endosulfan II				
4,4'-DDD				
Endrin Aldehyde				
4,4'-DDT				
Endosulfan Sulfate				
Aroclor 1016				
Aroclor 1221				
Aroclor 1232				
Aroclor 1242				
Aroclor 1248				
Aroclor 1254				
Aroclor 1260e				
Chlordane				
Toxaphene				
Methoxychor				
DBC				

CF -Calibration Factor from daily standard at ug/L
CF-Average Calibration Factor from initial calibration Form VI
%D-Percent Difference
CCC-Calibration Check Compounds

IX. ANALYTICAL PROCEDURES

Analytical methods employed at PACE can be EPA methodologies from the Federal Register and SW 846 (References 2 and 3) or approved equivalent methods. When there is no approved EPA method, industrial methods are used. A list of analytical methods utilized at PACE is as follows:

A. LIST OR ANALYTICAL METHODS

1. Organic Analyses

Parameter	Method	DW	WW Method	SW 846	Spec.
Purgeable Halocarbons	GC	502.1/502.2	601	8010	
Non-Halogenated Volatile Organics	GC			8015	
Purgeable Aromatics and Unsaturated Organics	GC	503.1/502.2	602	8020	
Acrolein & Acrylonitrile	GC		603	8030	
Phenols	GC	515.1	604	8040	
Benzidines	HPLC		605		
Phthalate Esters	GC		606	8060	
Nitrosamines	GC		607		
Organochlorine Pesticides and PCBs	GC	508/505/508A 507/515.1	608/608.1 608.2	8080	CA Mod 8080 MN. 570A
Nitroaromatics and Isophorone	GC		609	8090	
Polynuclear Aromatic Hydrocarbons	HPLC/GC	502.2/503.1	610	8310/ 8100	
Haloethers	GC		611		
Alachlor, Atrazine, Chlordane, Hepatchlor, Heptachlor Epoxide, Lindane, Methoxychlor, Toxaphene, and PCBs (as Aroclors)	GC	505/507	645		MN 570A

Parameter	Method	DW	WW Method	SW 846	Spec.
Chlorinated Hydrocarbons	GC		612	8120	
2, 3, 7, 8 - TCDD	GC/MS		613		
Volatile Organics					(MN)465C
Base/Neutrals & Acids	GC/MS	525 (NCA)	625	8250/8270	
Organophosphorus Pesticides	GC	507	614/622	8140/ 8220	(MN)570A (CA)AB1803
Chlorinated Herbicides	GC	515.1	615/608.1/ 608.2	8150	(MN)574A (CA)509B
EDB and DBCP	GC	504			(CA) DOHS
Volatile Organic Compounds	GC/MS	524.2/524.1	624	8240	
Carbamates & Urea & Pesticides	HPLC	531.1	632		(CA)AB1803 (MN)572A
Fuel Hydrocarbons & BTEX	GC		602	8020	(CA) Mod. 8015
Alachlor, Atrazine	GC	507/505	619/645		(CA)AB1803 (MN)570A
Chlordane, Heptachlor, Heptachlor Expoxide, Lindane; Methoxychlor	GC	508/505	608/617	8080	
Aldicarb; Aldicarb sulfone; Aldicarb sulfoxide; Carbofuran	GC	531.1			(CA)AB1803

2. INORGANIC ANALYSES

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	ASTM	SW 846
A. Non Metals					
Acidity	Potentiometric Titration	402	305.1	D1067-82	
Alkalinity	Potentiometric Titration	403	310.1	D1067-82	
Bacteria,					
Total Coliform	Membrane Filter	909A			9132
Fecal Coliform	Membrane Filter	908C			
Fecal Strept.	Membrane Filter	910A			
Total Plate Count	Agar Medium	907			
Biochemical Oxygen Demand, 5-Day	Winkler Electrode	507 507	405.1		
Boron	Curcumin 405-A	404A	212.3		
	ICP		200.7		6010
Chemical Oxygen Demand	Dichromate Reflux (High)	508A	410.1	D1252-83	
	Dichromate Reflux (Low)	508A	410.2	D1252-83	
Chloride	Mercuric Nitrate	407B	325.3	D512-81	9252
	Auto. Ferricyanide	407D	325.2		9251
	Titration	407A			
Chlorine, Residual	Amperometric Titration	408C	330.1 330.5	D1253-76	
	Colorimetric	408E			
Color	Visual Comparison	204A	110.2		
Cyanide, Total	Pyridine-Barbitutic Acid, Colorimetric	412D	335.2	D2036-82	9010
Amenable	Chlorination-Colorimetric	412F	335.1	D2036-82	9010

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	ASTM	SW 846
Flouride, Total	Distillation-Electrode	413A/B	340.2	D1179-80	
Flouride, Diss.	Electrode	413B	340.2	D1179-80	
Hardness, Total	EDTA Titration Calculation	314B	130.2	D1126-80	
Hardness, Calcium	EDTA Titration	303A	242.1	D511-84	
Nitrogen,					
Ammonia	Distillation Titration	417D	350.2		
	Potentiometric		350.3		
Kjeldahl	Digestion Distillation	420B	351.3	D3590-84	
Nitrate	Automated Cadmium	418F	353.2	D3867-85	9200
	Brucine Sulfate		352.1	D091-71	
Nitrite	Automated Cadmium	418F	353.2	D3867-85	
	Colorimetric	419			
Organic	Kjeldahl-NH_3	420A	351.3	D3590-84	
	Kjeldahl-Potentiometric		351.4		
Oil & Grease	Soxhlet	503C			
	Partition-Gravimetric	503A	413.1		9070/ 9071
Oxygen	Winkler	421B	360.2	D888-81	
Dissolved	Electrode	421F	360.1		
pH (Hydrogen Ion)	Electrode	423	150.1	D1293-84	9040
Phenol	Distillation-Extraction Colorimetric		420.1	D1783-80	9066
Phosphorus,	Persulfate Digestion-	424C/F	365.2	D515-82	
Total	Ascorbic Acid Reduc.				
Ortho	Ascorbic Acid Reduc.	424F	365.2	D515.82	
Silica,	Molybdosilicate	425C	370.1	D859-80	
Dissolved	ICP		200.7		
Solids					
Total	Gravimetric	209A	160.3		
Total Volatile	Gravimetric	209D	160.4		
Suspended	Gravimetric	209C	160.2		
Suspended Volatile	Gravimetric	209D	160.4		
Total Dissolved	Gravimetric	209B	160.1		
Settleable	Gravimetric	209E	160.5		

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	ASTM	SW 846
Specific Conductance	Meter	205	120.1	D1125.82	9040
Sulfate	Ion Chromatography	426C	375.4	D516-82	
	Automated Methyl Thymol Blue		375.2		9036
Sulfide	Colorimetric	427C	376.2		9030
	Titration	427D	376.1		
Sulfite	Titration	428A	377.1	D1339-84	
Surfactants (MBAS)	Methylene Blue	512B	425.1	D2330-82	
Turbidity	Meter	214A	180.1	D1889-18	

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1979	SW 846
B. Metals				
Aluminum	AA-Direct Aspiration	303C	202.1	7020
	AA-Furnace	304	202.2	
	ICP-AES		200.7	6010
Antimony	AA-Direct Aspiration	303A	204.1	7040
	AA-Furnace	304	204.2	7041
	ICP-AES		200.7	6010
Arsenic	AA-Gaseous Hydride	303E	206.3	7061
	AA-Furnace	304	206.2	7060
	ICP-AES		200.7	6010

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	SW 846
Barium	AA-Direct Aspiration	303C	208.1	7080
	AA-Furnace	304	208.2	7081
	ICP-AES		200.7	6010
Beryllium	AA-Direct Aspiration	303C	210.1	7090
	AA-Furnace	304	210.2	7091
	ICP-AES		200.7	6010
Cadmium	AA-Direct Aspiration	303A	213.1	7130
	AA-Furnace	304	213.2	7131
	ICP-AES		200.7	6010
Calcium	AA-Direct Aspiration	303A	215.1	7140
	AA-Furnace	311C	215.2	
	ICP-AES		200.7	6010
Chromium,				
Total	AA-Direct Aspiration	303A	218.1	7190
Hexavalent	AA-Furance	304	218.2	7191
	ICP AES		200.7	6010
	Colorimetric	312B		7196
	MIBK Extraction			7197
Cobalt	AA-Direct Aspiration	303A	219.1	7200
	AA-Furnace	304	219.2	7201
	ICP-AES		200.7	6010
Copper	AA-Direct Aspiration	303A	220.1	7210
	AA-Furnace	304	220.2	7211
	ICP-AES		200.7	6010
Iron	AA-Direct Aspiration	303B	236.1	7380
	AA-Furnace	304	236.2	7381
	ICP-AES		200.7	6010
Lead	AA-Direct Aspiration	303A	239.1	7240
	AA-Furnace	304	239.2	7241
	ICP-AES		200.7	6010

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	SW 846
Lithium	AA-Direct Aspiration	317B		
Magnesium	AA-Direct Aspiration	303A	242.1	7450
	ICP AES		200.7	6010
Manganese	AA-Direct Aspiration	303A	243.1	7460
	AA-Furnace	304	243.2	7461
	ICP AES		200.7	6010
Mercury	AA-Cold Vapor	303F	245.1	7470 or 7471
Molybdenum	AA-Direct Aspiration	303C	246.1	7480
	AA-Furnace	304	246.2	7481
Nickel	AA-Direct Aspiration	303A	249.1	7520
	AA-Furnace	304	249.2	
	ICP AES		200.7	6010
Potassium	AA-Direct Aspiration	303A	258.1	7610
Selenium	AA-Gaseous Hydride	303E	270.3	7740
	AA-Furnace	304	270.2	7741
	ICP AES		200.7	6010
Silver	AA-Direct Aspiration	303A	272.1	7760
	AA-Furnace	304	272.2	7761
	ICP AES		200.7	6010
Sodium	AA-Direct Aspiration	303A	273.1	7770
	ICP AES		200.7	6010
Strontium	AA-Direct Aspiration	303A		7780
Thallium	AA-Direct Aspiration	303A	279.1	7840
	AA-Furnace	304	279.2	7841
	ICP AES		200.7	6010
Tin	AA-Direct Aspiration	303A	282.1	7870
	AA-Furnace	304	282.2	

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	SW 846
Titanium	AA-Direct Aspiration	303C	283.1	
	AA-Furnace	304	283.2	
Vanadium	AA-Direct Aspiration	303C	286.1	7910
	AA-Furnace	304	286.2	7911
	ICP AES		200.7	6010
Zinc	AA-Direct Aspiration	303A	289.1	7950
	AA-Furnace	304	289.2	7951
	ICP AES		200.7	6010

3. WASTES & OIL ANALYSIS

Parameter	Method	Standard Methods 15th Ed.	ASTM	SW 846
% Ash	Gravimetric	209F		
% Chlorine	Bomb Calorimeter		D808-81	
Density	Gravimetric	213E		
Flash Point Closed Cup	Tag		D93-80	1010
Free Liquids	Paint Filter			9095
Heat of Combustion	Bomb Calorimeter		D240-76	
Leach Test. EP Toxicity	Extraction			1310
ASTM Water	Extraction		D3987-85	
% Sulfur	Bomb Calorimeter		D129-64	

Parameter	Method	Standard Methods 15th Ed.	ASTM
Viscosity	Saybolt		D88-81
% Water	Distillation		D95-83

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1982	SW 846
Sulfide, Total	Titration			9030
Reactive	Titration		261.23	Chap. 7 7.3.4.2
pH	Electrode			9040
Specific Conductance	Meter			9050
Specific Gravity	Mass Displacement	213E		
Cyanide, Total	Pyridine-Barbituitic Acid Colorimetic			9010
Amenable	Chlorination-Colorimetric			9010
Cyanide, Reactive	Pyridine-Barbitutic Acid Colorimetric		261.23	Chap. 7 7.3.3.2
TCLP			40CFR268	

4. **List of Sample Preparation Methods**

3510	Separatory Funnel Liquid - Extraction
3520	Continuous Liquid - Extraction
3540	Soxhlet Extraction
3550	Sonication Extraction
3580	Waste Dilution
5080	Purge and Trap
3005	Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by Flame AA or ICP
3010	Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by Flame AA or ICP
3020	Acid Digestion of Aqueous Samples and Extracts for Total Metals by Furnace AA
3050	Acid Digestion of Sediments, Soils, and Sludges

Method numbers refer to EPA Methods except:

1. S.M. = Standard Methods for the Examination of Water and Wastewater
2. USATHAMA = U.S. Army Toxic and Hazardous Materials Agency
3. NIOSH = Manual of Analytical Methods
4. Hach, Chevron, Calgon = Industrial Methods

B. GAS CHROMATOGRAPHY PROCEDURES

1. Calibration and Calibration Verification

All GC methods are calibrated by external calibration procedures using three to five standard concentrations, depending upon the method. A new calibration is performed at least once per month or as needed on routine analyses. Methods not utilized on a daily basis are calibrated before each run.

2. Laboratory Control Sample (LCS)

An EPA check sample is analyzed at least once per week, and when a new initial calibration is performed.

3. Matrix Spike

Performed at a minimum of every 20 samples or as required by either state or project-specific requirements.

4. Surrogate Spike

Surrogates are added to and analyzed for in every sample for methods 601, 602, 8010, 8020, 608, 8080, 8015, 615, 8150.

5. **Duplicate Sample Analysis**

Performed at a minimum of every 20 samples or as specified by state/project requirements. Many samples contain non-detectable amounts of the parameters to be measured, therefore, the matrix spike is duplicated. (Matrix Spike Duplicate)

6. **Blank Analysis**

The reagent/method blank must have no contaminants greater than the detection limit of the method. In the case of volatile organic analysis, common laboratory solvents may be present at a concentration of less than 5 times the MDL. Blank subtraction is normally not allowed by contract/project protocols, unless specified by terms of the contract/project.

7. **Other**

Method 608/8080 are also subject to the following QC criteria:

a. Combined breakdown of endrin and DDT may not exceed 20%. This is monitored through the daily analysis of an LCS containing these compounds.

b. Two LCS (each containing 1/2 the compounds of the method) are alternately analyzed after every tenth sample.

C. **GAS CHROMATOGRAPHY/MASS SPECTROMETRY PROCEDURES**

1. **Calibration and Continuing Calibration**

An internal three point calibration is performed when indicated by the continuing calibration. One check standard is analyzed at the beginning of each 12-hour shift to verify calibration. The acceptance limit for the check standard is 25% RSD. Recalibration is necessary from once per week to once per month. Fresh calibration standards must be prepared weekly.

2. **Validation of Mass Spectrometer**

The mass spectrometers are tuned at the start of each run period and at 12-hour intervals. The tuning procedure utilizes the EPA recommended compounds 4-bromofluorobenzene (BFB) for 624/8240 and decafluorotriphenyl phosphine (DFTPP) for 625/8270.

3. **Internal Standards**

All sample results are quantified using the internal standard technique described in EPA methods 624, 8240, 625, 8270. Three (VOA) or six (BNA) internal standard compounds are added to each sample immediately before analysis. The internal standard nearest the retention time of the analyte of interest is used in the quantitation of the analyte.

4. **Laboratory Control Sample**

An EPA check sample is analyzed at a minimum once every month. A standard is run every 12 hour shift.

5. **Matrix Spike and Matrix Spike Duplicate**

Performed at a minimum of every 20 samples or as specified by state/project requirements. This is the same procedure as the GC section.

6. **Surrogate Spikes**

Surrogate spiking compounds are added to and analyzed for, with every sample. A surrogate is a volatile sample prior to purging and prior to extracting a semi-volatile sample.

7. **Reagent/Method Blank**

VOA - one per 12-hour per shift
BNA - one per batch of samples extracted

Common laboratory solvents present in the blank at a concentration less than 5 times the MDL will be footnoted on the analysis report. Common solvents at greater concentrations or the presence of any contaminant not considered a common laboratory solvent at a concentration greater than the MDL indicates the need to re-extract/re-analyze the blank and associated samples.

D. **METALS PROCEDURES**

1. **Calibration and Calibration Verification**

All instruments are calibrated at the start of each run. The graphite furnace requires 4 point calibration. The Flame AA and ICP methods utilize a minimum of 3 points. Cold vapor analysis of mercury requires a 5 point calibration. Recalibration is performed after 50 samples, or more often if indicated by the laboratory control sample.

2. **Laboratory Control Sample**

Performed at a minimum of every 20 samples, or as specified by state/project requirements.

3. **Matrix Spike**

Performed at a minimum of every 20 samples, or as specified by state/project requirements.

4. **Duplicate Samples**

Performed at a minimum of every 20 samples, or as specified by state/project requirements.

5. **Blank Analysis**

a. Method Blank

If the concentration of the blank exceeds the MDL, all samples associated with the blank are redigested and reanalyzed concurrent with a new blank. Samples with a concentration greater than 10 times the blank are reported, without blank value correction.

b. Reagent Blank

Any reagent blank result greater than the MDL terminates the analysis until corrective action resolves the problem. For ICP metals, a negative blank value greater than two times the MDL also requires corrective action. In rare cases, if all corrective action fails to resolve the problem and the blank value still hovers at 1-3 times the MDL, the analyst may run the samples, report all values greater than 10 times the blank value, and correct the sample values less than that amount for the blank value.

E. **GENERAL CHEMISTRY PROCEDURES**

1. **Calibration and Verification**

All instruments are calibrated daily with 3-6 point curves, depending upon instrument requirements. The calibration is continuously verified throughout the run, with either a calibration standard or laboratory control standard inserted after every 10th sample.

2. **Laboratory Control Sample**

A laboratory control sample is analyzed at least once during each batch of samples.

3. **Matrix Spike and Duplicate Samples**

Performed at a minimum of every 20 samples, or as specified by state/project requirements.

F. RECORD KEEPING AND REVIEW

All records and data are stored in safe places such as metal cabinets or hard cover bound books.

The extractions section utilizes method-specific bound books to record all data pertaining to sample extraction and preparation. A copy of the extraction benchsheet is transferred to GC or GC/MS with each extracted sample (Exhibit 16 and 17).

The organic and inorganic departments utilize benchsheets, maintained by analysts; specific for injection data and instrument maintenance. Spectras and chromatograms are filed by acquisition date.

The individual analysts and technicians are responsible for maintaining accurate, legible records and logs in accordance with standard operating procedures. The supervisors are responsible for ensuring adherence to procedures.

Secondary review of all records and logs is performed periodically by someone other than the person generating the document, preferably the department supervisor. Evidence of secondary review is provided on the document as initials and review date by the secondary person.

See Section X for magnetic media storage.

Exhibit 16

PROJECT #

GC-MS EXTRACTABLES

BATCH #

Sample Location	Sample Number	Date/Time of Extraction	Initial Volume	Surrogate	Spike	Final Volume	Date of Conc.	% Emulsion	Comments	Extract Location

EXTRACTION METHOD

- Separatory Funnel ☐
- Continuous Liq/Liq ☐
- Soxhlet ☐
- Sonication ☐
- Other: _____ ☐

Spike #

Dup. Spike #

QUALITY CONTROL INFORMATION

Surrogate:

Spike:

ROUTING

Person Who:	Initial
Extracted	_____
Concentrated	_____
Supervisor	_____
GC/MS	_____

WPPWGJ5

Exhibit 17

PROJECT #

GC EXTRACTION

BATCH #

Location	Sample Number	Weight of Sample	Date & Time of Extraction	Final Volume	Date of Conc.	% Emulsion	Comments	Extraction Location	Column	NCLSON File	% Recovery	Date & Time

EXTRACTION METHOD

Separatory Funnel ☐

Continuous Liq/Liq ☐

Soxhlet ☐

Sonication ☐

Other: _____ ☐

Spike #

Dup. Spike #

QUALITY CONTROL INFORMATION

Surrogate:

Spike:

ROUTING

Person Who:	Initial
Extracted	_____
Concentrated	_____
Supervisor	_____
GC/MS	_____

G. ACCEPTANCE LIMITS AND CONTROL CHARTS

Acceptance criteria for quality control samples and instrument calibration/verification are summarized in Table 3.

TABLE #3

ACCEPTANCE CRITERIA FOR QUALITY CONTROL SAMPLES & INSTRUMENT CALIBRATION

	MATRIX SPIKE % RECOVERY	SURROGATE SPIKE % RECOVERY	RPD DUPLICATE SAMPLES	INITIAL CALIBRATION LINEARITY	CALIBRATION VERIFICATION	LCS/EPA QC SAMPLE
GC	Within calculated control limits*	Within calculated control limits	≤ maximum RPD acceptance limit	RSD ≤ 20%	± 15% of true value or initial response	±15% of true value or EPA limit
MS	Within calculated control limits*	Within calculated control limits	≤ maximum RPD acceptance limit	RSD ≤ 30%	± 30% of initial average RF	± 15% of true value or EPA limit
GENERAL CHEMISTRY	Within calculated control limits*	N/A	0-67 on samples < 10x MDL 0-20 on samples > 10x MDL MDL = Method Detection Limit	Correlation coefficient ≥ .995	± 10% of true value	± 15% of true value or EPA limit
METALS	Within calculated control limits*	N/A	0-67 on samples < 10x MDL 0-20 on samples > 10x MDL MDL = Method Detection Limit	Correlation coefficient of: ≥ .995 ≥ .995 :AA ≥ .995 :Cold Vapor	± 10% of true value	± 15% of true value or EPA limit

Establishment and Utilization of Acceptance Limits

X. DATA REDUCTION, VALIDATION AND REPORTING

Final results are entered into the LDMS system by the analyst, independently validated, and reviewed by the department supervisor for verification (Exhibit 18).

Result verification sheets are attached to the QC files and reviewed by the QC manager. After QC file review by the QC manager, the department manager verifies the completeness and the validity of the report. When all required analyses on all of the samples in a project are complete, entered and verified, a report is generated. The report goes to the project manager for review. Each project is assigned to a project manager after samples are received at PACE. The project manager is responsible for tracking sample progress while in-house and ensuring timely analysis.

When the data re complete, the project manager reviews the final report according to these criteria:

- Reasonableness of data, i.e., whether the various sample analyses results make sense when compared to each other. Analyses such as BOD, COD, amount of organic contamination, general mineral balances, volatile organics measured by different methods, pH and electrical conductivity, and other analytical interrelationships are compared. Data on samples within the same project number are compared and if descriptive information about the samples is available, then it may be concluded that the results are reasonable in comparison to each other.

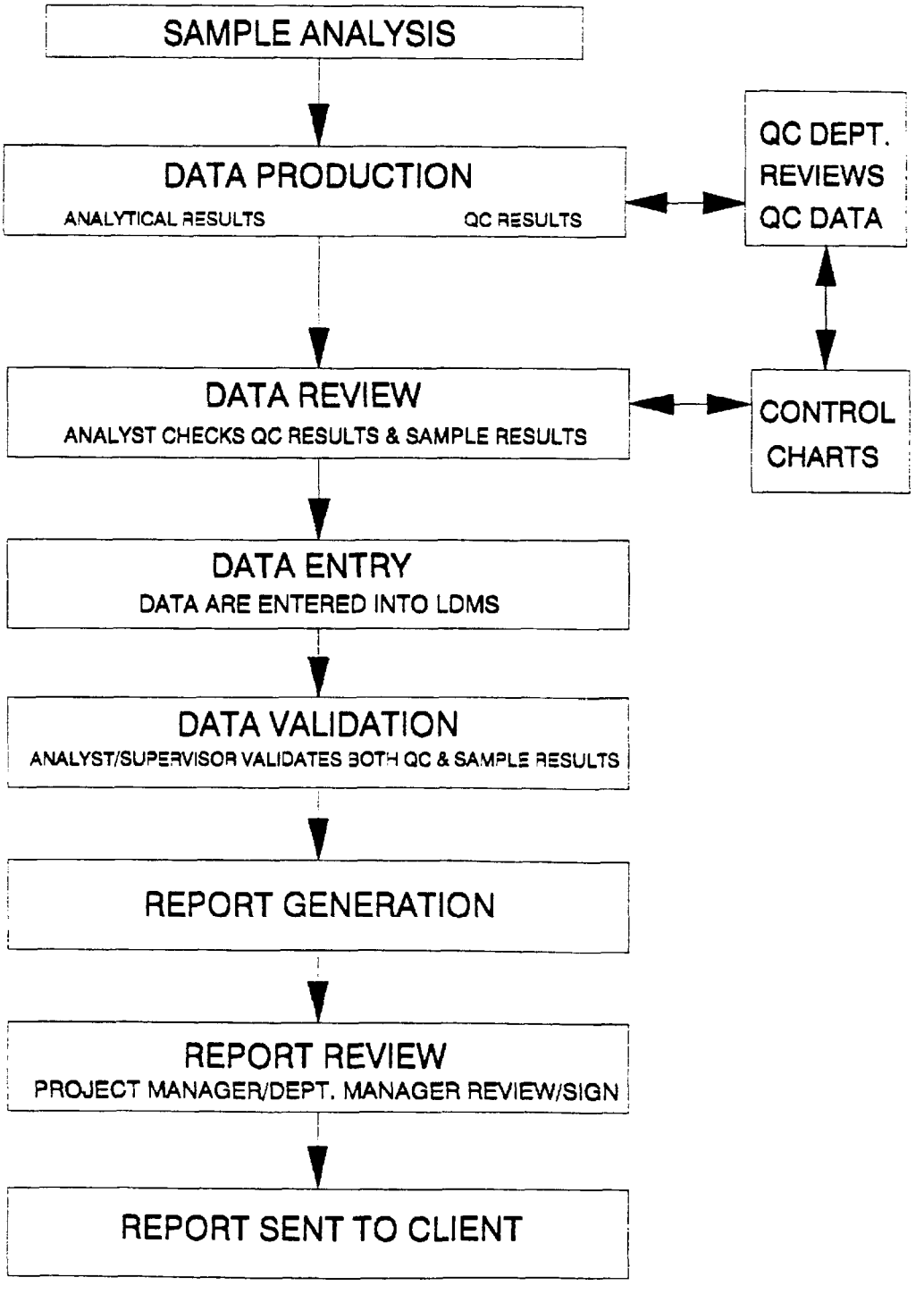
The report requires the signature of the project manager and the department manager. Client questions about the final report may be directed to these individuals or the Client Services manager when appropriate.

- Data Storage

  Data and reports are archived onto computer tape and written in documents for either off-site storage within a secured building, or within a locked storage cabinet.

EXHIBIT 18

LABORATORY DATA FLOW CHART



XI. INTERNAL QUALITY CONTROL

The Quality Assurance Plan is a document that reflects the actual operating and quality control programs in use at PACE. The reliability and credibility of analytical results is established by inclusion of a program of randomly scheduled replicate analyses, analysis of standard of spiked samples, and the cooperative analysis of split samples by several laboratories. These quality control checks are an integral part of the sampling and analytical plan.

Quality assurance, as practiced at PACE, consists of general quality control and assessment procedures that are adapted to the specific operating conditions within each section. The general elements of quality control are outlined below.

A. BLANK ANALYSIS

Reagent/Method Blanks: A reagent blank consists of laboratory pure water and any reagents added to a sample during analysis only, or straight solvent. A method blank is a water or soil blank which undergoes all of the preparation procedures applied to a sample (i.e., extraction, digestion).

It is standard policy throughout the laboratory to prepare and analyze a reagent or method blank (whichever is appropriate) with each sample batch. Separate water and soil method blanks are prepared for mixed matrix batches.

Reagent blanks may also be inserted at regular intervals on large (20 samples) batches, or after highly concentrated samples to check for carryover/contamination. For methods utilizing surrogate compounds, the surrogates are added to all blanks and are subject to meeting acceptance criteria.

A trip blank is submitted for analysis with most samples analyzed for volatile organic compounds. A field blank or procedure blank may also be submitted at the discretion of the client. Field, procedure, and trip blanks are analyzed upon request of the client. Reagent blanks are run daily on each instrument to check the contaminant level (Exhibit 19).

METHOD BLANK SUMMARY FORM

METHOD:

EXHIBIT 19

INST. ID:

Y	M	D	CONTAMINANT/ PPB	CORRECTION	S.R.	COMMENT
		1				
		2				
		3				
		4				
		5				
		6				
		7				
		8				
		9				
		10				
		11				
		12				
		13				
		14				
		15				
		16				
		17				
		18				
		19				
		20				
		21				
		22				
		23				
		24				
		25				
		26				
		27				
		28				
		29				
		30				
		31				

RE= REEXTRACTED

S.R.= PERCENT SURROGATE RECOVERY

ND= NOT DETECTED

P.Q.C.= PASS Q.C.

B. MATRIX SPIKE AND SURROGATE ADDITIONS

Accuracy and matrix biases are monitored using spiked samples and where possible, surrogate additions. It is standard policy throughout the laboratory to prepare and analyze at least one matrix spike for each batch of 20 samples, for each matrix type within the batch, or as specified by state/project requirements.

Surrogate spiking compounds (if available), are added to and analyzed for, with every sample. A measured amount of spike/surrogate concentration is added to the sample before extraction of preparation. Surrogate spiking is utilized for GC and GC/MS analyses only.

C. DUPLICATE SAMPLE ANALYSIS

Precision is assessed by result comparison of a sample prepared and analyzed in duplicate. It is standard policy throughout the laboratory to prepare and analyze at least one duplicate sample for each batch of 20 samples and matrix type within the batch, or as specified by state/project requirements.

D. STANDARDS

The term standard shall apply to any analyte solution of known concentration which is traceable to a certified reference material. This includes calibration standards, spiking solutions, and laboratory control samples. Claims of traceability establishes the accuracy of measurements. Therefore, maintaining standard traceability is critical to the achievement of known and defensible data quality.

To establish traceability, all purchased reference materials (neat and stock solutions) are recorded into section-specific standard log books when received.

All entries and PACE standard labels contain a unique PACE ID number, date received, date opened, and expiration date. Log book entries also include the manufacturer's lot number, certified purity, and storage location. Subsequent preparations of stock, intermediate, and working solutions are also recorded in the standard log books. These entries must include all discrete measurements made during a preparation, parent materials, solvent used, and a PACE ID number.

Exhibit 20 illustrates a standard log book entry. Standard Operating Procedure for standards preparation contains further instructions for assigning unique ID numbers, proper syringe technique, shelf life of standards, and good laboratory practices.

Labeling: The standard vial should have a reference label (covered with cellophane tape) with the following information:

1 - Standard
2 - Name of Standard
3 - Prep. Date
4 - Prep. Personnel Initials
5 - Solvent

Certified reference standards from the EPA Repository are used for calibration or laboratory control standards in many organic analyses. Reference standards may also be purchased from approved commercial vendors. Currently approved vendors for organic reference standards are Ultra-Scientific, Supelco, Chem-Service, Inc., and Aldrich Chemical Company, Inc. Inorganic standards are purchased from major scientific supply companies (Fisher, American Scientific, and VWR). Certificates of analyses are requested with each purchase.

E. METHOD DETECTION LIMIT

The method detection limit (MDL) is defined as the minimum substance concentration that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero. In general, the protocol described in Appendix B to 40CFR 136 (Federal Register, Vol. 49, No. 209, 10/26/84) is used to establish MDL's.

For GC/MS analyses and organochlorine pesticides by GC/EDC, the MDL has been determined according to EPA Contract Required Detection Limits (CRDL) as established for the Contract Laboratory Program. The MDL's for other organic analyses are set according to industry standards, client requirements, and instrument/method limitations. The MDL is validated using prepared standard solutions analyzed at detection limit concentrations.

The metals analyses MDL's correspond to instrument detection limits, and are established in the following manner: A standard solution of analyte in laboratory pure water with a concentration of 3-5 times the estimated instrument detection limit is analyzed seven consecutive times. The MDL is set at 3 times the standard deviation of the seven consecutive measurements.

EXHIBIT 20

NEAT STANDARDS:

NAME: Acephate CODE: Acephate-1

OTHER NAMES: Methamidophos

BRAND: Chem Service WARNING: POISON

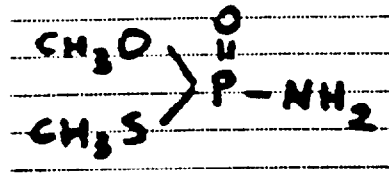
CAT. NO: PS-738

LOT NO: 30-13 LOCATION: Fr. # 2

PURITY: 98% Rack # 1

EXP. DATE: 9-90 position # 23

RECEIV. DATE:



Solvent used: Acetone

Source:

Purity:

Lot #:

GC Extraction

DILUTIONS:

CODE: Acephate-D 1

STOCK SOLUTIONS AND STANDARDS

STD #	CONC. (PPM)	SOLVENT	PREP. DATE	LOCATION
# 502	2,000 ppm	Acetone	3-1-89	Fr. #1, Rack # 5
# 503	D.W. 20 ppm	Hexane	3-2-89	Fr. #1, Rack #7
# 503 A	40 ppm	"	"	"
# 503 B	60 ppm	"	"	"
# 503 C	100 ppm	"	"	"

GC Extraction

For general (wet) chemistry methods, the MDL is established using a calibration standard analyzed at doubled dilutions until it becomes impossible to distinguish an instrument response for the analyte. The MDL is set at the lowest observable standard concentration.

F. CONTROL CHARTS

Control charts monitor daily variations in precision and accuracy of routine analysis and detect variation trends. QC charts are constructed from performance data of the complete analytical method. Control chart construction requires initial data to establish the mean and range of measurements. Currently, spikes, spike duplicates, RPD's and external check sample values are charted.

G. LABORATORY CONTROL SAMPLES

EPA quality control check samples are analyzed at least once per week, and when new calibrations are performed. They provide a means of assessing the accuracy and precision of a measurement system's performance. Parameters of interest that initially fall outside of QC acceptance criteria are compared against a prepared EPA QC check sample. If laboratory performance for the parameter is found to be out of control, then necessary corrective actions are implemented.

XII. PERFORMANCE AND SYSTEM AUDITS

A. PACE's INTERNAL SYSTEM AUDITS

1. All records, logs, and data files are routinely audited for completeness, accuracy, and adherence to standard operating procedures by an on-site auditing team. Audit team members generally include Corporate Vice-Presidents and Regional Directors. Several random project files are evaluated quarterly for compliance to procedure throughout the analytical process (i.e., from sample receipt through the final report). Supervisors, QC managers, and lab analysts routinely check all records for the same criteria.

2. System Audits:

   PACE is audited as required by regulatory agencies to maintain laboratory certifications, and by various commercial clients with laboratory auditing programs. These audits include audits by USEPA, USATHAMA, AIHA, and other appropriate federal, state and private agencies.

3. Performance Audits:

   a. USEPA Performance Evaluation Studies - PACE participates in the EPA semi-annual drinking water (WS Series) and semi-annual wastewater (WP Series) performance evaluation studies (four studies per year).

   b. PACE participates in various client sponsored performance evaluations by analyzing QC samples prepared and submitted by commercial clients in conjunction with their own QA program.

   c. Several government proficiency samples are analyzed annually to maintain various laboratory certifications (Exhibit 21).

   d. PACE regional offices are provided blind QC check samples quarterly.

4. Total Quality System Audit:

   The Corporate Quality Office performs a yearly on-site audit at each regional facility. Examples of the forms used as shown in Exhibit 22.

pace. laboratories, inc

CONTRACTS AND CERTIFICATIONS

- ✔ U.S. Environmental Protection Agency Contract Laboratory (CLP) - 3 Facilities
  MN, KS, NY
- ✔ U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) Certification
  MN
- ✔ Department of Energy Hazardous Waste Remedial Action Program (HAZWRAP) Certification
  NY
- ✔ American Industrial Hygiene Association (AIHA) Laboratory Accreditation - 2 Facilities
  MN, NC
- ✔ Contracted as an Analytical Support Laboratory for Minnesota Superfund Projects
  MN
- ✔ Accreditation in the National Voluntary Laboratory Accreditation Program (NVLAP) for Bulk Asbestos Analysis
  MN, NCA, FL
- ✔ Successfully Audited by the Missouri River Division of the U.S. Army Corps of Engineers
  NCA, FL
- ✔ Successful Participation in the National Institute for Occupational Safety and Health (NIOSH) Proficiency in Analytical Testing (PAT) Program
  MN
- ✔ Alabama Drinking Water Certification
  FL
- ✔ California Air Resources Board Certification for Emissions Monitoring
  NCA, MN
- ✔ California Drinking Water Certification
  NCA
- ✔ California Hazardous and Toxic Waste Certification - 3 Facilities
  NCA, SCA, MN
- ✔ California Pesticide Analysis Certification
  NCA
- ✔ Connecticut Laboratory Certification
  NY
- ✔ Florida Drinking Water Certification - 3 Facilities
  FLA, MN, NY (pending)
- ✔ Florida Environmental Laboratory Certification - with Approved Generic Quality Assurance Plan
  FL, MN, NY (pending)
- ✔ Iowa Drinking Water Certification
  IA, FL
- ✔ Kansas Drinking Water Certification
  KS, MN
- ✔ Kansas Solid & Hazardous Waste Certification
  KS, MN
- ✔ Minnesota Drinking Water Certification for Microbiological Analysis
  MN
- ✔ New Jersey Dept. of Environmental Protection Contract Laboratory for Environmental Analysis
  NY
- ✔ New Jersey Laboratory Certification
  NY
- ✔ New York Drinking Water Analysis Certification - 2 Facilities
  MN, NY
- ✔ New York Environmental Laboratory Certification - 2 Facilities
  MN, NY

March, 1990

- ✔ North Carolina Drinking Water Certification
  NC, FL
- ✔ North Carolina Wastewater Certification
  NC, FL
- ✔ North Carolina Biological Toxicity Certification
  NC
- ✔ South Carolina Laboratory Certification - 2 Facilities
  NC, FL
- ✔ Tennessee Drinking Water Certification
  NC
- ✔ Virginia Drinking Water Certification
  NC
- ✔ Virginia Wastewater Certification
  NC
- ✔ Wisconsin Drinking Water Certification
  MN
- ✔ Wisconsin Environmental Laboratory Certification
  MN

RATING SCA

EXHIBIT 2

(Doc. 349 - 27-31)

THE FOLLOWING SCALE MAY BE USED FOR ANY APPLICABLE AREA

1) UNSATISFACTORY Performance below acceptable level. Expected results have not been achieved.	2) PROVISIONAL Some requirements satisfied but needs improvement in several areas.	3) FULLY ADEQUATE All requirements met. Satisfied all standards and achieved expected results.	4) SUPERIOR Results above job standards. Achieved more than expected results.	5) DISTINGUISHED Results far in excess of standards extraordinary and exceptional results.

SECTION	RESULTS/STANDARDS OF PERFORMANCE	RATING 1	2	3	4	5	YES	NO	COMMENTS/RECOMMENDATIONS
Quality Control	SOP's: 1. Quality Control Manager aware of and familiar with Standard Operating Procedures for the company.								
	2. Documented Standard Operating Procedures for the Quality Control department.								
	3. Standard Operating Procedures for program areas on file in the Quality Control office.								
	4. Documented procedures for all Quality Control activities are displayed in the appropriate area.								
	5. Standard Operating Procedures updated regularly for analytical areas.								
	6. Analytical procedures updated regularly.								

SECTION	RESULTS/STANDARDS OF PERFORMANCE	RATING 1	2	3	4	5	YES	NO	COMMENTS/RECOMMENDATIONS
Quality Control (Cont.)	7. Analytical procedures are dated and initialed by QC Manager and Department Supervisor at time of update.								
	8. Procedure sections are updated rather than replacement of entire document.								
	Staff: 1. Defined roles for the Quality Control Manager, adherence to job description.								
	2. Defined roles for staff in the Quality Control department.								
	3. Staffing is adequate and staff assignments are documented.								
	Administrative: 1. Regularly scheduled meetings with Quality Control staff. Agenda for meetings are documented.								

SECTION	RESULTS/STANDARDS OF PERFORMANCE	RATING 1	2	3	4	5	YES	NO	COMMENTS/RECOMMENDATIONS
Quality Control (Cont.)	2. Regularly scheduled meetings with Analytical Department staff/managers. Agenda for meetings are documented.								
	3. Regularly scheduled meetings with Sampling and Analytical Services Division Director. Meeting agenda documented								
	<u>Control Charts/Corrective Actions</u>: 1. Quality Control charts available in Quality Control area for all analytical procedures.								
	2. Control chart acceptance limits are based upon current data. - Specify "current" date range of control charts/last update - Specify frequency of acceptance limits updating								
	3. Preventative maintenance records for all instruments present in Quality Control.								

SECTION	RESULTS/STANDARDS OF PERFORMANCE	RATING 1	2	3	4	5	YES	NO	COMMENTS/RECOMMENDATIONS
Quality Control (Cont.)	4. Provision of quality control charts are in on a timely manner to analytical threats.								
	5. Record of corrective action taken when out-of-control situations are noted.								
	<u>QC Samples</u>: 1. Records of performance evaluations on blind PE samples in-house kept in Quality Control area.								
	2. Records of performance on quality control samples (MS, MSD, LCS, surrogates, & blanks) are available in Quality Control department.								
	3. Record of standard traceability to NIST present in the Quality Control area.								
	4. Standards are labeled with purchase date, date opened, expiration date, analyst initials.								

SECTION	RESULTS/STANDARDS OF PERFORMANCE	RATING 1	2	3	4	5	YES	NO	COMMENTS/RECOMMENDATIONS
Quality Control (Cont.)	<u>Sample Check-In</u>: 1. Chain-of-custody records kept on file when necessary, in the Quality Control area.								
	2. Sample check-in documentation present in sample check-in area.								

B. TRAINING AND TECHNICAL REVIEW

PACE considers competent, well-trained personnel to be a key to successful production of valid and reliable data. An extensive training and technical review program is in place at PACE, Inc. It includes:

1. Training Plans

The type and schedule of training required for each new or transferred employee is determined individually. A training plan is established to reflect individual and general training needs.

2. Training Classes

All sections conduct regularly scheduled training sessions specific to their needs.

Audio/visual training programs and open learning texts are available for use by all personnel.

Other laboratory QA and general training classes are offered periodically.

3. Technical Review Program

All employees are subject to technical reviews with their supervisor. The technical review assesses an individual's training progress and technical development and provides an opportunity to redirect the training plan accordingly to comprehensively cover further developmental needs. The schedule for technical reviews is:

a. New hire or transfer to new position/responsibilities: 6 months, 1 year.

b. After 1 year in same position/responsibilities: annually.

4. Support Programs

Attendance at outside seminars, classes, etc., is highly encouraged. PACE participates in many of these throughout the year. In-house seminars are presented by employees for employee bi-monthly meetings. Various topics are covered, including regulatory items and information from attendance at outside seminars. The PACE in-house library contains current periodicals and journals pertinent to the environmental industry and analytical chemistry, in addition to reference books, text books, and regulatory publications.

XIII. PREVENTIVE MAINTENANCE

PACE maintains service contracts for most major analytical equipment including all chromatography instruments, balances, atomic absorption, and inductively coupled plasma instruments. All instruments and equipment receive routine preventive maintenance, which is recorded in instrument specific maintenance logs. Routine maintenance insures that all equipment is operating under optimum conditions, reducing the possibility of instrument malfunction (consequently affecting sample results). An example of an instrument maintenance log is included (Exhibit 23).

EXHIBIT 23

INSTRUMENT MAINTENANCE LOGBOOK FORM

INSTRUMENT I.D.:

DATE	MAINTENANCE ACTIVITY	NAME

XIV ASSESSMENT OF PRECISION, ACCURACY, COMPLETENESS REPRESENTATIVENESS, AND COMPARABILITY

The Quality Control Program at PACE uses precision and accuracy data to determine the acceptability of analytical results. Precision refers to result reproductibility and accuracy measures the degree of difference between observed and true values. One of every 20 analyses performed at PACE is run in duplicate (precision). Also, one of every 20 samples is spiked with a synthetic standard to assist in evaluating the accuracy of the method. Once 20 sets of precision or accuracy data have been obtained, a quality control chart is prepared. The Shewhart technique is the statistical method used to construct the charts. These quality control charts provide a quick visual means for monitoring the daily performance of the laboratory. Exhibits 24 and 25 contain examples of accuracy and precision charts along with their corresponding data sheets (Exhibits 26 and 27).

A. ACCURACY

The actual test result is compared to the theoretical result of 100% recovery and the percent recovery is calculated.

$$\% \text{ Recovery} = \frac{\textbf{Spiked Sample Result - Sample Result}}{\textbf{Spike Quantity}} \times 100$$

The percent recovery must fall within specific control limits for the results to be accepted and subsequent data validated. (See Table 2)

B. PRECISION

The results of the duplicate analyses are computed and the absolute relative percent difference (RPD) is calculated.

$$\text{RPD} = \frac{|\textbf{Sample Result - Duplicate Result}|}{\textbf{Average Result}} \times 100$$

The RPD must fall within set control limits for the results to be accepted and subsequent data validated. A one-sided distribution with zero as a target value is typical, given absolute value requirements (CLP).

C. WARNING LIMITS

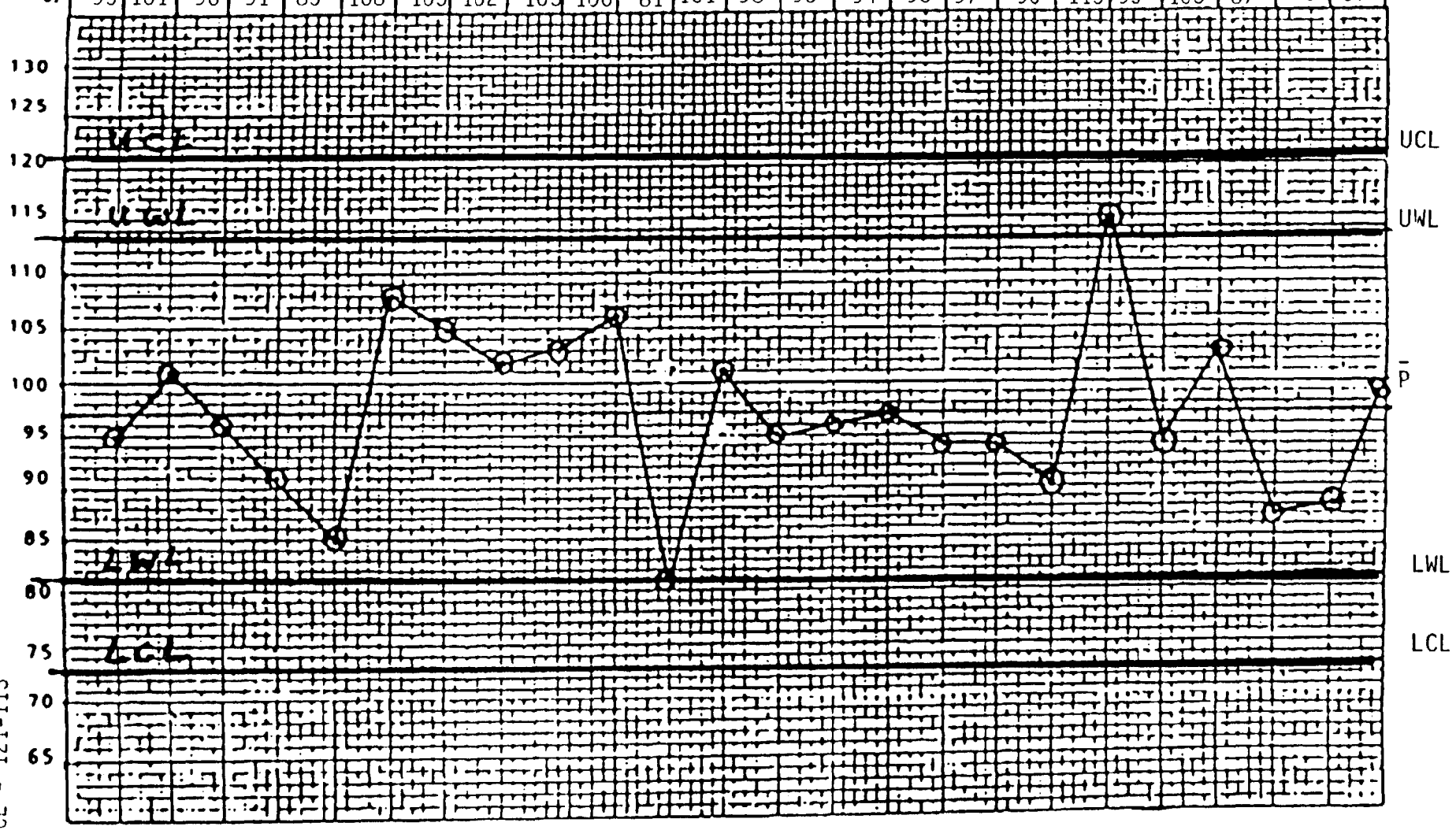
Warning limits represent the 95% confidence interval and are equal to the mean value for the control sample, plus or minus two standard deviations ($\pm$ 2S). Exceeding these limits is a warning that the analytical system may be approaching an out-of-control situation, and should be inspected for possible sources of error before continuing the analysis. Analysts will inform the QC manager or the supervisor of such problems.

EXHIBIT 24

SURROGATE % RECOVERY CHART

Matrix: Soil

Sample I.D #	71669	71673	71670	71671	71619	71710	71711	71712	71713	71715	71714	71721	71815	71816	71821	71670	71856	71668	71829	71824	71822	71669 SP	71669 SP	71856 SP
	95	101	96	91	85	108	105	102	103	106	81	101	98	95	94	96	97	90	115	95	103	87	89	97



WL = 73-81
CL = 121-113

INSTRUMENT: METHOD: 5030/8015 ANALYTE: Fluorobenzene

Date: 4/3-4/5

Average Recovery= 97% J Standard= 24

EXHIBIT 25

PACE PRECISION CHART

CHLORIDE IN WATER

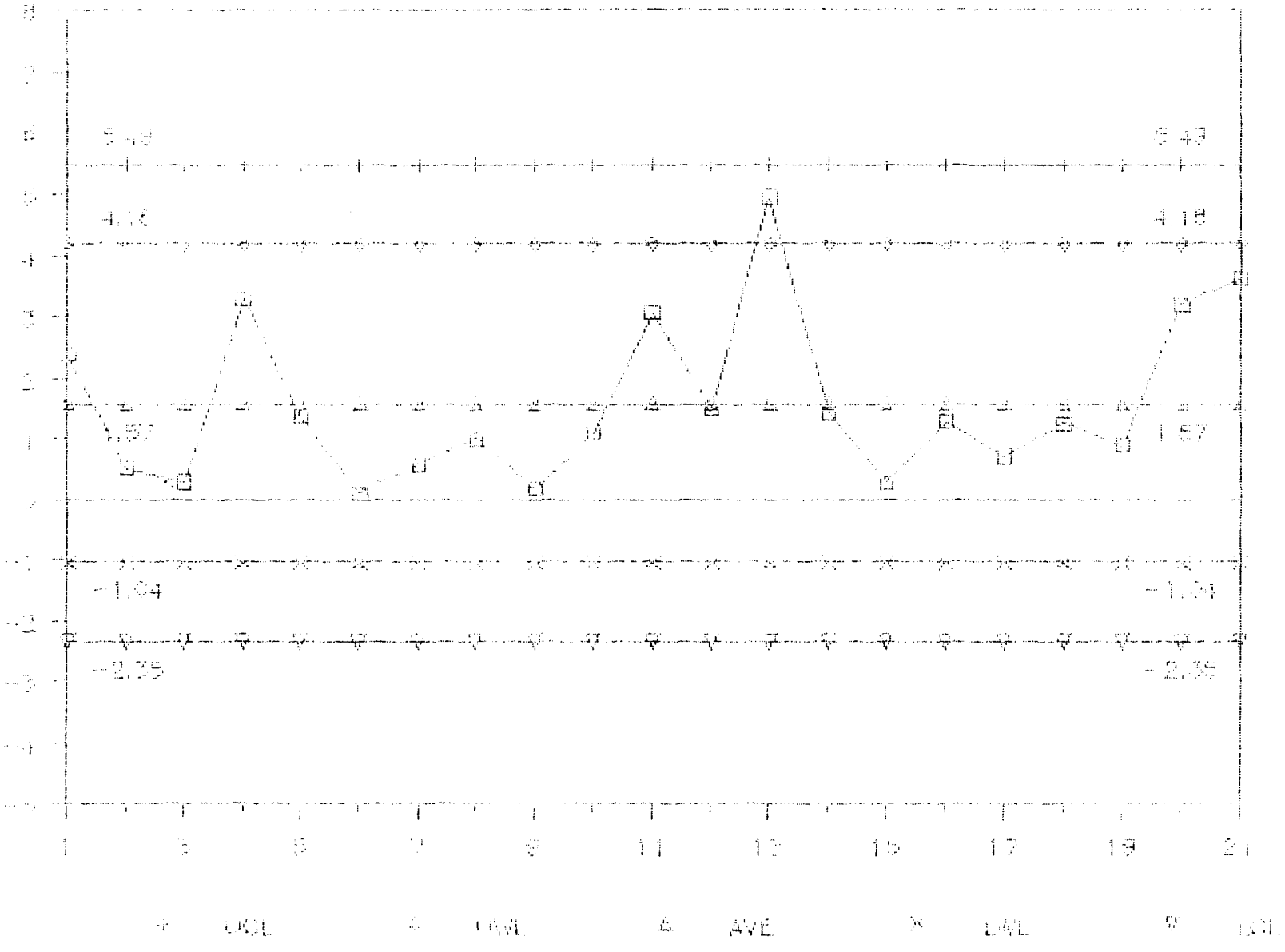


EXHIBIT 26

ANALYSIS:

RAW DATA SHEET

CLIENT NAME: _____ DATE ANALYZED _____

PROJECT NAME: _____ ANALYZED BY: _____

FILE #: _____ TIME: _____

DATE COLLECTED: _____ DATA REVIEWED BY: _____

DATE RECEIVED: _____ ENTERED BY: _____

SAMPLE #	ANALYSIS			SAMPLE VOL (mls) A	RESULT OF DIL SAMPLE B
	RESULTS	UNITS	COMMENTS		

A = SAMPLE VOLUME USED (mls)

B = RESULT OF DILUTED SAMPLE

EXHIBIT 27
SPIKE SUMMARY FORM

Soil Matrix TPH/BTX

Date			Benzene					Toluene					O-Xylene					TPH-L				
Y	M	D	S	SD	$\bar{P}$	R	$\bar{R}$	S	SD	$\bar{P}$	R	$\bar{R}$	S	SD	$\bar{P}$	R	$\bar{R}$	S	SD	$\bar{P}$	R	$\bar{R}$
98	4	1																				
		2																				
		3																				
		4	87	89		2		91	91		0		93	95		2		114	89		25	
		5	101	101		0		100	111		10		102	104		2		120	100		18	
		6	94	85		10		83	81		2		85	96		12		96	98		2	
		7																				
		8																				
		9																				
		10	92	101		9		120	100		18		94	92		2		75	77		3	
		11																				
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		29																				
		30																				
		31																				
			} S_p = ±					} S_p = ±					} S_p = ±					} S_p = ±				

S= Spike Recovery SD= Spike Dup. Recovery $\bar{P}$ = Average Recovery S_p = Stand. Deviation

R= Relative Deviation R= Average Relative Deviation

D. CONTROL LIMITS

Control limits represent the 99% confidence interval and are equal to the mean value of the control sample, plus or minus three standard deviations (±3S). Exceeding these limits indicates that the analytical system is out-of-control. The QC manager or the supervisor shall be informed and corrective action shall be taken.

1. Method of Setting Limits

Control limits are established via statistical analysis, using QC sample results. Limits are determined for a parameter of each method as analyzed on a specific instrument.

The mean value (P) and the standard deviation (S) for each data set is calculated and the limits are set as:

Warning (WL) = P + 2S = 95% Confidence limit
Control (CL) = P + 3S = 99% Confidence limit

Where $P = \frac{X1 + X2 + X3 \ldots Xn}{n}$ x = Sample result

and $S = \sqrt{\frac{\Sigma(X - P)^2}{n-1}}$ n = Total # of results in set
P = mean value

The minimum number of results to be used for statistical calculation (n) is 15-20. Limits will generally be calculated from a data point set every thirty days, depending on the method. Updated limits are issued at the beginning of every month.

2. Utilization of Acceptance Limits

QC sample results must fall within the established warning limits (P ± 2S) for each parameter.

Results that fall outside of warning limits, but remain within the control limits (P ± 3S), are considered suspect. These results must be carefully examined for possible sources of error in the analysis, or justified as a matrix bias effect. All such results are recorded in a Discrepancy Report form/Corrective Action form (See Section XV).

Any three consecutive results outside of warning limits but within control limits is an out-of-control event which shall be documented and corrected.

Results that fall outside of control limits (P ± 3S) must be documented and corrective action taken.

E. COMPLETENESS

Data completeness can be quantified during data assessment. It is expected that laboratories should provide data, meeting QC acceptance criteria, for 90% or more of the requested determinations. It is incumbent for planners to identify any sample types, such as control or background locations, which require 100% completeness.

F. REPRESENTATIVENESS

Representativeness is a qualitative element that is related to the ability to collect a sample that reflects the characteristics of that part of the environment that is to be assessed. Sample representativeness is dependent on the sampling techniques used and is considered individually for each project. It is specifically addressed in each work plan.

G. COMPARABILITY

Comparability is also considered during preparation of the work plan. The objective of comparability is to ensure that results of similar activities conducted by different parties are comparable. For example, the use of EPA-approved, etc., methods and procedures ensure comparability with other data from previous or following studies.

XV. CORRECTIVE ACTION

If, as a result of audits or QC sample analyses, methods systems prove to be unsatisfactory, corrective action shall be implemented. The project manager, department manager, Quality Control manager, supervisor, and analyst may be involved in the corrective action. If previously reported data are affected by a situation requiring correction or if the corrective action impacts a project budget or schedule, the action will directly involve the project manager (and Quality Control manager).

For immediate or long-term corrective actions, steps comprising a closed-loop corrective action system are as follows:

1. Define the problem.

2. Assign responsibilities for problem investigation.

3. Investigate and determine the cause of the problem.

   a. Check all calculations

   b. Re-analyze the sample

   c. Verify the integrity of the spiking solution, laboratory control sample, or calibration standard.

   d. Check instrument and operating conditions to preclude the possibility of malfunctions or operator error.

4. Determine the corrective action(s) necessary to eliminate the problem.

5. Assign and accept responsibilities for implementing the corrective action.

6. Establish the effectiveness of the corrective action and implement the correction.

7. Verify and document that the corrective action has eliminated the problem (Exhibit #28).

   Depending upon the nature of a problem, the corrective action implemented may be formal or informal. In either case, occurrence of the problem, the corrective action employed, and verification that the problem has been eliminated must be documented.

   In addition, if the corrective action mandates the preparation of a new standard or calibration solution(s), a comparison study between the new solution versus the old solution will be performed. The results are supplied with the weekly QC submittal as verification of problem elimination.

EXHIBIT 28

CORRECTIVE ACTION

INSTRUMENT _____
MONTH/YEAR _____

DATE	PROBLEM	ACTION	INITIAL

XVI. QUALITY ASSURANCE REPORTS TO MANAGEMENT

A. OBJECTIVE

This section describes the methods used by PACE to store and retrieve quality assurance records and issue of appropriate reports.

B. REQUIREMENTS

Comprehensive records shall be maintained to provide evidence of the quality assurance activities. All charted QC values which indicate an out-of-control situation must be evaluated and explained. Any corrective actions and re-analysis of samples must be fully explained and documented.

C. IMPLEMENTATION

Procedures for recording all aspects of the Quality Assurance Program are written and filed.

D. REPORTS TO MANAGEMENT

Quarterly reports are provided by the Quality Control officer to the President, Vice President of Quality and Regional Director. This report addresses the quarterly quality assurance activities including details of corrective actions implemented, audit results, and QC summary information.

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1. Handbook for Analytical Quality Control in Water and Wastewater Laboratories, U.S. EPA 600/4-79-019, March, 1979.

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JUNE 1988

SAMPLING AND CHEMICAL ANALYSIS QUALITY ASSURANCE REQUIREMENTS FOR THE NAVY INSTALLATION RESTORATION PROGRAM

NEESA 20.2-047B

NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY

Port Hueneme, California 93043

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SAMPLING AND CHEMICAL ANALYSIS QUALITY ASSURANCE REQUIREMENTS FOR THE NAVY INSTALLATION RESTORATION PROGRAM

NEESA 20.2-047B
Project Manager: Anthony R. Sturtzer

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LIST OF ACRONYMS

AA	Atomic Absorption
ASTM	American Society for Testing Materials
BNA	Base Neutral Acids
CCC	Calibration Check Compounds
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Protocol
COC	Chain of Custody
DQO	Data Quality Objective
EFD	Engineering Field Division (U.S. Navy)
EIC	Engineer in Charge (U.S. Navy)
FEL	Field Equipment Log
GC	Gas Chromatography
HSL	Hazardous Substances List
IRP	Installation Restoration Program
ICP	Inductively Coupled Plasma
LQAC	Laboratory Quality Assurance Coordinator
MPR	Monthly Progress Report
MS	Mass Spectrometry
NCR	NEESA Contract Representative (Martin Marietta Energy Systems, Inc.)
NEESA	Naval Energy and Environmental Support Activity
NPL	National Priorities List
PCB	Polychlorinated Biphenyl
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
RRF	Relative Response Factor
RSD	Relative Standard Deviation
SOW	Statement of Work
SPCC	System Performance Check Compounds
TCL	Toxic Contaminant List
VOA	Volatile Organic

1. INTRODUCTION

The Installation Restoration Program (IRP) identifies and evaluates past hazardous material disposal sites in order to control the migration of hazardous contaminants. The program also controls hazards that may result from these past disposal operations. The IRP has the following phases: Preliminary Assessment/Records Search, Site Inspection/Remedial Investigation, Technical Base Development, Feasibility Study, and implementation of selected alternatives for remediation. During any of these phases, analysis of soil, water, and waste samples may be performed. The Navy program for the IRP includes performing field investigations and analysis of samples. The purpose of this document is to specify the requirements for the control of the accuracy, precision, and completeness of the samples, and data from the point of collection through reporting. Because every instance and concern may not be addressed in this document, contractors are encouraged to discuss any questions with the Navy engineer in charge (EIC) or the appropriate Naval Energy and Environmental Support Activity (NEESA) contract representative (NCR).

1.1 SCOPE

Laboratories performing studies in support of the IRP are required to obtain Navy approval prior to beginning field studies or analyses of samples and to maintain that approved status throughout the site characterization. The laboratory approval is specific to a particular study for a given site and Statement of Work (SOW). The Navy Requirements document provides guidance to the laboratories on obtaining and maintaining approval. Should more than one laboratory be involved in the analysis of samples from a single site, each laboratory performing analysis must be approved and must comply with the quality control (QC) requirements. These objectives and requirements conform, in general, with the *U.S. Environmental Protection Agency Federal Register*, November 29, 1983 (p. 53937 or 40 CFR 792), the *Food and Drug Administration Federal Register*, December 22, 1978 (p. 59986 or 21 CFR 58), the *Quality Assurance Program Requirements for Nuclear Facilities*, ANSI/ASME NQA-1, 1986 ed., and the *Interim Guidelines and Preparing Quality Assurance Project Plans* (U.S. EPA, EPA-600/4-83-004, QAMS-005/80).

Each laboratory is required to submit a Laboratory Analysis Quality Assurance (QA) Plan. Each engineering contractor must submit a site work plan as part of the approval process. The laboratory's QA plan and the site work plan are emphasized, since the content of those plans and the laboratory's strict adherence to it are essential for obtaining and maintaining Navy approval. Certain basic requirements are stressed--a laboratory QA coordinator (LQAC), the use of accepted analytical methods, careful documentation of chain of custody (COC), corrective action policy, and use of control charts. The laboratory-approval process and subsequent laboratory reporting requirements provide the mechanism for verifying that a laboratory is adhering to its QA and work plan.

Currently, most IRP studies do not include analysis of air, plant, or tissue samples. Future revisions that will include more discussion as to available methods for biota and air are planned. If questions on these methods arise, the NCR may be consulted at the Martin Marietta Energy Systems, Inc., Analytical Chemistry Department at the Oak Ridge Gaseous Diffusion Plant. Where Environmental Protection Agency (EPA) methods are not available for biota, methods from other agencies and published methods which have undergone method validation by the laboratory requesting approval must be used. On occasion, when methods are required for biota and no EPA method is available, the proposed method must be submitted to the NCR for approval.

1.2 APPROACH

The approach reflected in this document is one of outlining requirements and allowing the laboratories, principally through their QA plans, to detail their approach to meeting these requirements. For example, with the exception of the laboratory control sample program, see Sect. 4.4, the discussion of QC procedures includes a requirement that warning and action limits be set but allows each laboratory to describe its procedures for establishing such limits. The specific organization and presentation of the laboratory plan are left largely to the discretion of the laboratory, although certain areas must be addressed.

In order for the above approach to work, emphasis must be placed on effective communication between the laboratory, the Navy EIC, the NCR, and the engineering subcontractor. All documents must be concise, well organized, and free of jargon that might hinder constructive review and evaluation.

1.3 LEVELS OF QC

Data quality objectives (DQOs) are requirements needed to support decisions relative to the various stages of remedial actions. Throughout the project planning process, DQOs are supplied through qualitative and quantitative statements. They are specified in such documents as sampling plans, work plans and QA plans. Five general levels of analytical options to support data collection are identified by Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The Navy has adopted three of the analytical levels as QC requirements. They are C, D, and E, which correlate with Levels 3, 4, and 5 described in *Data Quality Objectives for Remedial Response Activities Development Process* by the EPA. These levels are based on the type of site to be investigated, the level of accuracy and precision required and the intended use of the data. The level of QC required at the site will be decided by the Navy EIC. Analytical requirements for the remaining two levels have not been defined. Table 1.1 outlines the basic QC requirements at each level. The laboratory method requirements for each level of QC are outlined in Sect. 7.

Table 1.1. Overall plan for QC based on type of site

DQO Levels[1]	Type of Site	QC Requirements						
3	Major Non-NPL Level C	PE sample	Laboratory[2] audit	QA Plan review	Use EPA-approved method[3]	Monthly review	10% field duplicates	Review of final data
4	NPL Level D	PE sample	Laboratory[2] audit	QA Plan review	Use CLP procedures	Monthly review	10% field duplicates	CLP validation
5	Non-NPL Level E	PE sample	Laboratory[2] audit	QA Plan review	Use EPA-approved methods.[3] Non-EPA methods for tissue and explosives.	Monthly review	5% Field duplicates	Review of final data

[1]QC criteria for DQO Levels 1 and 2 has not been defined.
[2]All laboratory audits will be performed by the NCR.
[3]Includes methods from SW 846, Amercian Society for Testing Materials, and Federal Register.

CLP = Contract laboratory protocol
PE = Performance evaluation samples
DQO = Data quality objective

1.3.1 Level C QC

A site requiring Level C QC would be a site near a populated area, not on the NPL, and not likely to be undergoing litigation. The Level C QC includes review and approval of the laboratory QA and the site work plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide MPRs on QA. The laboratory that performs Level C QC must have passed the performance sample furnished by the Superfund CLP in the past year. The laboratory does not need to be receiving CLP bid lots of samples.

Level C allows the use of non-CLP methods but requires that the methods be accepted EPA methods listed in Tables 7.1 through 7.5. All methods used must be EPA methods or be equivalent to EPA methods. Further discussion about these methods is presented in Sect. 7. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide MPRs on QA. These audits will be administered and evaluated by the NCR. The Navy audit and performance sample are required in addition to any specified by the EPA Superfund Program.

1.3.2 Level D QC

Level D QC is to be used for sites that are on or about to be on the National Priorities List (NPL). These sites are typically near populated areas and are likely to undergo litigation. Level D QC includes review and approval of the laboratory QA plan, the site work plan, and the field QA plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide monthly progress reports (MPRs) on QA. These activities will be administered and evaluated by the NCR. This audit and the analysis performance sample are in addition to those related to the EPA Superfund Program. The laboratory that performs Level D QC must have passed the performance sample furnished through the Superfund Contract Laboratory Protocol (CLP) and must be able to generate the CLP deliverables. For a Level D site, the CLP methods are used and the CLP data package generated. The Navy audit and performance sample are required in addition to any specified by the EPA Superfund Program.

1.3.3 Level E QC

A site requiring Level E QC will be located away from a populated area, will not be an NPL site, and will have a low probability of litigation. Level E QC includes review and approval of the laboratory QA plan and the site work plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide MPRs on QA. For Level E, the laboratory is not required to have passed a CLP performance sample. Level E allows the use of non-CLP methods but requires that the methods be accepted EPA methods listed in Tables 7.1 through 7.5. All methods used must be EPA or equivalent. Further discussion about these methods is presented in

Sect. 7. Level E QC is also appropriate for analysis of the contents of underground storage tanks where the samples are primarily pure product or waste.

1.4 ROLES AND RESPONSIBILITIES

As indicated in Fig. 1.1, the organizations involved are NEESA, the Navy Engineering Field Division (EFD), and the subcontractors. Each organization has multiple tasks and groups that support the project. Fig. 1.1 includes the structure of the organization related to the IRP process. A brief description of the key roles and responsibilities is listed.

1. Navy Energy and Environmental Support Activity

   NEESA is responsible for ensuring that the quality of laboratory analyses performed during the various phases of the IRP is acceptable. NEESA is also responsible for managing the NCR.

2. Engineering Field Division

   The EIC at the EFD provides the site information and history, provides logistical assistance, specifies the site requires investigation and reviews results and recommendations.

3. Engineer in Charge

   The EIC is responsible for coordinating procurement, finance, and reporting; for ensuring that all documents are reviewed by the NCR; for communicating comments from the NCR and other technical reviewers to the subcontractors; and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

4. NEESA Contract Representative

   The NCR is responsible for ensuring that each project has appropriate overall QA. The NCR reviews laboratory QA plans, work plans, submits performance sample data, provides field and laboratory audits, and reviews data from the site. The questions from subcontractors and the EIC regarding specific field and laboratory QC practices are directed to the NCR. The NCR also provides evaluation of referee samples.

5. Engineering Subcontractor

   Each project has an engineering subcontractor that specializes in setting up the sampling for IRP studies, evaluating the hydrology and geology of a site, assessing risks of contamination, and designing and implementing clean-up techniques. Each engineering firm is required to have a laboratory available to perform sample analysis.

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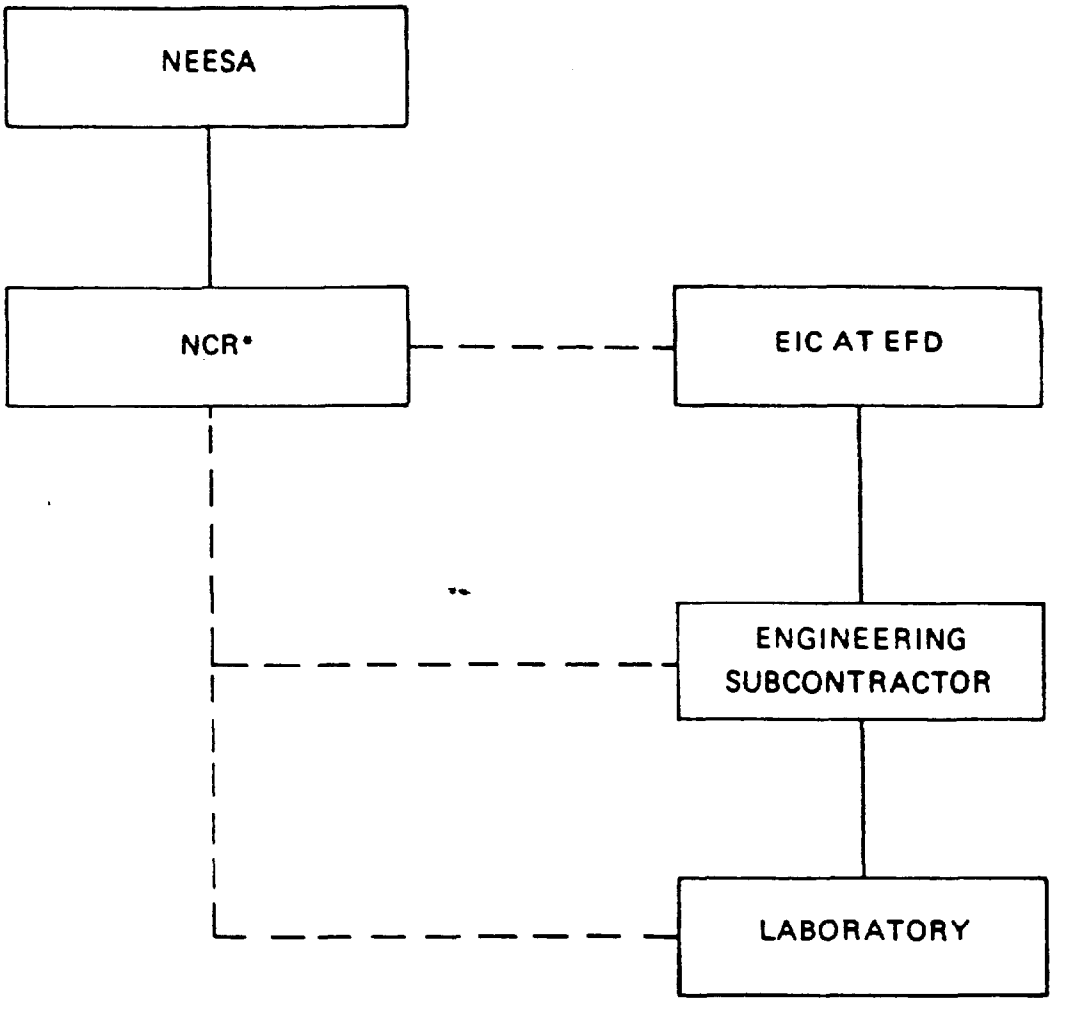

*NCR-MARTIN MARIETTA ENERGY SYSTEMS, INC.

Fig. 1.1. QA Organization

The engineering firm also employs drillers and other personnel to perform IRP tasks. The engineering firm submits a site-specific work plan.

6. Analytical Laboratory

The analytical laboratory is employed by the engineering firm and must adhere to the laboratory requirements in this document. The laboratory is required to prepare and submit a laboratory QA plan, to analyze and submit the results of proficiency testing, to submit to an on-site inspection, and to correct any deficiencies cited during inspection by the NCR. The laboratories are required to identify a LQAC responsible for overall QA. The LQAC must not be responsible for schedule, costs, or personnel other than QA assistants. It is preferred that the LQAC report to the laboratory director. The LQAC must have the authority to stop work on projects if QC problems arise which affect the quality of the data produced.

2. APPROVAL PROCESS

Prior to beginning any field studies or analysis of samples from the field, contract laboratories will be required to receive Navy approval. This section describes the laboratory approval process in terms of the activities and documentation required of participants in the process.

2.1 OVERVIEW

Laboratory approval is necessary to ensure that contract laboratories meet the minimum requirements for a QC program that facilitates the generation of data of defensible accuracy and precision. Specific objectives of the approval process are as follows:

- to communicate Navy's QC requirements to the laboratories,
- to verify that such requirements are being met by each laboratory prior to analysis of Navy field samples,
- to establish plans for maintaining the QC program while work is being done for the Navy, and
- to ensure that proper communication and planning have been done between the engineering subcontractor and the laboratory prior to the laboratory receiving samples.

The above objectives will be met through an approval process that includes the following elements:

- proficiency testing through analysis of performance samples,
- laboratory inspection and audit,
- reviewing laboratory QA plans,
- reviewing site-specific QC plans, and
- reviewing of sampling plans including QC procedures.

The overall process and the above elements are described in detail in the remainder of this section.

2.1.1 The Laboratory Approval Process

The laboratory approval process, as depicted in Fig. 2.1, begins with the engineering subcontractor awarding a contract to the laboratory. The engineering subcontractor is responsible for supplying a site-specific work plan to the NCR. The laboratory and engineering contractors are required to prepare a site-specific work plan and laboratory QA plan.

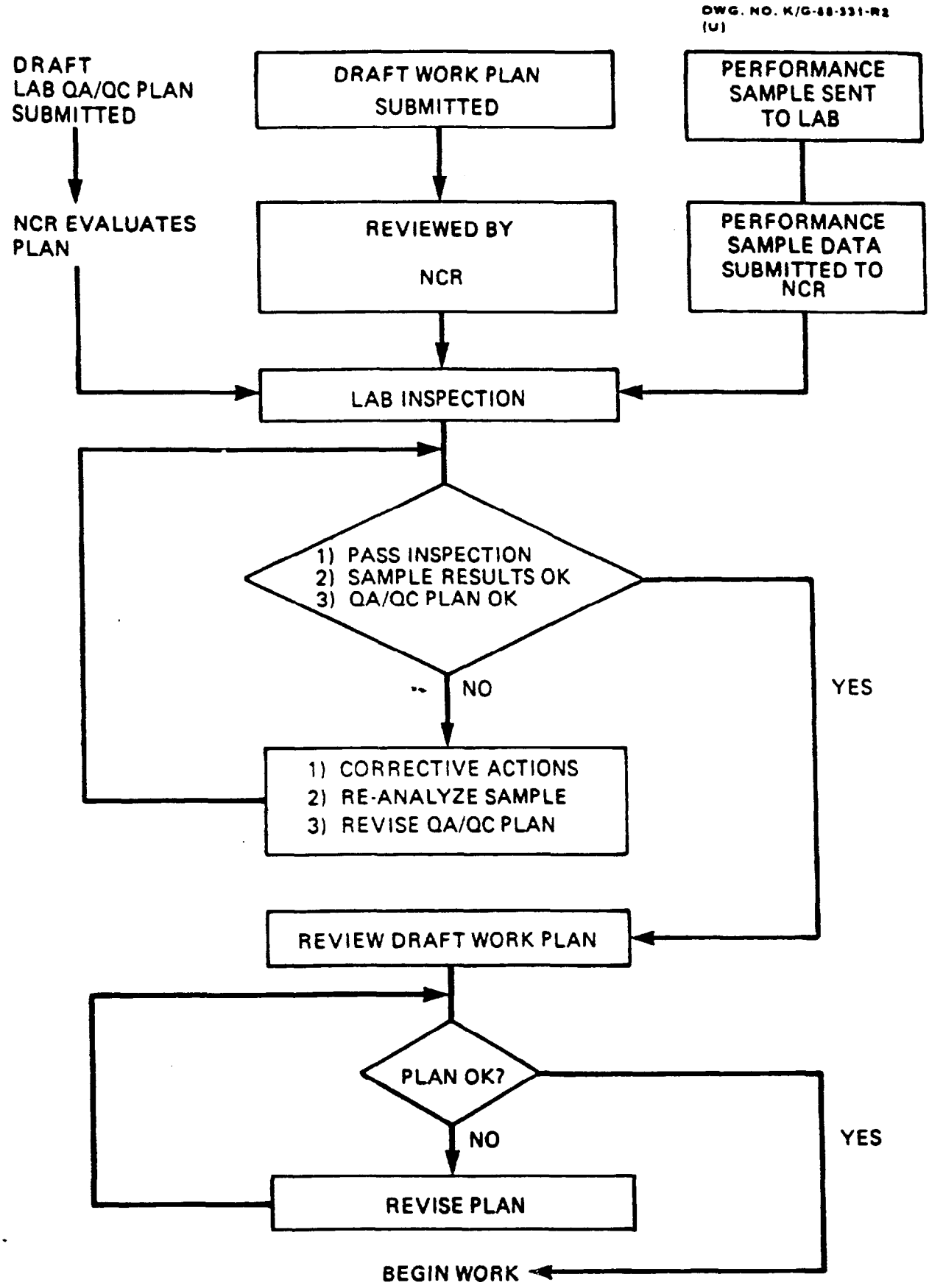

Fig. 2.1. Approval and Review Process

The site-specific work plan shall include a section on QA. This section shall either outline the field and laboratory QA or shall reference documents which outline the QA procedures. The laboratory shall successfully analyze proficiency samples. The site-specific work plan, QA plans, and the results of the proficiency test are submitted to the NCR who will evaluate this information. The QA plans, the proficiency test results, and a draft work plan shall be received and evaluated by the NCR prior to scheduling a laboratory inspection. Based on the results of these evaluations and the inspection, the laboratory and engineering firm may be required to revise their QA plans, to retest a proficiency sample(s), to revise the work plan, or to prepare and implement a corrective action plan addressing deficiencies cited during the inspection.

Approval to begin work on samples is based on a combination of satisfactory QA plans and a site-specific work plan, satisfactory results of proficiency testing, and acceptable laboratory inspection. Approval may be granted to perform all or part of the methods required for a study.

2.1.2 Laboratory Reapproval

If a laboratory is requested to analyze samples from a second site, the NCR will evaluate the similarity between the analysis from the first and the second sites. The past performance of the laboratory and the time elapsed from previous sample analysis determine the steps the laboratory must follow to be reapproved. If a laboratory has performed well in the past, if the methods in the first and second work plan are similar, and if it has been less than a year since the first approval, the engineering contractor may only need to submit the site work plan, and work may proceed. If the laboratory's past performance was satisfactory but it has been longer than a year since a performance sample was analyzed, the laboratory must successfully analyze a new performance sample.

Any changes in personnel or general laboratory QA must be submitted to the NCR prior to receiving approval to begin the next site.

Figure 2.2 shows a flow diagram of the reapproval process.

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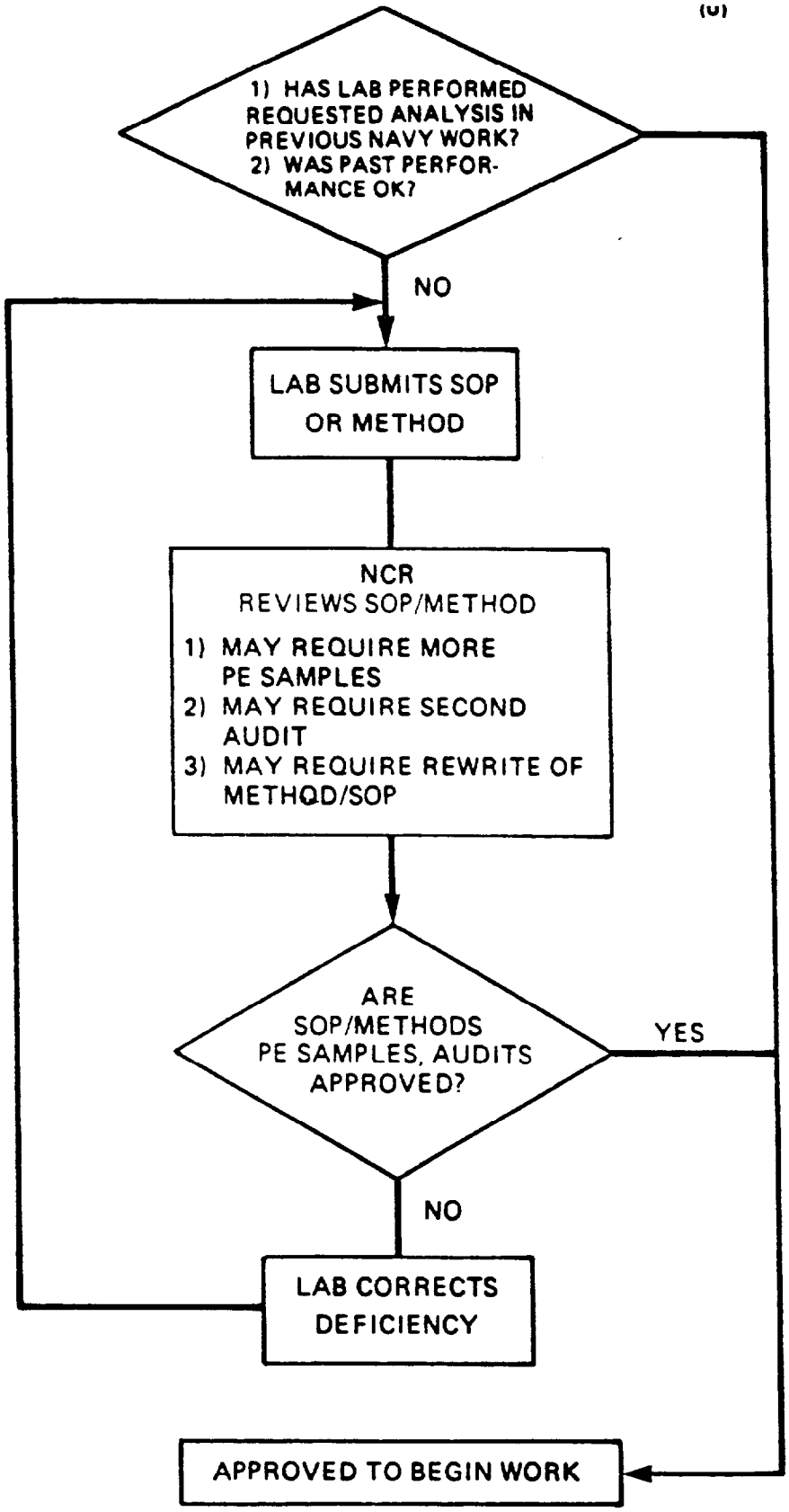

Fig. 2.2. Laboratory Reapproval Process

3. SITE-SPECIFIC QC REQUIREMENTS

The following are the requirements for the site-specific QC section to be included in the site-specific work plan or to be presented as a separate QC document.

3.1 CONTENTS OF SITE-SPECIFIC QC SECTION

1. The laboratory must be identified along with all other subcontractors.

2. Any pertinent state environmental or EPA federal/regional requirements shall be presented. This includes specific procedures or clean-up levels.

3. References must be made to the appropriate corporate or laboratory QA plans which contain pertinent information.

4. A discussion of COC and shipping practices must be provided.

5. Tables of the following shall be included.

   - Analytical methods and numbers of samples of each matrix to be collected at each site.

   - List of analytes to be identified and quantitated.

   - List of holding times, preservatives, amount of sample required, and container requirements.

   - List of the number, type, and matrix of field and laboratory QC samples by site. This includes trip blanks, equipment rinsates, field blanks, field duplicates, laboratory method blanks, laboratory matrix spikes and duplicates.

   - List of sample volume and bottles vs method.

6. All site-specific field sampling procedures which are not included in any corporate QA plan shall be presented.

7. Decontamination procedures for both drilling and sampling equipment shall be described.

8. Data quality objectives shall be discussed. This shall include precision, accuracy, and completeness required for acceptable data.

3.2 STATE AND REGION REQUIREMENTS FOR SITE QC PLAN

In addition to, or in place of, the requirements in this document, those requirements specific to the state or EPA region applicable to the

site shall be considered. Any state- or region-specific requests must be addressed in the site work plan.

3.3 SAMPLING DESIGN

Every site is unique in its own way. To this end, a sampling rationale shall be included with the work plan. The rationale should define and explain thoroughly the sampling statistics, the equipment involved, and anticipating data to be gained by this proposed methodology.

3.4 PRESERVATIVES

After samples have been taken, they shall be sent to the laboratory for analysis within 24 h after collection to ensure that the most reliable and accurate answers will be obtained as a result of the analysis. The holding time begins from the date of collection in the field. Preservatives shall be added in the field. Tables 3.1, 3.2, and 3.3 present the holding times, type of containers, and preservatives to be used. A table corresponding to each of the three different methods such as those from the *Federal Register; SW-846* 3rd ed.; and CLP is presented. The site-specific plan shall outline which preservatives will be used, and it shall be based on these tables. Freezing of samples shall not be permitted.

3.5 SAMPLE CONTAINER CLEANING PROCEDURES

In general, glass bottles with Teflon lids are used for organic samples, while polypropylene is used for metals and other inorganics. The following specifies the bottle cleaning required. If precleaned bottles are purchased, this must be noted in the work or field QA plan and approved by the NCR. If precleaned bottles are used, a certificate indicating that the bottles are analyte free must be provided.

3.5.1 Cleaning Procedure for Glass Bottles

1. Wash glass bottles, Teflon liners, and caps in hot tap water with laboratory-grade nonphosphate detergent.

2. Rinse three times with tap water.

3. Rinse with 1:1 nitric acid (metals-grade), American Society for Testing Materials (ASTM) Type I deionized water.

4. Rinse three times with ASTM Type I deionized water.

5. Rinse with pesticide-grade methylene chloride using 20 mL for 1/2-gal container and 5 mL for 4- and 8-oz containers.

6. Oven dry at 125°C. Allow to cool to room temperature in an enclosed contaminant-free environment.

Table 3.1 Required containers, preservation techniques, and holding times (40 CFR, Part 136, July 1, 1987)

Parameter No./name	Container[1]	Preservation[2,3]	Maximum holding time[4]
Table IA—Bacterial Tests			
1-4 Coliform, fecal and total	P, G	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	6 hours
5 Fecal streptococci	P, G	do	Do
Table IB—Inorganic Tests			
1 Acidity	P, G	Cool, 4°C	14 days
2 Alkalinity	P, G	do	Do
4 Ammonia	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
5 Biochemical oxygen demand	P, G	Cool, 4°C	48 hours
11 Bromide	P, G	None required	28 days
14 Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours
15 Chemical oxygen demand	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
16 Chloride	P, G	None required	Do
17 Chlorine, total residual	P, G	do	Analyze immediately
21 Color	P, G	Cool, 4°C	48 hours
23-24 Cyanide, total and amenable to chlorination	P, G	Cool, 4°C, NaOH to pH > 12, 0.6g ascorbic acid[6]	14 days[7]
25 Fluoride	P	None required	28 days
27 Hardness	P, G	HNO_3 to pH < 2, H_2SO_4 to pH < 2	6 months
28 Hydrogen ion (pH)	P, G	None required	Analyze immediately
31, 43 Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
Metals[8]			
18 Chromium VI	P, G	Cool, 4°C	24 hours
35 Mercury	P, G	HNO_3 to pH < 2	28 days
3, 5-8, 10, 12, 13, 19, 20, 22, 26, 29, 30, 32-34, 36, 37, 45, 47, 51, 52, 58-60, 62, 63, 70-72, 74, 75 Metals, except chromium VI and mercury	P, G	do	6 months
38 Nitrate	P, G	Cool, 4°C	48 hours
39 Nitrate-nitrite	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
40 Nitrite	P, G	Cool, 4°C	48 hours
41 Oil and grease	G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
42 Organic carbon	P, G	Cool, 4°C, HCl or H_2SO_4 to pH < 2	Do
44 Orthophosphate	P, G	Filter immediately, Cool, 4°C	48 hours
46 Oxygen, Dissolved Probe	G Bottle and top	None required	Analyze immediately
47 Winkler	do	Fix on site and store in dark	8 hours
48 Phenols	G only	Cool, 4°C, H_2SO_4 to pH < 2	28 days
49 Phosphorus (elemental)	G	Cool, 4°C	48 hours
50 Phosphorus, total	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
53 Residue, total	P, G	Cool, 4°C	7 days
54 Residue, Filterable	P, G	do	48 hours
55 Residue, Nonfilterable (TSS)	P, G	do	7 days
56 Residue, Settleable	P, G	do	48 hours
57 Residue, volatile	P, G	do	7 days
61 Silica	P	do	28 days
64 Specific conductance	P, G	do	Do
65 Sulfate	P, G	do	Do
66 Sulfide	P, G	Cool, 4°C add zinc acetate plus sodium hydroxide to pH > 9	7 days
67 Sulfite	P, G	None required	Analyze immediately
68 Surfactants	P, G	Cool, 4°C	48 hours
69 Temperature	P, G	None required	Analyze
73 Turbidity	P, G	Cool, 4°C	48 hours
Table IC—Organic Tests[9]			
13, 18-20, 22, 24-26, 34-37, 38-43, 45-47, 56, 66, 68, 69, 82-85, 87 Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	14 days
6, 57, 60 Purgeable aromatic hydrocarbons	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], HCl to pH2[10]	Do
3, 4 Acrolein and acrylonitrile	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], Adjust pH to 4-5[11]	Do
23, 30, 44, 49, 53, 67, 70, 71, 80, 85, 86 Phenols[12]	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction
7, 39 Benzidines[12]	do	do	7 days until extraction[13], 40 days after extraction
14, 17, 48, 50-52 Phthalate esters[12]	do	Cool, 4°C	7 days until extraction[13], 40 days after extraction
72-74 Nitrosamines[12,14]	do	Cool, 4°C, store in dark, 0.008% $Na_2S_2O_3$	Do
75-82 PCBs[12], acrylonitrile	do	Cool, 4°C	Do
54, 55, 65, 69 Nitroaromatics and isophorone	do	Cool, 4°C, 0.008% $Na_2S_2O_3$, store in dark	Do
1, 2, 5, 8-12, 32, 33, 58, 59, 64, 68, 84, 86 Polynuclear aromatic hydrocarbons[12]	do	do	Do
15, 16, 21, 31, 75 Haloethers[12]	do	Cool, 4°C, 0.008% $Na_2S_2O_3$	Do
29, 35-37, 80-83, 91 Chlorinated hydrocarbons[12]	do	Cool, 4°C	Do
87 TCDD[12]	do	Cool, 4°C, 0.008% $Na_2S_2O_3$	Do
Table ID—Pesticides Tests			
1-70 Pesticides[12]	do	Cool, 4°C, pH 5-9[15]	Do
Table IE—Radiological Tests			
1-5 Alpha, beta and radium	P, G	HNO_3 to pH < 2	6 months

[1] Polyethylene (P) or Glass (G).

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

[3] When any samples are to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater), Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.82 or greater), Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater), and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[4] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time, and has received a variance from the Regional Administrator under (§136.3(e)). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See (§136.3(e)) for details.

[5] Should only be used in the presence of residual chlorine.

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

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

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

[9] Sample receiving no pH adjustment must be analyzed within seven days of sampling.

[10] The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

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

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

[13] Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (extract-free) atmosphere.

[14] For the analyses of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.

[15] The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

Table 3.2 Preservative and holding times for the contract laboratory protocol

Parameter	Container	Preservative	Holding Time Soil	Holding Time Water
Volatiles by gas chromatography/mass spectroscopy (GC/MS)	Water - 40-mL glass vial with Teflon-lined septa	Cool, 4°C	10 days	10 days
	Soil-glass with Teflon-lined septa			
PCB/ pesticides	G, Teflon-lined-lid	Cool, 4°C	Extract within 10 days, analyze 40 days	Extract within 5 days, analyze 40 days
Extractable organics	G, Teflon lined-lid	Cool, 4°C	Extract within 10 days, analyze 40 days	Extract within 5 days, analyze 40 days
Metals	P, G	HNO_3 to pH<2	6 months	6 months
Mercury	P, G	HNO_3 to pH<2	26 days	26 days
Cyanide	P, G	NaOH to pH>12 Cool 4°C add 0.6 g ascorbic acid if residual chlorine present	14 days	14 days
Chromium VI	P, G	HNO_3 to pH<2	24 h	24 h

7. Place liners in lids and cap containers.

8. Store in contaminant-free area. (Amber glass containers shall not be exposed to sunlight).

Table 3.3 Preservatives and holding times for EPA-document SW-846 (3rd ed.)

Parameter	Container	Preservative	Holding Time Soil	Holding Time Water
Volatiles by GC/MS, and GC	Water - 40-mL glass vial with Teflon-lined septa Soil-glass with Teflon-lined septa	Cool, 4°C	14 days	14 days
PCB/ pesticides	G, Teflon-lined lid	Cool, 4°C	Extract within 7 days, analyze 40 days	Extract within 7 days, analyze 40 days
Extractable organics	G, Teflon-lined lid	Cool, 4°C	Extract within 7 days, analyze 40 days	Extract within 7 days, analyze 40 days
Metals	P, G	HNO_3 to pH<2	6 months	6 months
Mercury	P, G	HNO_3 to pH<2	28 days	28 days
Cyanide	P, G	NaOH to pH>12 Cool 4°C add 0.6 g ascorbic acid if residual chlorine present	14 days	14 days
Chromium	P, G	HNO_3 to pH<2	24 h	24 h

3.5.2. Cleaning Procedure for Bottles Used for Volatile Organics (40-mL Glass)

1. Wash glass vials, Teflon-backed septa, Teflon liners, and caps in hot tap water using laboratory-grade nonphosphate detergent.

2. Rinse three times with tap water.

3. Rinse three times with ASTM Type I deionized water.

4. Oven dry vials, septa, and liners at 125°C.

5. Allow vials, septa, and liners to cool to room temperature in an enclosed contaminant-free environment.

6. Seal 40-mL vials with septa (Teflon side down) and cap.

7. Store in contaminant-free area.

3.5.3. Cleaning Procedure for Polyethylene Bottles

1. Wash polyethylene bottles and caps in hot tap water with laboratory-grad nonphosphate detergent.

2. Rinse with 1:1 nitric acid (metals-grade), ASTM deionized water).

3. Rinse three times with ASTM Type I deionized water.

4. Invert and air dry in contaminant-free environment.

3.5.4. All Bottles Should Be

1. Capped and labeled with sample numbers and packed in cooler or box.

2. Stored in contaminant-free area.

3.6 ORGANIZATION AND PERSONNEL

All management personnel responsible for performing field sampling or analytical work shall be listed along with their job assignment and years of experience in performing this type of work. Any education and training related to the tasks performed for this project shall also be listed.

3.7 FIELD QC SAMPLES

Although the number of QC samples changes, the types of field QC samples remain the same regardless of the level of QC implemented. Table 3.4 lists the percentage of field QC samples per level per sample matrix. A sampling event is considered to be from the time the sampling personnel arrive at the site until these personnel leave for more than a day. An example of two events would occur if sampling personnel went to a site for three weeks, drilled borings, and put groundwater wells in place. During this visit, soil and water samples were collected. The sampling crew left the site for two months, thus concluding the first sampling event. The crew later returned to collect another set of groundwater samples over a three-day period. The second visit would constitute the second sampling event.

Table 3.4. Field QC samples per sampling event

Type of Sample	Level C		Level D		Level E	
	Metal	Organic	Metal	Organic	Metal	Organic
Trip blank (for volatiles only)	NA[1]	1/cooler	NA[1]	1/cooler	NA[1]	1/cooler
Equipment rinsate[2]	1/day	1/day	1/day	1/day	1/day	1/day
Field blank	1/source/event for all levels and all analytes					
Field duplicates[3]	10%	10%	10%	10%	5%	5%
Referee duplicate[3]						

[1]NA - Not applicable.

[2]Samples are collected daily; however, only samples from every other day are analyzed. Other samples are held and analyzed only if evidence of contamination exists.

[3]The duplicate must be taken from the same sample which will become the laboratory matrix/spike duplicate for organics or for the sample used as a duplicate in inorganic analysis.

The following information defines and explains the blanks, duplicates, and referee samples.

1. Trip Blanks

Trip blanks are defined as samples which originate from analyte-free water taken from the laboratory to the sampling site and returned to the laboratory with the volatile organic (VOA) samples. One trip blank should accompany each cooler containing VOAs, should be stored at the laboratory with the samples, and analyzed by the laboratory. Trip blanks are only analyzed for VOAs.

2. Equipment Rinsates

Equipment rinsates are the final analyte-free water rinse from equipment cleaning collected daily during a sampling event. Initially, samples from every other day should be analyzed. If analytes pertinent to the project are found in the rinsate, the remaining samples must be analyzed. The results from the blanks will be used to flag or assess the levels of analytes in the samples. This comparison is made during data validation. The rinsates are analyzed for the same parameters as the related samples.

3. Field Blanks

Field blanks consist of the source water used in decontamination and steam cleaning. At a minimum, one field blank from each event and each source of water must be collected and analyzed for the same parameters as the related samples.

4. Field Duplicates/Splits

Duplicates or splits for soil samples are collected, homogenized, and split. All samples except VOAs are homogenized and split. Volatiles are not mixed, but select segments of soil are taken from the length of the core and placed in 40-mL glass vials. Cores may be sealed and shipped to the laboratory for subsampling if the project deems this appropriate. The duplicates for water samples should be collected simultaneously. Field duplicates should be collected at a frequency of 10% per sample matrix for Levels D and C. For Level E, the duplicates should be analyzed at a frequency of 5%. All the duplicates should be sent to the primary laboratory responsible for analysis. The same samples used for field duplicates shall be split by the laboratory and be used as the laboratory duplicate or matrix spike. This means that for the duplicate sample, there will be analyses of the normal sample, the field duplicate, and the laboratory matrix spike/duplicate.

5. Referee Duplicates

Duplicates/splits shall be sent to the referee QA laboratory if regulators (state or region) collect split samples or if a special problem occurs in sample analysis or collection. These duplicates/splits are collected and analyzed in addition to the field duplicates mentioned in the previous paragraph.

3.8 CHAIN OF CUSTODY

Samples, other than those collected for *in situ* field measurements or analyses, are identified by using a standard sample label which is attached to the sample container. The sample labels are sequentially numbered and are accountable. The following information shall be included on the sample label.

1. Site name.
2. Field identification or sample station number.
3. Date and time of sample collection.
4. Designation of the sample as a grab or composite.
5. Type of sample (matrix) and a brief description of the sampling location.
6. The signature of the sampler.
7. Sample preservation and preservative used.
8. The general types of analyses to be conducted.

If a sample is split with another party, sample labels with identical information shall be attached to each of the sample containers.

The COC record is used to record the custody of samples and shall accompany samples at all times. The following information shall be supplied to complete the COC record.

1. Project name.
2. Signature of samplers.
3. Sampling station number or sample number, date and time of collection, grab or composite sample designation, and a brief description of the type of sample and sampling location.
4. Signatures of individuals involved in sample transfer (i.e., relinquishing and accepting samples). Individuals receiving the samples shall sign, date, and note the time that they received the samples on the form.
5. Matrix.

Sample analysis request sheets serve as official communication to the laboratory of the particular analyses required for each sample and provide further evidence that the COC is complete.

COC records initiated in the field shall be placed in a plastic cover and taped to the inside of the shipping container used for sample transport from the field to the laboratory.

3.9 SHIPPING REQUIREMENTS

Shipping containers shall be secured using nylon strapping tape and custody seals to ensure that samples have not been disturbed during transport. The custody seals shall be placed on the containers so they cannot be opened without breaking the seal.

Samples which must be kept at 4°C shall be shipped in insulated containers with either freezer forms or ice. If ice is used, it shall be placed in a container so that the water will not fill the cooler as the ice melts. The samples shall be shipped within 24 h of collection to allow the laboratory to meet holding times. The Department of Transportation regulations shall be used for packaging, quantities of shipment, and the way samples are sent. Each subcontractor responsible for sampling shall become familiar with the regulations.

Copies of the signed COC forms shall be delivered with the data packages. The originals shall remain on file with the contractor or with the laboratory.

3.10 SAMPLE RECEIPT

Upon receipt, the laboratory shall sign and keep copies of the air bill. The COC shall be signed. The temperature of the cooler shall be

measured and documented. The condition of the samples shall be documented. If any breakage or discrepancy arises between COC, sample labels, and requested analysis, the sample custodian will notify the engineering subcontractor. The pH of incoming samples shall be checked and documented upon receipt. Any discrepancy or improper preservation shall be noted by the laboratory as an out-of-control event and shall be documented on an out-of-control form with the corrective action taken. The out-of-control form shall be signed and dated by the custodian and any other person responsible for corrective action.

4. LABORATORY QA PLAN REQUIREMENTS

An essential step in the sequence of events leading to Navy approval of contract laboratories is the preparation and acceptance of a QA plan for each laboratory.

The contents and format of an acceptable plan are described below. If the laboratory has a general QA plan in place, this should be sent for review. In this case, a site-specific QA plan may not be needed. Any deviations or additions to the normal laboratory QA should be documented in the site-specific work plan.

4.1 PURPOSE AND SCOPE

The QA plan is a statement of the laboratory's approach to ensuring that quality data are generated from the analysis of Navy samples. In the context of laboratory approval, the plan provides a basis for evaluating a laboratory's QC procedures. This evaluation includes a critical review of the plan and verification of the laboratory's adherence to the plan through inspection.

4.2 ORGANIZATION AND CONTENTS OF PLAN

The items listed below may be presented in any order that the laboratory desires; however, the list includes the items that are required in the QA plan.

1. Title Page with Provision for Signatures
2. Table of Contents
3. Organization and Personnel
4. Personnel Training
5. Sample-Handling Practices and COC
6. Material Procurement and Control
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17. Document Control
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19. Accuracy, Precision, and Completness

1. Title Page with Provisions for Signature

   A title page with provision of approval signatures and date of revision shall be provided.

2. Table of Contents

   A table of contents shall be provided.

3. Laboratory Organization and Personnel

   This section provides an overview of the laboratory organization as it relates to implementation of the QC program. The roles, responsibilities, and authority of key laboratory personnel are described with emphasis on the authority given the LQAC with regard to QC monitoring, reporting, and corrective action.

   An appendix shall contain a list of all the personnel, their assignments and responsibilities, degrees of education, and the years of applicable experience.

4. Personnel Training

   The plan shall address how personnel are trained in laboratory methods, in QC, and in safety policies.

5. Sample-Handling Practices and COC

   This section shall include tracking of samples through the laboratory, receipt of samples, verification of preservation, login of samples, and COC. Sample storage and disposal shall also be included. Preparation of bottles and glassware washing shall also be included.

6. Material Procurement and Control

   This section shall include a description of procedures for purchasing materials, quality inspection prior to use in sample analysis, chemical and standard inventory, solvent storage policies, and laboratory waste disposal.

7. Facilities and Equipment

   A list of basic types of equipment, year of purchase, and general description of the facility assures that the laboratory is large enough to handle the sample load expected and that the equipment is capable of performing the analysis.

8. Equipment Maintenance

   This section shall include general information as to who performs both major, preventive, and day-to-day maintenance and how it is documented.

9. Analytical Procedures

This section shall contain a list of all procedures that the laboratory offers (by method number and matrix) in the event that future work may require analyses not specified in the SOW.

Any method variances must be reported, and any documentation from EPA for approvals-of-method variances shall be presented to assure that they are known prior to sample analysis.

The laboratory policy and implementation procedures shall emphasize that methods are available to the analyst.

10. Calibration

This section shall include calibration procedures by instrument type, calibration frequency, reference standards used, calibration acceptance criteria, and calibration documentations procedures. Calibration applies to both instruments such as gas and liquid chromatography, GC/MS, inductively coupled plasma (ICP), atomic absorption (AA), infrared and ultraviolet spectroscopy, and wet chemical methods.

The method for assuring that balances, refrigerators, and ovens are accurate and how these pieces of equipment are checked must be outlined. Balances and ovens must be checked prior to use. Balances must also be checked by an outside company annually.

11. Limits of Detection

The laboratory shall indicate what the typical method-detection limits are for water, soil, and any other matrix commonly analyzed by the laboratory, with the understanding that this varies with the sample matrix. The procedures for determining the limits of detection for each type of method and the frequency of detection limit verification shall be outlined.

12. Analysis of QC Samples and Documentation

This section shall summarize the QC procedures and documentation to be used in the day-to-day operation of the laboratory. The discussion shall emphasize the following:

- analysis of field, method, and reagent blanks;
- analysis of duplicates, spiked samples, spiked laboratory blanks, and reference or control standards such as EPA check standards;
- the criteria used to establish warning and action limits for the above types of QC samples;

- documentation and examples of control data and control charts (see Sect. 4.4) for explanation of control charts and their usage;
- the frequency of blanks and other QC samples and controls;
- how the data from the QC samples are reported and reviewed;
- who reviews and makes decisions from the QC data;
- details of how requirements of minimum control program in Sect. 8.2 will be met; and
- verification of calibration.

13. Out-of-Control Events and Corrective Action

This section shall contain a definition as to the types of out-of-control occurrences, how these occurrences are documented, and who is responsible for correction and documentation. It is recognized that several out-of-control events occur. Four examples are given.

- Observations Corrected at the Bench - If the calibration of an instrument is not linear, the analyst may find this and correct it prior to continuing to analyze samples. The laboratory may document this and note that the corrective action was to recalibrate and that no samples were affected, as none were analyzed prior to calibration.
- Corrective Actions Taken by Supervisor - A matrix spike recovery is out of control and the laboratory supervisor finds this after the samples for the day have been analyzed. The supervisor shall document that the laboratory blank spiked with surrogates or standards was in control and that other sample spikes were in control; therefore, no reanalysis of the sample is required.
- Corrective Actions at the Receiving Level - If the sample is broken, the analyst may note this and document whether or not more sample is available. If no more sample is available, the customer shall be notified and the decision documented.
- Statistical Out-of-Control Events - If a control chart is being monitored and the measured parameter exceeds the 99% confidence limit then explanation shall be documented as to when the parameter exceeded statistical limits.
    - Procedures shall be outlined as to what corrective action is taken if an out-of-control event occurs and how it is documented and used to improve laboratory performance. The documentation shall be easily used by all personnel and shall be part of routine laboratory procedure.

- Procedures for assuring that results for samples processed during out-of-control conditions are not reported shall be outlined.

- The conditions necessary to reestablish control and criteria for assuring the system is operating properly.

14. Data Evaluation and Data Reduction

A discussion of data evolution procedures for each analytical method as well as for an entire data set shall be included. The process of certification of reviewed data shall be outlined with an explanation of how suspect data are flagged if they are suspect but still reported.

15. Holding Times and Preservatives

The document shall include laboratory policy for meeting holding times for sample analysis and how it is assured that these are met. The sample storage requirements, holding times, and preservatives specified in Tables 3.1, 3.2 and 3.3 are minimal criteria for Navy approval.

16. Internal Laboratory Audits and Approvals from Other Agencies

A listing of approvals from other agencies and states gives an indication of the general quality and type of laboratory experience the organization has. If the laboratory performs self-audits, the frequency and method of documentation shall be outlined.

17. Document Control

The QA plan shall outline the flow of documents containing COC and data. The plan shall explain how documents are checked, signed, and filed.

18. QA Reports to Management

The plan shall include the frequency and information of management QA reports.

19. Accuracy, Precision, and Completeness

The plan shall include the laboratory's definition and method of evaluating the precision, accuracy, and completeness of measurement parameters and of evaluating data sets.

4.3 CONTROL SAMPLES

Control samples are those samples containing known concentrations of analytes that are introduced into a run of environmental samples to

monitor the performance of the analytical system. Control samples involving duplicates, blanks, analytical standards, reference materials, and spikes can be used in different phases of the overall analysis from sampling through storage, transportation, and preparation to the analytical method itself. The choice of types of controls relates to the analysis phase(s) to be controlled and the information (e.g., precision, accuracy, interferences, recovery) to be developed.

The QA plan describes generally how and where such control mechanisms are used by the laboratory. Control materials may be purchased from commercial sources, the National Bureau of Standards, or the EPA. A brief description of each control sample (or set of samples) used shall be provided in the MPR, subsequent to its introduction, and shall cover the following items.

1. Where the control samples are made.

2. How they are made.

3. How many are made and with what frequency.

4. How they are used.

   - Physically (e.g., placed in the sample tray along with 14 environmental samples just before the samples enter the processing stream).

   - Analytically (e.g., used to determine the recovery factor of the procedures; used to check for interferences).

5. Frequency of analysis of control sample.

4.4 CONTROL CHARTS

Control charts provide a useful tool in assessing QC efforts and improving processes through graphic displays of a parameter(s) and its variability over time. The parameter plotted on the chart is usually related to control sample testing--either directly in terms of concentrations or indirectly in terms of derived information such as means of concentrations, ranges of concentrations, percent recovery of spikes, relative percent differences based on duplicate results, or slopes of least-squares data fits.

The laboratory should include in its QA plan, as required in Sect. 4.2, a brief description of the basic methodology used in control charting, covering such considerations as the following.

1. Verification that the methods are valid and working properly prior to beginning control charts.

2. Number of control samples per run.

3. Number of runs analyzed.

4. Parameters to be plotted against time and the general formulae for developing these parameters.

5. Statistical/mathematical basis for assigning warning and rejection limits on the charts in terms of, for example, standard deviation.

6. Types of shifts, trends, or biases that may typically be revealed by these charts.

4.4.1 Method Blank/Spike Control Program

Controls are required for only the methods and analytes pertinent to the program. The laboratory shall employ a measurement-control program which, as a minimum, consists of monitoring the results of laboratory preparation and analysis of control samples using statistical control charts. The basis of this program is to demonstrate that the laboratory method for sample preparation and analysis is working properly. This minimum program consists of using the laboratory's distilled and/or deionized water and spiking it with known compounds or elements. By plotting the results of the method blank spike on control charts, a true picture of the actual process of sample analysis is obtained with fewer problems from matrix effects and sample nonhomogeneity. This information, used in conjunction with matrix spike recoveries, can aid in determining whether an out-of-control condition is due to laboratory problems or matrix problems. Therefore, one batch of control material is the spiked laboratory blank water. The second batch of control material is a soil or sand. This soil can be pulverized and homogenized. If the soil used is known to contain some of the analytes of interest, then no spiking may be required. Additional spiking may be done to an aliquot of control soil just prior to sample preparation. The method blank/spike water (laboratory water) should be analyzed when water samples are analyzed and the method blank/spike soil analyzed alongside soil or waste samples.

The analytes selected for spiking should be representative of the compound class for the organics. It is suggested that the surrogates used for volatiles and base/neutral/acids (BNAs) analyses be used as control analytes for the GC/MS methods. At least two pesticides should be used when pesticide methods are performed and one polychlorinated biphenyl (PCB) when PCBs are analyzed. For wet chemical methods, a single spike of an appropriate control for each method may be used. As an example for cyanide, a control of sodium cyanide from a source other than that used for calibration may be spiked into water and analyzed alongside the water samples. For the metals, it is suggested that at least three of the metals typically analyzed by ICP be monitored and that each element analyzed by furnace or flame atomic absorption be monitored.

4.4.2 Control Sample Quality

The laboratory QA plan shall describe the steps which will be taken to ensure and verify the quality of the two types of control samples of Sect. 4.4.1. The QA plan shall address the following concerns pertaining to the control batches.

1. How the batch will be selected.
2. Shelf life of control batch.
3. Under what conditions the batch will be stored.
4. How the batch will be homogenized.
5. How and when the individual samples will be taken.
6. How and when the sample will be spiked.
7. How the batch will be replaced as it is depleted.
8. How the control charts will be affected by changes in batches.

The QA plan shall address the following concerns pertaining to the spikes.

1. What compound/element will be used to spike.
2. How the spike material will be selected.
3. Target concentration of spiking compound/element.
4. How long the spike is expected to last.
5. Under what conditions the spike will be stored.
6. How the spike will be homogenized.
7. How and when the individual samples will be taken.
8. How the spike will be replaced as it is depleted.
9. How the control charts will be affected by changes in spikes.

4.4.3 Minimum Statistical Control Charting

As a minimum, the laboratory shall run two control charts for each analyte listed in Table 4.1. These charts shall monitor the laboratory measurements obtained from individually spiked water samples and individually spiked soil samples.

Each control chart shall consist of a center line, two warning limits, and two control limits. The control chart parameters should be calculated according to the formulae provided in Table 4.2. A minimum of 20 points/chart shall be obtained prior to the initial attempt to establish the control chart parameters.

If the laboratory does not have 20 points to use in setting control chart limits, the recommended EPA recoveries for the method will be used until such time as 20 points are attained.

4.4.4 Minimum Criteria for an Out-of-Control Condition

A laboratory process for a particular analyte should be considered out of statistical control whenever, as a minimum, any one of the following conditions is demonstrated by a control chart monitoring that analyte.

1. Any one point is outside of the control limits.
2. Any three consecutive points are outside the warning limits.
3. Any eight consecutive points are on the same side of the centerline.
4. Any six consecutive points are such that each point is larger (smaller) than its immediate predecessor.
5. Any obvious cyclic pattern is seen in the points.

Table 4.1. Typical number of analyses to be monitored through measurement control program

Number	Analyses
10	Metals by AA and ICP
1	Mercury
3	Volatiles
1	Wet chemicals
1	PCB
2	Pesticides
3	Base neutrals
3	Acids

4.4.5 Reactions to Out-of-Statistical-Control Conditions on Control Samples

The laboratory QA plan shall describe the steps which will be taken in the occurrence of an out-of-statistical-control condition from the control charts of Sect. 4.2.3. The steps should be similar to those requested in Sect. 4.6 but shall include those actions related to the quality and stability of the control batches, sampling, spiking, and handling of the control samples.

4.4.6 Administration of the Control Charts

The laboratory QA plan shall address the following aspects of administering the control charts of Sect. 4.4.2.

1. What types of laboratory activities the control charts will monitor.
2. How often control samples will be run.
3. How soon after results are obtained will charts be monitored.
4. Who is responsible for reading the charts.
5. How will changes in people, equipment, processes affect the charts.
6. How often and under what circumstances will limits be updated.

4.4.7 Statistical Quality of the Control Charts

The formulae for the control chart parameters given by Table 4.2 are those commonly accepted and used. They are based on normally distributed measurements and short-term variation. If these bases are inappropriate, the charts will not perform as desired. The charts will either falsely signal out-of-control warnings more frequently than usual, fail to detect existing out-of-control conditions as often as they ordinarily would, or both (for different types of out-of-control states). In order to correct any problems due to improperly fitting control charts, the laboratory may propose alternate methods for setting the control chart parameters for those analytes of Table 4.2. All such proposals

Table 4.2. Control chart formula for Water and Soil Control Batch Program

Definitions

Let X_1, X_2, X_3, ..., X_n ($n \geq 20$) represent the first n time-ordered determinations for an analyte of Table 4.2 from either the water or soil control batch program.

Then, define the following:

$\bar{X}$ = average = $(1/n)(X_1 + X_2 + \ldots + X_n)$,
$Ri = |X_i - X_{(i-1)}|$ $i = 2,3,\ldots,n$
R_2 = average moving range of two successive points,

$$= [1/(n-1)][\,|X_2 - X_1| + |X_3 - X_2| + \ldots + |X_n - X_{(n-1)}|\,] .$$

Control Chart Parameter Estimation

Parameter	Symbol	Formula
Centerline	CL	$\bar{X}$
Upper control limit	UCL	$\bar{X} + 3R_2/d_2$
Lower control limit	LCL	$\bar{X} - 3R_2/d_2$
Upper warning limit	UWL	$\bar{X} + 2R_2/d_2$
Lower Warning limit	LWL	$\bar{X} - 2R_2/d_2$

(d_2 = 1.128, factor from tables for control charting within n = 2, see American Society for Quality Control)

should include data and supportive statistical evidence. Possible alternate statistical approaches can include using nonparametric techniques, medians instead of averages for the centerlines, identifying sources of variation, using long-term variation instead of short-term variation in setting limits, and transformations of the data.

4.4.8 Example of Setting Control Limits

As an example of setting control chart parameters and a very brief introduction to interpretation of the chart, consider the following:

A sample is obtained from the batch of control soil which has been thoroughly mixed and is stored in a special atmospherically controlled location. It is carefully spiked with known amounts of the constituents of Table 4.2 and sent to sample preparation to be processed with a customer's solid waste samples. It is analyzed along with the other samples. It is subjected to the same types of treatment as the other samples in the batch. This scenario is repeated until 20 control samples have been analyzed.

The data are listed in Table 4.3. Also shown are calculations according to the formulae in Table 4.2. Figure 4.1 displays the results of the initial attempt at sizing the data to the control chart parameters. The point falling above the upper control limit was investigated. It was determined that the sample had received a double spiking and, thus, was deleted from the second iteration calculation of the chart parameters. Figure 4.2 shows the second fitting. This fit appears adequate, and the chart is approved by the LQAC authority. Had no explanation for the high result been found, the first calculations would have been used. The chart would have been placed under a probationary condition and its performance monitored with guarded caution.

4.5 OUT-OF-CONTROL EVENTS

The interpretation of control charts can reveal shifts, trends, biases, and conditions where parts of the analytical system are out-of-control. The contract laboratory should specify in the QA plan its criteria of defining an out-of-control condition related to the different zones on a control chart [e.g., data beyond the rejection limits, data in the zone(s) between the rejection and warning limits, and data inside the warning limits] and different patterns within these zones [e.g., number of consecutive data points on one side of the mean, number of consecutive data points in the middle zone number of monotically changing data points, obviously repetitive patterns (Garfield, 1984)].

The laboratory shall identify what actions will be taken when the warning and/or control limits are exceeded. Warning conditions may only require more frequent observations of a piece of equipment, while rejection conditions require shutting down an instrument.

Any incident that delays sample processing for a period of time, affects holding times, or delays work by more than two days should immediately be reported by phone to the NCR. The NCR should be informed as soon as the problem is solved and an explanation given as to the corrective action taken. An example of this type of event would be the breakdown of a GC/MS system used for VOAs which could not be repaired for several days. If the laboratory could not use another instrument in its laboratory, then provisions for another approved laboratory to analyze the samples would need to be made.

Table 4.3. Data and calculations for control chart example

Order I	Result X	Moving range $\lvert X_I - X_{I-1} \rvert$
1	12.25	
2	7.52	4.73
3	12.29	4.78
4	10.04	2.25
5	8.48	1.56
6	10.89	2.40
7	9.57	1.32
8	11.40	1.83
9	9.28	2.12
10	11.66	2.39
11	12.06	0.40
12	8.52	3.54
13	11.14	2.62
14	19.56	8.42
15	10.48	9.08
16	9.12	1.35
17	12.79	3.66
18	10.30	2.49
19	5.54	4.76
20	8.93	3.39
Sum	211.82	63.0

First calculations (Fig. 4.1)

Average = 211.82/20 = 10.591
Average moving range = 63.09/19 = 3.321

Centerline = 10.591
Upper control limit = 10.591 + 3 × 3.321/1.128 = 19.423
Lower control limit = 10.591 - 3 × 3.321/1.128 = 1.758
Upper warning limit = 10.591 + 2 × 3.321/1.128 = 16.479
Lower warning limit = 10.591 - 2 × 3.321/1.128 = 4.703

Second Iteration after Removing Point #14 (Fig. 4.2)

Average = 192.26/19 = 10.119
Average moving range = 46.26/18 = 2.570

Centerline = 10.119
Upper control limit = 10.119 + 3 × 2.570/1.128 = 16.954
Lower control limit = 10.119 - 3 × 2.570/1.128 = 3.284
Upper warning limit = 10.119 + 2 × 2.570/1.128 = 14.676
Lower warning limit = 10.119 - 2 × 2.570/1.128 = 5.562

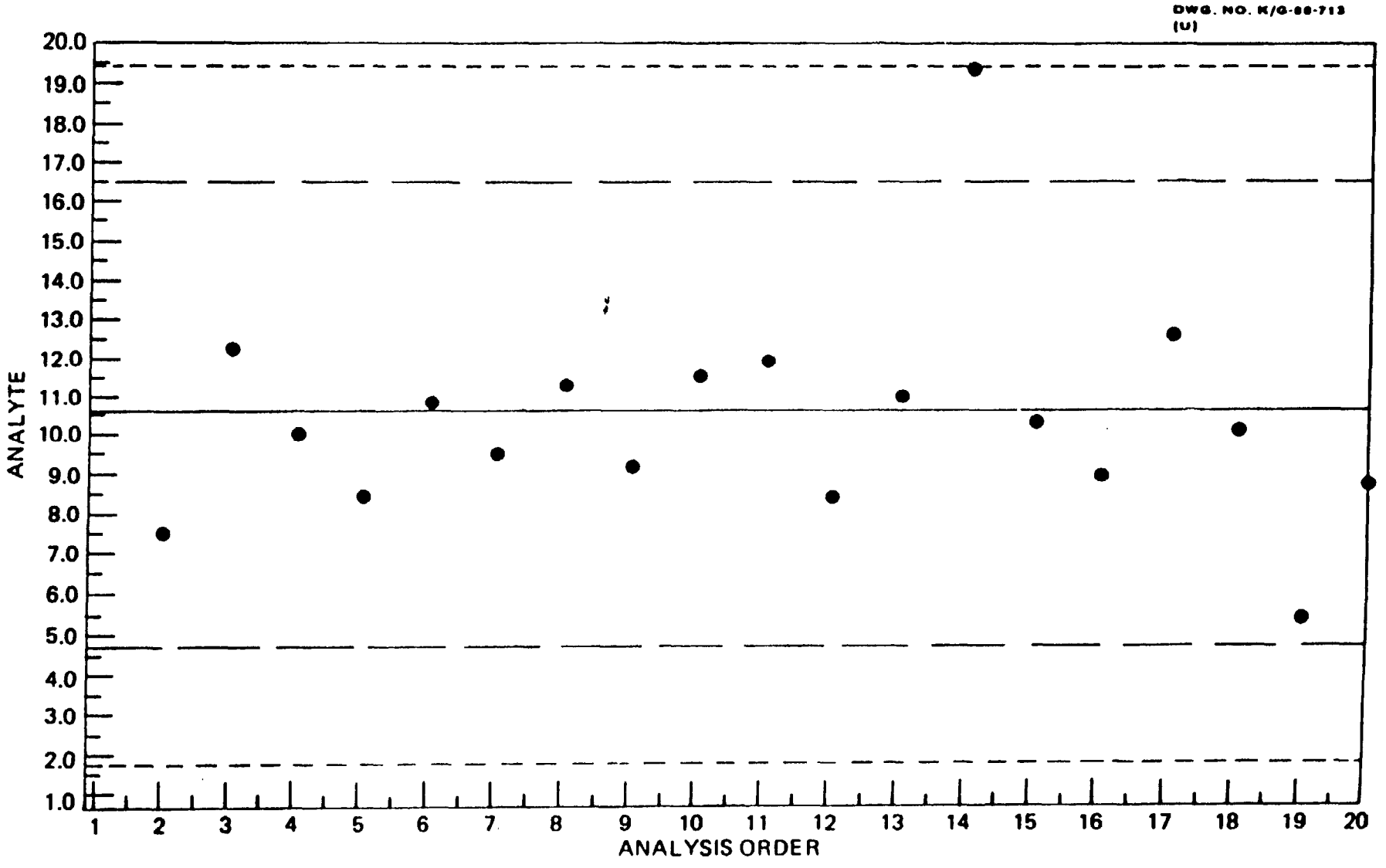

Fig. 4.1. Control Chart Example Data and Control Values of Table 4.3

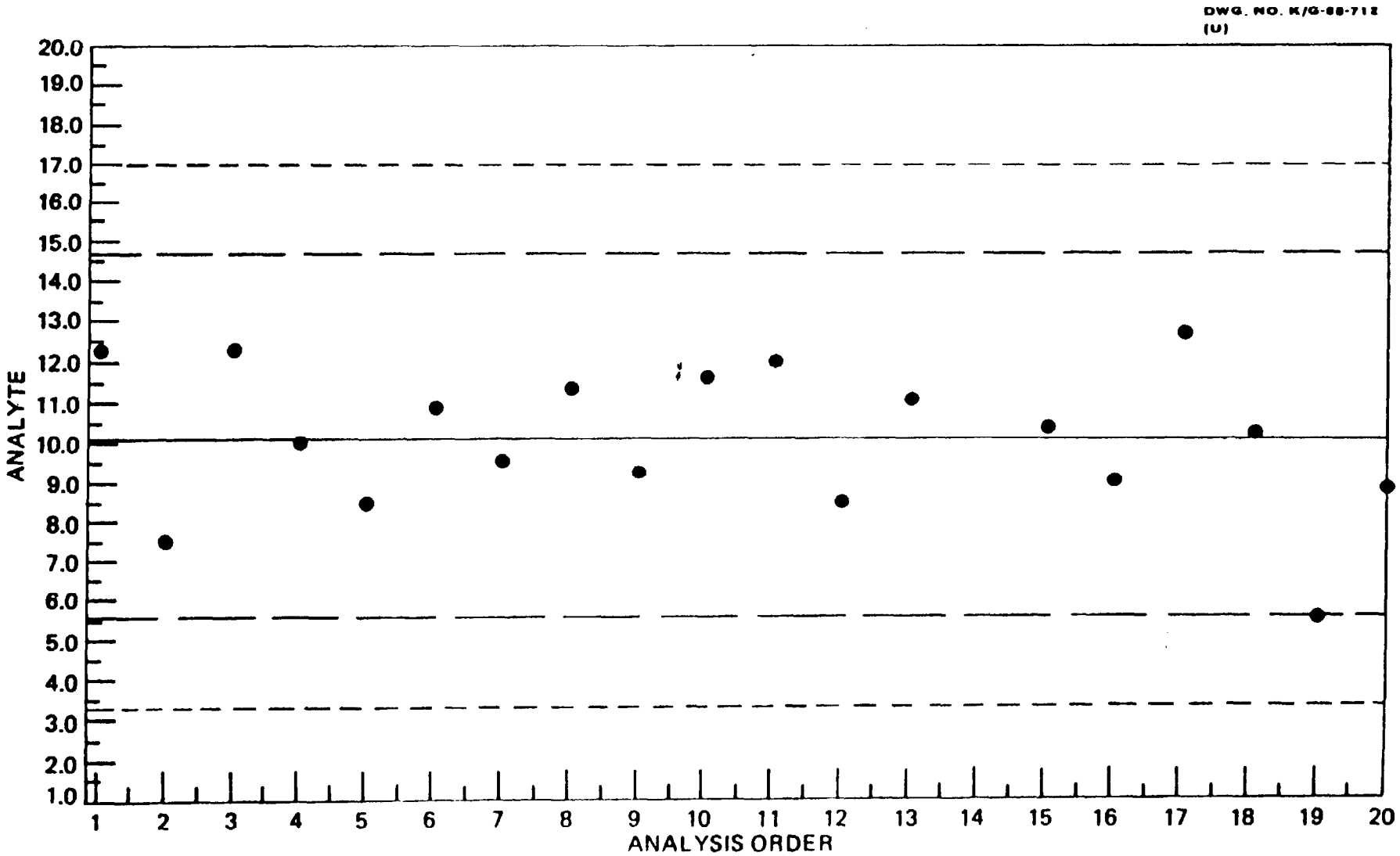

Fig. 4.2. Control Chart Example Data and Second Iteration Control Values of Table 4.3

Many laboratories use forms to aid in rapidly reporting out-of-control events and corrective actions. One way to expedite the more routine out-of-control occurrences, which are frequently corrected by the analyst prior to running samples, is to list these on a form. For instance, a form for the GC/MS laboratory might list events such as continuing check standard outside limits, tune not met, and peak areas for the internal standard outside criteria. The analyst would check the occurrence, note that the item was corrected prior to sample analysis, initial, and date the form. If forms for out-of-control events are made specific to the group using these, time can be saved in documenting events and corrective actions (see Sect. 4.2 for examples of out-of-control events).

4.6 CORRECTIVE ACTION REPORT

For out-of-control incidents, it is essential to document the nature of the incident and the corrective actions taken to set the system back "in control." A corrective action report, to be signed by the laboratory director and the LQAC, should be reported in the MPR to the NCR and discuss the following topics.

1. Where - did the out-of-control incident occur (laboratory name, address, telephone number, section name)?

2. When - did the incident occur?

   - was it corrected?

3. Who - discovered the out-of-control incident?

   - verified the incident?

   - corrected the problem?

4. What - was the name of the test?

   - was the disposition of the test or control and/or instrument?

   - was the nature of the corrective action?

   - will be done to prevent the reoccurrence of the problem?

5. Why - did the incident happen (if scientific explanation is available)?

A copy of the subject control charts and other data describing the out-of-control conditions should be included in the corrective action report.

All out-of-control incident documentation and copies of the corrective action reports sent to the NCR should be

1. placed in the laboratory archive record for the sample(s) in question,
2. placed in the LQAC's file of incidents documentation, and
3. referenced and briefly described in the MPR.

5. PROFICIENCY TESTING

Prior to beginning analysis of field samples, each laboratory must analyze proficiency samples for chemical substances representative of those anticipated in environmental samples. The purpose of proficiency testing is to gage each laboratory's proficiency with samples which are designed to mimic field samples. A second benefit of performance samples is to provide a known material from a source outside the laboratory which can be used to evaluate the laboratory's performance.

5.1 SUBMITTING THE PROFICIENCY SAMPLES

Proficiency samples will be provided to the LQAC within ten working days of receipt of the site work plan. The samples may be soil or water samples or vials of concentrate. The laboratory will be directed as to any required sample reconstitution and the analytes to be determined. If analyses are to be subcontracted to a second laboratory, appropriate proficiency samples must be sent by the NCR to that laboratory as well.

5.2 RESULTS OF PROFICIENCY SAMPLES

Results of proficiency sample analyses are to be received by the NCR within 20 working days after receipt of the samples. The NCR must have the data at least five working days prior to inspection in order to properly evaluate the data. If performance samples are to be subcontracted to a second laboratory, the data report should be sent directly to the primary laboratory by the subcontract laboratory. The entire performance data package is then submitted to the NCR. QC data such as blanks, spikes, EPA controls, daily calibration check standards, sample chromatograms, mass spectra of identified compounds and raw absorbance data for metals shall be provided.

5.3 EVALUATION OF PROFICIENCY SAMPLE RESULTS

The NCR will compare the laboratory's evaluation of proficiency sample results to peer group proficiency sample results.

Performance will always be acceptable if the laboratory results are not statistically different from the peer group results, at 95% confidence, and no procedural problems are found during the laboratory inspection. For nonacceptable results, the records will be reviewed to determine the cause for the nonconformance. The actual limits for a batch of performance samples will be provided only after the batch is discontinued.

6. LABORATORY INSPECTION

The laboratory inspection will occur within 45 days after the laboratory(s) have provided the first edition of the QA plan, the site-specific work plan, and the performance sample data. The inspection will be performed by an experienced chemist from the NCR. The chemist may be accompanied by the EIC.

6.1 PURPOSE OF INSPECTION

The purpose of laboratory inspection is to verify that the Navy QC requirements are being met as reflected by the laboratory's daily operations in adherence to the QC plan received by the NCR.

6.2 INSPECTION PROCEDURE

The laboratory inspection involves four phases.

1. Overview and Orientation

   The inspector meets with the laboratory management, including the laboratory director, the LQAC, and others as the director deems appropriate. The objectives of the visit are reviewed and a schedule established. The inspector discusses the review of the laboratory's QA/QC plan and the results of the proficiency testing.

2. Observation, Examination, and Review

   According to the schedule, the inspector does the following.

   - Witnesses performance of specified analytical procedures.

   - Reviews sample handling and storage procedures. The inspector will follow the trail of the performance samples through the laboratory.

   - Examines the QC records including QC manuals, instrument calibration and maintenance records, control charts, instrument run logs, sample preparation logs, notebooks used to document analysis, corrective action reports for out-of-control events, and performance data generated for other programs such as Superfund CLP and state drinking water.

3. Findings

   The inspector conducts an exit interview with the laboratory director, the LQAC, and any other laboratory personnel the director deems appropriate. The inspector summarizes the findings of the visit and details specific deficiencies to be addressed by corrective action.

Recommendations regarding corrective action may be provided. A written report summarizing the findings is provided to the LQAC, the Navy EIC and NCR, and engineering contractor within ten working days of the inspection.

4. Corrective Action (if required)

Within ten days of receipt of the findings, the laboratory submits to the NCR and the EIC a plan to correct the deficiencies identified in the inspection. The plan should include for each deficiency, a description of the corrective action and a date indicating when the action is to be implemented or completed.

A repeat inspection may be required in instances where the number of deficiencies requiring corrective actions are complex. Repeat inspections will be scheduled for the earliest possible date after the last corrective action plan is received by the NCR.

The laboratory shall send a follow-up report which supplies information indicating the proof that the plan has been carried out. For example, if no control charts exist, then the plan would state that these would be in place by a specific date, and the follow-up report would contain copies of the control charts.

7. ANALYTICAL METHODS

An analytical method is a series of steps or procedures that must be performed to determine the identity and quantity of analyte in a sample. The methods to be employed by the Navy-approved laboratory fall mainly into two categories--those which have been approved by the EPA and those which have been developed by the Army. The former refer primarily to the methods presented in the *Federal Register* of October 26, 1984 (49 FR 43234), where the EPA has listed ~250 pollutants (pp. 43251-43258) or pollutant categories and the method(s) by which each must (by virtue of final or final interim ruling status of the methods) be tested. The acceptance of methods not under either status will be handled on a case-by-case basis among the concerned parties. Non-standard methods shall be submitted to the NCR who will discuss the method with Navy and EPA personnel prior to use on Navy projects. Other applicable EPA methods include the *SW-846* methods which are applicable to Resource Conservation and Recovery Act sites and the Superfund CLPs which are applicable to the CERCLA sites.

Many of the EPA methods are found in the documentation of other organizations (e.g., U.S. Geological Services, ASTM) and are incorporated by reference into the regulations. Such incorporation involves listing the organization, the specific document and its date, the method number assigned by the other organization, and perhaps a page number in the document of the other organization. Technically speaking, to maintain the applicability of the regulation, no deviations from the given citations are allowed by the EPA, even in cases where an organization (ASTM, for example) may have an updated version of the method. However, there are instances where EPA regional offices have granted exceptions to different laboratories for the testing of various substances. If a laboratory has such a variance, in writing, from the EPA (either to use a different ASTM method, for example, than the one cited in the October 26, 1984 *Federal Register* or to use a somewhat modified method, for example, than the one cited in the October 26, 1984 *Federal Register*), a copy of the variance (sent to the NCR) may be used to seek Navy approval of the different or modified method. It must also be shown that the conditions for which the variance was issued by the EPA are similar to the expected conditions (sampling and handling techniques, environmental matrix, concentration range, interferences, etc.) in the IRP.

It is also recognized that the analyst may have some leeway resulting from the regulations themselves. For instance, in the October 26, 1984 *Federal Register*, several methods are listed involving GC. Typically, in paragraph 8.1.2, these methods allow the analyst "certain options," provided various subsequent QC requirements are met. For example, the EPA allows some flexibility in the procedures (and no written permission is needed from the EPA) once a sample has been extracted and placed into the instrument. On the other hand, changes in operations prior to this instrumental analysis (e.g., preparation, storage) would probably require written documentation.

The *Federal Register* of October 26, 1984 (49 FR 43437) also contains a proposed ruling where additional substances and methods are listed: specifically, some proposed modifications to Tables IC and ID (Tables 7.1 through 7.5 of this guide) of the previously mentioned final rule. In those cases where a substance/method does not appear on one of the earlier tables but does occur on one of the proposed listings, the method in the proposed listing is recommended by the EPA (Medz, 1985) but without any regulatory force.

For the analytical method to be used in the case of munition-related substances, the laboratory should consult the NCR who will forward a copy(s) of the appropriate method developed by the Army Toxic and Hazardous Materials Agency.

For biota and air samples, the methods must be evaluated individually by the NCR to determine whether they may be used for the work in question.

A list of references containing methods, statistics, and sampling information is supplied in the Bibliography of this document.

For Level D QC sites, the current CLP methods and documentation must be followed. For methods not covered by CLP and for sites requiring Level D, the latest edition of *SW-846* or other methods listed in Tables 7.1 through 7.5, may be used. For the Levels C and E sites, CLP methods, *SW-846* methods, or other methods listed in Tables 7.1 through 7.5 shall be used. The exception to the Levels C and E method requirement occurs in the volatile and semivolatile area. In any level of QC and for any site where volatiles and semivolatiles are analyzed by GC/MS, the current CLP methods shall be used.

7.1 QC REQUIREMENTS FOR THE LABORATORY

The following are the minimum QC requirements for the laboratory analyses. For Level D QC, the current CLP QC requirements are specified. For methods not defined in the CLP, the blank, blank/spike, matrix spike, and matrix spike duplicate shall be performed for every 20 samples of similar matrix. The batch size for Level D QC is 20 samples.

In Levels C and E, the optimum batch size is determined by the number of samples of similar matrix which can be processed simultaneously through the entire preparation and analysis process. For example, if 5 samples can be extracted and 20 analyzed by the instrument, the batch size is 5. Once this is determined, it is used with the blank/spike control program in the following manner.

In Levels C and E, a blank/spike control shall be analyzed with each batch and shall be plotted on control charts as described in Sect. 4.4. For metals, anions, and other wet chemical analysis, a method blank shall also be processed with each batch and shall contain less than the method detection limit for compounds of interest. In any method using surrogates spiked into the blank, the blank shall serve as both the method blank

Table 7.1. List of approved biological test procedures (40 CFR, Part 136, July 1, 1987)

Parameter and units	Method [1]	EPA [2]	Reference (Method Number or Page)		
			Standard Methods 15th Ed.	ASTM	USGS
Bacteria					
1 Coliform (fecal) number per 100 ml	MPN, 5 tube, 3 dilutions, or, membrane filter (MF) [4], single step	p 132	908C		
		p 124	908C		B-0050-77
2 Coliform (fecal) in presence of chlorine number per 100 ml	MPN, 5 tube, 3 dilution	p 132	908C		
3 Coliform (total), number per 100 ml	MPN, 5 tube, 3 dilution, or, MF [4] single step or two step	p 114	908A		
		p 108	908A		B-0025-77
4 Coliform (total) in presence of chlorine, number per 100 ml	MPN, 5 tube, dilution, or MF [4] with enrichment	p 114	908A		
		p 111	909 (A + A.5c)		
5 Fecal streptococci, number per 100 ml	MPN, 5 tube, 3 dilution, MF [4] or, plate count	p 139	910A		
	p 136	910B		B0055-77 [5]	
	p 143	910C			

Table IA Notes

[1] The method must be specified when results are reported

[2] "Microbiological Methods for Monitoring the Environment, Water and Wastes, 1978", EPA-600/8-78-017, U.S. Environmental Protection Agency

[3] Greeson, P.E., *et al.*, Methods for Collection and Analysis of Aquatic Biological and Microbiological Samples, "U.S. Geological Survey, Techniques of Water-Resources Investigations Book 5, Chapter A4, Laboratory Analysis, 1977.

[4] 0.45 um membrane filter or other pore size certified by the manufacturer to fully retain organisms to be cultivated, and free of extractables which could interfere with their growth and development

[5] Approved only if dissolution of the KF Streptococcus Agar (Section 5.1, USGS Method B-0055-77) is made in a boiling water bath to avoid scorching of the medium

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
12. Cadmium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	213.1	303A or B	D3557-84(A or B)	I-3135-84 or I-3136-84	33.089[3], p.37[6]
	AA furnace,	213.2	304	—	—	
	Inductively coupled plasma,	—	—	—	—	200.7[4]
	Voltametry[16], or	—	—	D3557-84(C)	—	
	Colorimetric (Dithizone).	—	3108	—	—	
13. Calcium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	215.1	303A	D511-84(B)	I-3152-84	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Titrimetric (EDTA).	215.2	311C	D511-84(A)	—	
14. Carbonaceous biochemical oxygen demand ($CBOD_5$), mg/L[11]	Dissolved Oxygen Depletion with nitrification inhibitor.	—	507(5 e.6)	—	—	
15. Chemical oxygen demand (COD), mg/L	Titrimetric, or.	410.1, 410.2, or 410.3	508A	D1252-83	I-3560-84-or I-3562-84	33.034[3], p.17[6]
	Spectrophotometric, manual or automated.	410.4	—	—	I-3561-84	Notes 12 or 13
16. Chloride, mg/L	Titrimetric (silver nitrate)	—	407A	D512-81(B)	I-1183-84	
	or (Mercuric nitrate), or	325.3	407B	D512-81(A)	I-1184-84	33.087[3]
	Colorimetric, manual or	—	—	D512-81(C)	I-1187-84	
	Automated (ferricyanide)	325.1, or 325.2	407D	—	I-2187-84	
17. Chlorine—Total residual, mg/L	Titrimetric					
	Amperometric direct,	330.1	408C	D1253-76(A)	—	
	Starch end point direct,	330.3	408A	D1253-76(B) Part 18.3	—	
	Back titration either end point[14], or	330.2	408B	—		
	DPD-FAS,	330.4	408D	—	—	
	Spectrophotometric, DPD,	330.5	408E	—	—	
	or Electrode	—	—	—	—	Note 15
18. Chromium VI dissolved, mg/L	0.45 micron filtration followed by					
	AA chelation-extraction,	218.4	303B	—	I-1232-84	
	or Colorimetric (Diphenylcarbazide).	—	—	—	I-1230-84	307B[16]
19. Chromium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	218.1	303A	D1687-84(D)	I-3236-84	33.089[3]
	AA chelation—extraction,	218.3	303B	—	—	
	AA furnace,	218.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Diphenylcarbazide).	—	312B	D1687-84(A)	—	
20. Cobalt—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	219.1	303A or B	D3558-84(A or B)	I-3239-84 or I-3240-84	p.37[6]
	AA furnace, or	219.2	304	—	—	
	Inductively coupled plasma	—	—	—	—	200.7[4]

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
21. Color, platinum cobalt units or dominant wavelength, hue, luminance, purity.	Colorimetric (ADMI), or	110.1	204D	—	—	Note 17
	(Platinum cobalt), or	110.2	204A	—	I-1250-84	
	Spectrophotometric.	110.3	204B	—	—	
22. Copper—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	220.1	303A or B	D1688-84(D or E)	I-3270-84 or I-3271-84	33.089[2], p.37[6]
	AA furnace,	220.2	304	—	—	
	Inductively coupled plasma,	—	—	—	—	200.7[4]
	Colorimetric (Neocuproine), or	—	313B	D1688-84(A)	—	
	(Bicinchoninate).	—	—	—	—	Note 18
23. Cyanide—Total, mg/L	Manual distillation with $MgCl_2$ followed by	—	412B	—	—	
	Titrimetric, or	—	412C	—	—	p.22[6]
	Spectrophotometric, manual or	335.2	412D	D2036-82(A)	I-3300-84	
	Automated.[19]	335.3	—	D2036-82(A)	—	
24 Cyanide amenable to chlorination, mg/L	Manual distillation with $MgCl_2$ followed by titrimetric or spectrophotometric	335.1	412F	D2036-82(B)	—	
25. Fluoride—Total, mg/L	Manual distillation[5] followed by	—	413A	—	—	
	Electrode, manual or	340.2	413B	D1179-80(B)	—	
	Automated,	—	—	—	I-4327-84	
	Colorimetric (SPADNS), or Automated complexone.	340.1	413C	D1179-80(A)	—	
		340.3	413E	—	—	
26 Gold—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	231.1	303A	—	—	
	AA furnace.	231.2	304	—	—	
27. Hardness—Total, as $CaCO_3$, mg/L	Automated colorimetric,	130.1	—	—	—	
	Titrimetric (EDTA), or	130.2	314B	D1126-80	I-1338-84	33.082[2]
	Ca plus Mg as their carbonates, by inductively coupled plasma or AA direct aspiration. (See Parameters 13 and 33.)					
28. Hydrogen ion (pH), pH units	Electrometric, measurement, or	150.1	423	D1293-84(A or B)	I-1586-84	33.006[2]
	Automated electrode.	—	—	—	—	Note 20
29. Iridium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	235.1	303A	—	—	
	AA furnace.	235.2	304	—	—	
30. Iron—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	236.1	303A or B	D1068-84(C or D)	I-3381-84	33.089[2]
	AA furnace,	236.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Phenanthroline).	—	315B	D1068-84(A)	—	Note 21

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
31. Kjeldahl nitrogen—Total, (as N), mg/L	Digestion and distillation followed by					
	Titration,	351.3	420A or B	D3590-84(A)	—	
	Nesslerization,	351.3	417D	D3590-84(A)	—	33.051[3]
	Electrode,	351.3	417B	D3590-84(A)	—	
	Automated phenate,	351.3	417E or F	—	—	
	Semi-automated block digestor, or	351.1	—	—	I-4551-78[7]	
	Potentiometric,	351.2	—	D3590-84(A)	—	
		351.4	—	D3590-84(A)	—	
32. Lead—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	239.1	303A or B	D3559-85(A or B)	I-3399-84	33.089[3]
	AA furnace,	239.2	304	—	—	
	Inductively coupled plasma,	—	—	—	—	200.7[4]
	Voltametry[10], or	—	—	D3559-85(C)	—	
	Colorimetric (Dithizone),	—	318B	—	—	
33. Magnesium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	242.1	303A	D511-84(B)	I-3447-84	33.089[3]
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Gravimetric	—	318B	D511-77(A)	—	
34. Manganese—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	243.1	303A or B	D858-84(B or C)	I-3454-84	33.089[3]
	AA furnace,	243.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Persulfate), or	—	319B	D858-84(A)	—	33.126[3]
	(Periodate)	—	—	—	—	Note 22
35. Mercury—Total[3], mg/L	Cold vapor, manual or	245.1	303F	D3223-80	I-3462-84	33.095[3]
	Automated.	245.2	—	—	—	
36. Molybdenum—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	246.1	303C	—	I-3490-84	
	AA furnace, or	246.2	304	—	—	
	Inductively coupled plasma.	—	—	—	—	200.7[4]
37. Nickel—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	249.1	303A or B	D1886-84(C or D)	I-3499-84	
	AA furnace,	249.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Heptoxime).	—	321B	—	—	
38. Nitrate (as N), mg/L	Colorimetric (Brucine sulfate), or	352.1	—	D992-71	—	33.063[3], 419D[16], p.28[9]
	Nitrate-nitrite N minus Nitrite N (See parameters 39 and 40).					
39. Nitrate-nitrite (as N), mg/L	Cadmium reduction,					
	Manual or	353.3	418C	D3867-85(B)	—	
	Automated, or	353.2	418F	D3867-85(A)	I-4545-84	
	Automated hydrazine.	353.1	—	—	—	

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
40. Nitrite (as N), mg/L	Spectrophotometric,					
	Manual or	354.1	418	D1254-67	—	Note 24
	Automated (Diazotization).	—	—	—	I-4540-84	
41. Oil and grease—Total recoverable, mg/L	Gravimetric (extraction).	413.1	503A	—	—	
42. Organic carbon—Total (TOC), mg/L	Combustion or oxidation.	415.1	505	D2579-85(A or B)	—	33.044[2], p.4[23]
43. Organic nitrogen (as N) mg/L	Total Kjeldahl N (Parameter 31) minus ammonia N (Parameter 4.)					
44. Orthophosphate (as P), mg/L	Ascorbic acid method,					
	Automated or	365.1	424G	—	I-4601-84	33.116[2]
	Manual single reagent,	365.2	424F	D515-82(A)	—	33.111[2]
	or Manual two reagent.	365.3	—	—	—	
45. Osmium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	252.1	303C	—	—	
	AA furnace.	252.2	304	—	—	
46. Oxygen, dissolved, mg/L	Winkler (Azide modification), or	360.2	421B	D888-81(C)	I-1575-78[7]	33.028[2]
	Electrode.	360.1	421F	—	I-1576-78[7]	
47. Palladium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	253.1	—	—	—	p.S27[9]
	AA furnace.	253.2	—	—	—	p.S28[9]
48. Phenols, mg/L	Manual distillation[25] followed by	420.1	—	D1783-80(A or B)	—	Note 26
	Colorimetric (4AAP) manual, or	420.1	—	—	—	Note 26
	Automated[19].	420.2	—	—	—	
49. Phosphorus (elemental) mg/L	Gas-liquid chromatography.	—	—	—	—	Note 27
50. Phosphorus—Total, mg/L	Persulfate digestion followed by	365.2	424C(III)	—	—	33.111[2]
	Manual or	365.2 or 365.3	424F	D515-82(A)	—	
	Automated ascorbic acid reduction, or	365.1	424G	—	I-4600-84	33.116[2]
	Semi-automated block digestor.	365.4	—	—	—	
51. Platinum—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	255.1	303A	—	—	
	AA furnace.	255.2	304	—	—	
52. Potassium—total[3], mg/L	Digestion followed by					
	AA direct aspiration,	258.1	303A	—	I-3630-84	33.103[2]
	Inductively coupled plasma	—	—	—	—	200.7[4]
	Flame photometric, or	—	322B	D1428-82(A)	—	
	Colorimetric (Cobaltinitrate).	—	—	—	—	317B[10]

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page)				
		EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
53. Residue—Total, mg/L	Gravimetric, 103-105°C.	160.3	209A	—	I-3750-84	
54. Residue—filterable, mg/L	Gravimetric, 180°C.	160.1	209B	—	I-1750-84	
55. Residue—nonfilterable, (TSS), mg/L	Gravimetric, 103-105°C post washing of residue.	160.2	209C	—	I-3765-84	
56. Residue—settleable, mg/L	Volumetric (Imhoff cone) or gravimetric.	160.5	209E	—	—	
57. Residue—volatile, mg/L	Gravimetric, 550°C.	160.4	209D	—	I-3753-84	
58. Rhodium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	265.1	303A	—	—	
	AA furnace.	265.2	304	—	—	
59. Ruthenium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	267.1	303A	—	—	
	AA furnace.	267.2	304	—	—	
60. Selenium—Total[3], mg/L	Digestion[3] followed by					
	AA furnace,	270.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	AA gaseous hydride.	270.3	303E	D3859-84(A)	I-3667-84	
61. Silica—Dissolved, mg/L	0.45 micron filtration followed by					
	Colorimetric, Manual or	370.1	425C	D859-80(B)	I-1700-84	
	Automated (Molybdosilicate), or	—	—	—	I-2700-84	
	Inductively coupled plasma.	—	—	—	—	200.7[4]
62. Silver—Total[3,6], mg/L	Digestion[3] followed by					
	AA direct aspiration,	272.1	303A or B	—	I-3720-84	33.089[2], p.37[8]
	AA furnace.	272.2	304	—	—	
	Colorimetric (Dithizone), or	—	—	—	—	3198[16]
	Inductively coupled plasma.	—	—	—	—	200.7[4]
63. Sodium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	273.1	303A	—	I-3735-84	33.107[2]
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Flame photometric.	—	325B	D1428-82(A)	—	
64. Specific conductance, micromhos/cm at 25°C	Wheatstone bridge.	120.1	205	D1125-82(A)	I-1780-84	33.002[2]
65. Sulfate (as SO_4), mg/L	Automated colorimetric (barium chloranilate),	375.1	—	—	—	
	Gravimetric, or	375.3	426A or B	D516-82(A)	—	33.124[2]
	Turbidimetric.	375.4	—	D516-82(B)	—	426C[19]

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page)				
		EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
66. Sulfide (as S), mg/L	Titrimetric (iodine) or	376.1	427D	—	I-3840-84	228A[30]
	Colorimetric (methylene blue).	376.2	427C	—	—	
67. Sulfite (as SO_3), mg/L	Titrimetric (iodine-iodate).	377.1	428A	D1339-84(C)	—	
68. Surfactants, mg/L	Colorimetric (methylene blue).	425.1	512B	D2330-82(A)	—	
69. Temperature, °C.	Thermometric.	170.1	212	—	—	Note 31
70. Thallium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	279.1	303A	—	—	
	AA furnace, or	279.2	304	—	—	
	Inductively coupled plasma.	—	—	—	—	200.7[4]
71. Tin—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	282.1	303A	—	I-3850-78[7]	
	AA furnace.	282.2	304	—	—	
72. Titanium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	283.1	303C	—	—	
	AA furnace.	283.2	304	—	—	
73. Turbidity, NTU	Nephelometric.	180.1	214A	D1889-81	I-3860-84	
74. Vanadium, Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	286.1	303C	—	—	
	AA furnace,	286.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Gallic acid).	—	327B	D3373-84(A)	—	
75. Zinc—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	289.1	303A or B	D1691-84(C or D)	I-3900-84	33.089[3], p.37[9]
	AA furnace,	289.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Dithizone) or	—	328C	—	—	
	(Zincon).	—	—	—	—	Note 32

[1] "Methods for Analysis of Inorganic Substances in Water and Fluvial Sediments," U.S. Department of the Interior, U.S. Geological Survey, Open-File Report 85-495, 1986, unless otherwise stated.

[3] "Official Methods of Analysis of the Association of Official Analytical Chemists," methods manual, 14th ed. (1985).

[30] For the determination of total metals the sample is not filtered before processing. A digestion procedure is required to solubilize suspended material and to destroy possible organic-metal complexes. Two digestion procedures are given in "Methods for Chemical Analysis of Water and Wastes, 1979." One (Section 4.1.3), is a vigorous digestion using nitric acid. A less vigorous digestion using nitric and hydrochloric acids (Section 4.1.4) is preferred; however, the analyst should be cautioned that this mild digestion may not suffice for all sample types. Particularly, if a colorimetric procedure is to be employed, it is necessary to ensure that all organo-metallic bonds be broken so that the metal is in a reactive state. In those situations, the vigorous digestion is to be preferred making certain that at no time does the sample go to dryness. Samples containing large amounts of organic materials would also benefit by this vigorous digestion. Use of the graphite furnace technique, inductively coupled plasma, as well as determinations for certain elements such as arsenic, the noble metals, mercury, selenium, and titanium require a modified digestion and in all cases the method write-up should be consulted for specific instruction and/or cautions.

NOTE: If the digestion included in one of the other approved references is different than the above, the EPA procedure must be used.

Dissolved metals are defined as those constituents which will pass through a 0.45 micron membrane filter. Following filtration of the sample, the referenced procedure for total metals must be followed. Sample digestion for dissolved metals may be omitted for AA (direct aspiration or graphite furnace) and ICP analyses provided the sample solution to be analyzed meets the following criteria:

Table 7.2. (continued)

a. has a low COD (<20)
b. is visibly transparent with a turbidity measurement of 1 NTU or less.
c. is colorless with no perceptable odor, and
d. is of one liquid phase and free of particulate or suspended matter following acidification.

[6]The full text of Method 200.7, "Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes," is given at Appendix C of this Part 136.

[7]Manual distillation is not required if comparability data on representative effluent samples are on company file to show that this preliminary distillation step is not necessary, however, manual distillation will be required to resolve any controversies.

[8]Ammonia, Automated Electrode Method, Industrial Method Number 379-75 WE, dated February 19, 1976, Technicon AutoAnalyzer II, Technicon Industrial Systems, Tarrytown, NY, 10591.

[9]The approved method is that cited in "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," USGS TWRI, Book 5, Chapter A1 (1979).

[10]American National Standard on Photographic Processing Effluents, Apr. 2, 1975. Available from ANSI, 1430 Broadway, New York, NY 10018.

[11]"Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency," Supplement to the Fifteenth Edition of *Standard Methods for the Examination of Water and Wastewater* (1981).

[12]The use of normal and differential pulse voltage ramps to increase sensitivity and resolution is acceptable.

[13]Carbonaceous biochemical oxygen demand ($CBOD_5$) must not be confused with the traditional BOD_5 test which measures "total BOD." The addition of the nitrification inhibitor is not a procedural option, but must be included to report the $CBOD_5$ parameter. A discharger whose permit requires reporting the traditional BOD_5 may not use a nitrification inhibitor in the procedure for reporting the results. Only when a discharger's permit specifically states $CBOD_5$ is required, can the permittee report data using the nitrification inhibitor.

[14]OIC Chemical Oxygen Demand Method, Oceanography International Corporation, 512 West Loop, P.O. Box 2980, College Station, TX 77840.

[15]Chemical Oxygen Demand, Method 8000, Hach Handbook of Water Analysis, 1979, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537

[16]The back titration method will be used to resolve controversy.

[17]Orion Research Instruction Manual, Residual Chlorine Electrode Model 97-70, 1977, Orion Research Incorporated, 840 Memorial Drive, Cambridge, MA 02138.

[18]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 14th Edition, 1976.

[19]National Council of the Paper Industry for Air and Stream Improvement, (Inc.) Technical Bulletin 253, December 1971.

[20]Copper, Biocinchoinate Method, Method 8506, Hach Handbook of Water Analysis, 1979, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537

[21]After the manual distillation is completed, the autoanalyzer manifolds in EPA Methods 335.3 (cyanide) or 420.2 (phenols) are simplified by connecting the re-sample line directly to the sampler. When using the manifold setup shown in Method 335.3, the buffer 6.2 should be replaced with the buffer 7.6 found in Method 335.2.

[22]Hydrogen Ion (pH) Automated Electrode Method, Industrial Method Number 378-75WA, October 1976, Technicon Auto-Analyzer II, Technicon Industrial Systems, Tarrytown, NY 10591.

[23]Iron, 1,10-Phenanthroline Method, Method 8008,"1980, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[24]Manganese, Periodate Oxidation Method, Method 8034, Hach Handbook of Wastewater Analysis, 1979, pages 2-113 and 2-117, Hach Chemical Company, Loveland, CO 80537.

[25]Goerlitz, D., Brown, E., "Methods for Analysis of Organic Substances in Water," U.S. Geological Survey Techniques of Water-Resources Inv., book 5, ch. A3, page 4 (1972).

[26]Nitrogen, Nitrite, Method 8507, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[27]Just prior to distillation, adjust the sulfuric-acid-preserved sample to pH 4 with 1 + 9 NaOH.

[28]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 14th Edition. The colorimetric reaction is conducted at a pH of 10.0 ± 0.2. The approved methods are given on pp. 576-81 of the 14th Edition: Method 510A for distillation, Method 510B for the manual colorimetric procedure, or Method 510C for the manual spectrophotometric procedure.

[29]R. F. Addison and R. G. Ackman, "Direct Determination of Elemental Phosphorus by Gas-Liquid Chromatography," *Journal of Chromatography*, vol. 47, No. 3, pp. 421-426, 1970.

[30]Approved methods for the analysis of silver in industrial wastewaters at concentrations of 1 mg/L and above are inadequate where silver exists as an inorganic halide. Silver halides such as the bromide and chloride are relatively insoluble in reagents such as nitric acid but are readily soluble in an aqueous buffer of sodium thiosulfate and sodium hydroxide to a pH of 12. Therefore, for levels of silver above 1 mg/L, 20 mL of sample should be diluted to 100 mL by adding 40 mL each of 2 M $Na_2S_2O_3$ and 2M NaOH. Standards should be prepared in the same manner. For levels of silver below 1 mg/L the approved method is satisfactory.

[31]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 15th Edition.

[32]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 13th Edition.

[33]Stevens, H. H., Ficke, J. F., and Smoot, G. F., "Water Temperature—Influential Factors, Field Measurement and Data Presentation," U.S. Geological Survey, Techniques of Water Resources Investigations, Book 1, Chapter D1, 1975.

[34]Zinc, Zincon Method, Method 8009, Hach Handbook of Water Analysis, 1979, pages 2-231 and 2-333, Hach Chemical Company, Loveland, CO 80537.

Table 7.3. List of approved test procedures for nonpesticide organic compounds (40 CFR, Part 136, July 1, 1987)

Parameter [1]	EPA Method Number [4, 7]			Other
	GC	GC/MS	HPLC	
1 Acenaphthene	610	625, 1625	610	
2 Acenaphthylene	610	625, 1625	610	
3 Acrolein	603	[5]624, 1624		
4 Acrylonitrile	603	[5]624, 1624		
5 Anthracene	610	625, 1625	610	
6 Benzene	602	624, 1624		
7 Benzidine		[5]625, 1625	605	Note 3, p. 1;
8 Benzo(a)anthracene	610	625, 1625	610	
9 Benzo(a)pyrene	610	625, 1625	610	
10 Benzo(b)fluoranthene	610	625, 1625	610	
11 Benzo(ghi)perylene	610	625, 1625	610	
12 Benzo(k)fluoranthene	610	625, 1625	610	
13 Benzyl Chloride				Note 3, p. 130; Note 6, p. S102.
14 Benzyl Butyl Phthalate	606	625, 1625		
15 Bis(2-chloroethoxy) methane	611	625, 1625		
16 Bis(2-chloroethyl) ether	611	625, 1625		
17 Bis(2-ethylhexyl) phthalate	606	625, 1625		
18 Bromodichloromethane	601	624, 1624		
19 Bromoform	601	624, 1624		
20 Bromomethane	601	624, 1624		
21 4-Bromophenylphenyl ether	611	625, 1625		
22 Carbon tetrachloride	601	624, 1624		Note 3, p. 130;
23 4-Chloro-3-methylphenol	604	625, 1625		
24 Chlorobenzene	601, 602	624, 1624		Note 3, p. 130;
25 Chloroethane	601	624, 1624		
26 2-Chloroethylvinyl ether	601	624, 1624		
27 Chloroform	601	624, 1624		Note 3, p. 130;
28 Chloromethane	601	624, 1624		
29 2-Chloronaphthalene	612	625, 1625		
30 2-Chlorophenol	604	625, 1625		
31 4-Chlorophenylphenyl ether	611	625, 1625		
32 Chrysene	610	625, 1625	610	
33 Dibenzo(a,h)anthracene	610	625, 1625	610	
34 Dibromochloromethane	601	624, 1624		
35 1,2-Dichlorobenzene	601, 602, 612	624, 625, 1625		
36 1,3-Dichlorobenzene	601, 602, 612	624, 625, 1625		
37 1,4-Dichlorobenzene	601, 602, 612	625, 1624, 1625		
38 3,3'-Dichlorobenzidine		625, 1625	605	
39 Dichlorodifluoromethane	601			
40 1,1-Dichloroethane	601	624, 1624		
41 1,2-Dichloroethane	601	624, 1624		
42 1,1-Dichloroethene	601	624, 1624		
43 trans-1,2-Dichloroethene	601	624, 1624		
44 2,4-Dichlorophenol	604	625, 1625		
45 1,2-Dichloropropane	601	624, 1624		
46 cis-1,3-Dichloropropene	601	624, 1624		
47 trans-1,3-Dichloropropene	601	624, 1624		
48 Diethyl phthalate	606	625, 1625		
49 2,4-Dimethylphenol	604	625, 1625		
50 Dimethyl phthalate	606	625, 1625		
51 Di-n-butyl phthalate	606	625, 1625		
52 Di-n-octyl phthalate	606	625, 1625		
53 2,4-Dinitrophenol	604	625, 1625		
54 2,4-Dinitrotoluene	609	625, 1625		
55 2,6-Dinitrotoluene	609	625, 1625		
56 Epichlorohydrin				Note 3, p. 130; Note 6, p. S102.
57 Ethylbenzene	602	624, 1624		
58 Fluoranthene	610	625, 1625	610	
59 Fluorene	610	625, 1625	610	
60 Hexachlorobenzene	612	625, 1625		
61 Hexachlorobutadiene	612	625, 1625		
62 Hexachlorocyclopentadiene	612	[5]625, 1625		
63 Hexachloroethane	612	625, 1625		
64 Indeno(1,2,3-cd)pyrene	610	625, 1625	610	
65 Isophorone	609	625, 1625		
66 Methylene Chloride	601	624, 1624		Note 3, p. 130;
67 2-Methyl-4,6-Dinitrophenol	604	625, 1625		
68 Naphthalene	610	625, 1625		
69 Nitrobenzene	609	625, 1625		
70 2-Nitrophenol	604	625, 1625		
71 4-Nitrophenol	604	625, 1625		
72 N-Nitrosodimethylamine	607	625, 1625		
73 N-Nitrosodi-n-propylamine	607	[5]625, 1625		
74 N-Nitrosodiphenylamine	607	[5]625, 1625		
75 2,2-oxybis(1-chloropropane)	611	625, 1625		
76 PCB-1016	608		625,	Note 3, p. 43;
77 PCB-1221	608		625,	Note 3, p. 43;
78 PCB-1232	608		625,	Note 3, p. 43;
79 PCB-1242	608		625,	Note 3, p. 43;
80 PCB-1248	608		625,	Note 3, p. 43;
81 PCB-1254	608		625,	Note 3, p. 43;
82 PCB-1260	608		625,	Note 3, p. 43;
83 Pentachlorophenol	604	625, 1625		Note 3, p. 140;

Table 7.3. (continued)

Parameter [1]	EPA Method Number [4,7]			Other
	GC	GC/MS	HPLC	
84. Phenanthrene	610	625, 1625	610	
85. Phenol	604	625, 1625		
86. Pyrene	610	625, 1625	610	
87. 2,3,7,8-Tetrachlorodibenzo-p-dioxin		[5] 613		
88. 1,1,2,2-Tetrachloroethane	601	624, 1624		Note 3, p. 130;
89. Tetrachloroethene	601	624, 1624		Note 3, p. 130;
90. Toluene	602	624, 1624		
91. 1,2,4-Trichlorobenzene	612	625, 1625		Note 3, p. 130;
92. 1,1,1-Trichloroethane	601	624, 1624		
93. 1,1,2-Trichloroethane	601	624, 1624		Note 3, p. 130;
94. Trichloroethene	601	624, 1624		
95. Trichlorofluoromethane	601	624,		
96. 2,4,6-Trichlorophenol	604	625, 1625		
97. Vinyl Chloride	601	624, 1624		

Table IC Notes

[1] All parameters are expressed in micrograms per liter (µg/L).

[2] The full text of Methods 601-613, 624, 625, 1624, and 1625, are given at Appendix A, "Test Procedures for Analyses of Organic Pollutants," of this Part 136. The standardized test procedure to be used to determine the method detection limit (MDL) for these test procedures is given at Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit," of this Part 136.

[3] "Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater," U.S. Environmental Protection Agency, September, 1978.

[4] Method 624 may be extended to screen samples for Acrolein and Acrylonitrile. However, when they are known to be present, the preferred method for these two compounds is Method 603 or Method 1624.

[5] Method 625 may be extended to include benzidine, hexachlorocyclopentadiene, N-nitrosodimethylamine, and N-nitrosodiphenylamine. However, when they are known to be present Methods 605, 607, and 612, or Method 1625, are preferred methods for these compounds.

[6] 625, Screening only.

[7] "Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency," Supplement to the Fifteenth Edition of *Standard Methods for the Examination of Water and Wastewater* (1981).

[8] Each analyst must make an initial, one-time, demonstration of their ability to generate acceptable precision and accuracy with Methods 601-613, 624, 625, 1624, and 1625 (See Appendix A of this Part 136) in accordance with procedures each in section 8.2 of each of these Methods. Additionally, each laboratory, on an on-going bases must spike and analyze 10% (5% for Methods 624 and 625 and 100% for methods 1624, and 1625) of all samples to monitor and evaluate laboratory data quality in accordance with sections 8.3 and 8.4 of these Methods. When the recovery of any parameter falls outside the warning limits, the analytical results for that parameter in the unspiked sample are suspect and cannot be reported to demonstrate regulatory compliance.

Note.—These warning limits are promulgated as an "interim final action with a request for comments."

Table 7.4. List of approved test procedures for pesticides[1] (40 CFR, Part 136, July 1, 1987)

Parameter µg/L	Method	EPA[1,1]	Standard Methods 15th Ed	ASTM	Other
Aldrin	GC	608	509A	D3086	Note 3, p. 7; Note 4, p. 30
	GC/MS	625			
2 Ametryn	GC				Note 3, p. 83; Note 6, p. S68.
3 Aminocarb	TLC				Note 3, p. 94; Note 6, p. S18.
4 Atratan	GC				Note 3, p. 83; Note 6, p. S68.
5 Atrazine	GC				Note 3, p. 83; Note 6, p. S68.
6 Azinphos methyl	GC				Note 3, p. 25; Note 6, p. S51.
7 Barban	TLC				Note 3, p. 104; Note 6, p. S64.
8. α-BHC	GC	608	509A	D3086	Note 3, p. 7.
	GC/MS	[1] 625			
9 β-BHC	GC	608		D3086	
	GC/MS	625			
10. δ-BHC	GC	608		D3086	
	GC/MS	[1] 625			
11 γ-BHC (Lindane)	GC	608	509A	D3086	Note 3, p 7; Note 4, p 30
	GC/MS	625			
12 Captan	GC		509A		Note 3, p 7
13 Carbaryl	TLC				Note 3, p 94; Note 6, p S60
14 Carbophenothion	GC				Note 4, p 30; Note 6, p S73
15 Chlordane	GC	608	509A	D3086	Note 3, p 7
	GC-MS	625			
16 Chloropropham	TLC				Note 3, p 104; Note 6, p S64
17 2,4-D	GC		509B		Note 3, p 115; Note 4, p 35
18 4,4'-DDD	GC	608	509A	D3086	Note 3, p 7; Note 4, p 30
	GC-MS	625			
19 4,4'-DDE	GC	608	509A	D3086	Note 3, p 7; Note 4, p 30
	GC/MS	625			
20 4,4'-DDT	GC	608	509A	D3086	Note 3, p 7; Note 4, p 30
	GC/MS	625			
21 Demeton-O	GC				Note 3, p 25; Note 6, p S51
22 Demeton-S	GC				Note 3, p 25; Note 6, p S51
23 Diazinon	GC				Note 3, p. 25; Note 4, p 30; Note 6, p S51.
24 Dicamba	GC				Note 3, p 115
25 Dichlofenthion	GC				Note 4, p 30; Note 6, p S73
26 Dichloran	GC		509A		Note 3, p 7
27 Dicofol	GC			D3086	
28 Dieldrin	GC	608	509A		Note 3, p 7; Note 4, p 30
	GC/MS	625			
29 Dioxathion	GC				Note 4, p 30; Note 6, p S73
30 Disulfoton	GC				Note 3, p ; Note 6, p S51
31 Diuron	TLC				Note 3, p 104; Note 6, p S64
32 Endosulfan I	GC	608	509A	D3086	Note 3 p 7
	GC/MS	[1] 625			
33 Endosulfan II	GC	608	509A	D3086	Note 3, p 7
	GC/MS	[1] 625			
34 Endosulfan sulfate	GC	608			
	GC/MS	625			
35 Endrin	GC	608	509A	D3086	Note 3 p 7; Note 4, p 30
	GC/MS	[1] 625			
36 Endrin aldehyde	GC	608			
	GC/MS	625			
37 Ethion	GC				Note 4 p 30; Note 6, p S73
38 Fenuron	TLC				Note 3, p 104; Note 6, p S64
39 Fenuron-TCA	TLC				Note 3, p 104; Note 6, p S64
40 Heptachlor	GC	608	509A	D3086	Note 3, p 7; Note 4 p 30
	GC/MS	625			
41 Heptachlor epoxide	GC	608	509A	D3086	Note 3, p 7; Note 4, p 30; Note 6, p S73
42 Isodrin	GC/MS	625			
	GC				Note 4 p 30; Note 6, p S73
43 Linuron	TLC				Note 3, p 104; Note 6, p S64
44 Malathion	GC		509A		Note 3, p 25; Note 4, p 30; Note 6, p S51
45 Methiocarb	TLC				Note 3, p. 94; Note 6, p S60
46 Methoxychlor	GC		509A	D3086	Note 3, p. 7; Note 4, p. 30
47 Mexacarbate	TLC				Note 3, p. 94; Note 6, p S60
48 Mirex	GC		509A		Note 3, p. 7
49 Monuron	TLC				Note 3, p. 104; Note 6, p. S64
50. Monuron-TCA	TLC				Note 3, p. 104; Note 6, p. S64.
51 Neburon	TLC				Note 3, p 104; Note 6, p. S64.
52 Parathion methyl	GC		509A		Note 3, p. 25; Note 4, p. 30
53. Parathion ethyl	GC		509A		Note 3, p. 25.
54 PCNB	GC		509A		Note 3, p. 7
55. Perthane	GC			D3086	
56. Prometon	GC				Note 3, p 83; Note 6, p. S68.
57 Prometryn	GC				Note 3, p. 83; Note 6, p S68.
58 Propazine	GC				Note 3, p 83; Note 6, p. S68.
59 Propham	TLC				Note 3, p. 104; Note 6, p. S64.
60. Propoxur	TLC				Note 3, p. 94; Note 6, p. S60.
61. Secbumeton	TLC				Note 3, p. 83; Note 6, p. S68.
62 Siduron	TLC				Note 3, p. 104; Note 6, p. S64.
63. Simazine	GC				Note 3, p. 83; Note 6, p. S68.
64. Strobane	GC		509A		Note 3, p. 7.

Table 7.4. (continued)

Parameter (µg/L)	Method	EPA[1,2]	Standard Methods 15th Ed	ASTM	Other
66. Swep	TLC				Note 3, p. 104; Note 6, p. 364.
68. 2,4,5-T	GC		509B		Note 3, p. 115; Note 4, p. 35
67. 2,4,5-TP (Silvex)	GC		509B		Note 3, p. 118.
69. Terbuthylazine	GC				Note 3, p. 83, Note 6, p. 366.
69. Toxaphene	GC	608	509A	D3086	Note 3, p. 7; Note 4, p. 30.
	GC/MS	625			
70. Trifluralin	GC		509A		Note 3, p. 7

Table 8D Notes

[1] Pesticides are listed in this table by common name for the convenience of the reader. Additional pesticides may be found under Table 1C, where entries are listed by chemical name

[2] The full text of methods 608 and 625 are given at Appendix A, "Test Procedures for Analysis of Organic Pollutants," of this Part 136. The standardized test procedure to be used to determine the method detection limit (MDL) for these test procedures is given at Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit", of this Part 136

[3] "Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater," U.S. Environmental Protection Agency, September, 1978 The EPA publication includes thin-layer chromatography (TLC) methods

[4] "Methods for Analysis of Organic Substances in Water," U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 5, Chapter A3 (1972)

[5] The method may be extended to include a-BHC, b-BHC, endosulfan I, endosulfan II, and endrin. However, when they are known to exist, Method 608 is the preferred method

[6] "Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency," Supplement to the Fifteenth Edition of *Standard Methods for the Examination of Water and Wastewater* (1981)

[7] Each analyst must make an initial, one-time, demonstration of their ability to generate acceptable precision and accuracy with Methods 608 and 625 (See Appendix A of this Part 136) in accordance with procedures given in Section 8.2 of each of these methods. Additionally, each laboratory, on an on-going basis, must spike and analyze 10% of all samples analyzed with Method 608 or 5% of all samples analyzed with Method 625 to monitor and evaluate laboratory data quality in accordance with Sections 8.3 and 8.4 of these methods. When the recovery of any parameter falls outside the warning limits, the analytical results for that parameter in the unspiked sample are suspect and cannot be reported to demonstrate regulatory compliance

Note.—These warning limits are promulgated as an "interim final action with a request for comments."

Table 7.5. List of approved radiological test procedures (40 CFR, Part 136, July 1, 1987)

Parameter and units	Methods	EPA [1]	Reference (method No. or page)		
			Standard Methods 15th Ed	ASTM	USGS [2]
1. Alpha-Total, pCi per liter	Proportional or scintillation counter	900.0	703	D1943-86	pp. 75 and 78 [3]
2. Alpha-Counting error, pCi per liter	Proportional or scintillation counter	Appendix B	703	D1943-86	p. 79
3. Alpha-Counting error, pCi per liter	Proportional counter	900.0	703	D1890-86	pp. 75 and 78 [3]
4. Beta-Counting error, pCi per liter	Proportional counter	Appendix B	703	D1890-86	p. 79
5. (a) Radium-Total, pCi per liter	Proportional counter	903.0	705	D2460-70	
(b) ^{226}Ra, pCi per liter	Scintillation counter	903.1	706	D3454-79	p. 81

Table IE Notes

[1] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032 (1980 update), U.S. Environmental Protection Agency, August 1980.
[2] Fishman, M.J. and Brown, Eugene, "Selected Methods of the U.S. Geological Survey of Analyses of Wastewaters," U.S. Geological Survey, Open-File Report 76-177 (1976).
[3] The method found on p. 75 measures only the dissolved portion while the method on p. 78 measures only the suspended portion. Therefore, the two results must be added to obtain the "total."

and blank/spike control. In methods not using surrogates such as metals, anions, and wet chemical analysis, a blank and a blank/spike (laboratory control sample) shall be analyzed. For pesticide/PCB methods, surrogates are often used. However, problems have been noted in surrogate recovery for the dibutyl chlorinate typically used. For pesticide/PCB analysis, a blank and a blank/spike shall be analyzed with each batch as separate samples. A pesticide or a PCB shall be used as the spiking compound.

In Level C, when performing analyses for petroleum hydrocarbons; oil and grease; anions such as nitrates, sulfates and chloride; and other wet chemical methods, a matrix spike and matrix spike duplicate are required for every 20 samples of similar matrix. Similar matrix is defined as either soil or water from the same military base.

All methods specified require calibration. In keeping with the method calibration requirements, the following requirements are presented. For all semivolatile and volatile analysis by GC/MS, the current CLP calibration method shall be used. The current CLP criteria shall be used for frequency of calibration, for the system performance check compounds (SPCCs), and for the calibration check compounds (CCCs).

For other methods, a minimum of three different concentration standards for each analyte shall be analyzed for initial calibration. Calibration shall be checked every 12 h of operation and prior to sample analysis. The laboratory shall use the calibration check acceptance criteria specified by the method. The daily calibration acceptance criteria to be used for each method shall be documented in the laboratory QA plan or in the site-specific QA plan. The initial calibration curve shall be plotted and the correlation coefficient and response factors evaluated. The laboratory shall indicate in the laboratory QA plan or in the site-specific QA plan the acceptance criteria to be used for the initial calibration curve. The calibration shall include one standard at a concentration at the method detection limits. The calibration curve shall bracket all samples in the concentration range. If the samples are not within the calibration range, appropriate dilution shall be performed to bring the samples into the calibration range. The aforementioned calibration requirements shall be used for Levels C and E.

In Level C, a matrix spike and matrix spike duplicate are required for volatiles, semivolatiles, and all GC analysis for every 20 samples of similar matrix. For metals analysis, a duplicate and a matrix spike are required for every 20 samples of similar matrix.

For all GC methods used in level C QC, second column confirmation shall be used for all positive responses for the analytes of interest. In Level E, second column confirmation is not required.

In Level E, no matrix spikes or duplicates are required; only the initial and continuing calibration, method blank, and blank/spike are required.

7.2 DELIVERABLES

For Level D QC, a CLP data package shall be delivered. This shall include the summary package and the remainder of the package, which includes initial and continuing calibration, matrix spikes, matrix spike duplicates, blanks, duplicates, surrogate recoveries, chromatograms, mass spectra, and absorbance data. For methods which are not defined by CLP, the calibration information, method blanks, blank/spikes, the chromatograms, absorbance, matrix spikes, and matrix spike duplicates shall be reported. The control charts plotted per Sect. 4 associated with the blank/spikes shall be presented with the data.

For Level C QC, the method blanks, blank/spike, surrogates, matrix spikes, matrix spike duplicates, duplicates, and initial and continuing calibration data shall be reported. Table 7.6 lists the required deliverables. The forms referred to in Table 7.6 are from the current CLP for organics and metals/cyanide. The form numbers will be upgraded as new revisions occur in the CLP, which require changes in form content or numbering.

In Level E, the only information to be submitted is the sample data, method blank data, and the control chart from the blank/spike.

The deliverables shall be presented to the NCR. The forms shall be used when reporting any data in the MPR and in submitting the final data package prior to its inclusion in the appendix and summary tables of the final report. The final data deliverables shall be presented to the NCR at least three weeks prior to issuing the draft of the final report.

7.3 DATA VALIDATION

7.3.1 Level D Validation

At a minimum, the data generated from Level D will be validated per the CLP criteria as outlined in the following documents.

EPA, Hazardous Site Control Division, *Laboratory Data Validation Functional Guidelines for Evaluating Pesticides/PCB's Analyses*, R-582-5-5-01, May 28, 1985.

EPA, Hazardous Site Control Division, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*, R-582-5-5-01, May 28, 1985.

EPA, Office of Emergency and Remedial Response, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*, 1985.

Table 7.6. Data set deliverables for Level C QA

	Method requirements	Deliverables
Organics	- Method blank spikes with results and control charts. Run with each batch of samples processed.	Control chart
	- Results to be reported on CLP Form 1 or spreadsheet per Sect. 9. Sample results using CLP data flags.	Form 1 or Sect. 9 1/Sample chromatograms/and mass spectra
	- Surrogate recovery from samples reported on CLP Form 2. Surrogates to be used in volatiles, semivolatiles, pesticides/PCB. For volatiles by GC, the names of surrogates should be changed to reflect the surrogate used.	Form 2
	- Matrix spike/spike duplicate 1 spike and spike duplicate per 20 samples of similar matrix reported on Form 3.	Form 3
	- Method blank reported on CLP Form 4.	Form 4 or Sect. 9
	For volatiles by GC, a similar format will be used as CLP Form 4 for blanks.	
	- GC/MS tuning for volatiles/semivolatiles. Report results on Form 5.	Form 5
	- Initial calibration data reported on Form 6.	Form 6
	For volatiles by GC, the initial calibration data with response factors must be reported.	No Form
	For pesticide/PCB data Form 9 must be used for calibration data.	Form 9
	- Continuing calibration GC/MS data reported on Form 7.	Form 7
	For volatiles, GC data, the response factors and their percent differences from the initial must be reported.	No Form
	Internal Standard Area for Volatiles and Semivolatiles.	Form 8

Table 7.6. (continued)

	Method requirements	Deliverables
Organics (cont'd)	- For pesticides/PCB data, the CLP Form 9 must be presented.	Form 9
	No chromatograms or mass spectra are presented for calibration. These data should be filed in the laboratory and available if problems arise in reviewing/validating the data. The calibration information should be available for checking during on-site audits.	
	- Internal standard area for GC/MS analyses CLP Form VIII shall be supplied.	
	- Second column confirmation shall be done for all GC work when compounds are detected above reporting limits. Chromatograms of confirmation must be provided.	Chromatograms
Metals	- Level C, requirements	Deliverables
	- Sample results with CLP flagging system	CLP Form 1 or Sect. 9
	- Initial and continuing calibration	CLP Form 2, Part 1 only
	- Blanks 10% frequency	Form 3
	- Method blank taken through digestion (1/20 samples of same matrix)	Form 3 or Sect. 9
	- ICP interference check sample	Form 4
	- Matrix spike recovery (1 per 20 samples of similar matrix)	Form 5, Part 1
	- Postdigestion spike sample recovery for ICP metals. Only done if predigest spike recovery exceed CLP limits.	Form 5, Part 2 (never used for GFAA work)
	- Postdigest spike for GFAA	Recovery will be noted on raw data
	- Duplicates (1 per 20 samples will be split and digested as separate	Form 6 samples

Table 7.6. (continued)

	Method requirements	Deliverables
Metals (cont'd)	- Method blank spike information will be plotted on control chart, one per batch of samples processed.	Control chart
	- Standard addition. The decision process outlined in CLP page E-3 will be used to determine when standard additions are required.	Form 8
	Holding times	Form 10
Wet Chemistry	Level C	
	- Blank spike 1/batch	Control chart
	- Method Blank 1/batch	Report result No format
	- Sample results	Report result No format
	- Matrix spike/spike duplicate or calibration information	Report result if applicable
	- Calibration check report percent RSD or percent difference from initial calibration	Report percent or percent difference No format

7.3.2 Level C Data Validation Guidelines

Listed below are the validation criteria which will be utilized in evaluating the analytical data for a Level C QC site. For methods not listed here, a similar procedure will be submitted by the prime contractor and the laboratory which outlines validation of the holding times, initial calibration, continuing calibration, and blank-vs-sample results. The validation procedure will be approved by the NCR.

1. For Petroleum Hydrocarbons (418.1/SW-3540, EPA 418.1)

   Holding Times - Holding times are 28 days for water samples which are preserved and refrigerated. No holding times are cited for soils.

Calibration - Ensure that a three-to-five point curve bracketing the sample concentration is performed daily.

Blanks - A blank should be run with each batch. If the blank concentration exceeds the reporting limit, the reporting limit shall be raised and the data flagged as estimated (UJ).

2. Target Compound List (TCL) for VOAs (CLP Methods)

Holding Times - Samples must be analyzed within the holding times specified in Sect. 3 or the data should be marked as estimated (J).

GC/MS Tuning - Check that bromofluorobenzene tune is completed each 12-h shift of operation. Check that it meets the CLP criteria. Assure that each sample is associated with a tune.

Initial Calibration - The maximum relative standard deviation [(RSD) percent RSD] shall not be >30% for indicted CLP CCC. The maximum mean relative response factor (RRF) for SPCC shall be >0.300 (0.250 for bromoform). The SPCCs are chloromethane, 1,1-dichloroethane, bromoform, 1,1,2,2-tetrachloroethane, and chlorobenzene. The CCC compounds are vinyl chloride, 1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, and ethylbenzene.

Continuing Calibration - The minimum response factor for the SPCC components for VOAs analyses shall not be <0.300 (0.250 for bromoform). The maximum response factor percent deviation for indicated CLP CCC components from the mean initial calibration response factor shall not exceed 25%. If these criteria are exceeded, a new calibration for the compound shall be employed.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data analyzed with the out-of-control point shall be discussed in the QC section of the MPR and final report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples within the holding times or the data will be flagged with an "R," and the data are not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Method Blanks - A method blank should be run each day following the Continuing Calibration Standard. Common laboratory solvents should not be found in the blank at levels over five times the detection

limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries shall meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blank spike data from the batch are satisfactory, the data is usable, and the low recovery is discussed in the final report QA/QC and in the QC report sent to the NCR.

Field, Trip and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

3. TCL Semivolatile Organics (CLP Methods)

Holding Times - Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction. Any samples which do not meet these requirements must be flagged as estimated.

GC/MS Tune - Make certain that a decafluorotriphenylphosphine tune is completed every 12 h of sample analysis, that each sample is associated with a tune, and that each tune meets CLP requirements. Data are not reported if the instrument does not meet tune.

Initial Calibration - Ensure that a 5-point curve has been completed. The RRF of the BNA compounds shall be a minimum of 0.050 for the SPCC listed in the current revision of the CLP. The maximum RSD for the CCC listed in the CLP procedure is 30.0%. The minimum RRF for the SPCC is 0.050, and the maximum percent difference for the CCC is 25%. If these limits are exceeded, a new calibration curve shall be generated.

Continuing Calibration - The continuing calibration check will be performed once every 12 h during operation. The minimum RRF for the SPCC is 0.05, and the maximum percent difference from the initial calibration shall not exceed 25% for the CCC. If these limits are exceeded, a new calibration curve shall be generated.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and the out-of-control point shall be discussed in the QC section of

the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data is not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Blanks - A method blank should be run each day following the Continuing Calibration Standard. Phthalate should not be found in the blank at levels over five times the detection limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries should meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blanks spike data from the batch is satisfactory, the data are usable, and the low recovery is discussed in the final QC report sent to the Analytical Environmental Support Section.

4. Metals

Holding Times - Samples must be analyzed within six months, except mercury shall be analyzed in 28 days from sample collection.

ICP Initial Calibration - A calibration blank and at least one standard must be analyzed daily. An initial calibration verification standard must be within 90 to 110% recovery or the samples should be reanalyzed. If it is not possible to perform reanalysis, the data are rejected and flagged with an "R."

AA Calibration - Calibration blank and at least three standards shall be used in establishing the curve prior to sample analysis. A curve shall be analyzed each day prior to sample analysis.

Calibration Verification - Verification using a standard obtained from a source other than that of the initial calibration shall be used and the result shall be within 90 to 110% of the true value for

both ICP and AA work. Calibration verification shall be done at a minimum frequency of 10% or every 2 h, whichever is more frequent, and shall be done at the end of the analytical run.

Method Blanks - At least one preparation blank shall be prepared with each batch of samples. The blanks shall contain less than the detection limit for all analytes. If the concentration of the associated blanks is above the detection limit and if the lowest analyte concentration is <10 times the blank, reanalysis of the sample must occur. If reanalysis is not done, the data shall be reported and flagged as estimated. The blank shall never be subtracted from the sample.

Field and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

Blank/Spike Laboratory Control Samples - Any laboratory control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and out-of-control point shall be discussed in the QC section of the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented. A discussion of data reported when the blank/spike laboratory control sample is out of control shall be presented in the QC section of both the final report and the MPR.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data are not usable.

8. MAINTAINING LABORATORY APPROVAL

Once a laboratory has received Navy approval to begin analysis of samples, maintaining that approval requires adherence to the QA plan and reporting of QA-related information. The performance and reporting requirements outlined below are essential to ensuring that data of known and defensible quality are being generated throughout the course of a site investigation. Topics covered include control samples, control charts, out-of-control events, corrective action reports, significant changes in the QA plan, and other reporting requirements.

8.1 MONTHLY PROGRESS REPORT

The primary means of communication from the laboratories to the NCR will be the MPR to be submitted by the laboratories to the NCR on the 15th of each month in which work for the Navy is performed. The following information is to be included in the MPR.

1. Site name and contract number.

2. Numbers, types and locations of samples collected and analyzed for Navy project only.

3. Data for blanks, spikes, laboratory duplicates and controls related to Navy samples.

4. New methods used for analysis and changes in old methods.

5. Copies of all control charts pertinent to Navy samples and to which results have been added over the reporting period.
6. Summaries of out-of-control incidents during the reporting period, including references to documentation and corrective action reports.

7. Descriptions of and justifications for significant changes in the QA.

8. Changes in LQAC personnel and other key technical personnel; resumes of new personnel must be submitted.

9. Completed sample data.

Much of the information presented in an MPR is incremental in nature and relates to changes and findings since the previous MPR.

1. Control charts from the minimizing control charts program and any additional control charts from monitoring matrix spikes, duplicates, or other QC parameters.

2. Personnel changes relating to QA responsibilities.

3. Method changes (e.g., a minor modification with an attached EPA variance).

4. Procedural changes in establishing control limits and/or the preparation and use of control charts.

Since the first such report for each laboratory has no precedent, more explanation and detail may be necessary; subsequent MPRs will likely not require as much detail in some areas.

8.2 FINAL REPORT

A draft of the final report shall be reviewed by the NCR prior to its release. This report is the final deliverable from the engineering subcontractor. An outline for a typical report is as follows.

1. Site name and Navy contract number.

2. Foreword--signed by those with major responsibilities for the QA program and by project management.

3. Executive Summary--brief review of the report.

4. Table of Contents--with specificity at approximately the same level as the Table of Contents in this Navy document.

5. Introduction--summarize the Navy field sites of interest, when the study occurred (dates of sampling, dates of analysis) and the objectives of the QA plan as they relate to the study.

6. Data Summary--summarize the results on a site-by-site basis.

7. Other Information--present any other information requested in the statement of work such as risk assessment, recommendation to perform more site characterization, or recommend site closure. This information was specified prior to beginning work and is directed by the Navy EIC.

8. The final report shall present the findings from the analytical, geological, and hydrogeological studies. The summary of analytical data will exclude non-detected compounds. No subtraction of blanks is allowed. Data will be flagged if blank contamination occurs. All data flags will follow the result in the summary.

9. QC Summary--the QC summary section will include a discussion of are data which flagged. Flagged data defined as data for which trip, field, or laboratory blanks were contaminated, matrix spike/spike duplicates exceed limits, calibration criteria are not met, and laboratory controls exceed limits. The QC summary will also discuss the results of laboratory blanks, matrix spikes/spike duplicates,

duplicates, control charts, surrogate holding times, field blanks, trip blanks, rinsates, and field duplicates. This section will also discuss precision, accuracy, and completeness.

10. Appendices--the appendices of the report shall include all field and analytical data. One appendix shall contain field logs and forms. A second appendix shall contain the laboratory data of each sample. These data shall be presented in a spreadsheet similar to the Format Section of this report. All trip, field, and laboratory blanks shall be marked so that each sample can be associated with the appropriate blanks.

    A third appendix shall include the method blank spike control charts, surrogate recoveries, matrix spike and duplicate, field, and laboratory duplicates for all spike samples.

8.3 FINAL QC DATA REPORT

A QC data report shall be sent to the NCR. This report shall contain the following.

For Level D QC, the contractor shall submit a subset of data from the CLP data packages. For 20% of the water and 20% of the soil samples, the subcontractor shall submit the full CLP package.

For Level C QC, the deliverables listed in Table 7.7 will be presented.

For Level E QC, the initial and continuing calibration forms, method blank, and blank spike control chart are required.

The report shall indicate the duration and location of storage for the data. The stored data consists of all raw data, QC charts, corrective action, logs, sample lists, COC information, notebooks, work sheets, automated data processing system output, and calibration.

The report shall be delivered to the NCR three weeks prior to the final report.

9. DATA FORMAT

The data format refers to the format in the final report. The contractor may use its own format in the body of the report. However, in the appendices (which contain sample and blank data) a spreadsheet type of format may be used, or the CLP forms for reporting samples and equipment, trip, field, and method blanks may be used. The spreadsheet format allows for more samples per page and for more information on blanks and their association with samples. The spreadsheet format is not meant to be a rigid form. The information listed in Fig. 9.1 must be present. The contractor may add other information which will assist it in review. For calibration, tuning, spikes, surrogates, and duplicates, the current CLP forms are required for data presentation. If any other format is to be used, this shall be discussed with the NCR.

Sample Number	J25019	JS5020
Date Sampled	03-18-87	03-18-87
Sample Prep..Date	11-25-87	11-25-87
Sample Analysis Date	11-26-87	11-26-87
Sample Numbers of Associated Analytes, Field, Trip, and Equipment Blanks	J4455667	L4455667

	Detection limit	Sample	Results
VOLATILE ORGANIC COMPOUNDS (µg/kg)			
TETRACHLOROETHANE	5	50	50
CHLOROBENZENE	5		
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)			
BIS(2-ETHYLHEXYL) PHTHALATE	330		750
2-METHYLNAPTHALENE	330		2500
INORGANIC COMPOUNDS (mg/kg)			
LEAD	10	360	25
HYDROCARBONS (2)			
PETROLEUM HYDROCARBON	1	0.611	0.268
OIL AND GREASE	1		

Sample Results

Analyte

Note: Petroleum hydrocarbon, oil, and grease results recorded in percent.

Fig. 9.1. Example of data format for final report.

GLOSSARY

Accuracy - The nearness of a result or the mean of a set of results to the true or accepted value.

Analyte - A chemical component of a sample to be determined or measured.

Analytical Method - Defines the samples preparation and instrumentation procedures or steps that must be performed to estimate the quantity of analyte in a sample.

Analytical Spike - The furnace postdigestion spike. The addition of a known amount of standard after digestion.

Background Correction - A technique to compensate for variable background contribution to the instrument signal and the determination of trace metals.

Calibration - The establishment of an analytical curve based on the absorbance, emission intensity, or other measured characteristic of known standards. The calibration standards must be prepared using the same type of acid or concentration of acids as used in the sample preparation.

Calibration Blank - A volume of acidified deionized/distilled water.

Comparability - is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable with other measurement data for similar samples and sample conditions.

Completeness - Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is to generate sufficient amount of valid data based on project needs.

Continuing Calibration - Analytical standard run every ten analytical samples or every 2 h, whichever is more frequent, to verify the calibration of the analytical system.

Control Limits - A range within which specified measurement results must fall to be compliant. Control limits may be mandatory, requiring corrective action if exceeded, or advisory, requiring that noncompliant data be flagged.

Correlation Coefficient - A number (r) which indicates the degree of dependence between two variables (concentration - absorbance). The more dependent they are, the closer the value to one. Determined on the basis of the least squares line.

Data Quality Objectives - are qualitative and quantitative statements which specify the quality of the data required to support decision during

GLOSSARY (continued)

remedial response activities. Data quality objectives are determined based on the end uses of the data to be collected.

Detection Limit - The minimum concentrations which must be accurately and precisely measured by the laboratory and/or specified in the quality assurance plan.

Dissolved Metals - Analyte elements which have not been digested prior to analysis and which will pass through a 0.45-μm filter.

Duplicates - Identical splits of individual samples which are analyzed by the laboratory to test for method reproducibility. In this case, samples are split in the laboratory.

Equipment Rinsates - The final analyte-free water rinse from equipment cleaning collected daily during a sampling event.

Field Blanks - Blanks are collected and analyzed to determine the level of contamination introduced into the sample due to sampling technique. They may consist of the source water used in decontamination and steam cleaning. At minimum, one sample from each event and each source of water must be collected and analyzed.

Field Duplicates/Splits - Samples that have been divided into two or more portions while in the field. Each portion is then carried through the remaining steps in the measurement process. A sample may be replicated in the field or at different points in the analytical process. For field replicated samples, precision information would be gained on homogeneity, handling, shipping, storage, preparation, and analysis.

Replicate samples divided into two portions and sent to different laboratories and subjected to the same environmental conditions and steps in the measurement process as the split samples.

Instrument Detection Limit - is defined in several ways. For example, (1) that concentration of analyte which produces an output signal twice the root mean square of the background noise may be determined under ideal conditions or (2) determined by multiplying by 3 the standard deviation obtained for the analysis of a standard solution (each analyte in reagent water) at a concentration of 3x-5x instrument detection limit on three nonconsecutive days with seven consecutive measurements per day.

Internal Standards - Compounds added to every standard, blank, matrix spike, matrix spike duplicate, sample (for volatile), and sample extract (for semivolatile) at a known concentration prior to analysis. Internal standards are used as the basis for quantitation of the target compounds.

GLOSSARY (continued)

Laboratory Control Sample - A control sample of known composition. Aqueous and solid laboratory control samples are analyzed using the same sample preparation, reagents, and analytical methods employed for samples received.

Laboratory Quality Assurance Coordinator - An employee of a laboratory with no analysis or production responsibilities and who implements QA and QC. This person is responsible for ensuring all quality problems are resolved.

Matrix - The predominant material comprising the sample to be analyzed. The most common matrices are water, soil/sediment, and sludge.

Matrix Spike - An aliquot of a matrix (water or soil) spiked with known quantities of compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

Matrix Spike Duplicate - A second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method.

Method Blank - A blank sample run to ensure reported analytical results are not the results of laboratory contamination.

Method Blank/Spike - Is the distilled and/or deionized water for soil or sand spiked with known compounds or elements. The method blank as defined by Contract Laboratory Protocol for organics and the laboratory control sample as defined by Contract Laboratory Protocol maybe use as the method blank/spike in the Navy Installation Restoration Program.

Method Detection Limits - Minimum concentrations of a substance that can be measured and reported with 99% confidence that the value is above zero. The sample is carried through the entire method under ideal conditions.

Method of Standard Additions - The addition of three increments of a standard solution (spikes) to sample aliquots of the same size. Measurements are made on the original and after each addition. The slope, x-intercept, and y-intercept are determined by least-squares analysis. The analyte concentration is determined by the absolute value of the x-intercept. Ideally, the spike volume is low relative to the sample volume (~10% of the volume). Standard addition may counteract matrix effects; it will not counteract spectral effects. It is also referred to as standard addition.

Out of Control - One or more of several conditions relating to the plotting of control data and indicating unacceptable results.

GLOSSARY (continued)

Percent Solids - The proportion of solid in a soil sample determined by drying an aliquot of the sample.

Precision - Measure of the reproducibility of a set of replicate results among themselves or the agreement among repeat observations made under the same conditions.

Preparation Blank (Reagent Blank, Method Blank) - An analytical control that contains distilled, deionized water and reagents, which is carried through the entire analytical procedure (digested and analyzed). An aqueous method blank is treated with the same reagents as a sample with a water matrix; a solid method blank is treated with the same reagents as a soil sample.

Purge and Trap - An analytical technique used to isolate volatile (purgable) organics by stripping the compounds from water or soil by a stream of inert gas, trapping the compounds on a porous polymer trap, and thermally desorbing the trapped compounds onto the gas chromatographic column.

Quality Assurance - A planned system of activities (program) whose purpose is to provide assurance of the reliability and defensibility of the data.

Quality Control - A routine application of procedures for controlling the monitoring process. QC is the responsibility of all those performing the hands-on operations in the field and in the laboratory.

Reagent Water - Water in which an analyte is not observed at or above the minimum quantitation limit of the parameters of interest.

Recovery - Usually expressed as a percent. The numerical ratio of the amount of analyte measured by the laboratory method divided by the known amount of analyte added to the matrix (i.e., spiked sample) to be analyzed.

Reporting Detection Limits - The same as method detection limits with consideration given for practical limitation such as sample size, matrix interferences, and dilutions.

Representativeness - Expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which is most concerned with the proper design of the sampling program.

Sample Holding Times - Times used to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis or sample preparation. Holding times may vary depending on the analysis, EPA regional preference, etc.

GLOSSARY (continued)

Semivolatile Compounds - Compounds amenable to analysis by extraction of the sample with an organic solvent. Used synonymously with base neutral acid or extractable compounds.

Serial Dilution - The dilution of a sample by a known factor. When corrected by the dilution factor, the diluted sample must agree with the original undiluted sample within specified limits. Serial dilution may reflect the influence of interferents.

Spikes - Known amounts of specific chemical constituents added by the laboratory to selected samples to test the appropriateness and recover efficiencies of specific analytical methods within the actual sample matrices.

Standard Deviation - The square root of the variance of a set of values.

Surrogates - Compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard and used to evaluate analytical efficiency of the method by measuring recovery. Surrogates are brominated, fluorinated, or isotopically labelled compounds not expected to be detected in environmental media. These are used typically in organic methods.

Tentative Identified Compounds - Compounds detected in samples that are not target compounds, internal standards or surrogate standards. Up to 30 peaks (those greater than 10% of peak areas or heights of nearest internal standards) are subjected to mass spectral library searches for tentative identification.

Total Metals - Analyte elements which have been digested prior to analysis.

Variance - The sum of the squares of the difference between the individual values of a set and the arithmetic mean of the set, divided by one less than the number of values.

Volatile Compounds - Compounds amendable to analysis by the purge and trap techniques. Used synonymously with purgable compounds.

Data Qualifiers' Definitions as defined by the Contract Laboratory Protocol for Organic Analysis

U - Indicates compound was analyzed for but not detected. The sample quantitation limit must be corrected for dilution and for percent moisture.

J - Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed, or when the mass spectral data indicate the presence of a compound that meets the identification criteria but the result is less than the sample quantitation limit but greater than zero.

GLOSSARY (continued)

C - This flag applies to pesticide results where the identification has been confirmed by gas chromatography/mass spectrometry. Single component pesticides ≥10 ng/ul in the final extract shall be confirmed by gas chromatography/mass spectrometry.

B - This flag is used when the analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action. This flag must be used for a TIC as well as for a positively identified TCL compound.

E - This flag identifies compounds whose concentrations exceed the calibration range of the gas chromatography/mass spectrometry instrument for that specific analysis. This flag will not apply to pesticides/PCBs analyzed by GC/EC methods. If one or more compounds have a response greater than full scale, the sample or extract must be diluted and reanalyzed. If the dilution of the extract causes any compounds identified in the first analysis to be below the calibration range in the second analysis, then the results of both analyses shall be reported.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor. If a sample or extract is reanalyzed at a higher dilution factor, as in the "E" flag above, the "DL" suffix is appended to the sample number on the Form I for the diluted sample, and all concentration values reported on that Form I are flagged with the "D" flag.

A - This flag indicates that a TIC is a suspected aldol-condensation product.

X - Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the Sample Data Summary Package and the Case Narrative. If more than one is required, use "Y" and "Z," as needed. If more than five qualifiers are required for a sample result, use the "X" flag to combine several flags, as needed. For instance, the "X" flag might combine the "A," "B," and "D" flags for some sample.

R - Quality control indicates that data are not usable (compound may or may not be present). Resampling and reanalysis are necessary for verification.

Q - No analytical result.

GLOSSARY (continued)

Inorganic Data Qualifiers

E - The reported value is estimated because of the presence of interference. An explanatory note must be included under Comments on the cover page (if the problem applies to all samples) or on the specific FORM I-IN (if it is an isolated problem).

M - Duplicate injection precision not met.

N - Spiked sample recovery not within control limits.

S - The reported value was determined by the Method of Standard Additions.

W - Postdisgestion spike for Furnace Atomic Absorption analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.

* - Duplicate analysis not within control limits.

+ - Correlation coefficient for the Method of Standard Addition is less than 0.995.

M (Method) Qualifier

"P" for ICP

"A" for Flame AA

"F" for Furnace AA

"CV" for Manual Cold Vapor AA

"AV" for Automated Cold Vapor AA

"AS" for Semiautomated Spectrophotometric

"C" for Manual Spectrophotometric

"T" for Titrimetric

"NR" if the analyte is not required to be analyzed

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KEY CONTACTS FOR THE NAVY INSTALLATION RESTORATION PROGRAM

Mailing Address for Premium Transport:

Martin Marietta Energy Systems, Inc.
Highway 58, Building K-1004A, Drop A20
Oak Ridge, TN 37830

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Oak Ridge, TN 37831-7440

Mitzi S. Miller, Program Manager (615) 576-2361

Duties: Organization and assignment of projects to staff, laboratory audits, QA/QC review, work plan review, etc., for all branches of the military.

Henry H. Beiro, Project Manager (615) 576-1568

Duties: Sampling plan review, work plan review, field audits, etc., for all branches of the military.

Ahmed A. Halouma, Project Manager (615) 574-7251)

Duties: Laboratory audits, QA/QC review, work plan review, etc., for Army and Corps of Engineers.

Nile A. Luedtke, Project Manager (615) 574-8752

Duties: Laboratory audits, QA/QC review, work plan review, etc., for the Southern Division of the Navy and asbestos site survey projects, plus backup for other project managers, as necessary.

Gloria J. Mencer, Navy Project Manager (615) 576-1570

Duties: Laboratory auidts, QA/QC review, work plan review, etc., for the Navy.

Margaret P. Ogawa, Secretary (574-0400)

Richard D. Westmoreland, Project Manager (615) 574-8072

Duties: Laboratory audits, QA/QC review, work plan review, etc., for the Air Force and Air National Guard; particularly those projects handled by HAZWRAP.

APPENDIX B

ANALYTICAL DATA VALIDATION CHECKLISTS

ANALYTICAL DATA VALIDATION CHECKLIST

Project Name: _____
Project Number: _____
Sample Identification: _____

_____

Sampling Team: _____
Analyzing Laboratory: _____
Analyses Performed: _____
Sample Matrix: _____
QA Reporting Level: _____

REPORTING REQUIREMENTS
ANALYTICAL DATA PACKAGE DOCUMENTATION
LEVEL A (QUALITATIVE)

Section I: General Information	YES	NO	NOT REQUIRED
1. Sample results complete			
2. Proper parameters analyzed			
3. Method of analysis reported			
4. Detection limits of analysis reported			
5. Master tracking list provided			
6. Sample collection date provided			
7. Sample received date provided			
8. Sample preparation/extraction date provided			
9. Sample analysis date provided			
10. Copy of Chain-of-Custody form signed by the lab sample custodian			
11. A narrative summary of QA or sample problems is provided.			

COMMENTS: _____

_____

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_____

Documentation

Section II: Inorganic Analyses	YES	NO	NOT REQUIRED
1. Results of ICVS and CCVS, %R, expected values			
2. Results of Digested LCS (may be called QC Check sample), %R and expected value			
3. Results of undigested QC Check sample, %R, Source (Lot No. and manufacturer)			
4. Results of method blanks			
5. Results of interference check sample (ICS) and expected value (ICP only)			
6. Results of a dilution check sample and expected value (ICP only)			
7. Results of laboratory duplicate analysis and %RSD or RPD and control value			
8. Results of Matrix spike (digested spike) analysis, amount spiked, %R and control limits			
9. Results of analytical (post-digested) spike analysis, amount spiked, %R, and control limits (furnace AAS only)			

COMMENTS: _____

_____

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Documentation

Section III: Organic Analyses	YES	NO	NOT REQUIRED
A. GAS CHROMATOGRAPHY (NO MASS SPEC)			
1. Results of water blanks (VOA), Extraction blanks, and/or trip blanks			
2. Results of latest independent QC check samples, expected value, %R and source (Lot No. and manufacturer			
3. Results of analysis of reagent water spike, expected value, %R, control limits			
4. Results of reagent water spike duplicate, expected value, %R, RPD and control limits:			
5. Results of matrix spikes, amount spiked, %R and control limit			
6. Results of matrix spike duplicates, amount spiked, %R, RPD or %RSD and control limit			
7. Results of laboratory duplicates (if performed), RPD or %RSD and control limit			
8. Results of surrogate spikes, %R, control limits			

COMMENTS: _____

_____

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Documentation

B. GAS CHROMATOGRAPHY/MASS SPECTROMETER	YES	NO	NOT REQUIRED
1. Verification statement acknowledging tuning with BFB or DFTPP that indicates compliance with acceptance criteria			
2. Results of continuing calibration standards (SPCC and CCC), expected value			
3. Results of water blanks, extraction (method) blanks, and trip blanks			
4. Results of analysis of reagent water spike, expected value, %R, control limits			
5. Results of reagent water spike duplicate, expected value, %R, RPD, and control limits			
6. Results of matrix spikes analysis, amount spiked, %R, and control limits			
7. Results of matrix spike duplicate analysis amount spiked, %R, RPD or %RSD an control limits			
8. Results of surrogate spike analysis, %R, control limits			
9. Results of latest Independent QC check samples (EPA or NBS traceable) analyzed expected value, and source (Lot No. and manufacturer)			
10. Results of blank spike analysis for matrix spike or matrix spike duplicate parameters not meeting recovery requirements			

COMMENTS: _____

_____

_____

_____

QUANTITATIVE STATISTICAL SIGNIFICANCE
LEVEL B (QUANTITATIVE)

DATA EVALUATION	PASS	FAIL	NOT APP
1. Samples were properly collected			
2. Samples were properly preserved			
3. Field measurements of pH and specific conductance are consistent with historical data.			
4. Samples were analyzed by the proper methods			
5. Sample extracted within holding time			
6. Sample analyzed within holding time			
7. Required detection limits were employed by the laboratory			
8. Results of Sampler rinsate blanks were contaminant free or less than five times the detection limit			
9. Sampler rinsate blanks were not contaminant free and field blanks were analyzed properly			
10. Field blanks were contaminant free			
11. Field blanks were not contaminant free and trip blanks were properly analyzed			
12. Trip blanks were contaminant free			
13. Trip blanks were not contaminant free			
14. Laboratory blanks (method blanks, extraction blanks, water blanks) are contaminant free			
15. Blanks summary (conclusions reached): _____			
16. RPD of field replicates is less than 25% for water matrices and less than 40% for soil matrices or the difference can be explained			

COMMENTS: _____

INORGANIC ANALYSES	PASS	FAIL	NA
1. ICVS and CCVS %R within control limits			
2. LCS %R within control limits			
3. QC Check Sample %R within control limits and source given			
4. Laboratory blanks acceptable			
5. Interference Check sample within control limits (ICP only)			
6. Dilution Check sample within control limits (ICP only)			
7. RPD for laboratory duplicate within allowable limits			
8. Matrix spike %R within control limits			
9. Analytical post digested spike within control limits (furnace AAS only)			

COMMENTS: _____

_____

_____

_____

_____

_____

ORGANIC ANALYSES	PASS	FAIL	NA
1. Laboratory blanks are acceptable			
2. QC check samples %R were within control limits and source given			
3. GC/MS properly tuned with BFB or DFTPP			
4. GC/MS continuing calibration (SPCC and CCC) standards within acceptable control limits			
5. Matrix spikes or reagent water spikes %R within control limits			
6. Matrix spike duplicates %R within control limits			
7. RPD of matrix spike duplicate or reagent water spike duplicate was within control limits			
8. Surrogate spikes within control limits			
9. Laboratory duplicates have acceptable RPD			

COMMENTS: _____

_____

_____

_____

_____

_____

DATA VALIDATION QUALIFIER CODES
FOR ORGANIC ANALYSES

	CODES								
	U	J	C	B	E	R	s	*	+
The analytical data validation level is (check one):									

EXPLANATION: _____

_____

_____

_____

_____

_____

FINAL CONCLUSION: _____

VALIDATION PERFORMED BY: _____

REPORTING QUALIFIERS:

U code:	Indicates that compound was analyzed for but not detected. Report the minimum detection limit for the sample with the U (e.g., 10U) based on necessary concentration/dilution actions. (This is not necessarily the instrument detection limit.) The footnote should read: U-Compound was analyzed for but not detected. The number is the minimum attainable detection limit for the sample.
J code:	Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed or when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the specified detection limit but greater than zero (e.g., 10J).
C code:	This flag applies to pesticide parameters where the identification has been confirmed by GC/MS. Single component pesticides $\geq$ 10 ng/ul in the final extract should be confirmed by GC/MS.
B code:	This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.
E code:	Indicates a value estimated or not reported due to the presence of interference. Explanatory note included on cover page.
R code:	Indicates spike sample recovery is not within control limits.
s code:	Indicates value determined by Method of Standard Addition.
* code:	Indicated duplicate analysis is not within control limits.
+ code:	Indicates the correlation coeficient for method of standard addition is less than 0.995.
Other:	Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the data summary report.

DATA CLASSIFICATION SUMMARY CHECKLIST
Class A Criteria
Matrix: Ground Water

To be classified for Class A use, the data must meet the following criteria:

Criteria	Evaluation Result
1. Sampling dates were recorded;	
2. Signatures of Sampling Team on each water sample log or soil sample log;	
3. Sampling locations were clearly designated and described;	
4. Sampling depth increment for soils was recorded;	
5. Sample collection technique was described on water sample log or soil sample log;	
6. Field preparation techniques were clearly described where applicable;	
7. Sample preservation techniques were clearly described, consistent, and adequate for the parameters to be analyzed and the sample matrix;	
8. Shipping bill of lading or constant surveillance documentation is available;	
9. The laboratory sample preparation or extraction date is recorded and available;	
10. The laboratory sample analysis date is recorded and available;	

Class A Criteria (continued)

Criteria	Evaluation Result
11. The laboratory sample preparation technique is recorded and available either in the laboratory report or in the laboratories approved SOP;	
12. The methods of analysis are listed in the laboratory reports and are consistent with the methods specified in the QAPP and laboratory contract;	
13. The laboratory analytical detection limits or limits of quantitation (LCQ) are given in lab reports and are adequate for project objectives;	
14. Field records include: • Soil/sediment log sheets • Water sampling log sheets • QC field checklist • Field instrument calibration logs • Master bound log book with sequentially numbered pages • Daily log book • Chain-of-custody forms	
15. All applicable records described above were properly created and are on file;	
16. Samples passed laboratory data validation without any R flags (samples with J flags may be accepted at this level).	

Remarks:

Conclusion:

DATA CLASSIFICATION SUMMARY CHECKLIST

Class B Criteria

Matrix: Ground Water

To be classified for Class B use, the data must meet the following criteria:

Criteria	Evaluation Result
A. **Data Validation Result**	
1. Samples of this matrix have not been flagged J or R during data validation;	
2. All samples of this matrix have been classified as Level A data;	
B. **Quantitative Statistical Significance**	
1. Laboratory and field instruments were properly standardized (calibrated) employing proper methods and records are available;	
2. Sample bottle preparation was proper and appropriate for the parameters measured and the sample matrix;	
3. All laboratory procedures were referenced to approved EPA methods and were contained in an approved SOP manual;	
4. Analytical QC data was available to demonstrate proper instrument calibration;	
5. Laboratory QC check sample standards are EPA and NBS traceable and were used at least once each three months;	
6. Laboratory reagent (method) blanks were analyzed at a frequency of at least 1 per 20 samples;	

Class B Criteria (continued)

Criteria	Evaluation Result
7. Laboratory duplicates were analyzed at a frequency of at least 1 per 20 samples;	
8. Laboratory matrix spikes and matrix spike duplicates were analyzed at a frequency of at least 1 per 20 samples;	
9. Field replicates if required were analyzed at a frequency of at least 1 per 10 samples;	
10. Field blanks were submitted at a frequency of at least 1 per 20 samples:	
11. One trip blank was submitted for VOCs analysis with each cooler;	
12. Field split samples if required were analyzed at a frequency of at least 1 per 20 samples per matrix;	
13. Appropriate and sufficient QC data with acceptance criteria were presented to allow data validation by the project QA officer;	
14. If required for the project, the laboratories used were approved by the EPA for participation in the Contract Laboratory Program (CLP);	
15. The laboratories participated in round-robin testing program by WPA or other accrediting agency;	
16. Quality control limits were consistent with or exceed the limits established by the EPA for all methods of analysis or the EPA CLP;	
17. All samples submitted were analyzed for the requested parameters.	

Class B Criteria (continued)

Criteria	Evaluation Result
C. Custody and Document Control	
1. Field custody of all samples was noted in a bound field log book;	
2. Transfer of custody documentation (chain-of-custody form) signed by field and laboratory sample custodians is available and properly completed;	
3. Laboratory custody is documented by a designated lab sample custodian in a master log and a secured sample storage area;	
4. Sample identification and assigned laboratory tracking numbers are traceable through the entire monitoring system;	
5. Field notebooks, log sheets, log books, checklists, reports, data validations, and all custody documents are stored in a secure repository or under the control of a document custodian;	
6. All records, forms, log books, etc., are filled out completely in indelible ink without alterations except as initialed;	
7. All sample log sheets have been signed by the sample collector;	
8. Field log book sheets signed by the field sample custodian.	
D. Sample Representativeness	
1. Compatibility exists between field and laboratory measurements or incompatibilities have been suitably explained;	

Class B Criteria (continued)

Criteria	Evaluation Result
2. Laboratory analysis and/or sample preparation or extraction were within allowable holding times established for the sample preservation and methods used;	
3. Sample storage was maintained within suitable temperature, light and moisture conditions to guarantee sample integrity;	
4. Proper sample containers were used for the parameters analyzed:	
5. Proper sample collection equipment was used such that the equipment would neither contribute nor remove any substance to or from the sample;	
6. The sample site selection criteria are consistent with the objectives of the investigation and will provide the required data.	

Remarks:

Conclusion:

FIELD DATA VALIDATION CHECKLIST

Project Name: _____
Project Number: _____
Sample Identification: _____
_____
Sampling Team: _____
Analyzing Laboratory: _____
Analyses Performed: _____
Sample Matrix: _____
QA Reporting Level: _____

REPORTING REQUIREMENTS

FIELD DATA PACKAGE DOCUMENTATION	YES	NO	NOT REQUIRED
1. Field (water and soil) sample logs completed properly and signed			
2. Sampling dates noted			
3. Sampling team indicated			
4. Sample identification traceable to location collected			
5. Sample location provided			
6. Sample depth for soils indicated			
7. Collection technique (bailer, pump etc.)			
8. Field preparation techniques and sample type indicated (grab, composite)			
9. Sample container type described			
10. Sample container type proper for analysis requested			
11. Preservation methods indicated			
12. Chain-of-custody form completed			
13. Proper analytical methods requested			
14. Proper number and type of field QC samples were collected (blanks, replicates, splits, etc.)			
15. Field equipment was properly calibrated before use and results documented.			

COMMENTS: _____
_____

FIELD DOCUMENTATION IS COMPLETE: _____
QA Officer

HEALTH AND SAFETY PLAN

FOR

SITE INSPECTION

PHASE I
OLSON ROAD LANDFILL

NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

SECTION III-HEALTH AND SAFETY PLAN

1.0 INTRODUCTION

The following is the Health and Safety Plan for Phase I of the Site Inspection (SI) to be conducted at the Olson Road Landfill (Site 42), Naval Ordnance Station (NOS), Indian Head, Maryland. This SI is being conducted to determine if hazardous or regulated materials were landfilled at the Olson Road Site which was used for the disposal of a variety of solid wastes including branches, pallets, and scattered cans and drums. There are no records to confirm or deny whether the landfill recieved hazardous waste or regulated materials. An environmental impact study was completed, the results of which are discussed in Section I - Sampling and Analysis Plan. This SI will involve the completion of a shallow geophysical survey to locate possible buried tanks, drums, or other metal objects. Based on the results of the geophysical survey, soil borings and groundwater monitoring wells will be installed on site. Soil and water samples will be collected and analyzed using on site screening instrumentation as well as analysis by a NEESA approved laboratory.

2.0 APPLICABILITY

The provisions of this plan are mandatory for all on-site EnSafe/Allen & Hoshall employees and all subcontractors engaged in on-site operations who will be exposed or have the potential to be exposed to on-site hazardous substances.

EnSafe/Allen & Hoshall subcontractors and Navy contractors may choose to use this health and safety plan as a guide in developing their own plan or may choose to adopt in full (by giving formal written notice to EnSafe/Allen & Hoshall). If the EnSafe/Allen & Hoshall plan is adopted, all personnel assigned to field activities for the project must read and sign the plan acceptance form before commencing site activities. EnSafe/Allen & Hoshall reserves the right to review and approve the subcontractor's/Navy contractor's plan at any time. In either case subcontractors/Navy contractors will hold EnSafe/Allen & Hoshall harmless from, and indemnify it against, all liability in the case of any injury. At a minimum, all provisions of the EnSafe/Allen & Hoshall health and safety plan will be followed.

Inadequate health and safety precautions by the subcontractor/ Navy contractors, or the belief that the subcontractor's/Navy contractor's personnel are or may be exposed to an immediate health hazard, can be cause for EnSafe/Allen & Hoshall to suspend the site work and ask the subcontractor/Navy contractor to evacuate the hazard area.

All Navy contractors, EnSafe/Allen & Hoshall subcontractors, and EnSafe/Allen & Hoshall personnel will be responsible for

operating in accordance with the most current Occupational Safety and Health Administration (OSHA) regulations including 29 CFR 1910.120 - Hazardous Waste Operations and Emergency Response. These regulations include the following provisions for employees exposed to hazardous substances, health hazards, or safety hazards: training as described in 120(e), medical surveillance as described in 120(f), and personal protective equipment described in 120(g).

3.0 PROJECT PERSONNEL

3.1 Project Management

This section outlines the EnSafe/Allen & Hoshall project management structure for Phase I of the SI to be completed at Olson Landfill Site, CHESDIV, NOS, Indian Head, Maryland. Management is discussed, the points of contact for Chesapeake Division and the activity are listed, along with and requirements to be fulfilled by NEESA.

3.2 EnSafe/Allen & Hoshall

Project Management structure for contract N62477-91-D-0043, Cost Plus Award includes the Task Order Manager, Project-Geologist, Project-Health and Safety Officer and Project-Site Health and Safety Officer. Complete Resumés are presented in Appendix A of this plan. The responsibilities of each are as follows:

Task Order Manager

Paul V. Stoddard, Manager of Geological Services

Responsibilities

The Task Order Manager is responsible for the proper maintenance of project budgets, schedules and deliverables, and is designated as the EnSafe/Allen & Hoshall point of contact.

Project-Geologist

Joseph R. Matthews, Professional Geologist

Responsibilities

The Project-Geologist will direct the site investigation and is responsible for proper sample collection, identification, preservation and documentation, and documentation of all field activities as outlined in the Sampling and Analysis Plan (SAP) and the Quality Assurance Plan (QAP). The Project-Geologist will prepare all draft and final reports.

Project-Health and Safety Officer(s)

Richard C. Barlow, Chemical Engineer
John H. Borowski, CIH

Responsibilities

The Project-Health and Safety Officer(s) has the primary responsibility for:

Assuring that all personnel are aware of:

Names of personnel and alternates responsible for site safety and health;

Safety, health and other hazards present on the site;

Use of personal protection equipment;

Work practices by which the employee can minimize risks from hazards;

Safe use of engineering controls and equipment on the site;

Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards; and

Site control measures, decontamination procedures, site standard operating procedures and the contingency plan and responses to emergencies including the necessary PPE.

Assuring that all employees have received a minimum of 40 hours of health and safety instruction, off the site, and actual field experience under the direct supervision of a trained experienced supervisor. Workers who may be exposed to unique or special hazards shall be provided additional training.

Monitoring the performance of personnel to ensure that mandatory health and safety procedures are being performed and correcting any performances that do not comply with the Health and Safety Plan. (Copies of health and safety training certificates must be available for review by the EnSafe/Allen & Hoshall Project Manager and Site Safety Officer.)

Ensuring that all field personnel employed on the site are covered by a medical surveillance program as required by 29 CFR 1910.120(f)

Consulting with the Site-Health and Safety Officer and/or other personnel.

Preparation and submittal of any and all project reports - includes progress, accident, incident, contractual, etc.

Project-Site Health and Safety Officer
Joseph R. Matthews, Professional Geologist

Responsibilities
The Project-Site Health and Safety Officer has the primary responsibility of: assuring that a copy of the Health and Safety Plan is maintained on site during all field activities; advising field personnel on all health and safety related matters involved at the site; directing and ensuring that the safety program is being correctly followed in the field, including the proper use of personal protective and site monitoring equipment; ensuring that the field personnel observe the appropriate work zones and decon tamination procedures; reporting any safety violations to the Project-Health and Safety Officer; and, conducting daily safety briefings during field activities.

4.0 TRAINING

Training is clearly defined within the EnSafe\Allen & Hoshall Health and Safety Policy. All personnel entering contaminated or potentially contaminated areas of this site must meet the requirements of 29 CFR 1910.120. Personnel without the required training **will not be permitted** in any area with potential for exposure to toxic substances or harmful physical agents (i.e., downrange). Refer to Appendix B for further information.

5.0 MEDICAL SURVEILLANCE

All personnel entering potentially contaminated areas of this site will be medically qualified for site assignment through a medical surveillance program outlined in the EnSafe\Allen & Hoshall Health and Safety Policy Manual. Personnel who have not recieved medical clearance **will not be permitted** in any area with potential for exposure to toxic substances or harmful agents (i.e., downrange). Refer to Appendix B, Section 6.0, for further information.

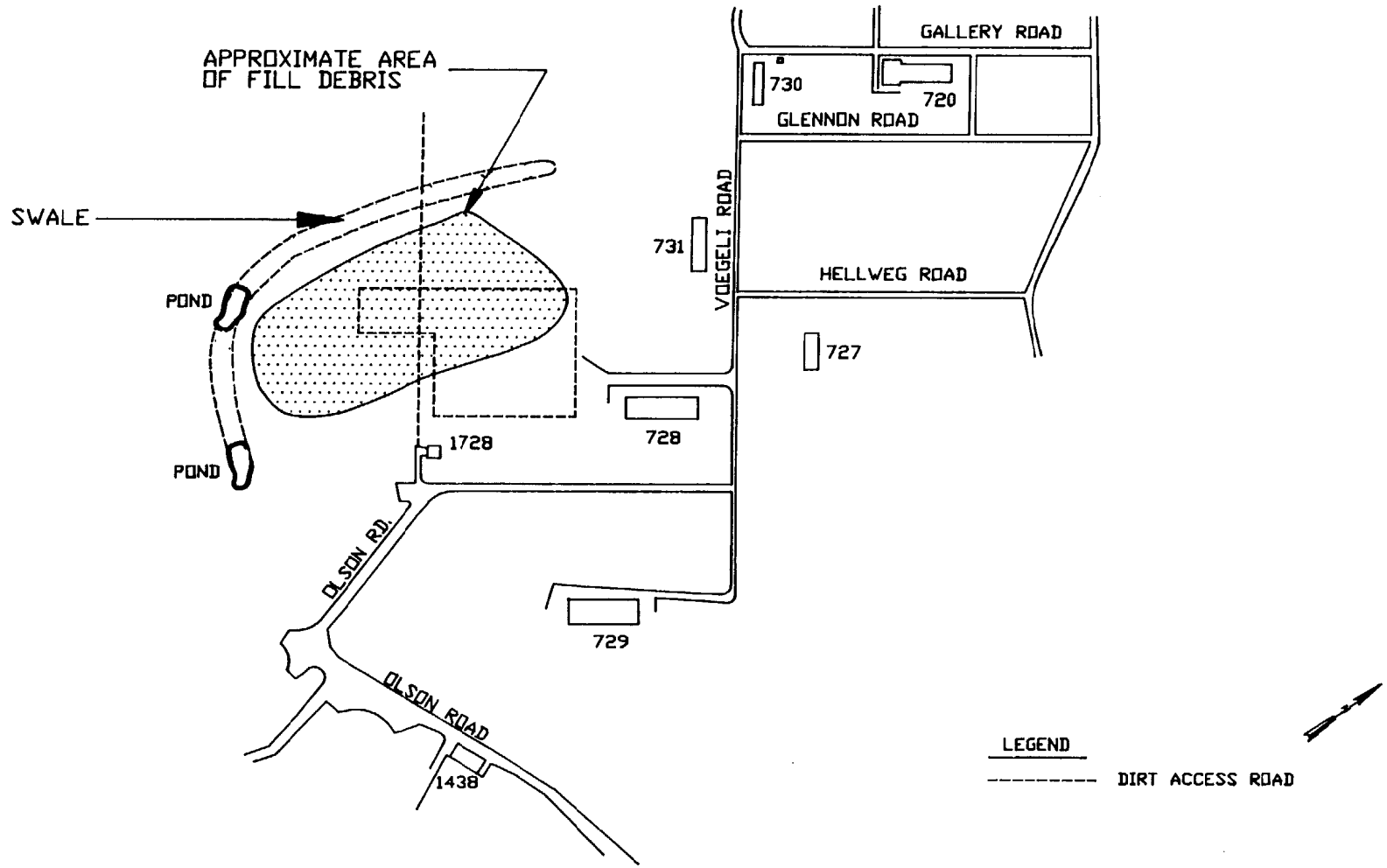
6.0 SITE CHARACTERIZATION AND ANALYSIS

6.1 Site Name, Location

The site is located at the Naval Ordnance Station, Indian Head, Maryland (NOS Indian Head) on Md., Route 210, Indian Head, Maryland 20640-5000. The study site under investigation is Site No. 42 - Olson Road Landfill at NOS Indian Head. A site map is provided as Figure 6.1.

6.2 Site History and Description

The landfill was used to collect refuse from the entire station over a five year period ending in 1987. It was used for the



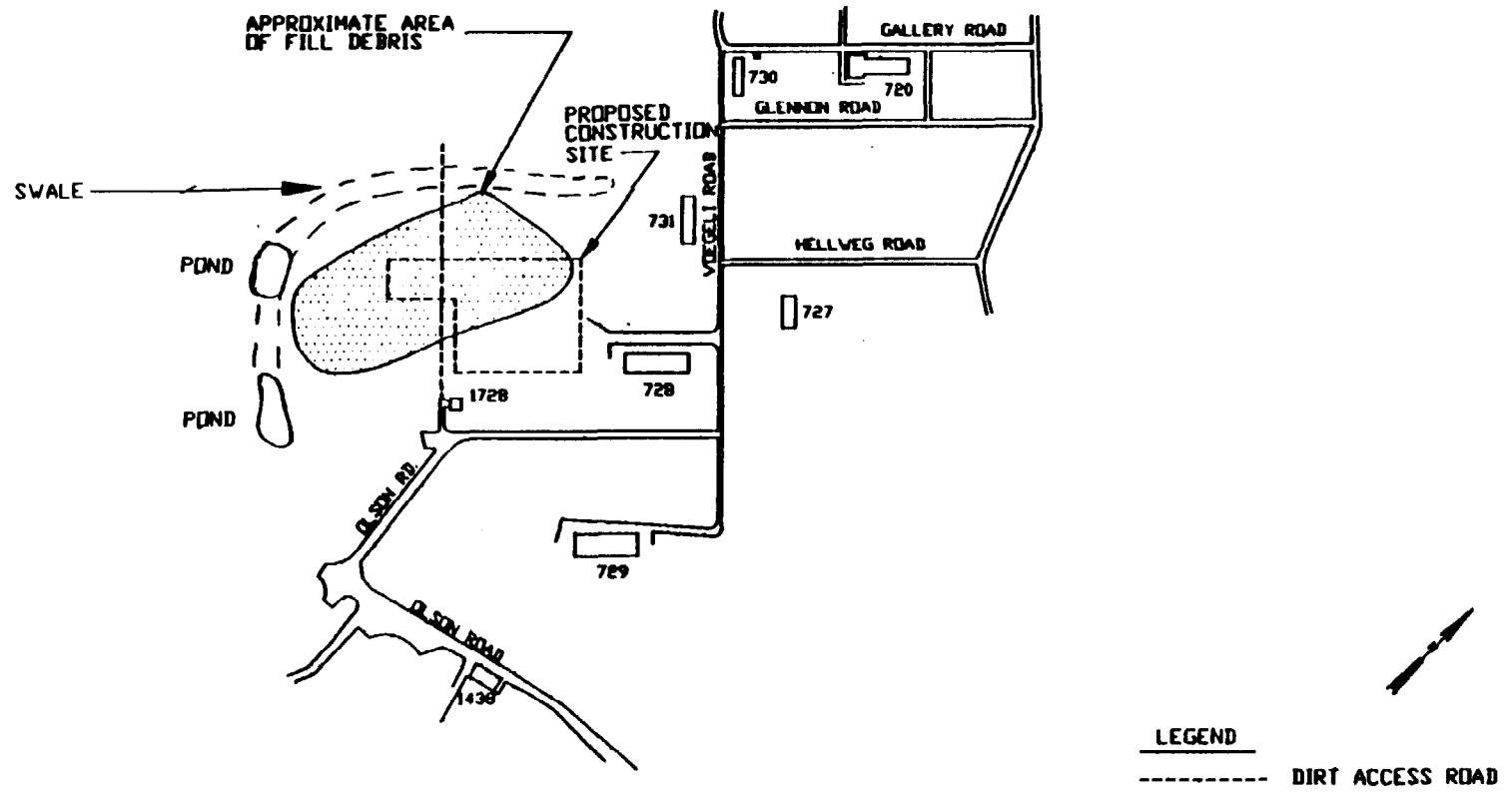
NOT TO SCALE

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
(MODIFIED FROM: PRELIMINARY
ASSESSMENT REPORT)

OLSON ROAD LANDFILL
FIGURE 6-1

DATE: 10/29/91

DWG NAME: MDOLSRLF



NOT TO SCALE

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
(MODIFIED FROM PRELIMINARY ASSESSMENT REPORT)

SITE PLAN
OLSON ROAD LANDFILL
FIGURE 6.1

DATE: 9/18/91

DWG NAME: MDOLSRLF

disposal of a variety of solid waste including branches, pallets, and scattered cans and drums. There are no records to confirm or deny whether the landfill received hazardous waste or regulated materials. The site is approximately two acres in size and is located on Olson Road at the NOS Indian Head. The landfill site and an area adjacent coincide with the construction site for the P-059 MILCON project.

An assessment was completed at Site 42, however, details of this investigation have not been disclosed to EnSafe/Allen & Hoshall prior to the preparation of this plan.

A limited visual inspection was completed at the Olson Landfill as part of the NOS Preliminary Assessment (NEESA 13-021A). Basic information and conclusions resulting from that assessment are as follows:

- Disposal apparently occurred over a five year period in the early and mid 1980's;
- Disposal of hazardous waste is not recorded nor recalled by site personnel;
- Debris currently visible includes branches, pallets, and a few scattered cans and drums;
- Disposal in this area was not authorized; and,
- Site 42 was recommended for a SI.

6.3 Scope of Work

The activities to be performed during the investigation include installation of 16 soil borings. Three of these borings are to be completed as groundwater monitoring wells, with associated well purging, development, and sampling as required. All boring/well installations and associated field work descriptions are provided in the Sampling and Analysis Plan (SAP).

The Assessment will provide data needed to determine if contamination is present at this site.

7.0 SITE CONTROL

Site control will be established and maintained according to the recommendations set forth in the EPA's "Interim Standard Operating Safety Guides, Revised September, 1982". Three general zones of operation will be established to reduce the potential for contaminant migration and risk of personnel exposure. These zones are (1) the exclusion zone, (2) the contamination reduction zone and (3) the support zone. The area of each zone is indicated on Figure 7-1.

The exclusion zone will be located such that the area between the decontamination station and the landfill will be included; the contamination reduction zone will include the decontamination station and the support zone will be located beyond the contamination reduction zone. Only authorized personnel with a minimum of 40 hours health and safety training meeting the requirements of OSHA 29 CFR 1910.120 are permitted within the exclusion and contamination reduction zones. The exclusion zone is considered contaminated and all personnel within the area must use the prescribed level of personal protection. A checkpoint will be established at the periphery of the exclusion zone to regulate the flow of personnel and equipment in and out of the area. The exclusion zone boundary is the "hotline". All personal crossing the hotline into the exclusion zone must be done using the "buddy system".

The contamination reduction zone serves as a buffer between the exclusion zone and the support zone and is intended to prevent the spread of contaminants from the work areas. All decontamination procedures will be conducted in this area. Entry into the contamination reduction zone from the support zone will be through a controlled access point. Personnel entering into this area must wear the prescribed personal protective equipment. Exit from the contamination reduction zone requires the removal of all contaminants through compliance with established decontamination procedures.

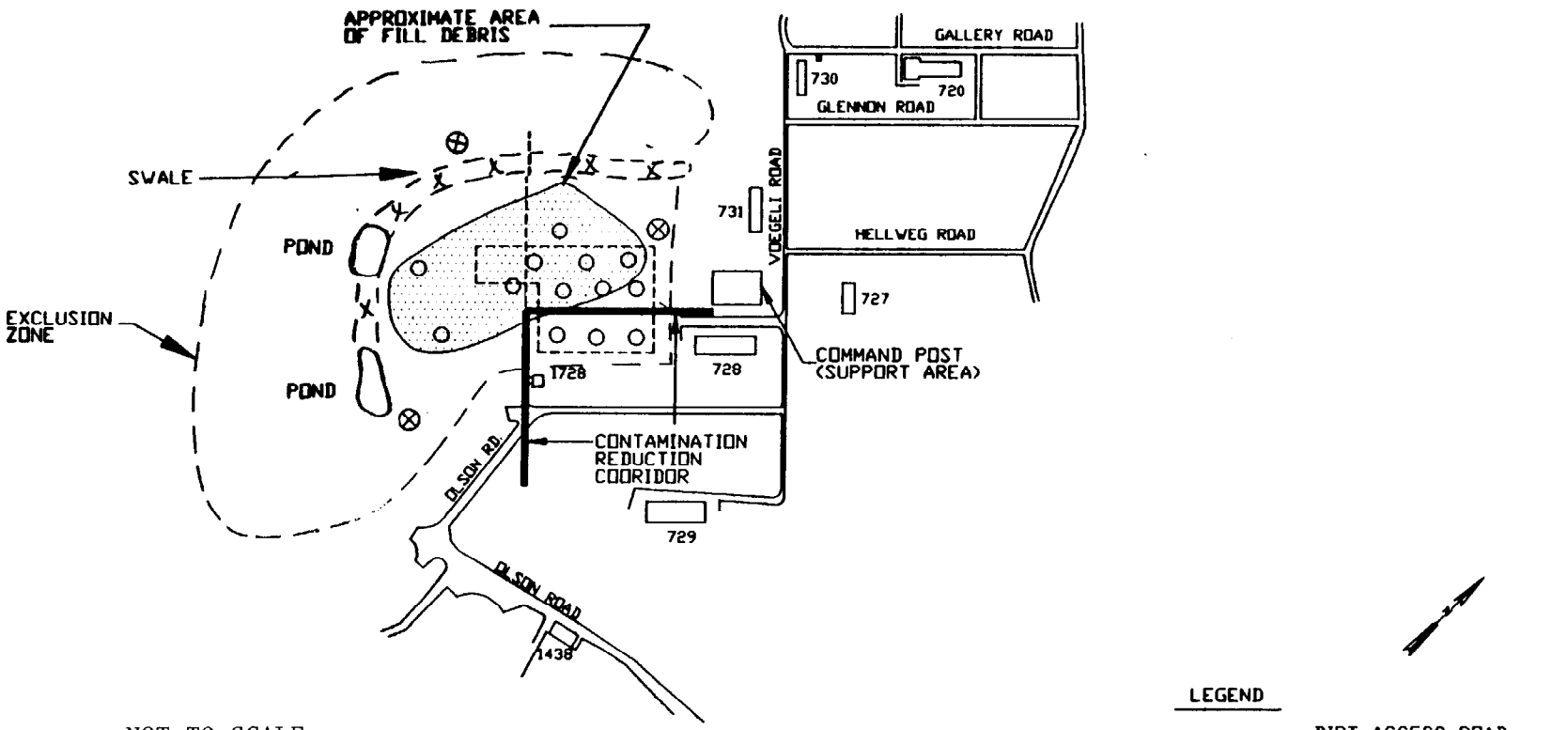
The support zone is the outermost zone and is considered a non-contaminated or clean area. The command post for field operations, first aid station and other site support elements are located in this area. The location of the command post was determined by the topography of the terrain.

7.1 Site Activities

The activities to be performed during the SI will include a geophysical study consisting of ground penetrating radar mapping, surface soil sampling, surface water sampling, subsurface soil borings, and groundwater monitoring well installation and sampling.

8.0 EMPLOYEE PROTECTION

Employee protection for this project includes standard safe work practices, personal protective equipment, procedures and equipment for extreme weather conditions, work limitations and exposure evaluation.



NOT TO SCALE

LEGEND

- --------- DIRT ACCESS ROAD
- ⊗ MONITORING WELL
- ○ SOIL BORINGS
- △ SURFACE WATER SAMPLE
- ⊀ SURFACE SOIL SAMPLES

SITE INSPECTION
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
(MODIFIED FROM: PRELIMINARY ASSESSMENT REPORT)

WORK ZONES
OLSON ROAD LANDFILL
FIGURE 7.1

DATE: 9/18/91

DWG NAME: MDOLSRLF

8.1 Standard Safe Work Practices

Standard safe work practices that will be followed include:

- Eating, drinking, chewing gum or tobacco, smoking or any activity that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated, unless authorized by the Site Health and Safety Officer.

- Hands and face must be thoroughly washed upon leaving the work area.

- Contact lenses shall not be worn on site.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate or discolored surfaces; or lean, sit or place equipment on drums, containers or on soil suspected of being contaminated.

- Medicine and alcohol can exacerbate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel on cleanup or response operations where the potential for absorption, inhalation or ingestion of toxic substances exists unless specifically approved by a qualified physician. Consumption of alcoholic beverages should be avoided during operations.

- Under garments should be made from natural fibers (i.e., cotton or wool).

9.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Field activities will be initiated in Level D protection consisting of chemical-resistant boots with steel toe and steel reinforced, puncture resistant soles, boot covers and inner and outer gloves. This level of protection was chosen because there is no record of contamination on site. An initial screening for volatile organic compounds (VOC) of the landfill site will be performed using a photoionization detector (PID). This screening will take place prior to the geophysical survey. If greater than 5 ppm VOC above background are detected the PPE will be up-graded to level C. Level B protection will be selected when IDLH concentration are encountered, when the oxygen level is less than

19.5% or when exposure to the unprotected areas of the body is likely to cause harm.

Level D Equipment:

- Hard hat (optional)
- Face shield or goggles (optional)
- Chemical-resistant boots with steel toe and shank
- Boot covers (optional)
- Gloves,(inner and outer)

Level C Equipment:

- Full-face piece, cartridge type, air purifying respirator with cartridges for the appropriate hazard;
- Chemical-resistant clothing, long sleeves, one or two piece;
- Inner gloves
- Chemical-resistant gloves
- Steel toe and steel reinforced, puncture resistant sole boots
- Hard hat (optional)
- Disposable boots (optional)

Criteria for Use of Level C:

- When concentrations of VOC are 5 ppm above background;
- When Level A or B is not indicated;
- When airborne particulates (dust) warrant respiratory protection;
- When work areas contain not less than 19.5 percent oxygen;
- When doubts exist about air quality, therefore preventing the use of Level D;
- The types of air contaminants have been identified, concentrations measured, and a canister respirator is available that can remove the contaminants;

Level B Equipment:

- Full-faced piece, self-contained breathing apparatus, pressure-demand or other positive pressure mode or pressure-demand airline respirator equipped with emergency escape device;

- Chemical-resistant clothing, long sleeves, hooded, one or two pieces.
- Inner gloves
- Chemical-resistant gloves
- Steel toe, steel reinforced, puncture resistant boots
- Hard hat
- Options as required:

- Coveralls
- Disposable outer boots

Criteria for Use of Level B:

- When Level A is not indicated
- When airborne particulates (dust) warrant respiratory protection
- When work areas contain less than 19.5 percent oxygen

Flammable gases present an additional hazard. All lights, test instruments and other electrical equipment must be explosion proof or intrinsically safe. Open flames and smoking are not permitted. Prior to the use of equipment with internal combustion engines, the atmosphere above the landfill must be sampled for the presence of flammable gases. If concentrations of flammable gases exceed 10% of the Lower Explosive Limits (LEL), a careful investigation and mapping of the area must be made. Before resumption of onsite activities, project personnel in consultation with personnel skilled in fire or explosion hazards must develop a refined safety plan. If the concentration of flammable gases exceeds 20% of the LEL all operations must be terminated immediately and the area evacuated. Operations may not be restarted until the atmosphere above the landfill contains less than 20% LEL of flammable gas.

10.0 PROCEDURES AND EQUIPMENT FOR EXTREME WEATHER CONDITIONS

Field activities for this site are scheduled during months with inconsistent weather. Therefore, both heat and cold stress will be concerns for the health and safety personnel. Adverse weather conditions are important considerations in planning and conducting site operations. Extremes in hot and cold weather can cause physical discomfort, loss of efficiency and personal injury.

10.1 Heat Stress

Heat stress can result when the protective clothing decreases natural body ventilation even when temperatures are moderate. Working under various levels of personal protection may require the wearing of low permeability disposable suits, gloves and boots. This clothing will prevent most natural body ventilation. Discomfort due to increased sweating and body temperature (heat stress) will be expected at the work site. Recommendations to reduce heat stress follow:

- Drink plenty of fluids (to replace loss through sweating).

- Wear cotton undergarments to act as a wick to absorb moisture.

- Make adequate shelter available for taking rest breaks to cool off.

In extremely warm weather, the Site Health and Safety Officer may also require these additional measures:

- Wear cooling devices to aid in ventilation (NOTE: the additional weight may affect efficiency).
- Install portable showers or hose down facilities to cool clothing and body.
- Shift working hours to early morning and early evening. Avoid the hottest time of the day.
- Frequently rotate crews wearing the protective clothing.

10.2 Cold Exposure

Persons working outdoors in temperatures at or below freezing may experience frostbite or hypothermia. Extreme cold for a short time may cause severe injury to the surface of the body. Areas of the body that have a high surface-area-to volume ratio, such as fingers, toes, and ears are the most susceptible.

Two factors influence the development of cold injury: Ambient temperature and the velocity of the wind. As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus the body cools suddenly when protective equipment is removed if the clothing underneath is soaked with perspiration.

Recommendations to reduce effects of cold exposure:

- Stay dry. When the temperature drops below 40°F, change perspiration soaked clothes frequently. When clothes get wet, they lose about 90% of their insulating value.
- Beware of the wind. A slight breeze carries heat away from bare skin much faster than still air. Wind drives cold air under and through clothing. Wind refrigerates wet clothes. Wind multiplies the problems or staying dry.
- Understand cold. Most hypothermia cases develop in temperatures between 30°F and 50°F. Cold water running down the neck and legs or cold water held against the body by sopping clothes causes hypothermia.

- Make adequate dry, warm shelter available.
- Provide warm drinks.

Never ignore shivering. Persistent shivering is a clear warning that a person is on the verge of hypothermia. Allow for the fact that exposure greatly reduces normal endurance. Physical activity may be the only thing preventing hypothermia.

11.0 WORK LIMITATIONS

All site activities will be conducted during daylight hours only. All personnel scheduled for these activities will have completed initial health and safety training which includes recognition of the symptoms and signs of over-exposure to the chemical hazards present at this site. Prior to starting work at the site, each employee must have three days of actual field training under the supervision of and experienced supervisor as specified in 29 CFR 1910.120. All supervisors must completed eight hours of training in site management. All personnel must complete an eight hour refresher training course on an annual basis in order to continue working at this site.

12.0 EXPOSURE EVALUATION

All personnel scheduled for site activities will have a baseline physical examination which will include a physical examination, stressing examination of the neurologic, cardio-pulmonary, musculoskeletal and dermatological systems, pulmonary function testing, multi-chemistry panel and urinalysis and be declared fit for duty. An exposure history form will be completed for each worker participating in site activities. An examination and updated occupational history will be repeated on an annual basis and upon termination of employment as required by 29 CFR 1910.120(f). The content of the annual/termination examination will be the same as the baseline physical. A qualified physician will review the results of the annual/termination examination and exposure data and request further tests or issue medical clearances as appropriate.

After any job-related injury or illness, there will be a medical examination to determine fitness for duty or for the need of any job restrictions. The site health and safety officer will review the results with the examining physician prior to releasing the employee for work. A similar examination will be performed if an employee has missed at least three (3) days of work due to a non-job-related injury or illness requiring medical attention. Medical records shall be maintained by the employer or the physician for at least thirty (30) years following the termination of employment.

Methane is classed as a flammable gas by the Department of Transportation. It is practically inert, but at very high concentrations is a simple asphyxiant. A concentration of 87 percent has been demonstrated to cause asphyxiation, and 90 percent respiratory arrest in mice. Methane is absorbed and readily metabolized. When inhaled, the main portion is exhaled again in unchanged form.

13.0 MONITORING REQUIREMENTS

Air monitoring will be accomplished using a photoionization detector (PID) and a combustible gas meter during all surface soil sampling, subsurface soil borings and groundwater monitoring well installations. Instruments shall be direct reading and will be specifically designed to detect volatile organic compounds and combustible gases to read gas concentrations. Instruments will be continuous reading and equipped with alarms. Each instrument calibration shall be checked daily before site activities commence and at the end of each days' activities. At the end of each work day and prior to calibration, each instrument shall be checked to ensure that they are free from surface contamination.

The following instruments will be used for monitoring airborne contaminants:

Oxygen - MSA 361 or equivalent

Flammable Gases - MSA 361 or equivalent

VOC - HNu IS101, and Photovac TIP Photoionization Detector

In addition to the above field checks of the instrument's calibration , all real-time direct reading survey instruments shall be maintained in accordance with the manufacturers' recommendations.

14.0 DECONTAMINATION

As a part of the system to prevent or reduce the physical transfer of contaminants by people or equipment from on-site areas, provisions must be made for decontaminating anything exiting the Exclusion and Contamination Reduction Zones. The extent of the decontamination procedures for personnel is highly site-specific and depends upon a number of factors: type of contaminants, amounts of contamination, level of protection, work activities, and reason for leaving the site. The USEPA has developed decontamination procedures for various levels of protection which can be consulted when formulating site specific decontamination protocols. These procedures are included as Appendix D to the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" (EnSafe/Allen & Hoshall reference 0100-072).

A decontamination zone will be established at an area not within the work zone but immediately adjacent to it and will include an area for sampling equipment and personnel decontamination.

14.1 Personnel Decontamination

The decontamination procedures, based on Level D\C protection, will consist of brushing heavily soiled boots, rinsing outer gloves and boots with soap and water. Removing outer gloves depositing them in a plastic lined container. Washing and rinsing safety suit, removing safety suit and boots. Safety suits to be deposited in a plastic lined container. Washing and rinsing inner gloves, removing facepiece, washing and rinsing inner gloves and removing inner gloves. Facepieces will be decontaminated and cleaned for reuse, inner gloves will be deposited in a plastic lined container.

The decontamination procedures for Level B protection will be similar except an additional step will be required to decontaminate the air bottle. Decontamination procedures will be conducted at the lunch break and at the end of each work day. If the field activities zone is left at other times during the work day, contaminated clothing will be left at the decontamination station on plastic sheeting to be reworn on returning.

If higher levels of personal protection equipment are needed, adjustments will be made to these procedures and an amendment will be made to this health and safety plan.

14.2 Equipment Decontamination

All equipment leaving the Exclusion Zone should be decontaminated to prevent the off-site migration of hazardous contaminants. In addition, all equipment used at the site should be decontaminated upon completion of the project. In limiting the potential environmental exposures, the following procedures should be used. All contaminated surfaces will be rinsed with the proper decontamination solution. The selection of these solutions will be made by the Project-Site Health & Safety Officer. In addition, all decontamination activities will be supervised by the Project-Site Health & Safety Officer. All waste water generated will be collected and disposed of as hazardous waste.

TYPES OF DECONTAMINATION SOLUTIONS
(This list is not all inclusive)

DECON SOLUTION A	A solution containing 5% sodium carbonate (Na_2CO_3) 5% trisodium phosphate (Na_3PO_4).
DECON SOLUTION B	A solution containing 10% calcium hypochlorite ($Ca(OCl)_2$).

DECON SOLUTION C	A solution containing 5% trisodium phosphate (Na_3PO_4). This solution can also be used as a general purpose rinse.
DECON SOLUTION D	A dilute solution of hydrochloric acid (HCl).
DECON SOLUTION E	A dilute solution of phosphate free analytical quality detergent.

14.3 Closure of the Personnel Decontamination Station

All disposable clothing and plastic sheeting used during site activities will be double-bagged and disposed in a refuse container. Decontamination and rinse solutions will be allowed to drain onsite. Reusable clothing will be dried and prepared for future use. All washtubs, pails, buckets, etc. will be washed, rinsed and dried at the end of each workday.

15.0 EMERGENCY INFORMATION

All hazardous waste site activities present a potential risk to onsite personnel. During routine operations, risk is minimized by establishing good work practices, staying alert and using proper personal protective equipment. Unpredictable events such as physical injury, chemical exposure or fire may occur and must be anticipated.

If any situation or unplanned occurrence requires outside or support services, the NOS Indian Head representative, Mr. Shawn Jorgensen will be informed and the appropriate contact from the following list will be made:

Contact	Person or Agency	Telephone
NOS Indian Head	Shawn Jorgensen	(301) 743-6745
Physicians Memorial Hospital		(301) 645-0100
Southern Maryland Hospital		(301) 868-8000
Law Enforcement	NOS Police Dept.	(301) 743-4333
Fire Department	NOS Fire Dept.	(301) 743-4281
Ambulance Service	NOS Rescue	(301) 743-4449
Regional Poison Center		(800) 962-1253

16.0 SITE RESOURCES

In case of an emergency, telephones for communications with outside agencies are located at Building 731, Phone # (301) 743-4628. A first aid kit, eye wash station and other emergency supplies will be located at the support zone. Restroom facilities and water supply are to be available near support zone.

17.0 EMERGENCY PROCEDURES

In the event that an emergency develops onsite, the procedures delineated herein are to be immediately followed. Emergency conditions are considered to exist if:

- Any member of the field crew is involved in an accident or experiences any adverse effects or symptoms of exposure while on site; or
- A condition is discovered that suggests the existence of a situation more hazardous than anticipated.

The following emergency procedures should be followed:

- Report any emergency situation, such as fire, or personnel injury immediately to the project manager.
- Emergency alerting will be accomplished vocally or by the use of hand signals.
- Exclusion Zone will be evacuated through the hotline control point. After emergency decontamination, all personnel will muster at the command post/site office. All other persons on site who are not in the Exclusion Zone will evacuate the site through the nearest exit but may not cross through the Exclusion Zone.
- In the event that any member of the field team experiences any effects or symptoms of exposure while on the scene, the entire field crew will immediately halt work and act according to the instructions provided by the Site Health and Safety Officer.
- For applicable site activities, wind indicators visible to all onsite personnel will be provided by the site safety officer to indicate possible routes for upwind escape.

- The discovery of any conditions that would suggest the existence of a situation more hazardous than anticipated will result in the suspension of work until the safety officer has evaluated the situation and provided the appropriate instructions to the field team. During this evaluation, all personnel in the exclusion zone will muster in the contamination reduction zone.

- In the event of fire or other disaster, evacuate the exclusion zone, muster in the contamination reduction zone and notify local authorities of the incident.

- In the event of an accident, decontamination of the injured person, as well as any persons accompanying the injured person to the hospital, will be required. A minimal level of decontamination will be needed to prevent contamination of the hospital and medical personnel. Care must be exercised so as not to cause further or additional injury to the individual.

- In the event of an emergency, entry into the exclusion zone will initially be controlled by the site manager and will be limited to life saving operations.

- Emergency response beyond evacuation of the exclusion zone and operations necessary for life saving shall not be attempted by on-site personnel. Those type operations will be left for organizations who have been trained for such activities (e.g. fire department).

- In the event that an accident occurs, the project manager is to complete an accident report form for submittal to the managing principal-in-charge of the project.

- This contingency plan shall be updated whenever changes occur which may affect the effective implementation. After each incident/accident, the effectiveness of this plan shall be evaluated and the plan shall be modified as needed.

17.1 Routes To Emergency Medical Facilities

The primary source of medical assistance for the site is:

PHYSICIANS MEMORIAL HOSPITAL, LA PLATA, MARYLAND

Directions To Primary: **TAKE INDIAN HEAD HIGHWAY (MD. ROUTE 210) NORTH TO MD. ROUTE 225. TURN RIGHT ON 225, AND FOLLOW UNTIL JUNCTION WITH MD. ROUTE 301. TURN RIGHT ON 301. TURN LEFT AT**

FIRST TRAFFIC LIGHT. THE HOSPITAL IS ON THE RIGHT, ABOUT 1/2 BLOCK PAST THE RAILROAD TRACKS.

The alternate source of medical assistance for the site is:

SOUTHERN MARYLAND HOSPITAL, CLINTON, MARYLAND

Directions to Alternate: **TAKE INDIAN HEAD HIGHWAY (MD. ROUTE 210) NORTH TO MD. ROUTE 373. FOLLOW UNTIL INTERSECTION WITH BRANCH AVE. (MD. ROUTE 5). TURN LEFT ON BRANCH AVE., AND FOLLOW UNTIL INTERSECTION WITH SURRATTS ROAD. TURN RIGHT ON SURRATTS ROAD. THE HOSPITAL IS JUST PAST THE COLONY SOUTH HOTEL.**

18.0 CONTINGENCY PLANS

The site safety plan address' emergency medical care and treatment of all personnel, including possible exposures to toxic substances and injuries due to accidents or physical problems. The following items are included in the emergency care provision:

- Name, address, and telephone number of the nearest medical treatment facility is in the site safety plan and will be posted in a conspicuous location. A map and/or directions for locating the facility, plus travel time, are included.

- The facility's ability to provide care and treatment of personnel exposed to toxic or other hazardous substances should be ascertained. If the facility lacks toxicological capability, The joint venture's safety and health officer should be consulted.

- All administrative arrangements for accepting patients will be made in advance with the facility.

- Arrangements will be made to obtain ambulance, emergency, fire, and police services. Telephone numbers and procedures for obtaining these services will be readily available.

- Emergency showers, eye wash fountains, and first aid equipment will be readily available on-site. Personnel qualified in first aid and CPR will be available.

- Provisions for providing medical personnel with information involving the nature and extent of the accident or injury will be made.

An evaluation for the possibility of events leading to evacuation of the site and surrounding community will be performed and protocols included in the site safety plan as appropriate.

19.0 FORMS

The following forms will be used in implementing this health and safety plan:

Plan Acceptance Form
Plan Feedback Form
Accident Report Form
Exposure History Form

The Plan Acceptance Form will be filled out by all employees working on the site prior to commencement of site activities. The Plan Feedback Form will be filled out by the site safety officer and any other onsite employee who wishes to fill one out. The Accident Report Form will be filled out by the Project Manager in the event that an accident occurs. The Exposure History Form will be completed by both the project manager and the individual(s) for whom the form is intended.

All completed forms must be returned to the Task Order Manager at EnSafe/Allen & Hoshall, Memphis, Tennessee.

PLAN ACCEPTANCE FORM

PROJECT HEALTH AND SAFETY PLAN

INSTRUCTIONS: This form is to be completed by each person working on the project work site and returned to , EnSafe/Allen & Hoshall, Memphis, Tennessee.

Job No. _____

Project _____

I represent that I have read and understand the contents of the above plan and agree to perform my work in accordance with it.

_____
Signed

_____
Print Name

_____
Company

_____
Date

PLAN FEEDBACK FORM

Problems with plan requirements

_____

_____

_____

_____

Unexpected situations encountered:

_____

_____

_____

_____

Recommendations for revisions:

_____

_____

_____

_____

ACCIDENT REPORT FORM

SUPERVISORS REPORT OF ACCIDENT	DO NOT USE FOR MOTOR VEHICLE OR AIRCRAFT ACCIDENTS
TO	FROM TELEPHONE (Include area code)

NAME OF INJURED OR ILL WORKER AND COMPANY

WORKER'S SOCIAL SECURITY NUMBER

DATE OF ACCIDENT	TIME OF ACCIDENT	EXACT LOCATION OF ACCIDENT

NARRATIVE DESCRIPTION OF ACCIDENT

NATURE OF ILLNESS OR INJURY AND PART OF BODY INVOLVED

LOST TIME

YES ☐
NO ☐

PROBABLE DISABILITY (Check one)

FATAL ☐

LOST WORK DAY WITH ____ DAYS AWAY FROM WORK

LOST WORK DAY WITH ____ DAYS OF RESTRICTED ACTIVITY

NO LOST WORK DAY ☐

FIRST-AID ONLY ☐

CORRECTIVE ACTION RECOMMENDED (By whom and by when)

NAME OF SUPERVISOR	TITLE
SIGNATURE	DATE

EMPLOYEE EXPOSURE HISTORY FORM

EMPLOYEE NAME: _____

JOB NAME: _____

JOB NUMBER: _____

DATE(S) ON SITE (FROM/TO): _____

HOURS ON SITE: _____

CONTAMINANTS (SUSPECTED/REPORTED)

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

(SEE ATTACHED LABORATORY ANALYSIS)

APPENDIX A
ENSAFE PERSONNEL RESUMES

PAUL V. STODDARD, P.G.
MANAGER, GEOLOGICAL SERVICES

EDUCATION: M.S., Geology, Memphis State University/1983
B.S., Geology, Memphis State University/1982
B.S., Biology, Memphis State University/1980

CERTIFICATION: Professional Geologist, TN, AR
Pending Certification, IN

EXPERIENCE:

- Generated stratigraphic correlations of upper Cretaceous and Tertiary trends of South Texas with concentration in the Wilcox and Frio formations. Responsible for regional correlations of E-logs, preparation of stratigraphic cross sections, development and updating of structure maps, and well spotting and digitizing.

- Conducted remedial site investigations at facilities for sites with potential soil and/or groundwater contamination involving chlorinated hydrocarbons and petroleum products. Field assessments included in-situ monitoring of organic vapors utilizing an organic vapor detector and/or a scanning infrared spectrophotometer.

- Responsible for the design and implementation of "preconveyance" investigations to determine potential soil contamination at various sites being considered for commercial development.

- Field supervision and implementation of closure plans for hazardous waste facilities at Charleston, SC Naval Shipyard. Tasks included removal of hazardous waste inventories, decontamination of tanks, confirmation sampling of decontamination solutions and soil sampling at container storage compounds operated by the Shipyard and Defense Reutilization and Marketing Office.

- Sampled groundwater monitoring wells for hazardous substance contamination and supervised well drillers at Shelby County, TN state Superfund site.

- Conducted a study of pesticide contamination in groundwater at an industrial facility in Missouri. Field Investigation included soil boring, monitoring well installation, determination of hydraulic gradients, data reduction and analyses, and report generation.

- Implemented groundwater investigation for photosensitive hazardous substance contamination at NPL site.

- Field supervision and implementation of closure plans for removal of underground waste oil storage tanks and investigation of potential contamination in soils and groundwater from tank releases.

- Field supervision and implementation of sampling plan for hazardous waste facilities at NAS Memphis. Task included Level B inspection of former waste plating treatment storm sewer, and the sampling of soils associated with defective joints. The task also included the sampling of a former salvage yard for petroleum hydrocarbons and lead.

- Field supervision and implementation of underground storage tank removal investigations. Field assessments include soil sampling and/or monitoring well installation with groundwater sampling and assessment of hydrogeologic conditions.

- Project geologist for interior survey of 120 acre underground room and pillar mine. Additional tasks included surface investigation of karst features, monitoring well installation, interpretation of borehole geophysics, and subsequent groundwater sampling and data reduction.

- Project geologist for hydrogeologic assessment of RCRA facilities. Tasks include site selection and installation of groundwater monitoring networks, slug tests, and subsequent data evaluation.

- Project geologist for MCAS Cherry Point, RFI. Tasks included design and implementation of Field Sampling Plan, including soil borings, monitoring well installation, groundwater sampling, slug tests, hydrogeologic characterization -- including diurnal and tidal influences on the shallow aquifer and subsequent data reduction and report generation.

- Project geologist for hydrogeologic assessment of a proposed TN state Superfund site. Investigation included step drawdown and constant rate aquifer pump test for design and installation of a groundwater treatment system.

- Project manager for CERCLA Remedial Investigation/Feasibility Study for a former pesticide manufacturing facility. Tasks included the design and implementation of geologic/hydrogeologic assessment for volatile organic and pesticide contamination, subsequent data reduction, and report generation. Project management included cost tracking, scheduling, and continued regulatory compliance (i.e. Administrative Order).

- Project manager for CERCLA RI/FS for an industrial manufacturing facility. Related tasks included the design and implementation of geologic/hydrogeologic assessments for chlorinated solvent contamination in soils and groundwater. Investigation included monitor well installations, soil vapor extraction, borehole and surface geophysics, and a constant rate aquifer pump test, with subsequent data reduction and interpretation and RI report generation. Project management duties included community relations, maintaining data quality objectives, scheduling, waste disposal, and meeting Administrative Order Requirements.

- Supervised and directed remedial investigations (RI) per CERCLA requirements at multiple NPL sites, Region 3, Region 4, Region 5 and Region 6. Investigations included, but were not limited to, soil analyses, monitor and recovery well installation, sampling and analyses of groundwater, aquifer tests, borehole geophysics, surface geophysics and data interpretation, including preparation and presentation of assessment reports.

CERTIFICATE OF ATTENDANCE

HAZARDOUS WASTE FIELD INVESTIGATION HEALTH AND SAFETY TRAINING

PAUL V. STODDARD

JUNE 22 - 25, 1987

Instructor

EnSafe®
Environmental and Safety Designs, Inc.

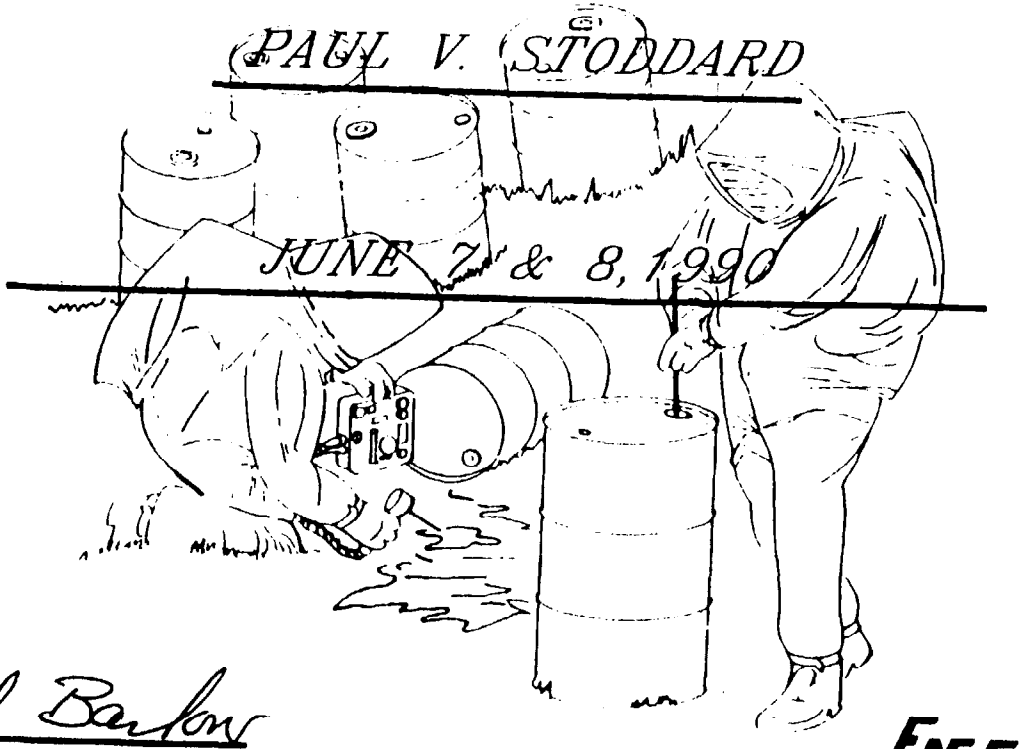
CERTIFICATE OF ATTENDANCE

HAZARDOUS WASTE FIELD INVESTIGATION HEALTH AND SAFETY TRAINING

8 HOUR REFRESHER COURSE

PAUL V. STODDARD

JUNE 7 & 8, 1990



Richard Barlow
Instructor
Richard Barlow

EnSafe®
Environmental and Safety Designs, Inc.

JOSEPH R. MATTHEWS,
GEOLOGIST

EDUCATION: M.S., Geology, Memphis State University/1989
B.S., Geology, University of Tennessee at Chattanooga/1985

CERTIFICATION: Registered Professional Geologist TN1112

EXPERIENCE:

- **Project Coordinator** overseeing the remedial response action at a PCB spill site in Akron, Ohio. Activities included removal of PCB-contaminated soils, removal of oil-cooled capacitors containing PCB dielectric fluids and removal and decontamination of PCB contaminated concrete floors and walls.

- **Project Manager/Geologist** developed RCRA Facility Investigations and directed field operations at Naval facilities. Investigated shallow subsurface and shallow aquifer systems to define contaminant migratory pathways and evaluate health risks. Data used to determine the proper worker protection for the demolition of a pesticide-contaminated storage facility.

- **Project Manager** developed and implemented UST closures in compliance with local, state and federal (RCRA) laws and regulations. Conducted assessments of leaking UST sites and completed corrective actions for petroleum hydrocarbon contaminated soil and groundwater systems. Completed UST-related projects in Tennessee, Mississippi, Missouri, Alabama, Indiana, and Kentucky.

- **Field Coordinator** on hazardous materials abatement sites: monitoring health and safety compliance, consulting, and assuring regulatory (OSHA) compliance.

- **Geologist** conducted and designed state and private industry site investigations: assessing geohydrologic conditions, determined nature and extent of site contamination, dealt with organo-pesticides, chlorinated hydrocarbons, non-halogenated

hydrocarbons, chlorides, cyanides and polychlorinated biphenyls.

- **Geologist** supervised drilling operations, installed monitoring wells, monitored health and safety compliance, and collected soil and groundwater samples following CLP protocol for a Remedial Investigation at a NPL site.

- **Geologist** investigating a proposed hazardous waste incinerator site: characterized stratigraphy, geologic structure and geohydrologic conditions.

- **Assistant Geologist** for a long-term groundwater monitoring program at a Tennessee State Superfund site: quarterly sampling of over 40 wells under CLP protocol, collected and reduced groundwater and prepared piezometric maps and geologic cross-section delineating the distribution of a chlorinated hydrocarbon plume in a multiple aquifer system.

- **Investigator** conducting Phase I environmental site assessments and environmental compliance audits consistent with the "due diligence" clause of CERCLA. Reviewed facility operation for compliance with local, state and federal environmental laws and regulations. Identified potential environmental compliance problems and estimated cost for corrective action. Conducted audits in close cooperation with investors, legal counsel, and lending institutions and their attorneys. Designed and conducted Phase II audit investigations where subsurface and groundwater contamination was indicated.

- **Project Assistant** prepared revisions of a Part B permit for the treatment of a "K" listed waste at a Open Burning/Open Detonation facility.

CERTIFICATE OF ATTENDANCE

HAZARDOUS WASTE FIELD INVESTIGATION HEALTH AND SAFETY TRAINING

8 HOUR REFRESHER COURSE

JOSEPH MATTHEWS

JUNE 7 & 8, 1990

Richard Barlow

Instructor

Richard Barlow

EnSafe®

Environmental and Safety Designs, Inc.

GERAGHTY & MILLER, INC.
Ground-Water Services

Certificate of Completion

Presented To

Joseph R. Matthews

July 17-21, 1989

In Recognition of Having Successfully Completed
the Prescribed Course of Study for
Hazardous Waste Site Activities
40-Hour Initial
Health and Safety Training

Andrew J. Barber
Corporate Safety Manager
Geraghty & Miller, Inc.

Kevin J. Donaly
Regional Health and Safety Manager
Geraghty & Miller, Inc.

RICHARD C. BARLOW,
CHEMICAL ENGINEER/INDUSTRIAL HYGIENIST

EDUCATION: M.S. Chemical Engineering, University of Maryland/1979
B.S. Engineering, U.S. Coast Guard Academy/1969

EXPERIENCE:

- Developed a health and safety plan, as prescribed by 29 CFR 1910.120, for an EPA National Priorities Listed underground storage area's emergency remedial action plan, remediation investigation, and feasibility study .

- Developed a health and safety plan, as prescribed by 29 CFR 1910.120, for an EPA National Priorities Listed pesticide facility's remediation investigation and feasibility study.

- Developed a health and safety plan, as prescribed by 29 CFR 1910.120, for an EPA National Priorities Listed landfill's remediation investigation and feasibility study.

- Developed numerous additional health and safety plans for underground tank removals, pesticide facility investigations, landfill studies, and plating shop remedial actions for both private industry and the U.S. Navy.

- Developed a respiratory protection program for a small company that meets the requirements of 29 CFR 1910.134.

- Experienced in developing personal protection programs for all phases of hazardous waste cleanup activities.

- Developed Oil and Hazardous Substance Spill Contingency plans for the Navy.

- Experienced in confined space entry techniques. Has received training as a "Competent Person" for gathering and evaluating data for confined space entry.

- Trained personnel in confined space entry techniques and exposure hazard recognition.

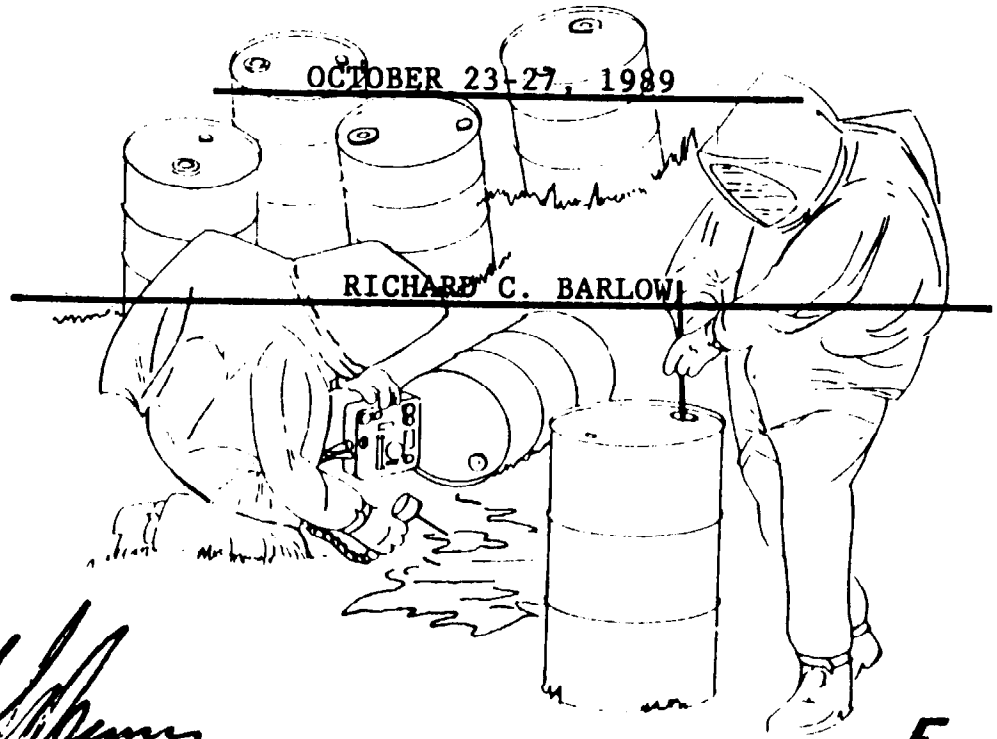
- Administered an inspection program which involved evaluation of exposure personnel to atmospheres that were toxic, oxygen deficient and/or flammable.

CERTIFICATE OF ATTENDANCE

HAZARDOUS WASTE FIELD INVESTIGATION HEALTH AND SAFETY TRAINING

OCTOBER 23-27, 1989

RICHARD C. BARLOW



Instructor

EnSafe®

Environmental and Safety Designs, Inc.

The Center for Professional Advancement

Be it known that

RICHARD BARLOW

has satisfactorily completed the intensive short course

INDUSTRIAL TOXICOLOGY

and in testimony thereof is awarded this

Certificate

In witness whereof I affix my signature this 23rd *day of* OCTOBER, 1986

Continuing Education Units: 2.4

Saul Gordon

Saul Gordon, Ph.D. President

Theodore Ellison

DR THEODORE ELLISON Course Director

JOHN H. BOROWSKI, C.I.H.
INDUSTRIAL HYGIENIST

EDUCATION:

B.S. Biochemistry, Northern Michigan University/1984

CERTIFICATIONS:

Certified Industrial Hygienist, American Board of Industrial Hygiene, Certification # 5098.
EPA/California Certified Asbestos Building Inspector/Management Planner,1991
EPA/California Certified Asbestos Practices and Procedures, 1991

EXPERIENCE:

- Assisted in the development of health and safety plans prescribed in 29 CFR 1910.120 for both the Navy and private industry cleanup projects.

- Developed procedures for the sampling, handling, and disposal of PCB contaminated dielectric fluid from non-operating capacitors and transformers for military and private concerns.

- Developed and enforced respiratory protection programs for clients and contractors performing asbestos and lead remediation to ensure compliance with the requirements of 29 CFR 1910.134.

- Assisted in development of personal protection programs for all phases of hazardous waste cleanup activities.

- Performed perimeter high volume air monitoring for VOC, PM10, Metals, and PBB emissions generated by installation of a slurry wall and capping of a hazardous waste landfill.

- Performed personal and area industrial hygiene sampling to determine worker exposure to toxins including; asbestos, lead, metal dusts, CO, CO_2, PBB, PCB, formaldehyde, bioaerosols, and various organic and inorganic acids.

- Performed source sampling of power plant and paint spray booth air emissions.

APPENDIX B

MEDICAL MONITORING PROGRAM

&

SAFETY TRAINING AND EDUCATION

MEDICAL MONITORING PROGRAM

All of The Joint Venture personnel who enter hazardous waste/spill sites or have the potential for exposure to hazardous materials from these sites must participate in the Joint Venture Medical Monitoring Program. The program is conducted by The Joint Venture's Company doctor in liaison with the Company Health and Safety Officer. The purpose of the program is to identify any preexisting illnesses or problems that would put an employee at unusual risk from certain exposures or respirators, and to monitor and evaluate exposure-related events where workers are involved in handling hazardous materials. Project managers should consult with the Health and Safety Officer and/or the company doctor concerning the scope of work and known or anticipated chemical hazards associated with each project. The Joint Venture maintains the right to exclude certain individuals from particular jobs based on reports from the company doctor. The program will be reviewed on an annual basis to determine its effectiveness.

The company doctor has been employed as an independent contractor to provide medical monitoring for The Joint Venture. The doctor is responsible for the following aspects of the medical monitoring program:

- Selection and quality assurance of medical and laboratory services involved in carrying out the monitoring program.
- Development of a uniform medical record.
- Record retention.
- Employee notification of examination results.
- Determination of content of the medical and biological monitoring programs.
- Record review and correlation between potential exposure and effect.
- Monitoring job related illness and injury for each employee.

1.0 Preplacement Examinations

Each employee will be given a preplacement examination to identify any preexisting illness or problem that would put the employee at an unusual risk from certain exposures; to assure that each employee can safely use negative pressure respirators; and to develop a data base to assess any exposure related events detected during periodic medical monitoring. Data accumulation will include variables such as age, sex, race, smoking, prior employment history, and other conditions that might bear upon the occurrence of subsequent events once employment begins.

The preplacement examination includes:

- Occupational history including previous chemical and carcinogenic exposures.
- Medical history including demographic data, family history, personal habits, past medical history and a current symptomatic review of systems.
- Fertility history.
- Physical examination, stressing examination of the neurologic, cardiopulmonary, musculoskeletal and dermatological systems.

- Physiological parameters including blood pressure and visual acuity testing.
- Pulmonary function testing including FVC, FEVI and FEV 25-75.
- Electrocardiogram.
- PA and lateral chest X-ray.
- A multi-chemistry panel including tests of kidney and liver function.
- Red blood cell cholinesterase.
- Audiogram.

The history, physiological parameters, X-ray, screening tests and laboratory studies will be done prior to the physical examination. After the physical examination the medical examiner will review the results of the examination and special studies with each employee and facilitate referral for further evaluation of abnormalities detected during this examination. OHS will provide each employee a written summary and detailed results of the examination along with treatment of any job restrictions.

2.0 Periodic and Exit Examinations

An examination and updated occupational history will be repeated on an annual basis. The content of the annual examination includes:

- Updated occupational and medical history
- Physical examination, stressing examination of the neurologic, cardiopulmonary musculoskeletal and dermatological systems
- Pulmonary function testing including FVC, FEVI and FEV 25-75
- Multi-chemistry panel including tests of kidney and liver function
- Urinalysis

The company doctor will review the results of annual examination and exposure data, and request further tests or issue medical clearances as appropriate. An examination will also be done when an employee terminates. The company doctor will be consulted for the contents of the exam. The exception to this is when the terminating employee has had an exam within six months or when there has been no site work since the time of the last examination.

3.0 Return-to-Work Examinations

After any job-related injury or illness, a medical examination is required to determine fitness for duty or to identify any job restrictions. The medical examiner will review the results of this back-to-work examination with company doctor prior to releasing the employee for work. A similar examination will be performed if an employee has missed at least three days of work due to a non-job-related injury requiring medical attention.

4.0 Biological and Medical Monitoring

Biological and medical monitoring for specific exposures will be done whenever feasible. Such monitoring is important to assess the adequacy of personal protective measures and work practices. After reviewing potential exposures at any one site, the company doctor will determine the content and frequency of a medical and biological monitoring program. The content and frequency might change as further information is acquired concerning specific

environmental exposure levels. The program might include:

- Measurements of specific substances:
  - * blood lead
  - * urine cadmium
  - * blood or urine mercury
  - * serum levels of PCBs, organochlorine compounds, etc.
- Metabolic products:
  - * urine azide-iodide test (carbon disulfide)
  - * urine phenol (benzene)
  - * carboxyhemoglobin (methylene chloride)
- Medical monitoring for specific exposures:
  - * red blood cell cholinesterase (organophosphates)
  - * quantitative urine protein (cadmium and mercury)
  - * reticulocyte count and platelet count (benzene)
  - * thyrozine (dinitrophenol/pentachlorophenol)
- Focused history and examinations such as:
  - * neurologic examination (organophosphates, carbon disulfide)
  - * psychological testing (carbon disulfide, mercury)
  - * skin examination (PCBs, dioxins)

These tests may be performed before and after site work, periodically during site work and after any specific identifiable spill where excessive exposure might have occurred.

5.0 Confidentiality

Medical records will be maintained in a confidential manner so that only authorized persons will have access to the records. These will include medical staff of The Joint Venture or contracted medical personnel, the individual, the individual's personal physician or the individual's designated representative. Upon request, the individual may obtain a copy of the medical file. This will be provided within 15 days of the receipt of the written request. Information used for research, testing, statistical, or epidemiologic purposes will have all identifying data removed, including the identity of the individual. Any medical information or findings obtained which do not affect the individual's job performance will not be made available to The Joint Venture. This is to maintain the patient-physician confidentiality. Upon death, retirement, resignation, or other termination of services, the records will be retained by The Joint Venture or contracting physician.

6.0 Safety Training and Education Program

Consistent with OSHA's 29 CFR 1910.120 regulation covering Hazardous Waste Operations and Emergency Response, all site personnel are required to be trained in accordance with the standard. At a minimum, all personnel are required to be trained to recognize the hazards on-site, the provisions of the Health and Safety Plan, and the responsible personnel.

Prior to arrival on-site, each employee will be responsible for certifying that his/her employees meet the requirements of preassignment training. Consistent with OSHA 29 CFR

1910.120(e)(3), each employee is to provide a document certifying dates of 24 hours of "training for workers occasionally on-site," or 40 hours of training for "general site workers." Personnel must receive eight hours of annual refresher training.

Consistent with OSHA 29 CFR 1910.120(e)(8), individuals designated as site supervisors require an additional eight hours of training.

6.0.1 Initial Training

A. Safety Orientation
   1) Administration
      a) policies
      b) programs - respiratory, training, medical monitoring
      c) right-to-know
   2) Work Organization and Control
      a) work zones
      b) site operations
      c) site security and access

B. Chemical and Physical Hazards
   1) Toxicity - routes of exposure
   2) Chemical hazard classes
   3) Mechanical hazards
   4) Heat stress
   5) Fire and Explosion Hazards
   6) Radiation

C. Respiratory Protection
   1) Types of equipment; Level of Protection
   2) TLVs; PELs; protection factors
   3) Selection
   4) Practice use (and fit-testing); maintenance
   5) Cascade system (optional)

D. **Protective Clothing**
   1) **Types of equipment; Levels of Protection**
   2) **Permeation; breakthrough**
   3) **Selection**
   4) **Practice use; maintenance**

E. **Decontamination Procedures**
   1) **Rationale**
   2) **Procedures**
   3) **Selection**

F. **Ambient Monitoring**
   1) **Rationale**
   2) **Types of equipment**
   3) **Guidelines for exposures**
   4) **Practice use of equipment**

G. **Sampling (optional)**
   1) **Procedures and equipment**
   2) **Shipping/Packaging/Manifesting**

H. **Safety Planning and Procedures**
   1) **General measures**
   2) **Site safety considerations**
   3) **Selection of protective and monitoring equipment (optional)**
   4) **Safety Plan development (optional)**

I. **First aid/CPR (at least one individual on site)**

6.0.2 Annual Review Training

A. Respiratory Protection
   1) Selection
   2) Practice use (and fit-testing)

B. Protective Clothing
   1) Selection
   2) Practice Use

C. Decontamination Procedures

D. Ambient Monitoring

E. First Aid/CPR (as needed)
   1) Maintain current certification
   2) Heat stress

F. Review specific jobs and discuss problems encountered and improvements needed.

Records will be kept of all health and safety training and copies provided to the health and safety officer upon request. Audits will be conducted at least annually by the health and safety officer to evaluate the program's effectiveness.