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BACKGROUND SOIL SAMPLING WORK PLAN PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE

Prepared for:

UNITED STATES NAVY
NAVAL FACILITIES ENGINEERING COMMAND
PHILADELPHIA, PENNSYLVANIA

Prepared by:

MCLAREN/HART ENVIRONMENTAL ENGINEERING CORPORATION
28 MADISON AVENUE EXTENSION
ALBANY, NEW YORK 12203

August 5, 1993

ENVIRONMENTAL AFFAIRS

PORTSMOUTH NAVAL SHIPYARD

BACKGROUND SOIL SAMPLING
WORK PLAN
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

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1.0 INTRODUCTION

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Background Soil Sampling Work Plan for the Portsmouth Naval Shipyard (PNS), Kittery, Maine, has been prepared in response to the Hazardous and Solid Waste Amendments of 1984 (HSWA) Permit issued by the United States Environmental Protection Agency (USEPA). The HSWA permit was prepared after a RCRA Facility Assessment (RFA) of the PNS was conducted by the USEPA at the facility.

The primary objective of the RFI was to characterize the nature and extent of potential releases of hazardous substances from thirteen (13) Solid Waste Management Units (SWMUs) identified in the HSWA permit. An attempt was made to identify hazardous substances in soil, sediment, groundwater, and air and assess potential risks imposed to human health or the environment. Background soil samples are necessary to establish comparative information for contaminant levels measured in soils collected from SWMUs during the RFI. This information will be used to support development of the media protection standards for soils.

1.1 Site Location and Description

Situated within the town limits of Kittery, Maine, the PNS is composed of four islands located in the Piscataqua River. The Piscataqua River is a tidal estuary which forms the southern boundary between New Hampshire and Maine.

The PNS is engaged in the conversion, overhaul, and repair of submarines for the U.S. Navy. The PNS has a long history dating back to 1690 when the first warship launched in North America, the *Falkland*, was built. The PNS was first established as a government facility in 1800. The PNS served as a repair and building facility for ships during the Civil War. The first government-built submarine was designed and built at the PNS during World War I and a large number of submarines were designed and constructed at the PNS from 1917 to the present. The PNS has continued servicing submarines to this day.

As the workload at the PNS expanded, fill material was used to create made-land adjacent to the original islands. Today the PNS is composed of 376 buildings on 278 acres of continuous land surface that extends between three of the original four islands. Much of the PNS is built on fill overlying former tidal flats as shown in Figure 1-1.

1.2 Physical Setting

The PNS is located in the Piscataqua River immediately south of the town of Kittery, Maine. The location of the PNS is shown in Figure 1-2. The PNS is built on an area comprising Dennett's, Seaveys, Jamaica, and Clark's Islands, as well as made-land between

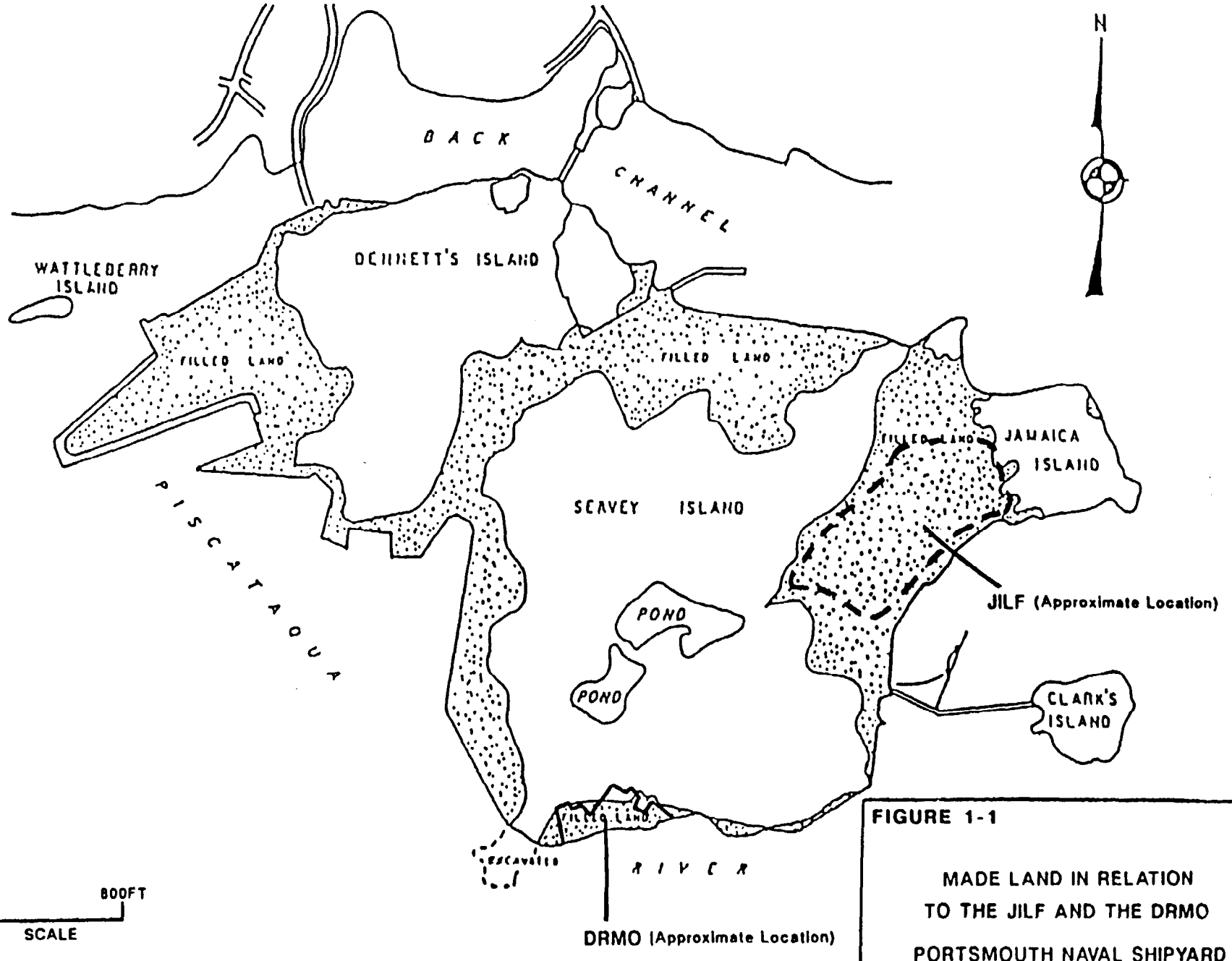

FIGURE 1-1

MADE LAND IN RELATION TO THE JILF AND THE DRMO

PORTSMOUTH NAVAL SHIPYARD

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FROM: USGS TOPOGRAPHIC 7.5MIN MAP SERIES;PORTSMOUTH QUADRANGLE, N.H.&ME. AND KITTERY QUADRANGLE, ME.&N.H.
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QUADRANGLE LOCATION

QUADRANGLE LOCATION

FIGURE 1-2

LOCATION MAP OF PORTSMOUTH NAVAL SHIPYARD

MCLAREN/HART

these islands. Approximate elevations on-site range from sea level to a maximum of sixty feet. Two-thirds of the site is high-density industrial area containing 376 buildings, while the remaining areas are flat-lying to gently sloping grass-covered fields. Minor wooded areas exist on the east side of Jamaica Island.

Surface soil on-site consists of a sandy fill material, presumably derived from local sources on the mainland, and natural deposits consisting of silt and clay rich till.

2.0 BACKGROUND SOIL SAMPLING PLAN

2.1 Introduction

The background soil sampling plan for the Portsmouth Naval Shipyard (PNS) involves a systematic sampling program. The objective is to evaluate the concentration of Target Compound List (TCL) organics and Target Analyte List (TAL) inorganics in background soil samples to characterize the chemical constituents in these soils and compare the concentration of organic and inorganic constituents in background soils to the concentrations found in soils from SWMU areas.

Selection of a truly representative background soil sample at the PNS is difficult because of the widespread use of fill to develop the PNS and numerous industrial facilities scattered throughout the island(s). The natural till on the island(s) may not have the same mineral composition or physical characteristics as the fill used to connect the islands.

An attempt will be made to collect sixteen (16) surface soil samples (to a depth of approximately one foot below grade) from areas on the islands that have no history of PNS industrial activity or waste disposal. The soil sample locations will be determined through discussions with the Navy and will be marked out by both a McLaren/Hart and a Navy representative prior to sampling. The samples will be collected from indigenous soil areas. Soil samples will be analyzed for TCL organics and TAL inorganics.

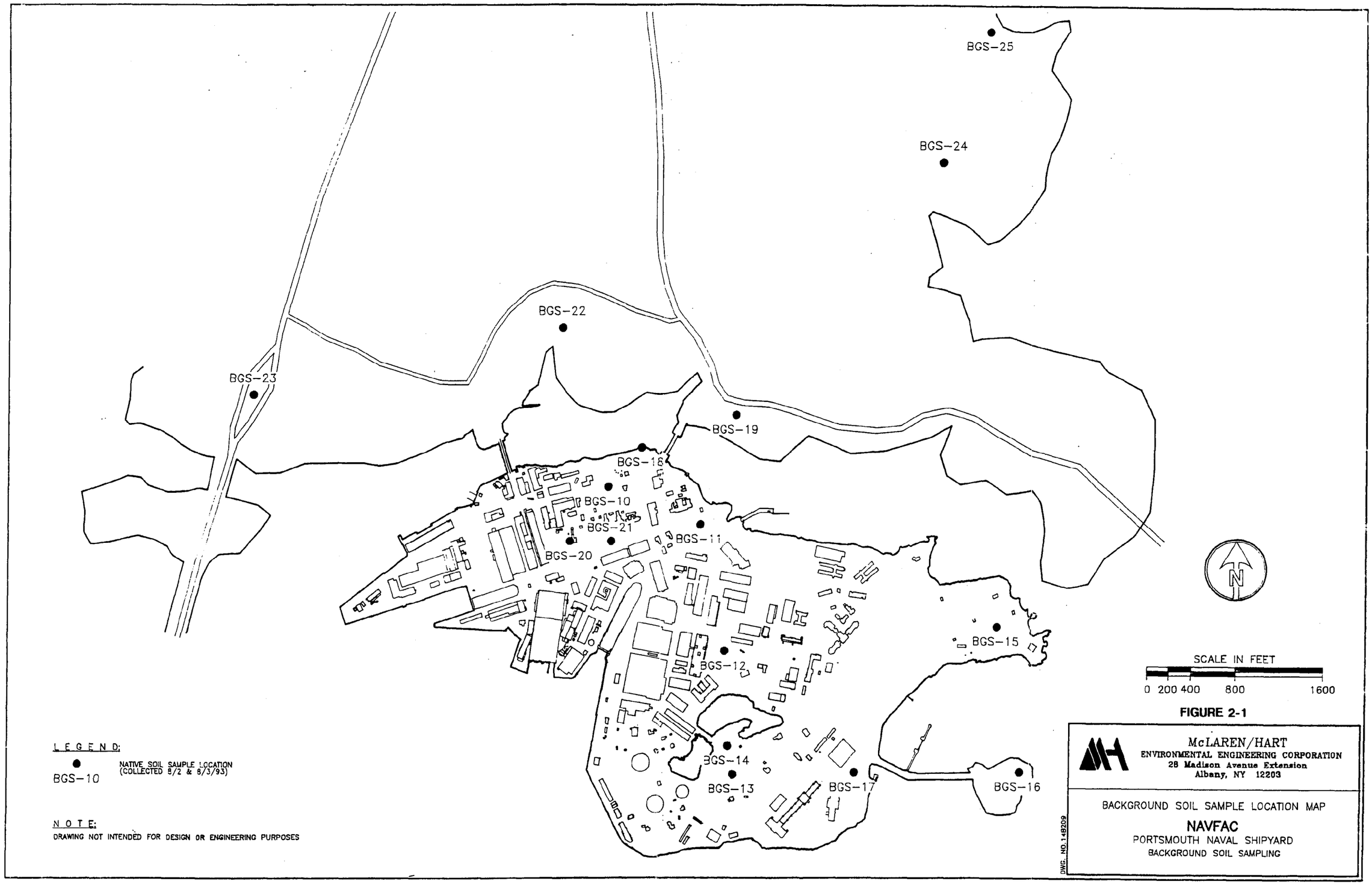
2.2 Sampling Locations

A total of five (5) locations have been proposed off-site and eleven (11) locations on-site for the collection of background soil samples. The proposed sample locations are shown in Figure 2-1. These locations were chosen to evaluate both on-site and nearby mainland soil concentrations. Specific sample locations will be determined in the field by both a McLaren/Hart and a Navy representative prior to sampling.

2.3 Field Supplies/Equipment

For the efficient implementation of the background soil sampling plan, field supplies/equipment shall include but may not be limited to the following:

- stainless steel trowels
- stainless steel mixing bowls
- hand bucket auger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BGS-24
BGS-22
BGS-23
BGS-19
BGS-18
BGS-10
BGS-21
BGS-11
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BGS-15
BGS-12
BGS-14
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BGS-17
BGS-16
N
SCALE IN FEET
0 200 400 800 1600
LEGEND:
BGS-10
NATIVE SOIL SAMPLE LOCATION (COLLECTED 8/2 & 8/3/93)
NOTE:
DRAWING NOT INTENDED FOR DESIGN OR ENGINEERING PURPOSES
McLAREN/HART
ENVIRONMENTAL ENGINEERING CORPORATION
28 Madison Avenue Extension
Albany, NY 12203
BACKGROUND SOIL SAMPLE LOCATION MAP
NAVFAC
PORTSMOUTH NAVAL SHIPYARD
BACKGROUND SOIL SAMPLING
DWG. NO. 148209

FIGURE 2-1

- laboratory prepared sample bottles
- scrub brushes
- buckets
- plastic wash buckets
- soap (Alconox)
- nitric acid
- methanol
- distilled water
- spray bottles
- appropriate protective clothing
- 200' measuring tape
- orange flag markers
- coolers
- aluminum foil
- labels
- field notebook

2.4 Sampling Methodology

All background soil sampling, at any given location, will include a composite sample from 0 - 12 inches or until refusal, whichever comes first. Soil samples shall be obtained using a properly decontaminated hand bucket auger, stainless steel trowel, and stainless steel mixing bowl. Decontamination methodologies are detailed in the following section. Each sample shall be placed in a stainless steel mixing bowl, homogenized and transferred to the appropriate laboratory prepared sample bottle. McLaren/Hart will not composite samples subject to volatile compound analyses. Samples shall be sent to a CLP-approved laboratory, for analyses.

Should it be impossible to obtain a soil sample at any of the proposed locations due to unforseen surficial obstructions (i.e., bedrock outcrops, concrete surfaces, etc.), a sample shall be obtained at a location in closest proximity to the original proposed location. The new location shall be measured and noted for subsequent plotting on the sample location map. Duplicate background soil samples will also be collected to allow McLaren/Hart's chemist to monitor laboratory performance. The number of duplicate samples is specified in the Quality Assurance Project Plan (QAPP). When soil samples are being collected for duplicate analysis, the sample will be homogenized in a stainless steel mixing bowl and equal portions will be placed into two sets of laboratory-supplied sample containers. One set of sample containers will be given the sample identifier indicative of the sample location and the second set of sample containers will be given a false sample identifier to disguise the identity of the replicate sample. Actual sample identifiers for duplicate samples will be noted in the field logbook.

2.5 Decontamination Methodology

In order to prevent cross-contamination of samples and sampling locations, all sampling equipment shall be decontaminated prior to and after each use as specified herein. The decontamination procedures shall be as follows:

1. Wash equipment using phosphate-free, laboratory grade detergent (Alconox or equivalent) and potable water.

2. Rinse thoroughly with potable water.

3. Rinse with 10% nitric acid for everything except carbon steel (1% nitric acid for carbon steel) followed by another potable water rinse.

4. Rinse with distilled or deionized water.

5. Applicable only when sampling for organic compounds:

    a. Rinse with pesticide grade solvent (Isopropanol is recommended; however, methanol is acceptable).

    b. Allow to air dry (when possible oven dry at 105°C for at least one (1) hour).

6. Wrap in aluminum foil if not ready for immediate use.

Note: This procedure modifies the decontamination outline found in Quality Control in Remedial Site Investigations (Perket, 1986).

All decontamination liquids will be collected and containerized during the investigation, stored and later disposed of at an EPA-approved facility. If not used immediately, all sampling equipment shall be wrapped in clean aluminum foil and stored in a clean, dry place until needed for sampling.

To provide a means to assess decontamination procedures employed for sampling equipment, one rinseate blank will be collected during the background soil sampling program. The rinseate blank will be collected by pouring laboratory-supplied pure water over decontaminated sampling augers, trowels and mixing bowls and allowing the water to run directly into a laboratory-supplied sample bottle. All information relevant to the collection of the rinseate blank will be noted in the field log book. The rinseate blank will be denoted by the letters "RB".

2.6 Soils Analyses

Samples obtained during the background soil sampling program shall be sent to a CLP-approved laboratory for chemical analyses. All soil samples will be analyzed for TCL organics and TAL inorganics. Five (5) locations have been proposed off-site and eleven (11) locations have been proposed on-site for the collection of background soil samples. McLaren/Hart will not composite samples subject to volatile compound analysis. All analyses will be conducted in accordance with CLP protocols and applicable Standard Operating Procedures (SOPs). Analytical parameters were selected for consistency to previous background soil sampling events.

2.7 Sample Preservation, Packaging and Shipment

Details for sample preservation, packaging and shipment are provided in the QAPP (Attachment A).

2.8 Sample Documentation

Sample documentation, labeling and chain-of-custody procedures are detailed in the QAPP (Attachment A).

3.0 DATA COLLECTION AND QUALITY ASSURANCE PLAN

The Quality Assurance Project Plan (QAPP) is provided as Attachment A to this work plan. The QAPP presents the organization, objectives, functional activities, and specific Quality Assurance (QA) and Quality Control (QC) activities associated with the background soil sampling program for the PNS. This plan has described procedures such that the precision, accuracy, completeness, representativeness, comparability, and all other QA/QC objectives of the collected data are known and documented.

4.0 HEALTH AND SAFETY PLAN

A Health and Safety Plan is provided as Attachment B to this work plan. The Health and Safety Plan has been prepared to address hazards that the investigative activities may present to the investigating team and to the surrounding community. The responsibilities of the personnel, protective equipment, procedures, and protocols are addressed in the plan. The Health and Safety Plan also identifies potential problems or hazards that may be encountered and possible solutions, as well as procedures for protecting third parties.

5.0 PROJECT MANAGEMENT PLAN

5.1 Report Preparation

Validated analytical results obtained from this background soil sampling program will be incorporated into the Media Protection Standards (MPS) Proposal. The MPS Proposal will establish cleanup levels for potential hazardous substances.

5.2 Project Organization

The following section describes the project organization for the PNS Background Soil Sampling Program in Kittery, Maine. Figure 5-1 shows the project organization.

5.2.1 Project Management

The following McLaren/Hart Personnel have been designated as team members for this project:

Name	Responsibility
Stephen F. Urschel	Project Director
Harold Hatfield	Project Manager
Henry Robinson	Project Safety Director
Donald Anné	Quality Assurance Officer
Kristen Sayers	Media Protection Standards Evaluation
Michael D'Eufemia	Field Team Leader
Michael D'Eufemia	Site Safety Officer
Charles Kavanaugh	Project Geologist

Subcontractor	Service
CEIMIC Corporation	Laboratory
E. Mahoney Associates, Inc.	Media Protection Standards Report

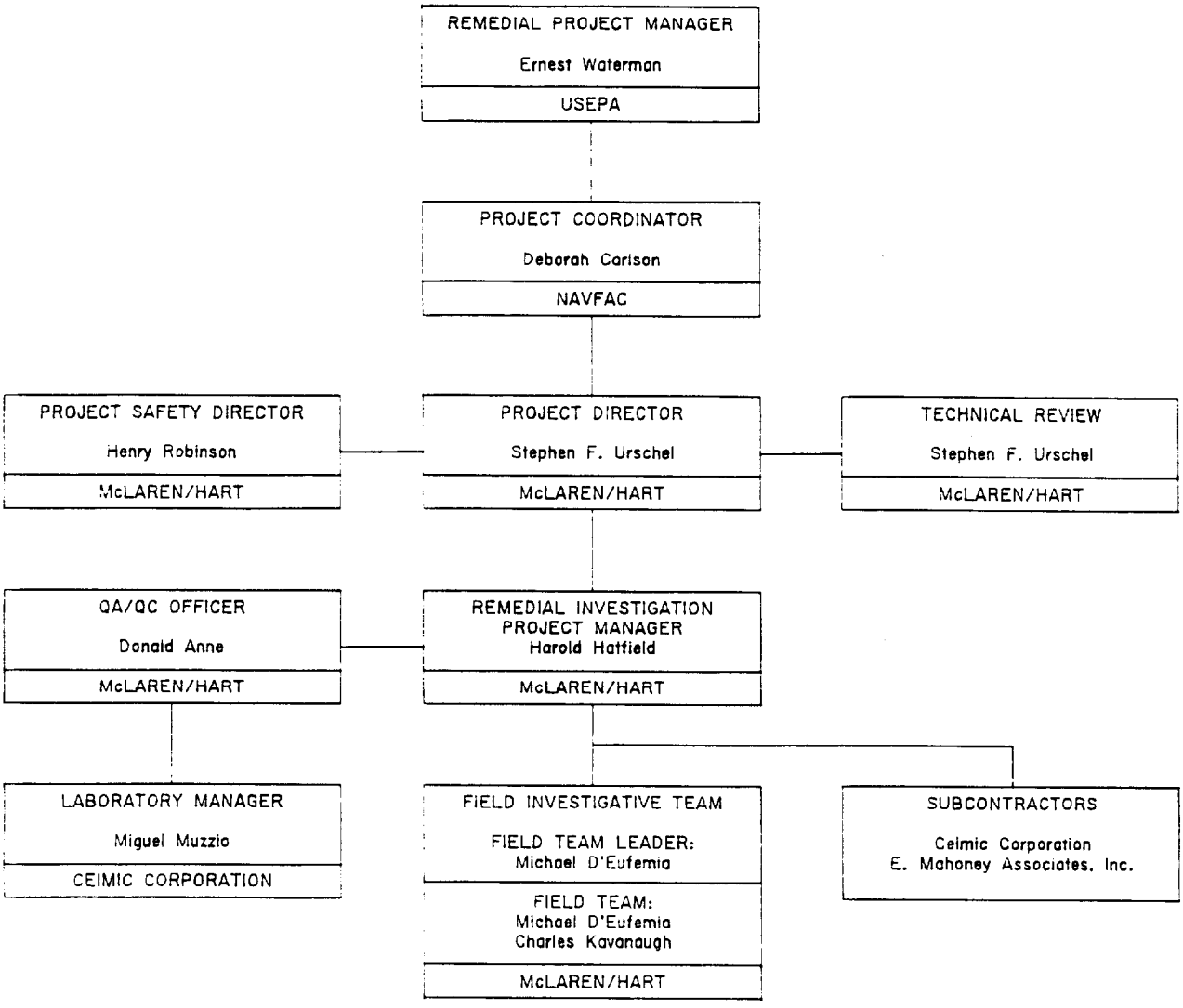

FIGURE 5-1

McLAREN/HART
ENVIRONMENTAL ENGINEERING CORPORATION
28 Madison Avenue Extension
Albany, NY 12203

PROJECT ORGANIZATION

NAVFAC

PORTSMOUTH NAVAL SHIPYARD
BACKGROUND SOIL SAMPLING

DWG NO. 14A208

6.0 REFERENCES

Duxbury, Alyn C., 1971, The Earth and Its Oceans, University of Washington, 244p.

Perket, Cary L. (ed), May 1986, Quality Control in Remedial Site Investigations: Hazardous and Industrial Solid Waste Testing, ASTM-STP 925, Fifth Volume, p.37-38.

Strahler, Arthur N., 1971, The Earth Sciences, Second Edition, Columbia University, 689p.

Attachment A

Quality Assurance Project Plan

ATTACHMENT A
QUALITY ASSURANCE PROJECT PLAN
FOR THE
BACKGROUND SOIL SAMPLING PROGRAM
AT THE
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

PREPARED FOR :

UNITED STATES NAVY
NAVAL FACILITIES ENGINEERING COMMAND
PHILADELPHIA, PENNSYLVANIA

PREPARED BY:

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ORIGINAL: AUGUST 5, 1993

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SECTION 1.0: PROJECT DESCRIPTION

INTRODUCTION

Any organization generating data has the responsibility to implement minimum procedures to assure that the precision, accuracy, completeness, representativeness and comparability of its data, are known and documented. To ensure that this responsibility is met uniformly, the Environmental Protection Agency (EPA) requires a written Quality Assurance Project Plan (QAPP) for each of its projects.

The QAPP herein presents the organization, objectives, activities, and specific Quality Control (QC) measures associated with the Background Soil Sampling Program for the Portsmouth Naval Shipyard, Kittery, Maine. This QAPP, in concert with the Background Soil Sampling Work Plan, is designed to achieve the data quality objectives of this project.

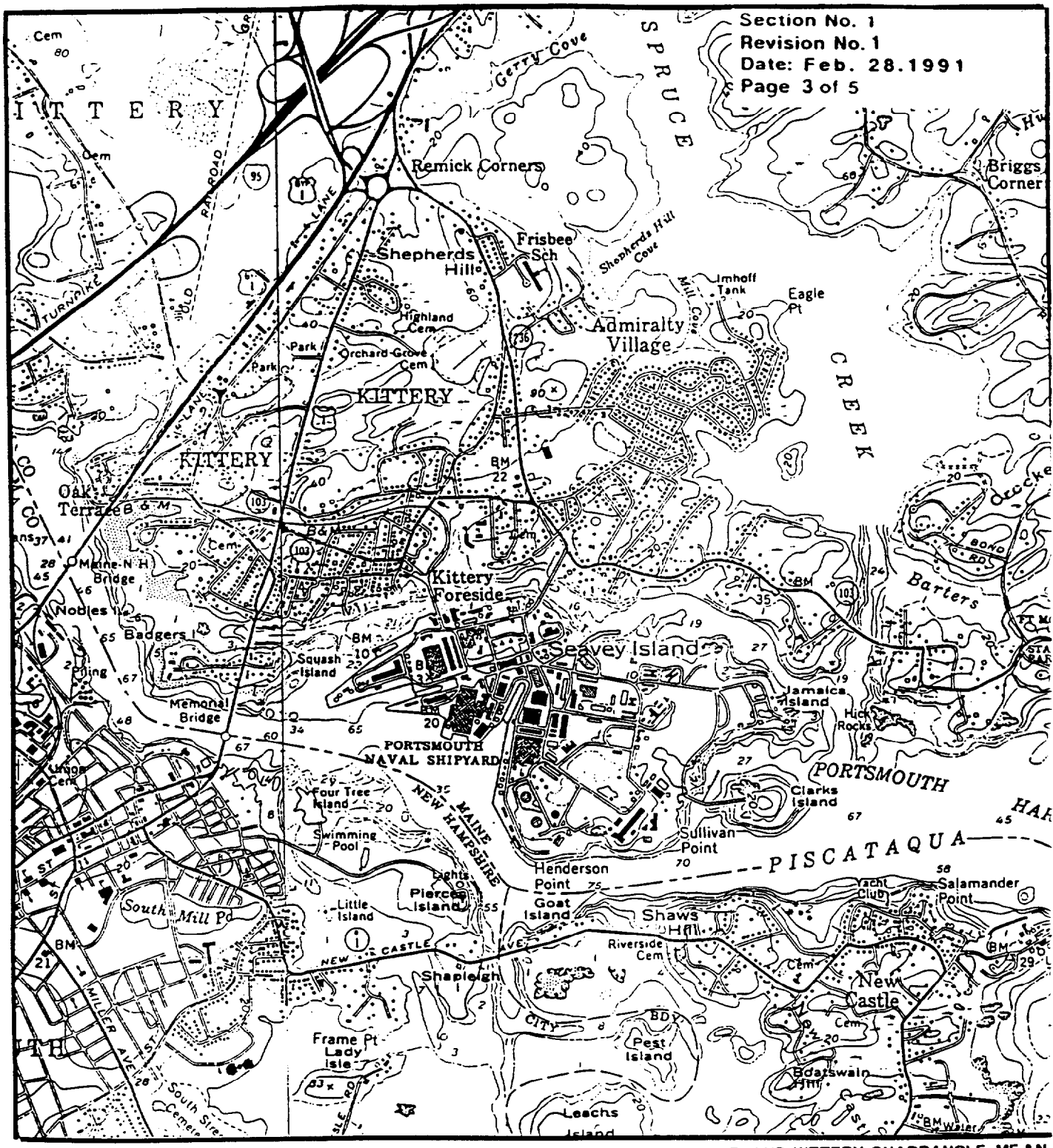
PROJECT OBJECTIVE

The primary objective of the Background Soil Sampling Program is to assess the extent of TCL Organics and TAL Inorganics in background soil samples to allow for the characterization and estimation of the extent and concentration of inorganic and organic constituents in background soils. Background soil samples are necessary to establish comparative information to contaminant levels in soils collected during the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). During the RFI, if hazardous substances were identified in soil, sediment, or groundwater, it was necessary to assess the risk imposed to human health or the environment. Background soil sampling will further aid in the assessment of these risks.

SITE DESCRIPTION

The Portsmouth Naval Shipyard is located on Seavey's Island in the Piscataqua River immediately south of the town of Kittery, Maine. The location of the shipyard is shown in Figure 1-1. The shipyard is built on an area comprising Dennett's, Seavey's, Jamaica, and Clark's Islands, as well as made-land between these islands. Approximate elevations on-site range from sea level to a maximum of sixty feet. Two-thirds of the site is high-density industrial area containing 376 buildings, while the remaining areas are flat-lying to gently sloping grass-covered fields. Minor wooded areas exist on the east side of Jamaica Island.

The islands composing the Portsmouth Naval Shipyard are formed on bedrock highs with thin veneers of glacial till and recent alluvium. Bedrock consists of tectonically deformed middle Ordovician volcanics and the highly fractured metamorphosed sandstones, shales, and siltstone of Silurian age belonging to the Kittery Formation. Metamorphism has destroyed original interparticle porosity in the sedimentary rocks, therefore, groundwater flow is controlled by fractures. Groundwater levels at the Portsmouth Naval Shipyard are probably shallow and are likely controlled by the thickness of glacial till and fill material overlying bedrock or former tidal flat areas. The thickness of the overburden sediment will determine the amount of pore space available to retain fresh water from precipitation and subsequent percolation, thereby determining the extent and volume of the fresh water lens on the island. It is believed that groundwater flow directions on-site vary considerably depending on thickness and composition of overburden, bedrock-overburden contact-surface dip, and tidal influence. Specific flow directions at various locations on-site are unknown at this time.



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QUADRANGLE LOCATION

QUADRANGLE LOCATION

FIGURE 1-1

LOCATION MAP OF PORTSMOUTH NAVAL SHIPYARD

MCLAREN/HART

HISTORY

The shipyard is engaged in the conversion, overhaul, and repair of submarines for the U.S. Navy. The shipyard has a long history dating back to 1690 when the first warship launched in North America, the *Falkland*, was built. The Portsmouth Naval Shipyard was first established as a government facility in 1800. The yard served as a repair and building facility for ships during the Civil War. The first government-built submarine was designed and built at the yard during World War I and a large number of submarines were designed and constructed at the yard from 1917 to the present. The shipyard has continued servicing submarines to this day.

The shipyard is now composed of 376 buildings on 278 acres of land. As the work load at the shipyard expanded, fill material was used to create made-land adjacent to the original islands. Today, continuous land surface extends between three of the original four islands and much of the facility is built on fill overlying former tidal flats as shown in Figure 1-2.

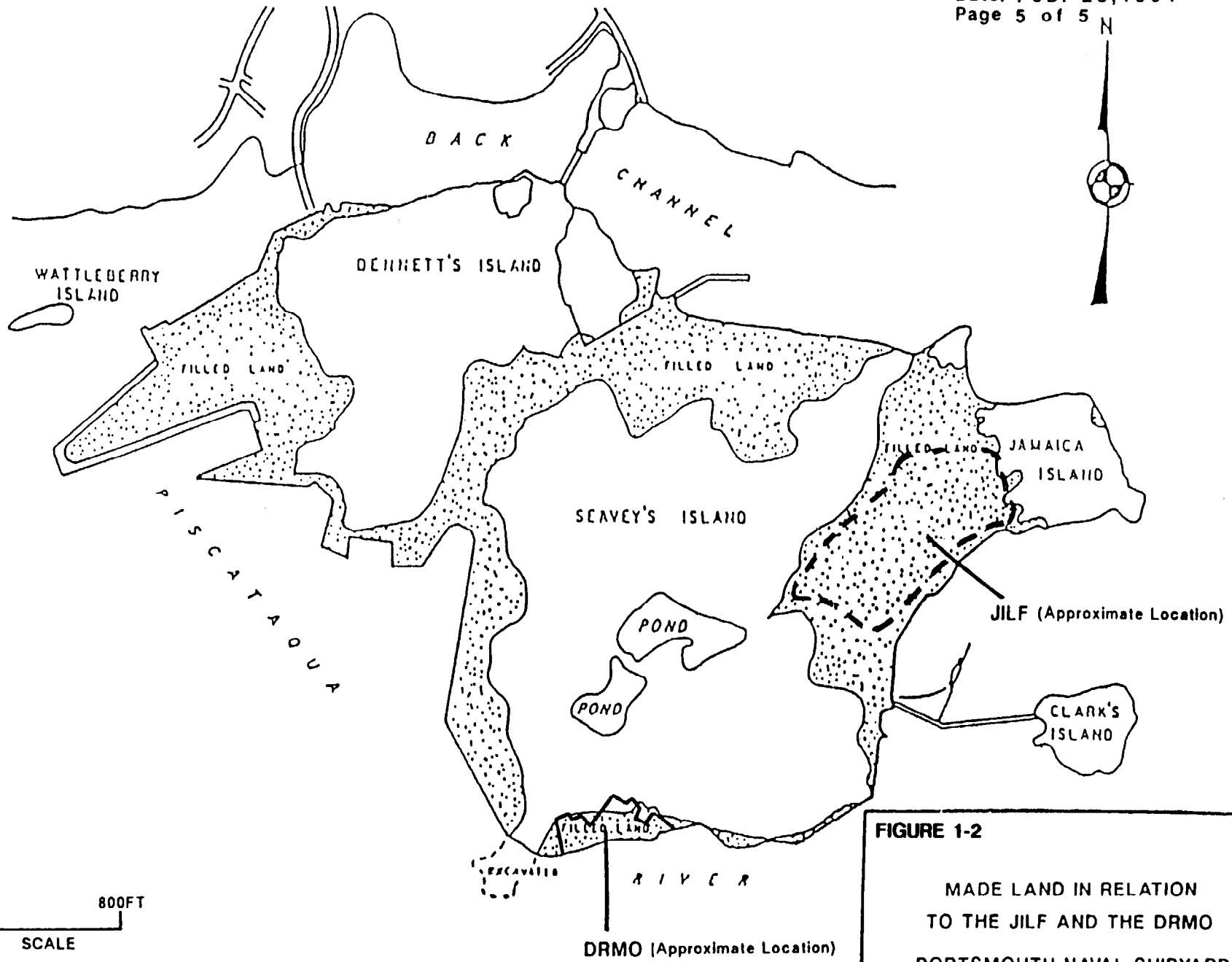

FIGURE 1-2

MADE LAND IN RELATION TO THE JILF AND THE DRMO PORTSMOUTH NAVAL SHIPYARD

MCLAREN/HART

SOURCE: Portsmouth Naval Shipyard Environmental Engineering Department Archives

SECTION 2.0: PROJECT ORGANIZATION AND RESPONSIBILITY

The individuals who are responsible for ensuring the collection of valid measurement data and the routine assessment of measurement systems for precision and accuracy include the project manager, the field team leader, the project and laboratory quality assurance officers and the technical reviewer. Figure 2-1 depicts the project organizational structure and the organizational relationships between the EPA Project Coordinator, NAVFAC's Project Coordinator, McLAREN/HART and its subcontractors. The responsibilities of the McLAREN/HART personnel filling these positions are detailed in the following subsections.

PROJECT DIRECTOR

McLAREN/HART's Project Director will be Stephen F. Urschel. Mr. Urschel will be responsible for coordinating McLAREN/HART's implementation of the elements in the Proposal and for technical quality control. The Project Director will serve as liaison between NAVFAC's Project Coordinator and the ongoing investigation. Additionally, the Project Director will be responsible for participating in meetings with the USEPA or its contractor during the course of the project.

PROJECT MANAGER

McLAREN/HART's Project Manager will be Harold Hatfield. Mr. Hatfield will be responsible for adherence to project schedules; reviewing and assessing the adequacy of the performance of technical staff and subcontractors assigned to the project; maintaining full orderly project documentation; interaction with NAVFAC and EPA during the progress of

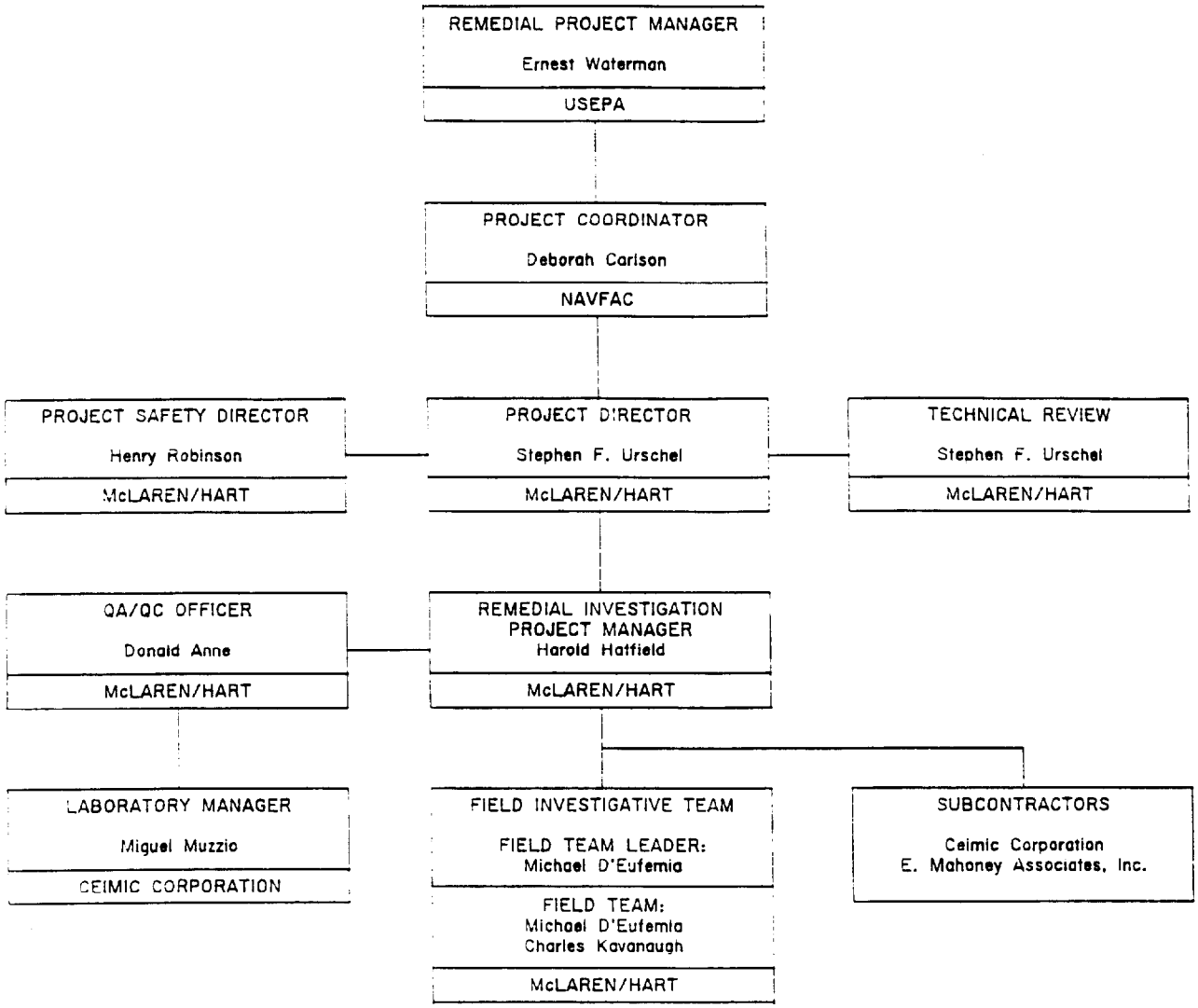

FIGURE 2-1

McLAREN/HART
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PROJECT ORGANIZATION

NAVFAC

PORTSMOUTH NAVAL SHIPYARD
BACKGROUND SOIL SAMPLING

DWG NO. H4208

the project as necessary; and preparing the RFI Proposal. The Project Manager will be responsible for ensuring that EPA personnel and/or EPA authorized representatives are allowed access to the laboratory, records and personnel utilized for analyses of samples collected.

FIELD TEAM LEADER

McLAREN/HART's Field Team Leader will be Michael D'Eufemia. Mr. D'Eufemia will be responsible for coordinating the activities of field personnel; adherence of the field work to project plans; documentation of field work; and management of sampling team and sampling activities from sampling to shipping. The field team leader will also have supervisory authority in the event any components of the Site Safety Contingency Plan have to be implemented.

PROJECT QUALITY ASSURANCE OFFICER

McLAREN/HART's Project Quality Assurance Officer will be Donald Anné. Mr. Anné will be responsible for review of field and laboratory data for compliance with QA objectives (precision, accuracy and completeness criteria) as stated in this QAPP; notification to the project manager of any QC deficiencies; conducting the performance and systems audits on the field team; and performing an independent validation of all analytical data generated by the project laboratory. Based on the time frame of this project (two days), the project quality assurance officer will not conduct a field audit. It will be the Field Team Leader's responsibility to verify that field samplers are correctly following sampling procedures described in the quality assurance and/or sampling plans.

NAVFAC shall report serious QA deficiencies within twenty-four (24) hours of the time NAVFAC became aware of the deficiency.

LABORATORY QUALITY ASSURANCE OFFICER

The selected laboratory for the Background Soil Sampling is Ceimic Corporation (CEIMIC). The Laboratory Quality Assurance Officer will be Fred Kwolek. Mr. Kwolek will be responsible for quality assurance procedures and QA checks in the laboratory and will ensure that laboratory protocols are strictly adhered to. CEIMIC has participated in the Contract Laboratory Program, and has undergone laboratory audits by Martin-Marietta on behalf of the Navy.

QC/SAMPLE TRACKING

The movement of each sample will be tracked from the time the sampling program begins until the final analytical data are assembled in the report. Test result reports and data management reports, including analytical results, quality control data, chain-of-custody, the appropriate chromatograms and spectra and any historical data, will be assembled by computer. Calculations will be given a final check by the laboratory senior analysts and/or laboratory managers. A data validation will be performed by the laboratory data review department.

TECHNICAL REVIEWER

McLAREN/HART's technical reviewer will be Stephen F. Urschel. Mr. Urschel will be responsible for providing review of project documents and reports with respect to technical adequacy and conformance to the scope of work. Documents such as laboratory analytical data and field data will be reviewed.

SECTION 3.0: QA OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, field analysis, and laboratory analysis and reporting, that will provide legally defensible results in a court of law. Specific procedures to be used for sampling, chain-of-custody, calibration, field and laboratory analysis, reporting, internal quality control, preventative maintenance, and corrective actions are described in other sections of this QAPP. The characteristics of major importance to quality measurement data are accuracy, precision, completeness, representativeness and comparability.

Before potential risks imposed to human health or the environment can be evaluated, there must be sufficient information available to develop, screen, and evaluate potential alternatives. The Background Soil Sampling will be performed to gather and assess information needed to accomplish the following:

- Assess and validate the data collected for use in the Media Protection Standards Proposal.
- Establish comparative levels of potential hazardous substances that are naturally occuring to levels observed in soils collected during the RFI.

DATA ACCURACY AND PRECISION

Accuracy is the degree of agreement of a measurement with an accepted reference or true value and is a measure of bias in a system. Precision is a measure of mutual agreement among individual measurements of the same properties and is best expressed in terms of the standard deviation or relative percent difference (RPD). QA targets for accuracy and precision are stipulated in the "Standard Operating Procedure" (standard procedure) for each analytical parameter and summarized on Table 3-1. The standard procedures for analysis of parameters are discussed in Section 7 of this QAPP, Analytical Procedures.

Accuracy and precision of analytical results can be affected by interferences. Potential interferences can be expected from materials such as paint wastes (metals, phenolics, phthlate esters, solvents), scrap metals, spent batteries (metals, acid), electrical gear (PCBs and oil), oily wastes, degreasing operations (chlorinated solvents, oil) and sand blast grit (same as paint). In addition, the high salt concentration associated with the marine environment will interfere with analyses. These interferences may adversely impact both organic and inorganic analyses by biasing results negatively or positively. The magnitude of the biasing may be larger or smaller depending on the type and extent of interferents.

DATA COMPLETENESS

Due to accessibility problems, the potential exists that less than 100 percent of the samples will be collected. It is expected that the laboratory will provide data meeting QC acceptance criteria for 90 percent or more of all samples analyzed (See Table 3-1). Laboratory data will be reviewed by the laboratory and project QA officer for completeness. Completely valid data are required for samples designated as "background samples". Corrective actions to achieve a complete data set may include any of the following: 1) reanalysis; 2) re-extraction; or 3) resampling.

TABLE 3-1

SUMMARY OF PRECISION, ACCURACY AND COMPLETENESS

Parameter	Matrix	Precision RPD %[1]	Accuracy % of Recovery	Completeness (%)
Inorganic[2]				
Aluminum	water	± 20	75-125	90
	solid	± 35	75-125	90
Antimony	water	± 20	75-125	90
	solid	± 35	75-125	90
Arsenic	water	± 20	75-125	90
	solid	± 35	75-125	90
Barium	water	± 20	75-125	90
	solid	± 35	75-125	90
Beryllium	water	± 20	75-125	90
	solid	± 35	75-125	90
Cadmium	water	± 20	75-125	90
	solid	± 35	75-125	90
Calcium	water	± 20	75-125	90
	solid	± 35	75-125	90
Chromium	water	± 20	75-125	90
	solid	± 35	75-125	90
Cobalt	water	± 20	75-125	90
	solid	± 35	75-125	90
Copper	water	± 20	75-125	90
	solid	± 35	75-125	90
Iron	water	± 20	75-125	90
	solid	± 35	75-125	90
Lead	water	± 20	75-125	90
	solid	± 35	75-125	90
Magnesium	water	± 20	75-125	90
	solid	± 35	75-125	90
Manganese	water	± 20	75-125	90
	solid	± 35	75-125	90
Mercury	water	± 20	75-125	90
	solid	± 35	75-125	90
Nickel	water	± 20	75-125	90
	solid	± 35	75-125	90
Potassium	water	± 20	75-125	90
	solid	± 35	75-125	90
Selenium	water	± 20	75-125	90
	solid	± 35	75-125	90
Silver	water	± 20	75-125	90
	solid	± 35	75-125	90
Sodium	water	± 20	75-125	90
	solid	± 35	75-125	90
Thallium	water	± 20	75-125	90
	solid	± 35	75-125	90

TABLE 3-1 (Continued)

SUMMARY OF PRECISION, ACCURACY AND COMPLETENESS

Parameter	Matrix	Precision RPD % (1)	Accuracy % of Recovery	Completeness (%)
Tin	water	± 20	75-125	90
	solid	± 35	75-125	90
Vanadium	water	± 20	75-125	90
	solid	± 35	75-125	90
Zinc	water	± 20	75-125	90
	solid	± 35	75-125	90
Cyanide	water	± 20	75-125	90
	solid	± 35	75-125	90
Sulfide	water	± 20	75-125	90
	solid	± 35	75-125	90
Organics[3]				
Volatiles				
1,1-Dichloro-	water	± 14	61-145	90
ethene	solid	± 22	59-172	90
Trichloro-	water	± 14	71-120	90
ethene	solid	± 24	62-137	90
Benzene	water	± 11	76-127	90
	solid	± 21	66-142	90
Toluene	water	± 13	76-125	90
	solid	± 21	59-139	90
Chlorobenzene	water	± 13	75-130	90
	solid	± 21	60-133	90
Semi-Volatiles				
Phenol	water	± 42	12-89	90
	solid	± 35	26-90	90
2-Chloro-	water	± 40	27-123	90
phenol	solid	± 50	25-102	90
1,4-Dichloro-	water	± 28	36-97	90
benzene	solid	± 27	28-104	90
N-Nitroso-	water	± 38	41-116	90
di-n-propyl- amine	solid	± 38	41-126	90
1,2,4-trichloro	water	± 28	39-98	90
benzene	solid	± 23	38-107	90
4-Chloro-3-	water	± 42	23-97	90
methylphenol	solid	± 33	26-103	90
Acenaphthene	water	± 31	46-118	90
	solid	± 19	31-137	90
N-Nitrophenol	water	± 50	10-80	90
	solid	± 50	11-114	90
2,4-Dinitro-	water	± 38	24-96	90
phenol	solid	± 47	28-89	90

TABLE 3-1 (Continued)

SUMMARY OF PRECISION, ACCURACY AND COMPLETENESS

Parameter	Matrix	Precision RPD % (1)	Accuracy % of Recovery	Completeness (%)
Pentachloro-	water	± 50	9-103	90
phenol	solid	± 47	17-109	90
Pyrene	water	± 31	26-127	90
	solid	± 36	35-142	90
Pesticides/PCBs				
gamma-BHC	water	± 15	56-123	90
	solid	± 50	46-127	90
Heptachlor	water	± 20	40-131	90
	solid	± 31	35-130	90
Aldrin	water	± 22	40-120	90
	solid	± 43	34-132	90
Dieldrin	water	± 18	52-126	90
	solid	± 38	31-134	90
Endrin	water	± 21	56-121	90
	solid	± 45	42-139	90
4,4'-DDT	water	± 27	38-127	90
	solid	± 50	23-134	90

[1] *RPD = Relative Percent Difference. Precision Limits for organic analyses are advisory only.*

[2] *For special requirements of inorganic precision and accuracy, see Exhibit E of the CLP Statement of Work, Feb. 1989 revision.*

[3] *The indicated percent recovery range represents the minimum and maximum acceptable value for the indicated U.S. EPA CLP compounds. Consult Exhibit E of the CLP Statement of Work for Organics, Multi-Media, Multi-Concentration, U.S. EPA Feb. 1988.*

DATA REPRESENTATIVENESS

Representativeness expresses the degree to which the samples analyzed are reasonably representative of the environmental conditions. The representativeness of the data from a sampling site depends on the sampling location selection method and sampling procedures. The sampling procedures, as described in the Background Soil Sampling Work Plan, have been selected with the goal of obtaining representative samples for the media (i.e., solid). Sampling locations have been chosen to provide a valid approximation of the nature, types, and quantities of inorganic and/or organic constituents in background soils at the site.

Representativeness of the analytical data is a function of the procedure used in processing the samples. Representativeness is established by the use of standard and/or validated sampling methods as described in the Background Soil Sampling Work Plan.

DATA COMPARABILITY

Analytical results are comparable to results of other laboratories because of the following procedures/programs: instrument standards traceable to National Institute of Science and Technology or EPA sources; use of standard or validated methodology; reporting of results from similar matrices in consistent units; applying appropriate levels of quality control within the context of the laboratory quality assurance program; and participation, as appropriate, in inter-laboratory studies to document laboratory performance. Comparability can be related to precision and accuracy as these quantities are measures of data reliability.

There are limitations to the comparability of data from different sampling events or when different analytical methods are used. However, the methods used for the collection and analysis of samples from this site, as documented in the RFIP and this QAPP, should provide comparable data.

Standard analytical methods from SW-846 or as referenced in this QAPP, will be used for the analysis of all samples. This will minimize variability which could occur during the analysis of samples, and provide data which are generated by the same analytical, quality assurance and data reduction techniques. All samples will be collected according to standard field sampling procedures as outlined in the Background Soil Sampling Work Plan. This will ensure that the same field procedures are employed throughout the project duration by all personnel involved. Standardization of both field and laboratory procedures increases data comparability.

The use of standard reporting units allows for the comparison of data from samples of the same matrix. All soil and sediment sample analysis results will be reported in ug/kg (ppb) or mg/kg (ppm).

SECTION 4.0: SAMPLING PROCEDURES

The Background Soil Sampling Work Plan addresses detailed sampling concerns such as description of decontamination procedures, sample location, work schedule, rationale for number of samples, and description of sampling devices. These procedures are described in the following sections of the RFIP:

- Section 2.2 Sampling Locations
- Section 2.3 Field Supplies/Equipment
- Section 2.4 Sampling Methodology
- Section 2.5 Decontamination Methodology

The types of containers used for soil samples for specified analyses, as well as the required preservation and applicable holding times, are detailed in Table 4-1 and 4-2.

At the request of the EPA, McLaren/Hart shall allow the collection of split or duplicate samples, to be taken by the EPA or its authorized representatives, of any samples collected by McLaren/Hart, pursuant to the approved Statement of Work (SOW) and/or Work Plans (WP). McLaren/Hart shall notify the NAVFAC Project Coordinator who will notify the EPA not less than ten (10) days in advance of any such sample collection activity. The EPA shall allow split or duplicate samples to be taken by McLaren/Hart or its authorized representatives, of any samples collected by the EPA that relate to matters referenced in the SOW or approved WP. The EPA shall give NAVFAC ten (10) days notice of its proposed sampling date.

Table 4-1. Aqueous Sample Handling (Equipment Rinseate Blank)

	Sample Type	Container	Sample Parameter Preservation	Holding Time
Volatiles	Grab	40 ml glass vials with teflon-lined septum	Cool at 4°C Add HCl to pH < 2	14 days
Semi-Volatiles	Grab	1 L amber glass with Teflon-lined caps	Cool at 4°C	14 days until extraction; analysis within 40 days of extraction
Pesticides/PCBs	Grab	1 L amber glass with Teflon-lined caps	Cool at 4°C	14 days until extraction; analysis within 40 days of extraction
Metals	Grab	1 L plastic bottles	Cool at 4°C Add HNO_3 to pH < 2	6 months*
Cyanide	Grab	1 L plastic bottles	Cool at 4°C Add NaOH to pH > 12	14 days

** - Recommended holding time, recommended holding time for mercury is 28 days.*
All holding times are from date of sampling.
Volatiles include Target Compound List (TCL) compounds.
Semi-Volatiles include TCL compounds.
Pesticides/PCB's includes TCL compounds.
Metals include Target Analyte List metals.

Table 4-2. Soil Sample Handling

	Sample Type	Container	Sample Parameter Preservation	Holding Time
Volatiles	Grab	4 oz glass jars with teflon-lined caps	Cool at 4°C	14 days
Semi-Volatiles	Grab	8 oz glass jars with Teflon-lined caps	Cool at 4°C	14 days until extraction; analysis within 40 days of extraction
Pesticides/PCBs	Grab	8 oz glass bottles with Teflon-lined caps	Cool at 4°C	14 days until extraction; analysis within 40 days of extraction
Metals/Cyanide	Grab	8 oz glass bottles	Cool at 4°C	6 months*

* *- Recommended holding time, recommended holding time for mercury is 28 days and for cyanide is 14 days.*
All holding times are from date of sampling.
Volatiles include Target Compound List (TCL) compounds.
Semi-Volatiles include TCL compounds.
Pesticides/PCB's includes TCL compounds.
Metals include Target Analyte List metals.

SECTION 5.0: SAMPLE HANDLING, SHIPPING AND CUSTODY

FIELD DOCUMENTATION

Following sampling, the sealed sample container, as specified in Tables 4-1 and 4-2, will be wiped with a moist paper towel, dried and labeled. The sample labels will contain, at a minimum, the following information:

- Media
- Sample ID Number
- Sample Location
- Name of Sampling Personnel
- Name of Sampling Organization
- Date and Time Sampled
- Type of Preservative, if any
- Analysis Requested.

Sample labels will be completed in indelible ink. Following labeling, sample containers will be packed in coolers for storage and shipment. At least two bags of ice, sealed in double plastic bags, or four frozen gel packs, will be placed in each cooler and cushioned using vermiculite, foam rubber, or other similar packaging material to maintain all samples at 4°C. Samples will be packaged, labeled, and transported in conformance with all applicable federal, state, and local regulations.

A sample ID labeling scheme has been developed for clarity, consistency, continuity and for easy data sorting for background soil sampling activities. The sample ID labeling scheme differentiates among sample sources (matrix type) and sample location.

The two or three letter prefix represents the sample matrix type (e.g., BGS-Background Soil). The first set of numbers indicate sample location (two or three digit number).

Trip blanks will be labeled using the prefix TB- followed by six numbers representing the month, day and year that the trip blank was shipped to the laboratory.

Example: **Trip blank that accompanied samples shipped on August 3, 1993.** **TB-080393**

Equipment rinseate blanks will be labeled using the prefix RB- followed by six numbers representing the month, day and year that the equipment rinseate blank was collected.

Example: **Equipment rinseate blank collected on August 3, 1993.** **RB-080393**

This sample ID labeling scheme should be used for all McLaren/Hart field investigations.

Field log books will provide the means of recording data collection activities performed. Entries into the field log book will be described in as much detail as possible, so that someone visiting the site could reconstruct a particular situation without reliance on memory.

Field log books will be bound field survey notebooks. Log books will be assigned to field personnel for recording pertinent notes and will be stored in the field project file when not in use. Each log book will be identified by a project specific number. The title page of each notebook will contain 1) person or organization to whom the book is assigned; 2) the book number; 3) project name; and, 4) start and end dates.

Measurements made and samples collected will be recorded in field log books. All entries will be made in waterproof ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station, which includes distance measurements from permanent landmarks, will be recorded. All equipment used to make measurements will be identified, along with the date and person doing the calibration. All persons involved with the sampling must be identified in the field log book.

SAMPLE CUSTODY

A sample is under custody if:

- It is in your possession, or
- It is in your view, after being in your possession, or
- It was in your possession and you locked it up, or
- It is in a designated secure area.

A chain-of-custody record is a tool to document traceable possession from time of collection until sampled data is introduced as evidence in legal proceedings. The field sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched. The Field Team Leader is responsible for assuring that proper custody procedures are followed during the field work.

When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on a chain-of-custody form. These records document sample custody transfer from the sampler to the analyst in the laboratory.

When samples are split with a source or government agency, a separate chain-of-custody form is prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the signature of a representative of the appropriate party acknowledging receipt of the samples. If a representative is unavailable or refuses to sign, this is noted in the "Received by" space. When appropriate, as in the case where the representative is unavailable, the custody record should contain a statement that the samples were delivered to the designated location at the designated time.

All shipments will be accompanied by the chain-of-custody record identifying contents of the shipment. The following information will be specified for each sample on the chain-of-custody form: 1) sequential sample number; 2) sample media; 3) sample date and time; 4) sample location; and, 5) analyses requested. A sample chain-of-custody form is provided in Figure 5-1.

The original form will accompany the cooler containing the samples designated on the form. Sample coolers will be hand delivered to the analytical laboratory.

McLaren/Hart Environmental Engineering Corp. Inc. D.C. No.: № 0109

Name: _____

Affiliation: _____

Phone: _____

Address: _____

Client/Job No: _____

Job Name: _____ Location: _____

CHAIN OF CUSTODY RECORD

Sample No.	Lab I.D. No.	Date	Time	Matrix	No.of Cont.	Preser-vatives	Analysis Requested/Remarks

Comments: _____

Relinquished by: _____ Date: _____ Shipment Method: _____
Time: _____ Airbill No.: _____

Received by: _____ Date: _____ Relinquished by: _____ Date: _____
Time: _____ Time: _____

Received by: _____ Date: _____ Relinquished by: _____ Date: _____
Time: _____ Time: _____

Final Disposition of Samples: _____

Received by: _____ Date: _____ Time: _____

Page _____ of _____ Pink/Field Copy - Yellow/Lab Copy - White/Original - To be returned with results.

LABORATORY DOCUMENTATION

The preparation of all sample containers (i.e., cleaning, addition of preservatives) prior to their use is described in Appendix A.

Upon arrival at the laboratory, samples will be checked by the laboratory representative and cooler temperature and pH of samples perserved with acid (equipment rinseate blanks) will be checked and documented. All samples contained in the shipment will be compared to the chain-of-custody form to ensure that all samples designated have been received. Sample custody within the laboratory includes:

- Identification of responsible party to act as sample custodian at the laboratory facility authorized to sign for incoming field samples, obtain documents of shipment and verify the data entered onto the sample custody records.
- Provision for a laboratory sample custody log consisting of serially numbered standard lab-tracking report sheets.
- Specifications of laboratory sample custody procedures for sample handling, storage, and dispersement for analysis.

Soil, sediment and groundwater samples for inorganics analyses will be retained by the laboratory to provide an opportunity for retesting, if necessary, for a period of three months after analysis or until permission to discard is received. Samples must be protected from light and refrigerated at 4°C until extraction. Soil, sediment and groundwater samples for organics analyses will be properly disposed of by the laboratory once the applicable holding times have been exceeded.

PROJECT DOCUMENTATION

A project file will be maintained by the Project Manager which will contain complete project documentation. This file will include: project plans and specifications; field log books and data records; maps and drawings; sample identification documents; chain-of-custody records; the entire analytical data package provided by the laboratory including QC documentation; copies of raw data computer printouts; gas chromatograms; mass spectra; data validation notes; references and literature; correspondence; and other pertinent information.

SECTION 6.0: EQUIPMENT CALIBRATION/MAINTENANCE

A maintenance, calibration, and operation program is implemented to ensure that routine calibration and maintenance is performed on all field instruments. The program provides equipment of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration of measuring and test equipment is performed internally using in-house reference standards or externally by agencies or manufacturers.

RESPONSIBILITY

The project quality assurance officer is responsible for ensuring that the field instruments used in this Background Soil Sampling are calibrated and maintained according to manufacturer's specifications. Field instrument manuals describing calibration, maintenance, and field operating procedures for these instruments are provided in Appendix B for easy reference by field personnel and government project personnel.

Team members are familiar with the field calibrations, operation and maintenance of the equipment, and will perform the prescribed field operating procedures outlined in the operation and field manuals accompanying the respective instruments. They will keep records of all field instrument calibrations and field checks in the field log books.

CALIBRATION PROCEDURES

The mini-ram PDM-3 total dust monitor will be calibrated in accordance with the operations manual and will be utilized as a health and safety monitoring instrument (See Appendix B).

Equipment that fails calibration or becomes inoperable during use, shall be removed from service and tagged to prevent inadvertent use. If on-site monitoring equipment should fail, the Site Safety Officer will be contacted immediately and will either provide replacement equipment or have the malfunction repaired immediately.

Records shall be prepared and maintained for each piece of calibrated measuring and test equipment to indicate that established calibration procedures have been followed (e.g. results of calibration, problems, corrective action). Records for field equipment used only for this specific project shall be kept in the project files.

PREVENTATIVE MAINTENANCE

Periodic preventative maintenance is required for sensitive equipment. Instrument manuals are kept on file for reference purposes should equipment need repair. Troubleshooting and preventative maintenance sections of manuals are often useful in assisting personnel in performing maintenance tasks (see Appendix B).

SECTION 7.0: ANALYTICAL METHODOLOGY

The analytical methodology sources are summarized in Table 7-1. Table 7-2 provides a summary of analytical parameters and holding times for soils and waters. Organic analytical methods will follow *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, SW-846, 3rd Edition (EPA SW-846 3rd Edition)* with updates. The identification and quantification of the volatile and semi-volatile TCL compounds in the samples are performed by GC/MS. GC/EC analysis is utilized for the identification and quantification of pesticides/PCB TCL compounds in samples. In addition, the 20 highest non-TCL semi-volatile peaks and 10 highest non-TCL volatile peaks are tentatively identified and the concentration estimated, using a forward search of the EPA/NIH Mass Spectral Library. Contract Required Quantitation Limits (CRQL) are found in Tables 7-3, 7-4, and 7-5.

Inorganic analytical methods will follow EPA SW-846 3rd Edition with updates. Analysis for specified metals and cyanide is performed by flame, furnace, and cold vapor atomic absorption (AA); colorimetric; distillation; and inductively coupled argon plasma (ICP) methods. Contract Required Detection Limits are found in Table 7-6. The samples will be analyzed for 24 constituents (i.e., metals plus cyanide).

TABLE 7-1

ANALYTICAL METHODOLOGY SUMMARY

Metallic Analytes

"Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, 3rd Edition with updates.

Samples Preparation Methods

Method 3005: Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by Flame Atomic Absorption Spectroscopy or Inductively Coupled Plasma Spectroscopy.

Method 3010: Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by Flame Atomic Absorption Spectroscopy or Inductively Coupled Plasma Spectroscopy.

Method 3020: Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by Furnace Atomic Absorption Spectroscopy.

Method 3050: Acid Digestion of Sediments, Sludges, and Soils.

Methods for Determination of Metals

Method 6010: Inductively Coupled Plasma Atomic Emission Spectroscopy
Method 7000: Atomic Absorption Methods
Method 7020: Aluminum (AA, Direct Aspiration)
Method 7040: Antimony (AA, Direct Aspiration)
Method 7041: Antimony (AA, Furnace Technique)
Method 7060: Arsenic (AA, Furnace Technique)
Method 7061: Arsenic (AA, Gaseous Hydride)
Method 7080: Barium (AA, Direct Aspiration)
Method 7090: Beryllium (AA, Direct Aspiration)
Method 7091: Beryllium (AA, Furnace Technique)
Method 7130: Cadmium (AA, Direct Aspiration)
Method 7131: Cadmium (AA, Furnace Technique)
Method 7140: Calcium (AA, Direct Aspiration)
Method 7190: Chromium (AA, Direct Aspiration)
Method 7191: Chromium (AA, Furnace Technique)
Method 7195: Chromium, Hexavalent (Coprecipitation)
Method 7196: Chromium, Hexavalent (Colorimetric)
Method 7197: Chromium, Hexavalent (Chelation/Extraction)
Method 7198: Chromium, Hexavalent (Differential Pulse Polarography)
Method 7200: Cobalt (AA, Direct Aspiration)
Method 7201: Cobalt (AA, Furnace Technique)
Method 7210: Copper (AA, Direct Aspiration)

Method 7380: Iron (AA, Direct Aspiration)
Method 7420: Lead (AA, Direct Aspiration)
Method 7450: Magnesium (AA, Direct Aspiration)
Method 7460: Manganese (AA, Direct Aspiration)
Method 7470: Mercury in Liquid Waste (Manual Cold-Vapor Technique)
Method 7471: Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique)
Method 7480: Molybdenum (AA, Direct Aspiration)
Method 7481: Molybdenum (AA, Furnace Technique)
Method 7520: Nickel (AA, Direct Aspiration)
Method 7550: Osmium (AA, Direct Aspiration)
Method 7610: Potassium (AA, Direct Aspiration)
Method 7740: Selenium (AA, Furnace Technique)
Method 7741: Selenium (AA, Gaseous Hydride)
Method 7760: Silver (AA, Direct Aspiration)
Method 7770: Sodium (AA, Direct Aspiration)
Method 7840: Thallium (AA, Direct Aspiration)
Method 7841: Thallium (AA, Furnace Technique)
Method 7870: Tin (AA, Direct Aspiration)
Method 7910: Vanadium (AA, Direct Aspiration)
Method 7911: Vanadium (AA, Furnace Technique)
Method 7950: Zinc (AA, Direct Aspiration)

Organic Analytes

"Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, 3rd Edition with updates.

Sample Preparation Methods

Extractions and Preparations

Method 3500: Organic Extraction And Sample Preparation
Method 3510: Separatory Funnel Liquid-Liquid Extraction
Method 3520: Continuous Liquid-Liquid Extraction
Method 3540: Soxhlet Extraction
Method 3550: Sonication Extraction
Method 3580: Waste Dilution
Method 5030: Purge-and-Trap

Cleanup

Method 3600: Cleanup
Method 3610: Alumina Column Cleanup
Method 3611: Alumina Column Cleanup And Separation of Petroleum Wastes
Method 3620: Florisil Column Cleanup

Method 3630: Silica Gel Cleanup
Method 3640: Gel-Permeation Cleanup
Method 3650: Acid-Base Partition Cleanup
Method 3660: Sulfur Cleanup

Determination of Organic Analytes

Gas Chromatographic Methods

Method 8000: Gas Chromatography
Method 8010: Halogenated Volatile Organics
Method 8080: Organochlorine Pesticides and PCBs
Method 8120: Chlorinated Hydrocarbons

Gas Chromatographic/Mass Spectroscopic Methods

Method 8240: Gas Chromatography/Mass Spectrometry for Volatile Organics
Method 8250: Gas Chromatography/Mass Spectrometry for Semivolatile Organics: Packed Column Technique
Method 8270: Gas Chromatography/Mass Spectrometry for Semivolatile Organics: Capillary Column Technique

Cyanide

EPA Method 9010 or 9012, "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, 3rd Edition with updates.

TABLE 7-2

SUMMARY OF ANALYTICAL PARAMETERS

Sample Matrix	Analytical Parameters	Sample Holding Time[1]
Soil/Sediment		
	Volatiles	14 Days
	Semi-volatiles	14 Days[2]
	Pesticides/PCB	14 Days[2]
	Metals (except Mercury)	6 Months
	Mercury	28 Days
	Cyanide	14 Days
Waters		
	Volatiles	14 Days[3]
	Semi-volatiles	7 Days[2]
	Pesticides/PCB	7 Days[2]
	Metals	6 Months
	Mercury	28 Days
	Cyanide	14 Days

NA = Not Applicable.
1 All holding times per EPA SW-846, 3rd Edition.
2 Days for extraction, after extraction 40 days to sample analysis.
3 If preserved with HCl. If samples are unpreserved, the holding time for aromatics is 7 days.

All holding times are from date of sample collection.

TABLE 7-3
VOLATILE

TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)*

	Volatiles	CAS Number	Quantitation Limits ** Water ug/L	Low Soil/Sediment[a] ug/kg
1.	Chloromethane	74-87-3	10	10
2.	Bromomethane	74-83-9	10	10
3.	Vinyl Chloride	75-01-4	10	10
4.	Chloroethane	75-00-3	10	10
5.	Methylene Chloride	75-09-2	5	5
6.	Acetone	67-64-1	10	10
7.	Carbon Disulfide	75-15-0	5	5
8.	1,1-Dichloroethene	75-35-4	5	5
9.	1,1-Dichloroethane	75-34-3	5	5
10.	1,2-Dichloroethene (total)	540-59-0	5	5
11.	Chloroform	67-66-3	5	5
12.	1,2-Dichloroethane	107-06-2	5	5
13.	2-Butanone	78-93-3	10	10
14.	1,1,1-Trichloroethane	71-55-6	5	5
15.	Carbon Tetrachloride	56-23-5	5	5
16.	Vinyl Acetate	108-05-4	10	10
17.	Bromodichloromethane	75-27-4	5	5
18.	1,2-Dichloropropane	78-87-5	5	5
19.	cis-1,3-Dichloropropene	10061-01-5	5	5
20.	Trichloroethene	79-25-2	5	5
21.	Dibromochloromethane	124-48-1	5	5
22.	1,1,2-Trichloroethane	79-00-5	5	5
23.	Benzene	71-43-2	5	5
24.	trans-1,3-Dichloropropene	10061-02-6	5	5
25.	Bromoform	75-25-2	5	5
26.	4-Methyl-2-pentanone	108-10-1	10	10
27.	2-Hexanone	591-78-6	10	10
28.	Tetrachloroethene	127-18-4	5	5
29.	Toluene	108-88-3	5	5
30.	1,1,2,2-Tetrachloroethane	79-34-5	5	5

(continued)

TABLE 7-3
VOLATILE

TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)*

Volatiles	CAS Number	Quantitation Limits ** Water ug/L	Low Soil/Sediment[a] ug/kg
31. Chlorobenzene	108-90-7	5	5
32. Ethyl Benzene	100-41-4	5	5
33. Styrene	100-42-5	5	5
34. Xylenes (Total)	1330-20-7	5	5

[a] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRQL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable. These CRQL's are from the Contract Laboratory Program (CLP), 2/88 Organic Statement of Work (Organic SOW).

** Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

TABLE 7-4
SEMI-VOLATILE

TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)*

Semi-Volatiles	CAS Number	Quantitation Limits ** Water ug/L	Low Soil/Sediment[b] ug/kg
35. Phenol	108-95-2	10	330
36. bis(2-Chloroethyl) ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-Dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl alcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. bis(2-Chloroisopropyl) ether	108-60-1	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-Nitroso-di-n-dipropylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic acid	65-85-0	10	1600
52. bis(2-Chloroethoxy) methane	111-91-1	10	330
53. 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330
55. Naphthalene	91-20-3	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330

(continued)

TABLE 7-4
SEMI-VOLATILE

TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)*

Semi-Volatiles	CAS Number	Quantitation Limits ** Water ug/L	Low Soil/Sediment[b] ug/kg
60. Hexachlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330
64. 2-Nitroaniline	88-74-4	50	1600
65. Dimethylphthalate	131-11-3	10	330
66. Acenaphthylene	208-96-8	10	330
67. 2,6-Dinitrotoluene	606-20-2	10	330
68. 3-Nitroaniline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. Diethylphthalate	84-66-2	10	330
75. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330
76. Fluorene	86-73-7	10	330
77. 4-Nitroaniline	100-01-6	50	1600
78. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
79. N-nitrosodiphenylamine	86-30-6	10	330
80. 4-Bromophenyl-phenylether	101-55-3	10	330
81. Hexachlorobenzene	118-74-1	10	330
82. Pentachlorophenol	87-86-5	50	1600
83. Phenanthrene	85-01-8	10	330
84. Anthracene	120-12-7	10	330
85. Di-n-butylphthalate	84-74-2	10	330
86. Fluoranthene	206-44-0	10	330
87. Pyrene	129-00-0	10	330
88. Butylbenzylphthalate	85-68-7	10	330
89. 3,3'-Dichlorobenzidine	91-94-1	20	660

(continued)

TABLE 7-4
SEMI-VOLATILE

TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)*

			Quantitation Limits **	
			Water	Low Soil/Sediment[b]
	Semi-Volatiles	CAS Number	ug/L	ug/kg
90.	Benzo(a)anthracene	56-55-3	10	330
91.	Chrysene	218-01-9	10	330
92.	bis(2-Ethylhexyl)phthalate	117-81-7	10	330
93.	Di-n-octylphthalate	117-84-0	10	330
94.	Benzo(b)fluoranthene	205-99-2	10	330
95.	Benzo(k)fluoranthene	207-08-9	10	330
96.	Benzo(a)pyrene	50-32-8	10	330
97.	Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98.	Dibenz(a,h)anthracene	53-70-3	10	330
99.	Benzo(g,h,i)perylene	191-24-2	10	330

[b] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Semi-Volatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable. These CRQL's are from the CLP 2/88 Organic SOW.

** Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

TABLE 7-5
PESTICIDE/PCB COMPOUNDS

TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)*

Pesticides/PCBs	CAS Number	Quantitation Limits ** Water ug/L	Low Soil/ Sediment[c] ug/kg
100. alpha-BHC	319-84-6	0.05	8.0
101. beta-BHC	319-85-7	0.05	8.0
102. delta-BHC	319-86-8	0.05	8.0
103. gamma-BHC (Lindane)	58-89-9	0.05	8.0
104. Heptachlor	76-44-8	0.05	8.0
105. Aldrin	309-00-2	0.05	8.0
106. Heptachlor epoxide	1024-57-3	0.05	8.0
107. Endosulfan I	959-98-8	0.05	8.0
108. Dieldrin	60-57-1	0.10	16.0
109. 4,4'-DDE	72-55-9	0.10	16.0
110. Endrin	72-20-8	0.10	16.0
111. Endosulfan II	33213-65-9	0.10	16.0
112. 4,4'-DDD	72-54-8	0.10	16.0
113. Endosulfan sulfate	1031-07-8	0.10	16.0
114. 4,4'-DDT	50-29-3	0.10	16.0
115. Methoxychlor	72-43-5	0.5	80.0
116. Endrin ketone	53494-70-5	0.10	16.0
117. alpha-Chlordane	5103-71-9	0.5	80.0
118. gamma-Chlordane	5103-74-2	0.5	80.0
119. Toxaphene	8001-35-2	1.0	160.0
120. Aroclor-1016	12674-11-2	0.5	80.0
121. Aroclor-1221	11104-28-2	0.5	80.0
122. Aroclor-1232	11141-16-5	0.5	80.0
123. Aroclor-1242	53469-21-9	0.5	80.0
124. Aroclor-1248	12672-29-6	0.5	80.0
125. Aroclor-1254	11097-69-1	1.0	160.0
126. Aroclor-1260	11096-82-5	1.0	160.0

[c] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide/PCB TCL compounds are 15 times the individual Low Soil/Sediment CRQL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable. These CRQL's are from the CLP, 2/88 Organic SOW.

** Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

TABLE 7-6

CLP DETECTION LIMITS FOR TARGET ANALYTE LIST[1]

COMPOUNDS (Metals and Cyanide)

Parameter	Contract Required Detection Level[2] (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Cyanide	10
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20

1 The Priority Pollutant and RCRA metal lists are contained within this list.

2 The Contract Required Detection Levels are from the Contract Laboratory Program (CLP), 2/88 Inorganics Statement of Work (Inorganic SOW).

SECTION 8.0: DATA REDUCTION, VALIDATION AND REPORTING

The analytical laboratory will review appropriate quality control data to assure the validity of the analytical results. The analytical laboratory will prepare and retain full analytical and QC documentation as required by the Contract Laboratory Program (CLP). Such documentation need not be hard copy, but may be in other storage media (e.g., magnetic tape). The analytical laboratory will supply one hard copy of the analytical and QC documentation to McLaren/Hart for storage in the project file and will be prepared to supply EPA a copy upon request. McLaren/Hart will perform an independent data validation on the final data package.

The analytical laboratory will provide the following information to McLaren/Hart in each analytical data package they submit:

- Analytical test methods and results for submitted samples, with appropriate data quality notations.
- Narrative including statement of samples received, description of any deviation from the QAPP, explanation of qualifications regarding data quality and other significant items encountered during analysis.
- According to CLP protocol, the laboratory is required to tentatively identify unknown compounds not included in the TCL list. This includes twenty (20) semi-volatile organic compounds, and ten (10) volatile organic compounds.
- All the hard copy deliverables as outlined in the *USEPA Contract Laboratory Program, Statement of Work for Organics, OLM01.8 (August 1991) and USEPA Contract Laboratory Program, Statement of Work for Inorganics, Document Number ILM01.0.*

Data assessment will be accomplished by the joint efforts of the Project QA Officer and Project Manager. The data assessment by the Project Manager will be based on the criteria that the sample was properly collected and handled according to the sampling plans and this QAPP.

The Project QA Officer will conduct a systematic review of the data for compliance with the established QA/QC criteria based on the spike, duplicate and blank results provided by the laboratory. An evaluation of data accuracy, precision, sensitivity and completeness will be performed and presented in the RFI report. This evaluation will be based on the following EPA documents:

1. *USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review, DRAFT December, 1990, Revised June, 1991.*

2. *Region I, Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, February 1, 1988, Modified November 1, 1988.*

3. *Region I, Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, June 13, 1988, Modified February, 1989.*

The Project QA Officer will identify any out-of-control data points and data omissions and interact with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analyses may be made by the Project Manager based on the extent of the deficiencies and their importance in the overall context of the project.

The Project QA Officer will provide data validation of analyses done by the laboratory, as described in the approved QAPP. This data validation shall determine data usability and shall be performed in accordance with the EPA Functional Guidelines for Data Review for data derived by CLP methods. If other than a CLP Method, the QA/QC criteria set forth in the method will be used for data validation. For methods lacking QA/QC data validation protocols, McLaren/Hart will establish validation criteria such as

those in Section 8 of the EPA Series Methods in 40 CFR 136. The appropriate quality assurance data validation summary reports will be submitted, along with sample data and summary sheets, to the EPA Project Coordinator at the time final sample results are provided to EPA.

NAVFAC will make available to EPA the results of all validated sampling and/or tests or other data generated by NAVFAC in conducting the background sampling.

SECTION 9.0: INTERNAL QUALITY CONTROL CHECKS

LABORATORY INTERNAL QC CHECKS

Ceimic Corporation, selected to conduct analyses of background soil samples taken at the Portsmouth Naval Shipyard, are a participant in the EPA's CLP. The laboratory has a documented Quality Assurance Program that complies with EPA Guidance Document QAMS-005/80. Inorganic and organic testing will be performed in accordance with the procedures specified in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, 3rd Edition with updates. There are two types of quality assurance used by SW-846 to ensure the production of analytical data of known and documented usable quality: 1) analytical method quality control (QC); and, 2) program quality assurance (QA).

It will be the responsibility of the laboratory, specifically the laboratory data reviewers, to document, in each data package provided, that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in non-conformance with QC criteria will be reanalyzed by the laboratory when sufficient sample volume is available and the allowed holding time is not exceeded.

FIELD INTERNAL QC CHECKS

For field quality control, replicate samples, field or equipment blanks, and trip blanks will be obtained for the background soil sampling. The procedures for obtaining these QA/QC samples are included in their respective sampling plans. The standard procedure for obtaining replicates is one replicate for every ten to twenty samples. Field blanks will be collected throughout the sampling event. Field blanks for soil will be obtained by

pouring distilled water obtained from the laboratory or a chemical supply company over decontaminated sampling equipment (trowels or mixing bowls). The water will pass over this equipment and be allowed to run directly into laboratory prepared bottles. All information relative to the field blank will be noted in the field log book and each field blank will be given numbers, as discussed in section 5.0, preceded by the letters "RB". One trip blank for TCL volatiles will be sent with each shipment of TCL volatile samples. Table 9-1 summarizes the number and types of replicate and field blank samples to be collected during the Portsmouth Naval Shipyard Background Soil Sampling Program.

Field quality control procedures employed during the soil gas sampling and analysis will include the following: use of precleaned sampling tubes; collection of one replicate sample for every ten samples obtained; and collection of trip blanks.

Table 9-1. Summary of Background Soil QA/QC Samples

Sample Media	Analytical Parameters	Number of Samples	Number of QA/QC Samples		
			Replicates	Field Blanks*	MS/MSD
Background Soil Samples	TAL Metals	16	1	1	1
	Cyanide	16	1	1	1
	Pesticide/PCBs	16	1	1	1
	TCL Volatiles**	16	1	1	1
	TCL Semi-Volatiles	16	1	1	1

* *For soil samples, a rinseate blank will be used for a field blank.*
** *One trip blank per sampling day will be analyzed for TCL volatiles.*

TCL--Target Compound List
PCBs--Polychlorinated biphenyls, Method 8080
MS/MSD--Matrix Spike/Matrix Spike Duplicate (2 samples)

SECTION 10.0: QUALITY ASSURANCE AUDIT

LABORATORY PERFORMANCE AND SYSTEMS AUDITS

The analytical laboratory will conduct both internal and external quality control checks. External quality control checks may include participation in various certification programs with various governmental agencies and/or analysis of QC samples of known concentrations received from the USEPA. Internal quality control checks (replicates, spikes and duplicates) are performed in accordance with specific methods and criteria required by the state in which analyses are performed. A Laboratory Quality Assurance Plan is provided in Appendix C.

SECTION 11.0: ROUTINE PROCEDURES TO ASSESS PRECISION, ACCURACY AND COMPLETENESS OF DATA

The EPA Contract Laboratory Program (CLP) has developed an extensive quality assurance/quality control program to assess the precision, accuracy, and completeness of laboratory data. By using the guidelines for inorganic and organic validation, a measure of precision and accuracy can be obtained. Table 3-1 defines the precision and accuracy in terms of relative percent differences (RPD) and percent spike recovery for the analytes of interest.

To assess field sampling precision, duplicate samples are analyzed to determine relative percent differences using the following equation:

$$RPD = \frac{|x_1 - x_2|}{\text{avg}\,(x_1 + x_2)} \times 100$$

Relative percent difference can only approximate field sampling precision. When taken into consideration with other quality assurance parameters, it can also be used as a measure of laboratory analytical precision in the absence of spike and blank analyses.

Completeness is a measure of the amount of valid data obtained from a measurement system, expressed as a percentage of the number of valid measurements that should have been (i.e., were planned to be) collected. Completeness is not intended to be a measure of representativeness, that is, how closely the measured results reflect the actual concentration or distribution of the pollutant in the media sampled. A project could produce 100% data completeness (all samples planned were actually collected and found to be valid), but the results may not be representative of the pollutant concentration actually present. For example, the analysis method might be biased, or the sampling times or locations might not provide a representative indication of the actual distribution of the pollutant in the media sampled.

SECTION 12.0: NON-CONFORMANCE/CORRECTIVE ACTION

Non-conforming items and activities are those which do not meet the project requirements, procurement document criteria, or approved work procedures. Non-conformance may be detected and identified by:

- Project Staff--During the performance of field investigation and testing, supervision of subcontractors, and preparation and verification of numerical analyses;
- Laboratory Staff--During the preparation for and performance of laboratory testing, calibration of equipment, and quality control activities; and
- Quality Assurance Personnel--During the performance of audits.

Each non-conformance affecting quality shall be documented by the personnel identifying or originating it. This may be done as part of a review summary of laboratory analysis quality control tests, post-audit report, internal memorandum, or letter, as appropriate. Documentation shall, when necessary, include:

- Identification of the individual(s) identifying or originating the non-conformance;
- Cause and description of the non-conformance;
- Method(s) for correcting the non-conformance (corrective action) or description of the variance granted; and
- Schedule for completing corrective action.

Documentation shall be made available to project, laboratory, and/or quality assurance management, and, if applicable, subcontractor management. It is the responsibility of the Field Team Leader, Project Manager, and/or cognizant Quality Assurance personnel to then notify personnel of the non-conformance. In addition, the Project Manager, through the Program Director, will report to the NAVFAC Project Manager in writing, significant nonconformances which could impact the results of the work and indicate the corrective action taken or planned.

Completion of corrective actions for significant nonconformance should be verified by Quality Assurance personnel as part of future auditing activities.

Guidelines for non-conformance and corrective actions involving CLP analyses can be found in "USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review, DRAFT December, 1990, Revised June, 1991" and "Region I, Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, June 13, 1988, Modified February, 1989."

Any significant recurring non-conformance should be evaluated by project, laboratory, and/or quality assurance personnel to determine its cause and appropriate changes instituted in project requirements and procedures to prevent future recurrence. When significant non-conforming conditions have been identified, the person(s) or contractor(s) involved will prepare a summary of all work affected during the project. If corrective action can be taken to mitigate the effects of non-conforming conditions, the summary report will contain a tabulation of dates and effects of the corrective action taken.

SECTION 13.0: QUALITY ASSURANCE REPORTS TO MANAGEMENT

QAPP REVISIONS

Revisions and modifications to any section of the QAPP is indicated by the information provided by the document control format in the upper right hand corner on each page. Any changes in the QAPP will require an updated signature approval page and all responsible parties signatures before going into affect.

APPENDIX A

CEIMIC CORPORATION

QUALITY ASSURANCE PLAN

CEIMIC CORPORATION

10 Dean Knauss Drive

Narragansett, Rhode Island 02882

QUALITY ASSURANCE PLAN

Approved by:

Laboratory Manager

QA/QC Director

Inorganic Laboratory Manager

President

Date Initiated: 11/88
Date Revised: 1/93

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3.0 Introduction

The Ceimic Corporation is an environmental testing and research laboratory, incorporated in the State of Delaware in 1988. The laboratory provides a wide range of analytical services covering soil, air, and water pollution; environmental impact assessment; industrial process control; effluent and emission pollution control; and research and development for hazardous waste management. These services are provided to various U.S Government and State agencies and to private industries as well.

The following Quality Assurance (QA) Plan describes the policies, organization, objectives, quality control activities, and specific quality assurance functions employed at Ceimic and demonstrates Ceimic's dedication to producing accurate, consistent data of known quality. The QA Plan follows the "Interim Guidelines and Specifications for Preparing Quality Assurance Plans" published by the USEPA, December, 1980.

4.0 Quality Assurance

Ceimic Corporation is firmly committed to the production of valid data of known quality through the use of analytical measurements that are accurate, reliable, and complete. To ensure the production of such data, Ceimic has developed an extensive Quality Assurance/Quality Control (QA/QC) Program that operates throughout the entire organization.

Quality control is defined as an organized system of activities, the purpose of which is to provide quality data, while quality assurance is more broadly defined as a system of activities designed to ensure that the Quality Control Program is effective. Quality control is included as part of quality assurance.

In supporting government regulatory and enforcement proceedings, a high degree of attention to quality is essential. Intense application of quality control principles and routine Quality Assurance Audits are required. The basic components of Ceimic's QA/QC Program are control, evaluation, and correction.

Control ensures the proper functioning of analytical systems through the implementation of an orderly and well-planned series of positive measures taken prior to and during the course of analysis, including quality control practices, training and personnel, routine maintenance and calibration of instruments, and frequent validation of standards.

Evaluation involves the assessment of data generated during the control process. For example, precision and accuracy are determined from the results of duplicates, spikes, and other check samples. Evaluation measures over the long term include performance and systems audits conducted by the Ceimic Quality Assurance Group, as well as outside regulatory agencies.

Correction includes the investigation, diagnosis, and solution of any problem detected in an analytical system. Proper functioning of the system may be restored through method reevaluation, analysis of additional check samples, troubleshooting and repair of instrumentation, or examination and comparison with historical data. Confidential records are maintained of corrective actions taken.

The management at Ceimic considers QA/QC to be of paramount importance in the success of the company and fully supports the staff in the implementation of a sound and thorough Quality Assurance Program. Our Ceimic Quality Assurance Policy Statement is included as Figure 4-1.

Figure 4-1

QUALITY ASSURANCE POLICY STATEMENT

CEIMIC CORPORATION

JUNE, 1991

The success of our laboratories is directly related to client perception of the reliability and accuracy of the data we generate. From the moment an environmental sample arrives in our laboratory, each step it passes through in sample management, preparation, analysis, and reporting will affect data reliability and accuracy. Thus, QA/QC procedures have been imposed at each step and operation in our laboratory to ensure our clients' satisfaction. Ceimic is firmly committed to the effective implementation of these procedures.

It is incumbent on every employee at all operation and management levels to thoroughly understand and carry out said procedures.

Our QA/QC Program is the key to our success and, as a company policy, will be strictly enforced. The QA/QC Director will direct and oversee this function, but we are all individually responsible for its execution.

John F. McGarry, Jr.
President
Ceimic Corporation

5.0 Quality Assurance Management, Organization, and Responsibility

Quality assurance at Ceimic is a company-wide function that depends on cooperative working relationships and multi-level review. Responsibilities for quality assurance functions begin with the bench scientist and extend to the President of Ceimic.

The primary level of quality assurance resides with the bench scientist who, after matriculation in the Ceimic training program, is responsible for: 1) Precisely following the analytical methods and Standard Operating Procedures (SOP's); 2) carefully documenting each step in the appropriate format; 3) conscientiously obtaining peer review, as required; and 4) promptly alerting laboratory managers and/or QA staff members to problems or anomalies.

The manager of each analytical laboratory is responsible for the quality of the data generated by the scientists in that laboratory. The Laboratory Manager implements and monitors the specific quality control protocols and quality assurance programs within the laboratory to ensure a continuous flow of high-quality data. It is the Laboratory Manager's responsibility to provide the bench chemists with ample resources including space, equipment, personnel and, especially, time, in order to accomplish top-quality performance.

Additionally, each laboratory has a scientist specifically designated to assist the Laboratory Manager with the quality assurance function. Their responsibilities may include monitoring

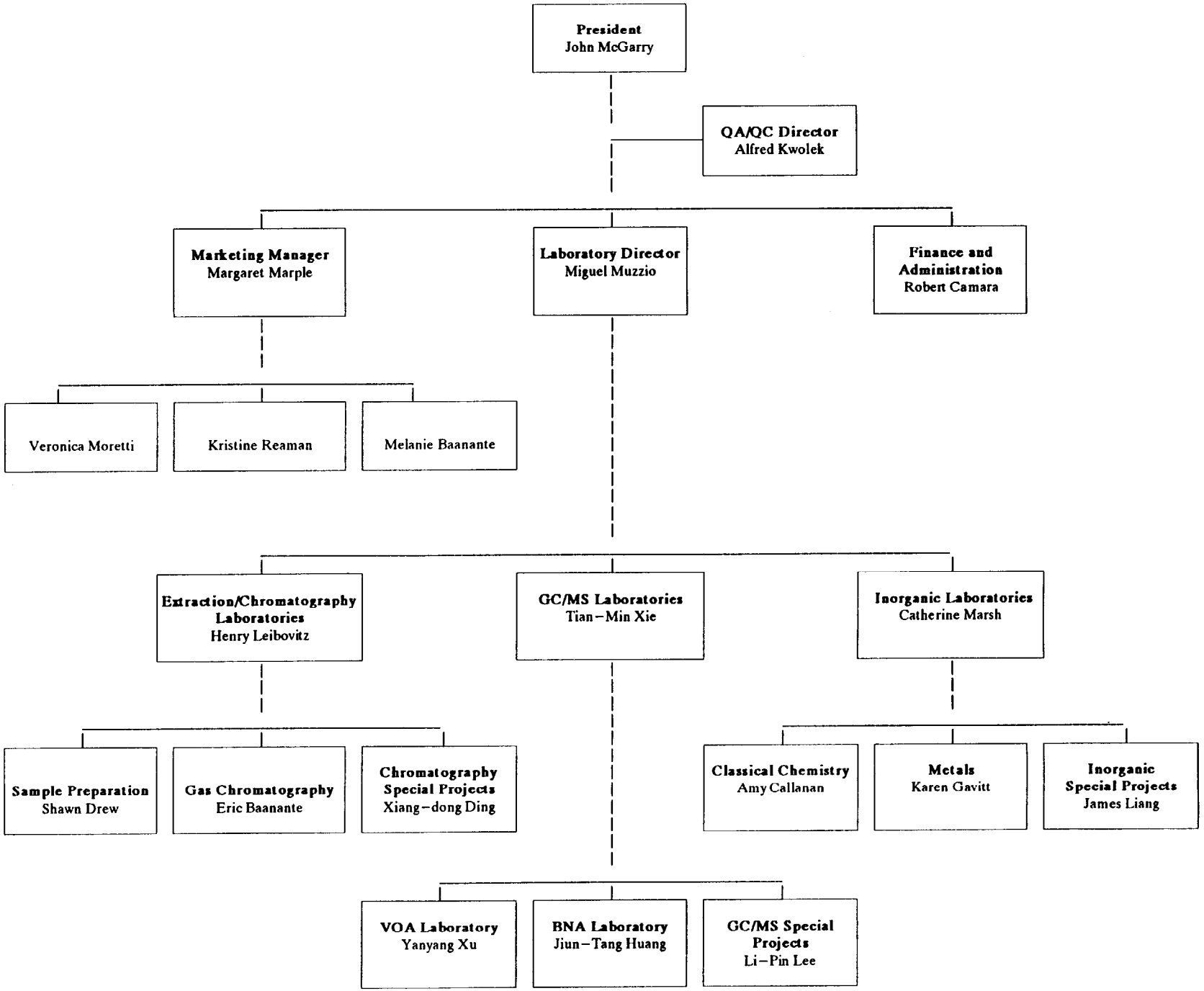
quality control practices, updating laboratory SOP's, and helping to manage analysis of Performance Evaluation (PE) samples. These scientists are part of Ceimic's QA staff and are important quality assurance links to the laboratories.

The overall Quality Assurance Program and associated activities are overseen by the QA/QC Director. While interacting on a daily basis with laboratory staff members, the QA/QC Director remains independent of the laboratories and reports directly to the President of Ceimic. Laboratory compliance with the QA Program is evaluated through informal and formal systems and performance audits by the QA/QC Director. Remedial action is suggested, if necessary.

With input from the appropriate staff members, the QA/QC Director writes and edits general and specific QA plans, QC protocols, safety procedures, and SOP's. An essential element of the QA Program is keeping records and archiving all information pertaining to quality assurance, including QA/QC data; pre-award check sample results and scores; performance evaluation sample results and scores; state certifications of the laboratories; and EPA and other audit comments, recommendations, and reports. The QA/QC Director also plays an important role in the corrective action mechanism described in Section 16. A semi-official QA function performed by the Director involves working with scientists and management to continually upgrade procedures and systems to make the laboratory work more effectively.

Ultimately, the success of the QA Program depends on the cooperation and support of the entire organization. Ceimic's most valuable resource is its staff of dedicated professionals who take personal pride in the quality of their performance.

Figure 5-1
CEIMIC ORGANIZATIONAL CHART



CEIMIC CORPORATION LABORATORY ORGANIZATION CHART

6.0 Quality Assurance Objectives for Measurement of Data in Terms of Precision, Accuracy, Representativeness, Completeness, and Comparability

6.1 Quality Assurance Objectives

As part of the evaluation component of the QA Program, laboratory results are compared with certain data quality objectives. These objectives, in terms of precision, accuracy, representativeness, completeness, and comparability, may be defined as follows:

6.1.1 Precision

The agreement or reproducibility among individual measurements of the same property, usually made under the same conditions.

6.1.2 Accuracy

The degree of agreement of a measurement with the true or accepted value.

6.1.3 Representativeness

The degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

6.1.4 Completeness

A measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct normal conditions.

6.1.5 Comparability

An expression of the confidence with which one data set can be compared with another data set in regard to the same property.

Quality assurance objectives vary according to the specific project and the parameters requested. The accuracy, precision, and representativeness of data will be functions of the origins of the samples, the procedures used to analyze samples and generate data, and the specific sample matrices involved in each project. Quality control practices utilized in the evaluation of these data quality objectives include blanks, replicates, spikes, standards, check samples, calibrations, and recoveries.

6.2 Precision and Accuracy

For each parameter analyzed, the QA objectives for precision and accuracy will be determined from: 1)

Published historical data; 2) method validation studies; 3) Ceimic experience with similar samples; and/or 4) project-specific requirements, such as those stipulated by the EPA in the Contract Laboratory Program (CLP) protocols.

6.3 Representativeness

The representativeness of the data from the sampling sites depends on the sampling procedures. The representativeness of the analytical data is a function of the procedures used in processing the samples. The objective for representativeness is to provide data of the same high quality as other analyses of similar samples using the same methods during the same time period within the laboratory. Representativeness can be determined for this objective by a comparison of the quality control data for these samples against other data for similar samples analyzed at the same times. Differences within 20% are acceptable.

6.4 Completeness

Completeness of an analysis is documented by including in the report sufficient information to allow the data user to assess the quality of the results. The objective is for completeness to be 100% in most cases and includes: Analysis of all samples; generation and

analysis of all required QC samples; sufficient documentation of associated calibration, tuning, and standardization; and records of data reduction processes.

Completeness is ensured by assigning to each project a specific Project Manager whose functions include sample management and tracking.

6.5 Comparability

The results of these analyses can be compared with other analyses by other laboratories because the objectives of the laboratory for comparability are: To demonstrate traceability of standards to NBS or EPA sources, to use standard methodology, to apply appropriate levels of quality control within the context of the Laboratory Quality Assurance Program, and to participate in inter-laboratory studies to document laboratory performance.

By using traceable standards and standard methods, the analytical results can be compared to other laboratories operating similarly. The QA Program documents internal performance, and the inter-laboratory studies document performance compared to other analysts at other locations.

7.0 Sampling Procedures

For most projects, outside sampling teams deliver or send samples to the Ceimic laboratories. When sampling by Ceimic personnel is required, the Ceimic sampling team follows the sampling procedures outlined in the EPA/OSW "Test Methods for Evaluating Solid Wastes - Physical/Chemical Methods", SW-846, 3rd Edition, or procedures found in the EPA "Handbook for Sampling and Sample Preservation of Water and Wastewater". Safety during the sampling process is discussed in the Ceimic document "Safety Procedures for Sampling Personnel". Site-specific sampling plans are prepared at Ceimic for projects requiring them.

Appropriately prepared sample containers are supplied by Ceimic if a client so requests. When required, preservatives are added to the sample containers by Ceimic scientists. Table 7-1 provides the Ceimic recommended methods for sampling and preservation of samples for analysis. Maximum holding times, as specified in 40 CFR, Part 136, are included in the table.

Table 7.1

REQUIRED CONTAINERS, PRESERVATION

TECHNIQUES, AND HOLDING TIMES

Table 7.1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

PARAMETER NO./NAME	CONTAINER[1]	PRESERVATION[2,3]	MAX. HOLDING TIME[4]
Table 1A-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	Cool, 4° C, 0.008% $Na_2S_2O_3$	6 Hours
Table 1B-Inorganic Tests			
1. Acidity	P,G	Cool, 4°C	4 Days
2. Alkalinity	P,G	Cool, 4° C	4 Days
4. Ammonia	P,G	Cool, 4° C, H_2SO_4 to pH<2	28 Days
9. 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	28 Days
17. Chlorine, total residual	P,G	None Required	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, 0.6 G Ascorbic Acid	14 Days[6]
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[7]			
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	HNO_3 to pH<2	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	28 Days
44. Orthophosphate	P,G	Filter Immediately, Cool, 4° C	48 Hours
46. Oxygen, dissolved probe	G Bottle & Top	None Required	Analyze Immediately
47. Winkler	G Bottle & Top	Fix on Site and Store in Dark	8 Hours
48. Phenols	G	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	Cool, 4° C	48 Hours
55. Residue, non-filterable (TSS)	P,G	Cool, 4° C	7 Days
56. Residue, settleable	P,G	Cool, 4° C	7 Days
57. Residue, volatile	P,G	Cool, 4° C	7 Days
61. Silica	P	Cool, 4° C	28 Days

Table 7.1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES (Cont'd)

PARAMETER NO./NAME		CONTAINER	PRESERVATION	MAX. HOLDING TIME
Metals (Cont'd)				
64.	Specific Conductance	P,G	Cool, 4° C	28 Days
65.	Sulfate	P,G	Cool, 4° C	28 Days
66.	Sulfide	P,G	Cool, 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 Immediately
73.	Turbidity	P,G	Cool, 4° C	48 Hours
Table IC-Organic Tests[8]				
13,18-20,22,24-28,34-37,39-43, 45-47,56,66,88,89,92-95, 97.	Purgeable Halocarbons	G, Teflon-lined Septum	Cool, 4° C, 0.0008% $Na_2S_2O_3$	14 Days
6,57,90.	Purgeable Aromatic Hydrocarbons	"	Cool, 4° C, 0.0008% $Na_2S_2O_3$, HCL to pH2[9]	14 Days
3,4.	Acrolein & Acrylonitrile	"	Cool, 4° C, 0.0008% $Na_2S_2O_3$, Adjust pH to 4-5[10]	14 Days
23,30,44,49,53,67,70,71,83, 85,96.	Phenols[11]	G, Teflon-lined Cap	Cool, 4° C, 0.0008% $Na_2S_2O_3$	7 Days Until Extraction, 40 Days After Extraction
7,38.	Benzidines[11]	"	Cool, 4° C, 0.0008% $Na_2S_2O_3$	"
14,17,48 50-52.	Phthalate Esters[11]	"	Cool, 4° C	"
72-74.	Nitrosamines[11,14]	"	Cool, 4° C, Store in Dark, 0.0008% $Na_2S_2O_3$	"
76-82.	PCB's[11] Acrylonitrile	"	Cool, 4° C	"
54,55, 65,69.	Nitroaromatics & Isophorone[11]	"	Cool, 4° C, Store in Dark, 0.0008% $Na_2S_2O_3$	"
1,2,5,8-12,32,33,58,59,64,68, 84,86.	Polynuclear Aromatic Hydrocarbons[11]	"	Cool, 4° C, Store in Dark, 0.0008% $Na_2S_2O_3$	"
15,16,21, 31,75.	Haloethers[11]	"	Cool, 4° C, 0.0008% $Na_2S_2O_3$	"
29,35-37, 60-63,9f.		Chlorinated Hydrocarbons[11]		"
Cool, 4° C		"		
87.	TCDD[11]	"	Cool, 4° C, 0.0008% $Na_2S_2O_3$	"
Table 1D-Pesticides Tests				
1-70	Pesticides[11]	"	Cool, 4° C, pH 5-9[15]	"
Table 1E-Radiological Tests				
1-5.	Alpha, Beta, and Radium	P,G	HNO_3 to pH<2	6 Months

Table 7.1
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES (Cont'd)

TABLE II NOTES

1. Polyethylene (P) or Glass (G).

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

3. When any sample is shipped by common carrier or sent through the US mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR, Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements 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 1.62 or greater); sulfuric acid (H_2SO_4) in water solutions of 0.35% 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 Section 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 Section 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 being 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. Samples receiving no pH adjustment must be analyzed within 7 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 preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°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 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in Footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and Footnotes 12 and 13 (re: the analysis of benzidine).

12. If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 $\pm$ 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 (oxidant-free) atmosphere.

14. For the analysis 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 2 Corrected by 50 CFR 691, January 4, 1985

8.0 Sample Custody

8.1 Chain-of-Custody

Samples are physical evidence collected from a facility or the environment. In hazardous waste investigations, sample data may be used as evidence in EPA enforcement proceedings. In support of potential litigation, laboratory chain-of-custody procedures have been established to ensure sample traceability from the time of receipt through completion of analysis.

The National Enforcement Investigations Center (NEIC) of the EPA considers a sample in custody under the following conditions:

- It is in your actual possession;
- it is in your view, after being in your physical possession;
- it was in your possession and then you locked or sealed it to prevent tampering; or
- it is in a secure area.

Chain-of-custody originates as samples are collected. Chain-of-custody documentation accompanies the samples as they are moved from the field to the laboratory, with shipping information and appropriate signatures indicating custody changes along the way. A Chain-of-Custody Record is included as Figure 8-1.

Laboratory chain-of-custody is initiated as samples are received and signed for by the Sample Custodian at Ceimic. Documentation of sample

whereabouts continues as samples are signed in and out of the central storage facility for analysis in the several Ceimic laboratories using the Sample Control Record (Figure 8-2). After analysis, extracts and any remaining samples are held in the central storage area to await disposal. Prior to disposal of the samples, tags and other identification are removed and placed in the case file.

8.2 Laboratory Security

Samples at Ceimic are kept within secure areas during all stages of tenure, including the periods of time spent in preparation, analysis, and storage.

The laboratory area is designated as a secure area. The doors to this area are kept locked at all times and may be accessed by key or combination. Authorized personnel only are allowed to enter the secure areas. Visitors to the laboratories must be accompanied by Ceimic staff members.

8.3 Duties and Responsibilities of the Sample Custodian

Duties and responsibilities of the Sample Custodian shall include, but not be limited to, the following.

- Receiving samples
- Inspecting sample shipping containers for presence/absence and condition of:

- o custody seals, locks, "evidence tape," etc.
- o container breakage and/or container integrity.

- o Recording condition of both shipping containers and sample containers (bottles, jars, cans, etc.) in appropriate logbooks. This also includes recording whether the samples were cool upon arrival and recording the pH of aqueous samples.

- o Signing appropriate documents shipped with samples (i.e., airbills, chain-of-custody record(s), Sample Management Office (SMO) traffic reports, etc.).

- o Verifying and recording agreement or non-agreement of information on sample documents (i.e. sample tags, chain-of-custody records, traffic reports, airbills, etc.) in appropriate logbooks or on appropriate forms. If there is non-agreement, recording the problems, contacting the SMO for direction, and notifying appropriate laboratory personnel. (SMO's corrective action directions shall be documented in the case file.)

- o Initiating the paperwork for sample analyses on appropriate laboratory documents (including establishing case and sample files and inventory sheets) as required for analysis or according to laboratory SOP's.

- o Marking or labelling samples with laboratory sample numbers, as appropriate, and cross-referencing laboratory numbers to SMO numbers and sample tags, as appropriate.

- o Placing samples, sample extracts, and spent samples into appropriate storage and/or secure areas.
- o Controlling access to samples in storage and assuring that laboratory Standard Operating Procedures are followed when samples are removed from and returned to storage.

- o Monitoring chain-of-custody of samples in the laboratory.

- o Assuring that sample tags are removed from the sample containers and included in the

appropriate sample file. Accounting for missing tags in a memo to the file or documenting that the sample tags are actually labels attached to sample containers or were disposed of due to suspected contamination.

- Monitoring storage conditions for proper refrigeration temperature and prevention of cross-contamination.
- Returning shipping containers to the proper sampling teams.
- Sending shipping containers, prepared sample bottles, and sampling instructions to clients who request them.

8.4 Sample Receipt

Sample shipments are received at Ceimic by the designated Sample Custodian. Shipping information is recorded in the Incoming Logbook and the paperwork filed chronologically. The shipping containers are then inspected and opened by the Sample Custodian, who records the following information on the Sample Log-in Sheet (Figure 8-3) as he or she unpacks the coolers.

8.4.1 Documentation

- Custody seals,
- chain-of-custody records,
- SMO forms (traffic reports),
- airbills or bills of lading documenting shipment of samples, and
- sample tags;
- Condition of custody seal (intact, broken, absent) and shipping container
- Condition of sample bottles

- Sample tag ID numbers <u>not</u> recorded on chain-of-custody records or packing list
- Verification of agreement or non-agreement of information on receiving documents
- Resolution of problems or discrepancies with the SMO.

Following resolution of any problems or discrepancies, the Sample Custodian signs the Sample Receipt Form and originates a custody file for the set of samples, including in it the Sample Receipt Form.

When the Sample Custodian is not available to receive samples, the sample container is signed for by a Ceimic staff member and the time, date, and name of the person receiving the container are recorded in the Incoming Log, along with the appropriate shipping information. The samples are then stored under refrigeration in the sample receipt area, which is located within the secured area. The samples are officially received and documented by the Sample Custodian or designee on the next business day.

8.5 Sample Log-in and Identification

8.5.1 Sample Identification

In order to maintain sample identity, each sample received at Ceimic is assigned a unique sample identification (Sample ID) number.

After inspecting the samples, the Sample Custodian assigns each sample a Ceimic Sample ID Number. These numbers are chronologically sequential. Ceimic Sample ID Numbers appear in the following format:

ww - xxxx - yy - zz

where:

"ww" - the last two digits of the current year;

"xxxx" -a four-digit project number which is assigned sequentially when a sample group (case) is received at Ceimic;

"yy" -the sample number within the group (case); and

"zzz" -an individual laboratory code

e.g. - 87 - 0014 - 06 - ABC

The Ceimic Sample Custodian assigns each sample a "ww-xxxx-yy" identification number. The "zzz" suffices are assigned within the individual laboratories and vary from one laboratory to another.

The Ceimic Sample ID Numbers are recorded on the Sample Log-in Sheet, in the Sample Receipt Log, and on the Sample Information Form (Figure 8-4), where they are cross-referenced with SMO numbers, sample tag numbers, and other client identifiers. Each sample is clearly labelled with its Ceimic

Sample ID Number by the Sample Custodian. The same Sample ID Number appears on each sample preparation container and extract vial associated with the sample.

8.5.2 Sample Log-In

The sample log-in system at Ceimic consists of computerized entry into the Sample Receipt Log. The information recorded includes:

- Ceimic sample identification number,
- date of receipt,
- client name,
- client sample identification,
- sample matrix,
- analyses required,
- project number,
- due date and comments, and
- initials of Sample Custodian or designee.

8.5.3 Sample Information

After completing the Sample Log-In Sheet and making sample entries in the Sample Receipt Log, the Sample Custodian prints out sample data on the Sample Information Form, including:

- Client name
- Ceimic project number
- number of samples received

- type(s) of samples received (sample matrix)
- due date of samples
- Ceimic sample ID numbers

- client ID number
- analyses to be performed
- provision for signature of Sample Custodian (or designee)
- date of sample log-in
- provision for signature of Project Manager

After signing and dating the Sample Information Form, the Sample Custodian notifies the Project Manager of the arrival of the samples. The Project Manager verifies that the information on the Sample Information Form is correct by countersigning and dating the form. The original Sample Information Form is placed in the chain-of-custody file for the case or project.

The custody file is originated by and remains with the Sample Custodian until the samples are disposed of. At that time, the custody file is entered in the Ceimic central file for the case or project.

Copies of the Sample Information Form are distributed to the Ceimic Project

Manager, the Accounting group, and the appropriate laboratory managers. Another copy of the form may be sent to the client as confirmation of sample receipt and specified analyses.

8.6 Sample Storage

Samples at Ceimic are stored in a central storage facility within the secured area. After sample receipt and log-in procedures are completed, the Sample Custodian places the samples in their original containers within the appropriate refrigerators in the sample storage area. Refrigerators #1, #2, and #3 are dedicated to inorganic samples, and refrigerators #4, #5, and #6 are dedicated to organic samples. Only samples for volatile organics analysis (VOA) are stored in refrigerator #4. No other type of sample may be stored in this refrigerator. The sample storage area is for samples only; no standards or reagents are present.

Refrigerators are maintained at 5°C (+/-4°C). A daily Temperature Log (Figure 8-5) is kept for each refrigerator by the Sample Custodian.

Access to the sample storage area is controlled by the Sample Custodian, who is responsible for monitoring sample custody. All transfers of samples into and out

of storage are documented on a laboratory chain-of-custody form, the Sample Control Record. When an analyst removes a sample for preparation and/or analysis, the sample is signed out. Similarly, a sample is signed back in when the analyst returns it to storage prior to the end of his/her working day.

When analysis is complete, extracts and any remaining samples are retained in the central storage area until they may be disposed of. Broken or damaged samples are promptly disposed of in a safe manner and the disposal documented.

All custody documentation is kept in case custody files originated by the Sample Custodian until samples are removed from storage for disposal. At that time, the case custody files are entered into the central case files and the disposal of samples and extracts documented.

Chain-of-custody of a sample ensures that the sample is traceable from when it was taken in the field through laboratory receipt, preparation, analysis and, finally, disposal. The primary chain-of-custody documents which may be used to locate a sample at any point in time are:

- the Chain-of Custody Form from the field describing the origin and transportation of a sample

- the laboratory Sample Receipt Log and supporting log-in records, documenting acceptance of a sample by the Ceimic laboratory

- the Ceimic sample control forms, documenting the analyst who has custody and the reason for removal of a sample from storage.

Figure 8-1
CHAIN-OF-CUSTODY RECORD

Fig. 1-1
CHAIN-OF-CUSTODY FORM

C H A I N - O F - C U S T O D Y
Original Chain-of-Custody Goes to Laboratory

Proj. # Project Name

Samplers (Please Print)

Date	Time	Comp.	Grab	Sample Identification	Type of Container	# of Containers	Remarks

Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time	Remarks:
Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time	
Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time	

CEIMIC CORPORATION, 10 Dean Knauss Drive, Narragansett, RI 02882 (401) 782-8900 FAX (401) 782-8905

Figure 8-2
SAMPLE CONTROL RECORD

Figure 8-2
SAMPLE CONTROL RECORD

S A M P L E C O N T R O L R E C O R D

Project #_____ Refrigerator ID_____

Laboratory Sample No.	Removed By	Date/Time Removed	Reason	Date/Time Returned

CEIMIC Corporation, 10 Dean Knauss Drive, Narragansett, RI 02882
(401) 782-8900

Figure 8-3
SAMPLE LOG-IN SHEET

Figure 8-3
SAMPLE LOG-IN SHEET

SAMPLE LOG-IN SHEET

Page _____ of _____

Received By (Print Name): _____ Received By (Signature): _____ Log-in Date: _____

Case #: _____

Sample Delivery Group #: _____

SAS #: _____

CORRESPONDING

EPA SAMPLE #	SAMPLE TAG #	ASSIGNED LAB #	REMARKS: CONDITION OF SAMPLE SHIPMENT, ETC.

CIRCLE THE APPROPRIATE RESPONSE:

1. Custody Seal(s) Present/Absent* Intact/Broken
2. Custody Seal #(s) _____ _____
3. Chain-of-Custody Records Present/Absent*
4. Traffic Reports or Packing List Present/Absent*
5. Airbill Airbill/Sticker Present/Absent*
6. Airbill # _____
7. Sample Tags Present/Absent*

   Sample Tag #s Listed/Not Listed on Chain-of Custody
8. Sample Condition Intact/Broken*/ Leaking
9. Does information on custody records, traffic reports, and sample tags agree? Yes/No*
10. Date Received _____
11. Time Received _____

SAMPLE TRANSFER

Fraction: _____ _____
Area #: _____ _____
By: _____ _____
On: _____ _____

---

* If circled, contact SMO and attach record of resolution.

Reviewed By: _____ Date: _____ Logbook No.: _____ Logbook Page No.: _____

Figure 8-4
CEIMIC SAMPLE INFORMATION FORM

CEIMIC CORPORATION
Sample Information

Page ____ of ____

Date: Ceimic Rep.: Stored:

Date Samples Received:

Due Date: Contract #:

Client: Bid Lot:

Client Contact: SDG:

Project No. Region:

Project Amount:

LAB ID	SAMPLE DESCRIPTION	MATRIX	DATE RECEIVED	ANALYSIS AND METHOD

Figure 8-5
TEMPERATURE LOG

CEIMIC CORPORATION
Temperature Log

DATE	TIME	TEMPERATURE	CORRECTIVE ACTION (If Required)	ANALYST

9.0 General Laboratory Practices

9.1 Glassware Cleaning Procedures - Inorganic

All inorganic glassware used in the laboratory is cleaned prior to use by first soaking in HNO_3 for a minimum of 30 seconds. The glassware is then rinsed with deionized water three times or more if needed and then allowed to dry before use.

9.2 Glassware Cleaning Procedures - Organic

The availability of clean glassware is vital to the analysis of organics trace levels. Each laboratory is responsible for cleaning its own glassware. To thoroughly remove the contaminants, which might interfere with the analysis and result in higher detection limits for the target compounds, the following steps are followed to ensure clean glassware:

- The dirty glassware used in the laboratory is rinsed with methanol to remove the presence of organics.
- The glassware is then washed in detergent solution (Alkonox).
- The washed glassware is rinsed with copious amounts of tap water.
- The glassware is rinsed twice with reagent grade methanol.
- The glassware is rinsed twice with resi-analyzed grade methylene chloride.
- The rinsed glassware is air dried, capped with aluminum foil, and placed in a clean glassware rack.
- Immediately prior to use, the clean glassware is rinsed with the solvent that will be added to it.

- Should the glassware be extremely dirty, it is washed with acid (permanganate in concentrated sulfuric acid) prior to Step 1.

Note: For petroleum hydrocarbon analysis, detergent-washed glassware is rinsed with freon only after it has been allowed to dry thoroughly.

9.3 Sample Bottle Cleaning Procedures

Sample bottles are purchased by Ceimic pre-cleaned to EPA specifications and used only once. No further cleaning is needed prior to shipment. If GC fingerprinting is to be done, the bottles are rinsed with methanol prior to shipment.

9.4 Sample Bottle Shipping and Storage

Sample bottles are stored in their original cartons until preparation for shipment. At this time, they are removed from their containers, prepared for preservation if necessary, then placed in a cooler for shipment. The cooler has a preassigned number that is recorded in the cooler tracking logbook along with a description of the cooler contents, destination, ship date, and other pertinent information.

9.5 Sample and Waste Disposal Policy

9.5.1 Waste Profiles

9.5.1.1 Solid Waste

Sodium Sulfate and Debris, Non-DOT Regulated, EPA Waste #MA99, Profile #R44570 (EPA ID). Solid waste can include any solid

material that is considered hazardous. It includes used pipettes, solid sample waste, used gloves, used sodium sulfate, open used vials, spent filters, etc. Under no circumstances are there to be containers with covers in solid waste. There are to be no liquids in solid waste.

9.5.1.2 Acid Waste

RQ Waste N.O.S. (nitric acid), corrosive material, NA1760, EPA Waste #D002, Profile #R44571 (EPA ID). Acid Waste is any aqueous sample waste with a pH <2.

9.5.1.3 Non-Halogenated Organic Solvent Waste

Hazardous Waste Liquid, N.O.S. (acetone, methanol), ORM-E, NA9189, EPA Waste #F003, Profile #R44567 (EPA ID). Non-halogen waste is any solvent waste that does not contain halogen compounds. Halogen compounds include chlorine, fluorine, and bromine (Cl, F, and Br). Non-halogen waste primarily consists of methanol, acetone, hexane, and ether.

9.5.1.4 Halogenated Organic Solvent Waste

Waste Dichloromethane (methylene chloride)UN1593, EPA Waste #F001, Profile #R44568 (EPA ID). Halogenated waste is any solvent waste that contains halogen compounds

(methylene chloride, freon, and carbon tetrachloride).

9.5.1.5 Sample Waste

Hazardous Waste Liquid, N.O.S. NA9179, EPA Waste #F001, Profile #R44569 (EPA ID). Sample waste is all liquid waste with a relatively neutral pH (between 2 and 12). This can include extracted samples or any aqueous sample waste that cannot be dumped down the drain.

9.5.2 In-Lab Storage

9.5.2.1 Solid Waste

Solid waste is interim-stored in a heavy cardboard box that has been lined with aluminum foil. When the box is full, solid waste is taken to the Hazardous Waste Storage Area (HWSA) and placed in the proper drum.

9.5.2.2 Acid Waste and Sample Waste

Acid waste is interim-stored in plastic containers with covers. These containers are clearly and properly labelled. As is necessary, these containers are taken to the HWSA and poured into the proper drum.

9.5.2.3 Halogenated Solvent Waste

Halogenated waste is initially collected in halogen waste beakers. These are identified by yellow tape around the beaker.

The beakers, when full, are poured into 15-gallon polypropylene intermediate storage drums. When the intermediate drums are half-full, they are taken into the HWSA and poured into the proper drum. All halogenated waste is currently removed from Ceimic by Clean Harbors, Inc., of Braintree, Massachusetts. The waste is then tracked cradle to grave, with certificates of disposal supplied on request.

9.5.2.4 Non-Halogenated Solvent Waste

Non-Halogenated waste is initially collected in non-halogen waste beakers. These are dentified by green tape around the beaker. The beakers, when full, are poured into 15-gallon polypropylene intermediate storage drums. When the intermediate drums are half-full, they are taken into the HWSA and poured into the proper drum. All non-halogenated waste is currently removed from Ceimic by Clean Harbors, Inc. of Braintree, Massachusetts. The waste is then tracked cradle to grave, with certificates of disposal supplied on request.

10.0 Laboratory Training

The QA/QC Director meets with all new employees to begin the laboratory training process. This meeting takes place before the employees are taken to their assigned work area.

During this meeting, the QA/QC Director discusses company policy, Ceimic's commitment to quality, laboratory safety, the laboratory training program, the important role Ceimic plays in the environmental industry, Ceimic's clients, and what demands will be placed upon the new employee.

This discussion is followed by a tour of the laboratory facility, and introduction to the employee's supervisor.

The formal laboratory training program for new personnel follows the Training of New Personnel SOP. Appropriate SOP's are explained to the employee. The employee receives a copy of the SOP. The employee must then demonstrate proficency with the appropriate SOP. Documentation in the form of a "Certificate of Training" becomes part of the employee's personnel file.

The Laboratory Supervisors, Organic Laboratory Manager, Inorganic Laboratory Manager and QA/QC Director provide employees with periodic technical articles and information. Employees must demonstrate knowledge in the form of oral and/or written examinations. The results are documented in the employees personnel file.

Each technical employee is given a Quality Control Sample to prepare and/or analyze. The results of their performance is documented in the employees personnel file.

11.0 Document Control

The Ceimic Document Controller assembles documentation relating to each project. A central file is maintained for each project and is the repository for all documentation associated with the project. Projects are arranged by Ceimic project number. All project files are located in the central filing area located in the secure area. The documents are assembled as follows, where appropriate.

- Each project is assigned one file folder or file section.
- Filing order is according to Ceimic project number.
- All documents, including sample tags, client documents, and laboratory-generated data pertaining to a project, are placed in the central file folder or file section assigned to the project.
- Chain-of-custody records are held in the central storage facility at Ceimic until sample disposal; at that time, custody records are entered into the central file for the project.
- All project files are located in the central filing area. Security is maintained by limiting access to the area.
- Prior to the release of analytical results, the Document Controller or designee assembles and cross-checks information on sample tags, custody records, laboratory worksheets and notebook pages, instrument logs, and other relevant data to ensure that the data pertaining to each sample in a project is consistent throughout the project file.
- The Ceimic Document Controller is responsible for ensuring that all documents for a specific project are accounted for and are present in the file when the project is completed.

The Ceimic Document Controller notifies the department laboratory managers of the receipt of samples. The

laboratory managers schedule analysis for timely completion. Following analysis of the samples, each laboratory provides the required data and documentation to the Document Controller so that the project records may be assembled, reviewed, corrected if necessary, and sent to the client.

Laboratory notebook are maintained by the laboratory managers. These documents are archived in the respective laboratory.

The QA/QC Director is responsible with assistance from the laboratory managers for the preparation, revision, review and distribution of SOP's.

Each Laboratory maintains appropriate logbooks, which are periodically reviewed by the QA/QC Director. All logbooks are stored in the respective laboratories. The Document Control Officer periodically archives all inactive logbooks with archived cases in document storage.

The QA/QC Director with assistance from the appropriate supervisor reviews all problems with data and makes any necessary technical and documentation revisions.

The QA/QC Director interacts on a periodic basis with laboratory staff members but is directly responsible to the President of Ceimic. Specific responsibilities for sample and document flow within the laboratories are shown in Table 11-1, "Laboratory Sample and Document Flow".

Table 11-1
LABORATORY SAMPLE AND DOCUMENT FLOW

Activity	Documents	Personnel
Sample Receipt	Airbills, Receiving Reports, Chain-of-Custody Records, Sample Receipt Logs, Traffic Reports	Sample Custodian/ Receiving Clerk
Transfer to Storage	Sample Control Records	Sample Custodian
Preparation	Preparation Logs, Extraction Logs, Bench Sheets, Analysts' Notebook Pages	Sample Custodian/ Analyst
Transfer to Storage	Sample Control Records, Preparation Logs, Bench Sheets, Extraction Logs, Analysts' Notebook Pages	Analysts/ Sample Custodian
Transfer for Analysis	Sample Control Records	Sample Custodian/ Analyst
Analysis	Instrument (Run) Logs, Printouts, Strip Charts, Spectra, etc.	Analyst
	Analyst Data Sheets, Bench Sheets, Analysis Data Summaries, Analysts' Logbook Pages	Analyst
Data Review	Printouts, Strip Charts, etc. Analysis Data Sheets, Analysis Data Summaries, Review Sheets, Analysts' Logbook Pages	Reviewer
Assembly	Inventory Sheets	Document Control Officer

12.0 Calibration Procedures and Frequency

12.1 Instruments

Instrument calibration establishes that the system is functioning correctly and at a level of sensitivity sufficient to meet required detection limits. Routine calibration provides a means of rapid detection of instrument variance and possible malfunction, ensuring that data quality is maintained. Specific calibration and check procedures are given in SOP 001, SOP 002, and SOP 004. Frequency of calibration and concentration of standards are determined by the cited methods and special contract requirements, as well as manufacturer recommendations.

Standard calibration curves of signal response versus concentration are generated on each analytical instrument used for a project prior to analysis of samples. A calibration curve of the appropriate linear range is established for each parameter that is included in the analytical procedure employed and is verified on a regular basis with check standards. In general, Ceimic adheres to the calibration criteria specified by the EPA for the CLP for both organics and inorganics. For analyses outside of the CLP protocols, other specified calibration practices are stipulated and maintained. The following are examples of calibration procedures for various instrument systems.

12.1.1 GC

An initial calibration is performed using three different concentration levels for each parameter of interest. The initial calibration is done on each quantitation column and each instrument and is repeated each time a new column is installed or other major changes in the chromatographic system take place.

For CLP-type analyses, pesticide/PCB analysis requires an initial calibration sequence which includes a resolution check, a performance evaluation using the breakdown of DDT and Endrin, and relative percent difference criteria for each single component pesticide and surrogate, and three level calibration. The specific criteria are listed in SOP 002.

12.1.2 GC/MS

Initial calibration at five different concentration levels for each analyte is carried out for each system. Recalibration takes place whenever a major change occurs in the system, such as a column change in the GC or a source cleaning of the mass spectrometer. Continuing calibrations take

place every twelve hours of instrument analysis time and, for CLP-type analysis, must meet % Difference criteria and minimum RF criteria listed. These criteria are listed in SOP 001 for semi-volatile and SOP 004 for volatiles. Prior to analysis of any samples, GC/MS systems are tuned to EPA specifications for BFB and DFTPP for volatile and semi-volatile analyses, respectively. Verification of tuning criteria occurs every twelve hours of instrument run time.

12.1.3 ICP

Mixed standards are used to perform the initial multi-level calibration. Calibration check standards are analyzed every ten samples to verify instrument calibration. If the signal response of the check standard deviates by more than 10% from the initial calibration, the instrument is recalibrated. An interference control standard is run once every twenty samples to check interference correction inaccuracies.

12.1.4 AA

Several concentrations of individual standards are analyzed to establish the initial calibration curve for each metal. A

calibration check standard is analyzed at the beginning and end of every analysis and after every twenty samples to verify the initial calibration of the instrument. If a check standard falls outside the control limit of +/- 10% from the initial calibration, the instrument is recalibrated. Calibration blanks are analyzed at the beginning and end of the analysis and after every twenty samples during the analysis.

12.2 Standards, Reagents, Solvents and Adsorbants.

Primary sources of standard reference materials used for calibration, calibration checks, and accuracy control are the EPA and National Bureau of Standards (NBS) repositories. Reliable commercial manufacturers with CRADA and/or A2LA registration represent a secondary source. Certain projects, especially those involving pesticide registration, may necessitate the use of reference standards supplied by the client. New standards are routinely validated against known standards that are traceable to EPA or NBS reference materials, if possible.

Reagents used in the preparation of matrix spike, surrogate standard, and internal standard spiking solutions for EPA/CLP work are validated using

standards obtained directly from the EPA or traceable to it. Quality Control Check Samples from the EPA-EMSL Quality Assurance Branch in Cincinnati, from CDADA and A2LA vendors, and from NIST are analyzed by the Ceimic laboratories. Standards are checked by laboratory analysts on a daily basis, for concentration changes, and visually inspected for signs of deterioration, such as color change and precipitate formation. A Standards Preparation Logbook, which contains all pertinent information regarding the source and preparation of each analytical standard, is maintained by each of the Ceimic laboratories.

Reagents and solvents that are produced and used in large quantities, such as solvents, are examined for purity by subjecting an aliquot to analysis prior to purchase of an entire lot or shipment. If the material appears satisfactory, the manufacturer or supplier is requested to set aside a sizeable portion of the same lot for Ceimic to be shipped over several months.

Adsorbants recoveries are documented and compared with historical data.

13.0 Analytical Procedures

The analytical methods that Ceimic uses are contained in the documents cited below. The methods are summarized in Tables 10-1 and 10-2. In addition, Ceimic will use other methodology as required by the specific project or contract.

Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/4-82-057, July 1982.

Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79- 020, 3/83 Revision.

Standard Methods for the Examination of Water and Wastewater, 17th Edition, APHA, Washington, D.C. 1989.

Chemical Characteristics of Marine Samples, API Publication No. 4307, API, Washington, D.C.

Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, SW-846, 3rd Edition. Office of Solid Waste, USEPA, Washington, D.C.

Annual Book of ASTM Standards - Part 31-Water. American Society for Testing and Materials, Philadelphia, PA, 1981.

Contract Laboratory Program, Statement of Work for Organic Analysis, USEPA, OLMO1.8.

Contract Laboratory Program, Statement of Work for Inorganic Analysis, USEPA, ILMO2.0.

Table 13-1
INORGANIC ANALYTICAL METHODS SUMMARY

PARAMETER	METHOD DESCRIPTION	METHOD REFERENCE
Sample Preparation (Bulk Analysis)	Acid Description	Method 3050 (1)
Instrumental Analysis		
Antimony	AA-GF	Method 204.2 (2)
Arsenic	AA-GF	Method 206.2 (2)
Barium	ICP	Method 200.7 (2)
Beryllium	ICP	Method 200.7 (2)
Cadmium	AA-GF	Method 213.2 (2)
Chromium	ICP	Method 200.7 (2)
Copper	ICP	Method 200.7 (2)
Iron	ICP	Method 200.7 (2)
Lead	AA-GF	Method 239.2 (2)
Manganese	ICP	Method 200.7 (2)
Mercury	Cold Vapor AA	Method 245.5 (2)
Nickel	ICP	Method 200.7 (2)
Selenium	AA-GF	Method 270.2 (2)
Silver	ICP	Method 200.7 (2)
Sodium	ICP	Method 200.7 (2)
Thallium	AA-GF	Method 279.2 (2)
Zinc	ICP	Method 200.7 (2)
Other Metals, as Required	ICP	Method 200.7 (2)
Hexavalent Cr	Colorimetric Diphenylcarbizide	Method D1687-80 (3)
Cyanide (Total)	Distillation Colorimetric	Method 335.2 (2)
Cyanide (Amenable)	Chlorination Colorimetric Distillation	Method 335.1 (2)
Acidity	Titrimetric	Method 305.1 (2)
Alkalinity	Titrimetric	Method 310.1 (2)
pH	Electrometric	Method 150.1 (2)
Nitrate/Nitrite	Colorimetric Manual Cadmium Reduction	Method 353.3 (2)
Phosphorus	Colorimetric Ascorbic Acid	Method 365.3 (2)
Ammonia	Distillation Colorimetric	Method 350.2 (2)
Total Kjeldahl Nitrogen	Digestion Colorimetric Distillation	Method 351.3 (2)

Table 13-1
INORGANIC ANALYTICAL METHODS SUMMARY (Cont'd)

PARAMETER	METHOD DESCRIPTION	METHOD REFERENCE
Chloride	Titrimetric Mercuric Nitrate	Method 325.3 (2)
Biological Oxygen Demand (BOD)	5 days at 2°C	Method 405.1 (2)
Chemical Oxygen Demand (COD)	Colorimetric	Method 410.4 (2)
Fluoride	Potentiometric Specific Ion Electrode	Method 340.2 (2)
Phenols	Distillation Spectrophotometric	Method 420.1 (2)
Sulfate	Turbidimetric	Method 375.4 (2)
Conductivity	Specific Conductance	Method 120.1 (2)
Solids		
Total Dissolved (TDS)	Gravimetric Dried at 180°C	Method 160.1 (2)
Total Suspended (TSS)	Gravimetric Dried at 103-105°C	Method 160.2 (2)
Total Solids (TS)	Gravimetric Dried at 103-105°C	Method 160.3 (2)
Total Volatile (TVS)	Gravimetric Ignition at 550°C	Method 160.4 (2)
Total Settleable (SS)	Volumetric Imhoff Cone	Method 110.2 (2)
Color	Colorimetric Pt-Co	Method 110.2 (2)
Sulfide	Titrimetric Iodine	Method 376.1 (2)
Sulfite	Titrimetric	Method 377.1 (2)
Surfactants (mBAS)	Colorimetric)	Method 425.1 (2)

1. USEPA. 1982. Test Methods for Evaluating Solid Waste-Physical/Chemical Methods. SW-846 (2nd Ed.). Office of Solid Waste, EPA, Washington, DC.

2. USEPA. 1979. Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020 (Rev. 3/83). EPA/EMSL, Cincinnati, Ohio.

3. ASTM. 1981. Annual Book of ASTM Standards. Part 31-Water. American Society for Testing and Materials. Philadelphia, PA.

ICP - Inductively Coupled Argon Plasma Emission Spectroscopy
AA-GF - Graphite Furnace Atomic Absorption Spectrophotometry
AA - Atomic Absorption Spectrometry

Table 13-2
ORGANIC ANALYTICAL METHODS SUMMARY

PARAMETER	METHOD REFERENCE	METHOD DESCRIPTION
Volatile Organic Compounds (Aqueous)	Method 624 (1)	Purge and Trap, Gas Chromatography/Mass Spectrometry
Volatile Organic Compounds (Halogenated; Aqueous)	Method 601 (1)	Purge and Trap, Gas Chromatography/ Halogen-Specific (Hall) Detection
Volatile Organic Compounds (Aromatic; Aqueous)	Method 602 (1)	Purge and Trap, Gas Chromatography/ Photoionization Detection
Semi-Volatile Organics Acid/Base/Neutral Extractables (Aqueous)	Method 625 (1)	Solvent Extraction, Gas Chromatography/ Mass Spectrometry
Pesticides/PCBs (Aqueous)	Method 608 (1)	Solvent Extraction, Gas Chromatography/ Electron Capture Detection
Herbicides (Aqueous)	Method 509B (2)	Solvent Extraction, Derivatization, Gas Chromatography/Electron Capture Detection
Petroleum Hydrocarbons	Method 2/6 (3)	Solvent Extraction, Gas Chromatography/ Flame Ionization Detection
Oil and Grease	Method 413.1 (4)	Solvent Extraction, Gravimetric Determination
Solvents (Direct Aqueous Injection)	Method D2908-74 (5)	Direct Aqueous Injection, Gas Chromatography/Flame Ionization Detection

Table 13-2
ORGANIC ANALYTICAL METHODS SUMMARY (Cont'd)

1. USEPA. 1984. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. Appendix A. 40 CFR Part 136. Federal Register, Vol. 49, No. 209, 1984.

2. APHA. 1985. Standard Methods for the Examination of Water and Wastewater. Sixteenth Edition. American Public Health Association, Washington, DC.

3. Warner, J.S 1987. Chemical Characteristics of Marine Samples. API Publication No. 4307. API, Washington, DC.

4. USEPA. 1979. Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, Ohio.

5. ASTM. 1981. Annual Book of ASTM Standards. Part 31-Water. American Society for Testing and Materials, Philadelphia, PA.

14.0 Data Reduction, Review, and Reporting

14.1 Data Reduction

Instrumental printouts, terminal readings, chromatograms, strip chart recordings, and physical measurements provide raw analytical data that are reduced to concentrations of analytes through the application of appropriate equations. Equations are generally given within the analytical methods referenced in Section 10. Data reduction may be performed manually by scientists or automatically by computerized data systems on the instruments.

14.2 Data Review

Data review is an essential element of the QA evaluation component. Review is the process of data assessment and subsequent acceptance or rejection based on established criteria. The following criteria are employed by Ceimic in the evaluation of data:

- Accuracy requirements,
- precision requirements,
- detection limit requirements,
- completeness,
- representativeness,
- correctness (of manual and computer calculations),
- contractual requirements, and
- documentation requirements.

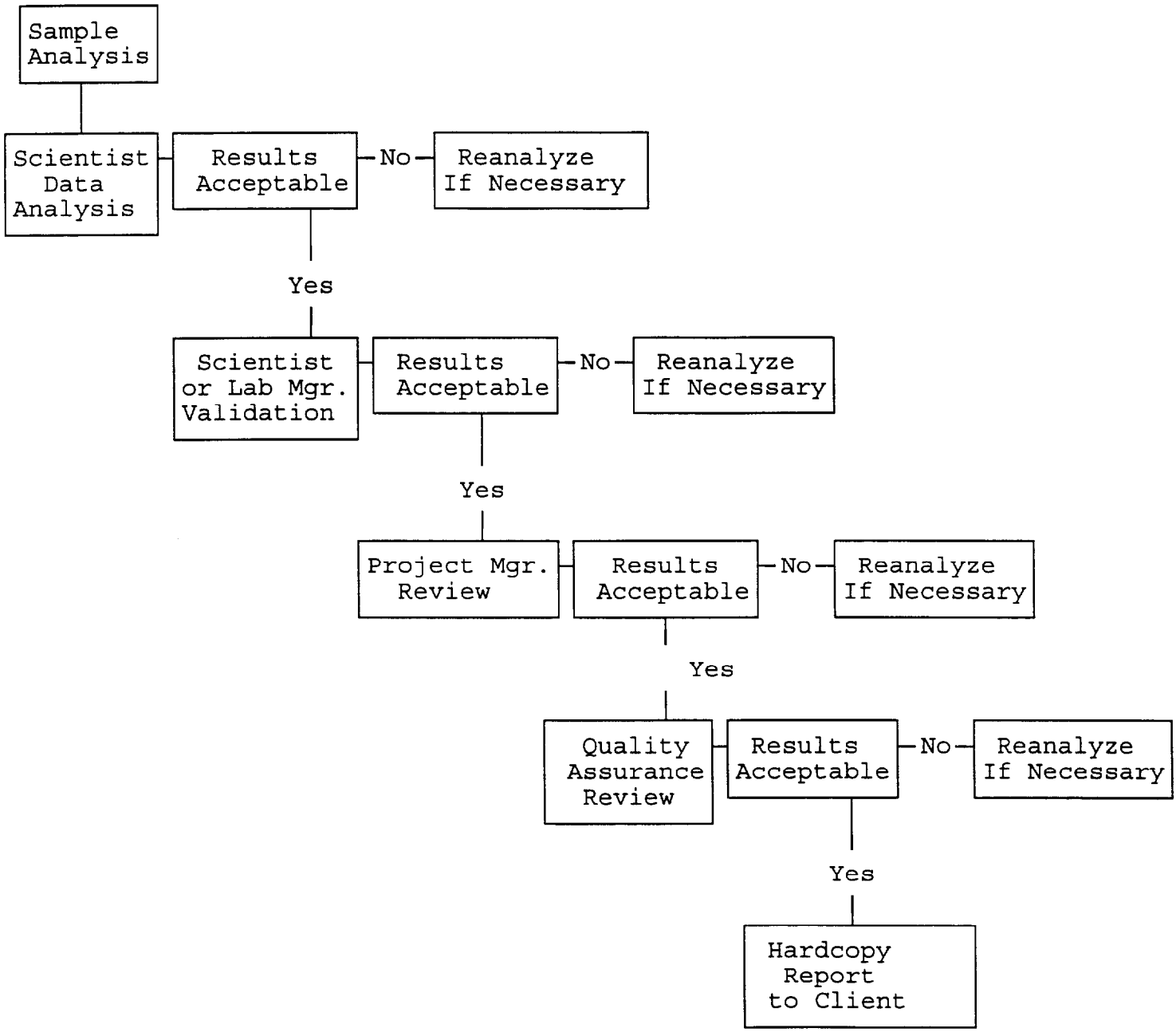
As in the case of EPA/CLP procedures, data acceptance limits may be defined within the method. The same windows are used for similar types of analyses if the sample matrix permits. As a tracking mechanism of data acceptability, quality control charts may be plotted for specific parameters determined in identical, homogeneous matrices. Control limits for methods development and research data may be statistically determined as analytical results are generated. Review includes data assessment at both the technical and editorial levels. Lab Managers and the QA/QC Director are responsible for technical review, which evaluates the application of analytical protocols and resultant effects on the data generated. The Data Reporting and Delivery Officer is responsible for editorial review, which assesses the content, lucidity, conciseness, and completeness of the data report. Corrective action may be initiated by the Laboratory Manager, QA/QC Director, or Data Reporting and Delivery Officer, and must be documented on a Corrective Action Form.

14.3 QA Reporting Relationships

Each analytical laboratory uses bench criteria checklists to assure that QC of analyses are within the SOW QC limits. The data generated is reviewed by the laboratory supervisor who logs computer file names of

acceptable analysis into the appropriate Laboratory Tracking Log. Analysts then reduce the data and prepare it for data input. Data review staff then review the data and forward it to data input staff. QA Formaster software (Finnigan MAT) is used to produce contract required deliverables and diskettes. The complete data package is reviewed by the Organic Laboratory Manager/Mass Spectral Interpretation Specialist. Records are maintained for all data, even for those results that are rejected as invalid. A flow chart showing the data reduction, validation, and reporting process is given in Figure 14-1.

FIGURE 14-1
DATA REPORTING PROCESS



15.0 Laboratory Quality Control

Ceimic analytical and field procedures are based on sound quality control methodology, which are derived from three primary sources:

- Standards for Good Laboratory Practice,
- specific EPA and other approved analytical methods, and
- "Handbook for Analytical Quality Control in Water and Wastewater Laboratories" (EPA 600/4-79-019).

In the application of established analytical procedures, Ceimic employs, at a minimum, the QC protocols described in the references found in the Analytical Methods section. Specific projects may require additional quality control measures due to such factors as difficult sample matrices or use of innovative techniques. For those projects, Ceimic will recommend and implement, subject to client approval, the QC measures necessary to produce data of known quality.

15.1 General QC Protocols

Each of the Ceimic laboratories has an individual QC program which includes, but is not limited to, the practices described below:

15.1.1 General QC Protocols - Organics Laboratory

- Trip blanks and holding blanks, when applicable, to detect contamination during sample shipping, handling, and storage.
- Procedural blanks, at a minimum of one in every 20 samples, to detect contamination during analysis.

- One matrix spike of laboratory water or soil every 20 samples to determine accuracy.
- One matrix spike duplicate of laboratory water or soil every 20 samples to determine precision.
- One Laboratory Control Spike is included with each batch of samples to determine accuracy.
- One Laboratory Control Spike Duplicate is included with each batch of sample to determine precision.
- Sample spikes and spike duplicates, as requisitioned by CLP, to determine accuracy and the presence of matrix effects.
- Check samples periodically to document accuracy.
- Performance evaluation samples from EPA to verify continuing compliance with EPA QA/QC standards.
- Surrogate standards and calculation of recoveries to determine matrix effects.
- Internal standards for GC/MS analysis to account for sample-to-sample variation.
- GC analysis of EPA traceable standards to verify working standard accuracy and instrument performance.
- Initial multi-level calibration of instruments to establish calibration curves.
- Daily calibration of instruments.
- Tuning of GC/MS systems once every 12 hours to EPA specifications for consistency in data generation.
- Control limits to determine acceptability.

15.1.2 General QC Protocols - Metals Laboratory

- Analysis by ICP (inductively coupled plasma spectroscopy) or flame atomic absorption spectroscopy for most metals.
- Analysis by Zeeman effect graphite furnace atomic absorption spectroscopy for low

concentrations of certain metals.

- Initial and continuing calibration blanks and procedural blanks to detect instrumental or laboratory contamination.
- Initial multi-level calibration of instruments to establish calibration curves by individual standards (AA) or mixed standards (ICP).
- Check standards every ten samples to verify instrument calibration.
- Control limit of +/- 10%; recalibration if check standard deviates by more than 10% from initial calibration.
- One matrix spike of laboratory water or soil every 10 samples to determine accuracy for AA analysis.
- One Laboratory Control Spike is included with each batch of samples to determine accuracy.
- One Laboratory Control Spike Duplicate is included with each batch of samples to determine precision.
- One sample spike of one element every 10 samples to determine accuracy and matrix effects for AA analysis.
- Method of standard additions if sample spike recovery falls outside +/- 15% control limit for AA analyses.
- One sample duplicate every 20 samples to determine precision and matrix effects for AA and ICP analyses.
- Interference control standard every 20 samples to check interference correction inaccuracies for ICP analyses.
- Check samples every 20 samples to document accuracy.
- Performance evaluation samples from EPA to verify continuing compliance with EPA QA/QC standards.

15.1.3 General QC Protocols - Classical Chemistry Laboratory (Cyanide/Mercury)

- One procedural blank per sample batch (minimum of 1 per 20 samples) to detect contamination during analysis.
- One matrix spike of laboratory water or soil every 20 samples to determine accuracy.
- One matrix spike duplicate of laboratory water or soil every 20 samples to determine precision.
- One sample spike every 20 samples to determine accuracy and matrix effects.
- One sample duplicate every 20 samples to determine precision and matrix effects.
- One Laboratory Control Spike is included with each batch of samples to determine accuracy.
- One Laboratory Control Spike Duplicate is included with each batch of samples to determine precision.
- Check samples periodically to document accuracy.
- Performance evaluation samples from EPA to verify continuing compliance with EPA QA/QC standards.
- Initial multi-level calibrations to establish calibration curves.
- Calibration checks to verify calibration.

  Cyanide (CN) - every 5 samples
  Mercury (Hg) - every 10 samples

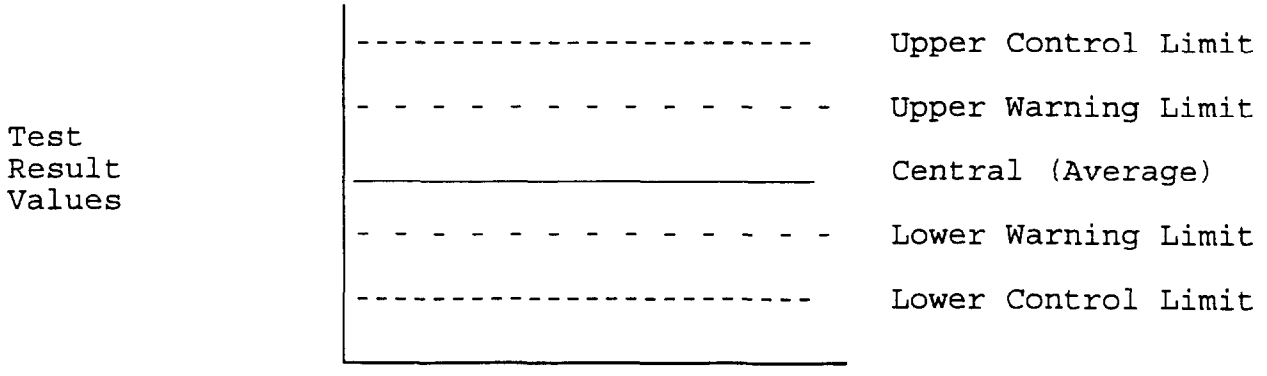
- Control limits to determine acceptability.

15.2 Control Charts

Control charts are used to monitor the variations in the analyses routinely performed by the laboratory and are intended to detect trends in these variations. Construction of a control chart requires an initial database of 20 points. As shown in Figure 15-1, the control chart limits and order of results are plotted

on the horizontal scale against a vertical scale which is in units of the test result. The upper and lower control limits shown on the chart are used as criteria for action. The central line represents the average or the standard value of the statistical measure being plotted.

Figure 15-1
ESSENTIALS OF A CONTROL CHART



Ceimic shall employ a measurement control program that will monitor the results of laboratory preparation and analysis of control samples using statistical control charts. Laboratory blank water, should be spiked with analyte(s) of interest. These are listed in Table 15-1.

Table 15-1
SPIKE COMPOUNDS

Semi-volatile Analysis Compounds

phenol
2-chlorophenol
acenaphthene
1,2,4-trichlorobenzene

Volatile Analysis Compounds

1,1-Dichloroethene
toluene

Pesticide/PCB Analysis Compounds

Aldrin
4,4'-DDT

Furnace Metals

As
Se
Pb
Tl

ICAP Metals

Cu

Cold Vapor

Hg

Cyanide

Cn

The spike solutions utilized for spikes shall be prepared as are other standard and spiking solutions in the laboratory and added to the blank water at sample preparation or analysis. It will be noted directly on the control chart when a change in spike solution occurs so as to flag any recovery fluctuations as possibly reflecting the use of a new batch. Aqueous spike samples and soil spike samples for the metals and cyanide are provided by the ICF branch of EPA-LV.

A control sample shall be introduced into each batch of water or soil samples analyzed. A batch will be defined by the number of samples grouped together for QC purposes; not-to-be-exceeded control limits will be established using the following calculations:

Average$=\bar{X}=(1/n)(X_1 + X_2 + X_3 + \ldots + Xn)$, where n = >20.

The estimate of the standard deviation is given by:

$S = \{ (x-\bar{x})^2/n-1 \}^{1/2}$

Table 15-2 lists control chart parameter estimations.

Table 15-2
CONTROL CHART PARAMETER ESTIMATION

Parameter	Symbol	Formula
Centerline	CL	$\bar{X}$
Upper Control Limit	UCL	$\bar{X} + 3S$
Lower Control Limit	LCL	$\bar{X} - 3S$
Upper Warning Limit	UWL	$\bar{X} + 2S$
Lower Warning Limit	LWL	$\bar{X} - 2S$

15.3 Chart Analyses

If the warning limits (WL) are at the 95% level, 1 out of 20 points, on the average, would exceed that limit, whereas only 1 out of 100 would exceed the control limits (CL). Take the following actions, which are based on these statistical parameters.

15.3.1 Control Limit

If one measurement exceeds a control limit, repeat the analysis immediately. If the repeat is within the control limit, continue analysis; if it exceeds the control limit, discontinue analysis and correct the problem.

15.3.2 Warning Limit

If two out of three successive points exceed a WL, analyze another sample. If the next point is less than WL, continue analysis; if the next point exceeds WL, discontinue analysis and correct the problem.

15.3.3 Standard Deviation

If four out of five successive points exceed 1S or are in decreasing or increasing order, analyze another sample. If the next point is less than 1S or changes the order, continue analysis; otherwise, discontinue analysis and correct the problem.

15.3.4 Central Line

If six successive samples are above the central line, analyze another sample. If the next point is below the central line, continue analysis; if the next point is on the same side, discontinue analysis and correct the problem. The above considerations apply when the conditions are either above or below the central line, but not on both sides (e.g., four of five values must exceed either +1S or -1S). After correcting the problem, reanalyze half the samples analyzed between the last in-control measurement and the out-of-control one. (Standard Method of Analysis for the Examination of Water and Waste Water. 1989, 17th Edition.)

15.4 Evaluation Criteria for Method Blank

15.4.1 Metals

An initial calibration blank, continuing calibration blank, and a preparation blank (reagent blank) are prepared and analyzed

with every sample group. The preparation blank is subdivided into two samples just prior to analysis. One preparation blank is spiked for graphite furnace analysis. The criteria for acceptance of the blank samples is stated below.

15.4.1.1 Initial and Continuing Calibration Blanks

A calibration blank is analyzed immediately after every initial and continuing calibration verification at a frequency of 10% or every two hours, whichever is more frequent. A blank is analyzed at the beginning of the run and after the last sample. If the absolute value of the blank exceeds the contract required detection limit (CRDL), the analysis is terminated. The analytical system is recalibrated, and all analytical samples are reanalyzed since the last good calibration blank.

15.4.1.2 Preparation Blank

The preparation blank or reagent blank consists of distilled water and is processed through sample preparation and analysis. Contamination of the samples is determined by the following criteria:

- If the absolute value of the blank ≤ the CRDL, the sample result is not corrected.
- If the blank is > the CRDL and the sample result is 10x the blank, the result is not corrected.
- If the blank is > the CRDL and the sample result is < 10x the blank, the samples associated with the blank are redigested and reanalyzed.
- If the blank is < the negative CRDL, all samples < 10x the CRDL are redigested and reanalyzed.

15.4.2 Organics

A method blank consists of reagent water in a volume approximate to the samples being analyzed. One blank is processed through sample preparation and analysis with each set of samples. Method interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are minimized. If the method blank exceeds the acceptance criteria, the analytical system is out of control and the source of the problem is investigated. Corrective action is employed and documented before analysis is continued. All samples processed with an out-of-control blank are reextracted, repurged, and reanalyzed. Acceptance criteria are below.

15.4.2.1 Volatiles Acceptance Criteria

- The method blank must contain ≤ 5x the contract required quantitation limit (CRQL) of methylene chloride, acetone, toluene, and 2-butanone.
- The method blank must contain ≤ the CRQL for all other target compounds.

15.4.2.2 Semi-volatile Acceptance Criteria

- The method blank must contain ≤ 5x the CRQL of the pathalate.
- The method blank must contain ≤ the CRQL for all other target compounds.

15.4.2.3 Pesticides/PCBs Acceptance Criteria

- The method blank must contain ≤ the CRQL of every pesticide/PCB target compound.

15.5 QC Level Protocols

Five general levels of analytical options to support data collection are identified by CERCLA. They are Levels 1 through 5, as described in the EPA "Data Quality Objectives for Remedial Response Activities Development Process." The Navy has adopted three of the analytical levels as QC requirements. They are C, D, and E, which correlate with EPA Levels 3, 4, and 5.

Ceimic routinely performs analyses using quality control protocols equivalent to Level D. As an option, Ceimic provides multiple levels of QC, based on the type of site being investigated, the level of accuracy and precision required, and the intended use of the data. It is the client's responsibility to specify the level of quality control required to support his or her

data quality objectives for making project decisions. The specific quality control requirements for each level of quality are detailed in NEESA 20.2-047B.

16.0 Quality Assurance Systems Audits, Performance Audits, and Frequency

As a participant in several certification programs and various contracts, the Ceimic laboratory is frequently subjected to rigorous performance evaluations and on-site inspections by regulatory agencies and commercial clients. The Ceimic Quality Assurance staff performs routine internal audits of the laboratory as well. The audits ensure that all laboratory systems, including sample control, analytical procedures, data generation, and documentation, meet contractual requirements and comply with good laboratory practice standards.

16.1 Systems Audits

The Director of the Laboratory Approval Program for the Department of Environmental Management (DEM) in the State of Rhode Island recently inspected the Ceimic laboratory facilities as part of the Rhode Island certification process.

The Ceimic laboratories are audited routinely by QA staff members in order to detect any problems in sample flow, analytical procedures, or documentation problems and to ensure adherence to the good laboratory practices as described in Ceimic laboratory operating manuals. The items covered in an internal systems audit at Ceimic are outlined on a general basis in Figure 16-1.

16.2 Performance Audits

The Ceimic laboratories are also subject to frequent performance audits. The states of Rhode Island, New York, Pennsylvania, New Jersey, and New Hampshire perform biannual on-site laboratory audits. Chemical waste Management, the Army Corps of Engineers, and NEESA performed on-site audits before admitting Ceimic into their programs. The Contract Laboratory Program performs a pre-award audit prior to awarding CLP contracts. These audits look at laboratory operations and follow an outline similar to figure 16-1.

The QA/QC Director is responsible for documentation and resolution of audit findings.

Figure 16-1
AUDIT OUTLINE

Laboratory Audit - General Considerations

- o Sample Flow-Through Lab
- o Chain-of-Custody
  - Usual
  - Strict
- o Sample Storage
  - Controlled Access
  - Proximity to Chemical Storage
  - Physical Conditions, e.g. Temperature
  - Holding Times
- o Sample Workup and/or Analysis
  - SOP's
  - Logbooks
    - * Standards Preparation
    - * Instruments - Sample Analysis
    - * Calibration/Tune
    - * Standards Analyses
    - * Check Samples
    - * Balance
    - * Temperature
  - Notebooks
    - * Dates
    - * Signature
    - * Filled Pages
    - * Initialed Errors with Single-line Crossouts
    - * Units Recorded
  - QC Samples
    - * Blanks
    - * Spikes
    - * Duplicates
    - * Surrogates
    - * Control Charts
- o Data File Storage
  - Hard Copies
  - Other Media - Magnetic Tape, Disk
- o Laboratory Safety
- o Organization, Order Sampling
- o Container Preparation
- o Preservative(s)
- o Techniques
- o QC Access - Corrective Action Forms

The EPA CLP requires successful performance of pre-award Performance Evaluation samples prior to acceptance into the program. Once established in the program, a lab must continue to demonstrate performance capabilities by successfully analyzing blind samples sent by the EPA each quarter. Ceimic also participates in the Water Supply (WS) and Water Pollution (WP) Series of PE's sponsored by the Quality Assurance Branch of the EPA. Successful analyses of these samples are required as part of the laboratory certification process for the environmental agencies of several states.

Table 16-1
CEIMIC PERFORMANCE EVALUATIONS

Agency/Program	Parameter(s)	Date
1. USEPA-EMSL/Water Supply Study (WS028)	VOA, Pesticides/ PCBs, Metals	8/91
2. USEPA-EMSL/Water Pollution Study (WP027)	VOA, Pesticides/ PCBs, Metals	12/91

Performance is monitored internally on a daily basis at Ceimic through the use of surrogate standards and matrix control samples. Check samples obtained from EPA-EMSL, Cincinnati, QA Branch, and from independent commercial sources are employed routinely in each of the Ceimic laboratories and ensure continuing high-level performance.

17.0 Preventive Maintenance

Preventive maintenance is a routine practice at Ceimic for each analytical instrument. Scheduled preventive maintenance minimizes instrument downtime and consequent interruption of analysis. The laboratory personnel at Ceimic are familiar with maintenance requirements of the instruments they operate. This familiarity is based on conventional education, specialized courses, and hands-on experience. Designated staff members are trained at manufacturer facilities in the routine maintenance procedures for major analytical instrumentation. An example logbook page for GC/MS routine maintenance is presented as Figure 17-1.

All GC/MS instruments and data systems are covered by a service contract. This includes preventative maintenance visits every six months. Instrument operators perform source cleanings and change columns and traps as necessary.

GC/EDC wipes are analyzed three times a year, and the injection ports and detector are cleaned between each initial calibration, every one to three weeks.

Ceimic maintains an inventory of replacement parts required for preventive maintenance and spare parts that often need replacement, such as electron multipliers for GC/MS systems and the more mundane fuses and ferrules. In the case of a downed instrument, the problem is diagnosed as quickly as possible. If necessary, replacement parts are

ordered and repairs performed by skilled in-house personnel. Key instrumentation is maintained under service contract. As a third option, a service call is placed with the manufacturer. Instrument problems and repairs are documented in logbooks kept in each laboratory; an example is given in Figure 17-2.

Figure 17-1
GC/MS ROUTINE INSTRUMENT MAINTENANCE
FOR SEMI-VOLATILES

Figure 17-1
GC/MS ROUTINE INSTRUMENT MAINTENANCE
FOR SEMI-VOLATILES

GC/MS ROUTINE INSTRUMENT MAINTENANCE FOR SEMI-VOLATILES

DATE	OPER.	INSTR. ID	SEPTUM CHANGED	LINER CHANGED	NEW O-RING	COLUMN MAINTENANCE FRONT-END	DETECTOR-END	OTHER	COMMENTS

Figure 17-2
GC/MS NON-ROUTINE INSTRUMENT MAINTENANCE

GC/MS NON-ROUTINE INSTRUMENT MAINTENANCE

Instrument: _____ Problem Site: _____

Date Reported: _____ By: _____ GC _____

Date Resolved: _____ By: _____ Gas Line _____

Comments on Repair: _____ Detector _____

_____ Other (Describe) _____

_____ _____

_____ _____

Description of Problem:

Resolution:

18.0 Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness

Precision, accuracy, and completeness are discussed in Section 6 as well.

18.1 Precision

Precision is frequently determined by the comparison of replicates, where replicates result from an original sample that has been split for identical analyses. Standard deviation of a sample is commonly used in estimating precision.

Sample standard deviation:

$$s = \{[1/(n-1)] \times \sum_{i=1}^{n} (x_i - x)^2\}$$

where a quantity x (e.g., a concentration) is measured n times with a mean, x.

The relative standard deviation, RSD (or sample coefficient of variation, CV), which expresses standard deviation as a percentage of the mean, is generally useful in the comparison of three or more replicates (although it may be applied in the case of n=2).

$$RSD = 100\ (s/\bar{x})$$

or

$$CV = 100\ (s/\bar{x})$$

where:

RSD = relative standard deviation, or
CV = coefficient of variation
s = standard deviation
x = mean

In the case of duplicates--samples that result when an original sample has been split in two for identical analyses--the % Difference between the two samples may be used to estimate precision:

$$\% \text{ Difference} = \{2 \times (D_1 - D_2)/(D_1 + D_2)\}$$

where:

% Difference = percent difference
D_1 = first sample value
D_2 = second sample value (duplicate)

18.2 Accuracy

The determination of accuracy of a measurement requires a knowledge of the true or accepted value for the signal being measured. Accuracy may be calculated in terms of bias as follows:

$$\text{Bias} = X - T$$
$$\% \text{ Bias} = 100\ (X - T)/T$$

Where:

X = average observed value of measurement
T = "true" value

Accuracy may also be calculated in terms of the recovery of spiked samples.

$$\% \text{ Recovery} = 100\ \{\bar{X}/T\}$$

18.3 Completeness

Determining whether a database is complete or incomplete may be quite difficult. To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. Less obvious is whether the data

are sufficient to achieve the goals of the project. All data are reviewed in terms of goals in order to determine if the database is sufficient.

Where possible, the percent completeness for each set of samples is calculated as follows:

$$\frac{\text{valid data obtained} \times 100}{\text{total data planned}} = \%\ \text{Completness}$$

19.0 Corrective Action

An essential element of the QA Program, Corrective Action provides systematic, active measures to be taken in the resolution of problems and the restoration of analytical systems to proper functioning.

19.1 Laboratory Corrective Action

Corrective actions for laboratory problems are described in Ceimic laboratory operating manuals. Personal experience often is most valuable in alerting the bench scientist to suspicious results or malfunctioning equipment. Specific QC procedures are listed in SOP 001, SOP 002, and SOP 004, and are designed to help analysts determine the need for corrective actions (see Section 14, "Data Reduction, Validation, and Reporting"). Corrective actions taken by scientists in the laboratory help to avoid the collection of poor quality data.

Examples of conditions that may warrant corrective actions are given below:

- Tuning or calibration of instruments outside of specifications.
- QC data for precision and accuracy outside of acceptance limits.
- Undesirable trends in concentration, surrogate and spike recoveries, response factors, or relative % Difference.
- Abnormal variation in detection limits.
- Check sample results out of range.

19.2 Corrective Action Request Forms

Problems not immediately detected during the course of analysis may require more formalized, long-term corrective action. The essential steps in the corrective action system are:

- Identify and define the problem.
- Assign responsibility for investigating the problem.
- Investigate and determine the cause of the problem.
- Determine a corrective action to eliminate the problem.
- Assign and accept responsibility for implementing the corrective action.
- Establish effectiveness of the corrective action and implement it.
- Verify that the corrective action has eliminated the problem.

This scheme is generally accomplished through the use of Corrective Action Request Forms (Figure 16-1), available to all Ceimic staff members. Using this form, any laboratory scientist or project manager may notify the QA/QC Director of a problem. The QA/QC Director initiates the corrective action by relating the problem to the appropriate laboratory managers and/or project managers who then investigate or assign responsibility for investigating the problem and its cause. Once determined, an appropriate corrective

action is approved by the QA/QC Director. Its implementation is later verified through a laboratory audit.

Information contained on Corrective Action Forms is kept confidential within Ceimic and is generally limited to the individuals involved. Severe problems and difficulties may warrant special reports to the President of Ceimic, who will ensure that the appropriate corrective actions are taken.

Figure 19-1
CEIMIC QUALITY ASSURANCE CORRECTIVE ACTION REQUEST FORM

CEIMIC CORPORATION
Quality Assurance Corrective Action Request

Originator: _____ Date: _____

Laboratory: _____ Project: _____

Problem: _____

_____

_____

_____

_____

_____

Action Planned: Implemented:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

20.0 Quality Assurance Reports to Management

The QA/QC Director submits a QA report each quarter to the President of Ceimic and the laboratory managers. The report contains detailed information on QA activities during the previous three months including:

- Summary of systems and audits
- PE samples analyzed and scores received
- Status of certifications
- Laboratory QA/QC review
- Problems and corrective actions
- Comments and recommendations

In the case of a severe problem or difficulty, a special report is prepared by the QA/QC Director and submitted in a timely manner to the management.

21.0 Facilities and Instrumentation

Ceimic's laboratories are located in a 12,500 square foot, one-story building. Approximately 4,400 square feet are actual laboratory space, 5,000 square feet are offices and support areas, and another 2,500 square feet are designated as a storage area.

21.1 Sample Receipt

All sample shipments received at Ceimic are sent to the Sample Receipt Room, where the Sample Custodian open coolers inspects them, signs appropriate document, initials appropriate paperwork, labels and stores samples.

This room is ventilated with an exhaust fan, and is set aside for sample storage and receipt; no standards are stored in this room. Semi-volatile and Pesticide/Aroclor samples are stored in refrigerators in the Sample Receipt Room. There are nine refrigerator/freezers in this room. Volatile samples are stored in 3 refrigerators in the Volatile Organics Laboratory.

21.2 Organic Laboratories

The organic laboratories consist of two preparation laboratories, Organic Preparation Laboratory 1 and 2, and two instrument rooms (Volatile Organics and Semi-Volatile Organics/Pesticides/PCB's). Organic Preparation Laboratory 1 is a large (1,170 sq. ft.) laboratory for the routine preparation of environmental samples. Organic Preparation Laboratory

2 is a smaller (324 sq. ft.) area where environmental samples that require special handling are prepared.

The Volatile Organic Analysis (VOA) Instrument Room (750 sq. ft.) is situated well apart from the Organic Preparation Laboratories to avoid contamination of VOA samples by solvents used in these preparation laboratories.

The Base Neutrals and Acid Extractables (BNA or semi-VOA) and Gas Chromatography (GC) Instrument Room (850 sq. ft.) is located between the VOA Instrument Room and the organic preparation laboratories.

The Organic Preparation Laboratory 1 contains 90 linear feet of bench space and will initially be outfitted with three (3) 6′ fume hoods. Bench space has been allocated for three additional fume hoods. This laboratory contains a 2′ x 8′ solvent storage room with a "blow-out" roof exposure. A Millipore Mili-Q ultrapure water system is located in this laboratory. Standard organic laboratory equipment located in this laboratory includes:

- muffle furnace
- drying oven
- sonicator
- analytical balance (0.1 mg accuracy)
- soxhlet extractors
- Rotovaps
- water baths
- continuous liquid-liquid extractors

The Organic Preparation Laboratory 2 has 40 linear feet of bench space and two (2) 6' fume hoods. Standard organic laboratory equipment located in this laboratory include:

- Rotovaps
- Soxhlet extractors

The VOA Instrument Room contains 64 linear feet of bench space and a canopy hood and sink bench (6 linear feet). This instrument room is equipped with six Hewlett Packard 5970 GC/MS units and three Hewlett-Packard 1000 RTE-A data system and accessories.

Three (3) GC/MS's are equipped with 1% SP-1000 packed columns and glass jet separators. The other three GC/MS's are equipped with DB-624 0.53 ID megabore columns and glass jet separators. The computer hardware is capable of acquiring continuous mass scans for the duration of the chromatographic program. There is also a Hewlett-Packard 5890 GC with dual Hall and PID capabilities.

The BNA/GC Instrument Room contains 84 linear feet of bench space and a canopy hood and sink bench (6 linear feet). This instrument room is equipped with four Hewlett-Packard 5970 GC/MS's and eight Hewlett-Packard 5890-A GC's. Each GC/MS is equipped with a 30 meter 0.32 mm DB-5 fused silica capillary column extended directly into the ion source. Seven GC's are outfitted with dual electron capture detectors

(ECD's) and automatic samplers; the other GC has FID and NPD dual capabilities. There is an additional GC in the organic prep lab with dual FID detectors.

Each computer (HP1000 RTE-A) is equipped with a magnetic tape storage device for saving all data from the GC/MS runs. The computer software allows the searching of GC/MS runs for specific ions and plotting the intensity of the ions with respect to time or scan number. The software also has the capability of identifying non-target compounds, by comparing sample spectra against the NBS 49K mass spectral library. All manually edited data files are flagged by the data systems. Data generated by the GC's is off-loaded onto an HP1000 RTE-A data system, HP 3396A integrators are also available.

21.3 Inorganic Laboratories

The inorganic laboratories are divided into an Inorganic Preparation/Wet Chemistry Laboratory (950 sq. ft.) and an Inorganic Instrument Room (350 sq. ft.).

Samples will be received and initially stored in a designated Sample Receiving Room (320 sq. ft.), directly adjoining the entrance hall of the Ceimic building. Additional sample storage space is available in the 2,500 sq. ft. storage area.

The inorganic laboratories are divided into an Inorganic Preparation/Wet Chemistry Laboratory (950 sq. ft.) and two Inorganic Instrument Rooms (590 sq. ft.).

Inorganic Instrument Room one, contains the AA and CVAA instruments, while room two contains the ICAP.

Samples will be received and initially stored in a designated Sample Receiving Room (320 sq. ft.), directly adjoining the entrance hall of the Ceimic building. Additional sample storage space is available in the 2,500 sq. ft. storage area.

The Inorganic Preparation/Wet Chemistry Laboratory has 131 linear feet of bench space, two (2) 6′ fume hoods, and two 4′ class 100 clean benches. Space is allocated for a third fume hood. In addition, the inorganic laboratory has eight feet of hood space dedicated to the twelve cyanide distillation columns. This facility also contains two spectrophotometers and two mercury analyzers. Standard inorganic laboratory equipment includes:

- Class A analytical balance (0.1 mg accuracy)
- Two electronic top loading balances (1 mg and 10 mg accuracy)
- Two drying ovens
- A CEM microwave digestion oven
- A pH/Selective Ion Meter (0.001 sensitivity)
- Air compressor and storage tank
- Water Bath
- Vacuum pump

The first Inorganic Instrument Room is equipped with four Graphite Furnace Atomic Absorption Spectrophotometer with Zeeman Background Correction,

two Perkin Elmer 5100Zs and two Perkin Elmer 5100ZLs. In addition, this room contains a Leeman Labs PS200 Automated Cold Vapor Mercury Analyzer. The second instrumentation area house two inductively coupled argon plasma emission spectrophotometers, a Thermo Jarrell Ash simultaneous instrument and a Perkin Elmer P-40 sequential instrument.

21.4 Laboratory Facility

LABORATORY FACILITY

	Square Feet	Bench Area Linear Feet
Office Space	5,000	
Sample Receipt	2,820	
Receptionist's Space	400	
GC/MS - VOA	750	85
GC/MS - BNA/ Pest/PCB's	850	110
Organic Prep Lab	1,494	170
Inorganic Prep Lab	950	131
Inorganic Instrument Areas	590	25
Chemical Storage Area	50	
Gas Cylinder Storage Area	100	
Hazardous Waste Storage Area	100	
File Storage Area	1,896	
TOTAL	15,000	520

SAMPLE ANALYSIS INSTRUMENTATION DETAIL

GC/MS/DS INSTRUMENTATION

ID	Manufacturer	Model/Revision	Installation Date
GC/MS ID#1	Hewlett-Packard	5890 GC 5970 MSD	Nov. 1988
GC/MS ID#2	Hewlett-Packard	5890 GC 5970 MSD	Nov. 1988
GC/MS ID#3	Hewlett-Packard	5890 GC 5970 MSD	Nov. 1988
GC/MS ID#4	Hewlett-Packard	5890 GC 5970 MSD	Nov. 1988
GC/MS ID#5	Hewlett-Packard	5890 GC 5970 MSD	May 1990
GC/MS ID#6	Hewlett-Packard	5890 GC 5970 MSD	May 1990
GC/MS ID#7	Hewlett-Packard	5890 GC 5970 MSD	June 1991
GC/MS ID#8	Hewlett-Packard	5890 GC 5970 MSD	June 1991
GC/MS ID#9	Hewlett-Packard	5890 GC 5970 MSD	June 1991
GC/MS ID#10	Hewlett-Packard	5890 GC 5970 MSD	June 1991
Data System ID#1	Hewlett-Packard	H-P 1000 RTE A	Nov. 1988
Data System ID#2	Hewlett-Packard	H-P 1000 RTE A	June 1989

GC/MS/DS INSTRUMENTATION CONTINUED

ID	Manufacturer	Model/Revision	Installation Date
Data System ID#3	Hewlett-Packard	H-P 1000 RTE A	May 1990
Data System ID#4	Hewlett-Packard	H-P 1000 RTE A	June 1991
Data System ID#5	Hewlett-Packard	H-P 1000 RTE A	June 1991
NBS Mass Spectral Library	NIH/EPA		Nov. 1988
Purge and Trap ID#1	Tekmar	LSC 2000	Nov. 1988
Auto Sampler	Tekmar	2016	Nov. 1988
Purge and Trap ID#2	Tekmar	LSC 2000	Nov. 1988
Auto Sampler	Tekmar	2016	Nov. 1988
Purge and Trap ID#3	Tekmar	LSC 2000	Nov. 1988
Auto Sampler	Tekmar	2016	June 1991
Purge and Trap ID#4	Tekmar	LSC 2000	May 1990
Auto Sampler	Tekmar	2016	May 1990

GC/MS/DS INSTRUMENTATION CONTINUED

ID	Manufacturer	Model/Revision	Installation Date
Purge and Trap ID#5	Tekmar	LSC 2000	May 1990
Auto Sampler	Tekmar	2016	May 1990
Purge and Trap ID#6	Tekmar	LSC 2000	June 1991
Auto Sampler	Tekmar	2016	June 1991
Purge and Trap ID#7	Tekmar	LSC 2000	June 1991
Auto Sampler	Tekmar	2016	June 1991

GC INSTRUMENTATION

ID	Manfacturer	Model	Date	Detector
GC ID#1	Hewlett-Packard	5890	Nov. 1988	ECD ECD
GC ID#2	Hewlett-Packard	5890	Nov. 1988	FID NPD
GC ID#3	Hewlett-Packard	5890	Nov. 1988	ECD ECD
GC ID#4	Hewlett-Packard	5890	Nov. 1988	PID ELCD
GC ID#5	Hewlett-Packard	5890	Sept. 1989	ECD ECD
GC ID#6	Hewlett-Packard	5890	Aug. 1989	ECD ECD
GC ID#7	Hewlett-Packard	5890	May 1990	ECD ECD
GC ID#8	Hewlett-Packard	5890	May 1990	ECD ECD
GC ID#9	Hewlett-Packard	5890	June 1991	ECD ECD
GC ID#10	Hewlett-Packard	5890	June 1991	FID FID
Data System ID#0	Hewlett-Packard	HP-1000 A900 RTE A	May 1991	
Data System ID#1	Hewlett-Packard	3396B	Sept. 1988	

GC INSTRUMENTATION CONTINUED

ID	Manfacturer	Model	Installation Date
Auto Sampler	Hewlett Packard	18593B	Nov. 1988
Auto Sampler	Hewlett Packard	18593A	Nov. 1988
Auto Sampler	Hewlett Packard	18593B	Nov. 1988
Auto Sampler	Hewlett Packard	18593A	Nov. 1988
Auto Sampler	Hewlett Packard	18593A	Nov. 1988
Auto Sampler	Hewlett Packard	18593A	Sept. 1989
Auto Sampler	Hewlett Packard	18593A	Sept. 1989
Auto Sampler	Hewlett Packard	18593B	May 1990
Auto Sampler	Hewlett Packard	18593B	May 1990
Auto Sampler	Hewlett Packard	18593B	May 1990
Auto Sampler	Hewlett Packard	18593A	May 1990
Auto Sampler	Hewlett Packard	18593A	May 1990
Auto Sampler	Hewlett Packard	18593B	June 1991
Auto Sampler	Hewlett Packard	18593B	June 1991
Auto Sampler	Hewlett Packard	18593A	June 1991

GC INSTRUMENTATION CONTINUED

ID	Manfacturer	Model	Installation Date
Data System ID#2	Hewlett-Packard	3392A	Aug. 1988
Data System ID#3	Hewlett-Packard	3396B	Nov. 1988
Data System ID#4	Hewlett-Packard	3396A	Nov. 1988
Data System ID#5	Hewlett-Packard	3396A	Nov. 1988
Data System ID#6	Hewlett-Packard	3396A	Nov. 1988
Data System ID#7	Hewlett-Packard	3396B	June 1991
Data System ID#8	Hewlett-Packard	3396B	Feb. 1992
Data System ID#9 (Prep)	Hewlett-Packard	3392A	Aug. 1988
Data System ID#10 (GPC)	Hewlett-Packard	3392A	Sept. 1988

OTHER ORGANIC ANALYSIS INSTRUMENTATION

ID	Manfacturer	Model	Installation Date
Infra-Red	Perkin-Elmer	167	Aug. 1989
Infra-Red	Perkin-Elmer	1310	Oct. 1990

OTHER ORGANIC ANALYSIS INSTRUMENTATION CONTINUED

ID	Manfacturer	Model	Installation Date
HPLC (IC)	Waters	5/10 715 ULTRA WISP RDM 484	Sept. 1990
HPLC (GPC)	Waters Fraction Collector	FRACTION	Sept. 1990
Autosampler	Waters	715	Sept. 1990
HPCL Pump	Waters	510	Sept. 1990
Tunable Absorbance Detector	Waters	484	Sept. 1990
Auto Sample Prep Station	Zymark	Benchmate	July 1992
LC Pump	SSI	300	July 1992
LC Pump	SSI	300	July 1992
LC Pump	SSI	300	July 1992
UV Detector	ISCO	UA-6	July 1992
UV Detector	ISCO	UA-6	July 1992
Fraction Collector	ISCO	Foxy 200	July 1992
Fraction Collector	ISCO	Foxy 200	July 1992

OTHER ORGANIC ANALYSIS INSTRUMENTATION CONTINUED

ID	Manfacturer	Model	Installation Date
Fraction Collector	ISCO	Foxy 200	July 1992
Total Organic Carbon Analyzer (TOC)	Dohrman	DC-190	June 1992
Total Organic Halide Analyzer (TOX)	Dohrman	DX20 A/B	July 1992

INORGANIC INSTRUMENTATION

ID	Quant.	Manfacturer	Model	Installation Date
Inductively Coupled Argon Plasma (ICAP) Spectrophotometer	1	Thermo Jarrell Ash	61E	July 1992
Autosampler for Thermo Jarrell Ash ICAP	1	Thermo Jarrell Ash	TJA-300	July 1992
Inductively Coupled Argon Plasma (ICAP) Spectrophotometer	1	Perkin-Elmer	P40	Oct. 1988
Autosampler for P40 ICAP	1	Perkin-Elmer	AS-51	Oct. 1988
Graphite Furnace Atomic Absorption Spectrometer	1	Perkin-Elmer	Zeeman 5100 Z	Oct. 1988
Autosampler for Zeeman 5100 PC.	1	Perkin-Elmer	AS-60	Oct. 1988
Electrodeless Discharge Lamp Dual Power Supply	1	Perkin-Elmer	0057-0759	Oct. 1988
Graphite Furnace Atomic Absorption Spectrometer	1	Perkin-Elmer	Zeeman 5100 Z	May 1990
Autosampler for Zeeman 5100 PC.	1	Perkin-Elmer	AS-60	May 1990
Electrodeless Discharge Lamp Dual Power Supply	1	Perkin-Elmer	0057-0759	May 1990

INORGANIC INSTRUMENTATION CONTINUED

ID Date	Quant.	Manfacturer	Model	Installation
Graphite Furnace Atomic Absorption Spectrometer	1	Perkin-Elmer	Zeeman 5100 ZL.	July 1992
Autosampler for Zeeman 5100 ZL.	1	Perkin-Elmer	AS-70	July 1992
Electrodeless Discharge Lamp Dual Power Supply	1	Perkin-Elmer	0303-0952	July 1992
Graphite Furnace Atomic Absorption Spectrometer	1	Perkin-Elmer	Zeeman 5100 ZL.	July 1992
Autosampler for Zeeman 5100 ZL.	1	Perkin-Elmer	AS-70	July 1992
Electrodeless Discharge Lamp Dual Power Supply	2	Perkin-Elmer	0303-0952	July 1992
Mercury Analyzer	2	Coleman	50B	Jan. 1989
Mercury Analyzer		Leeman Labs	PS200	Sept. 1992
Spectrophotometer	2	Spectronic 20	20	Oct. 1988
Microwave Digestion Unit	1	CEM	2000	Dec. 1991
Tubidimeter	1	HACH	18900	June 1991

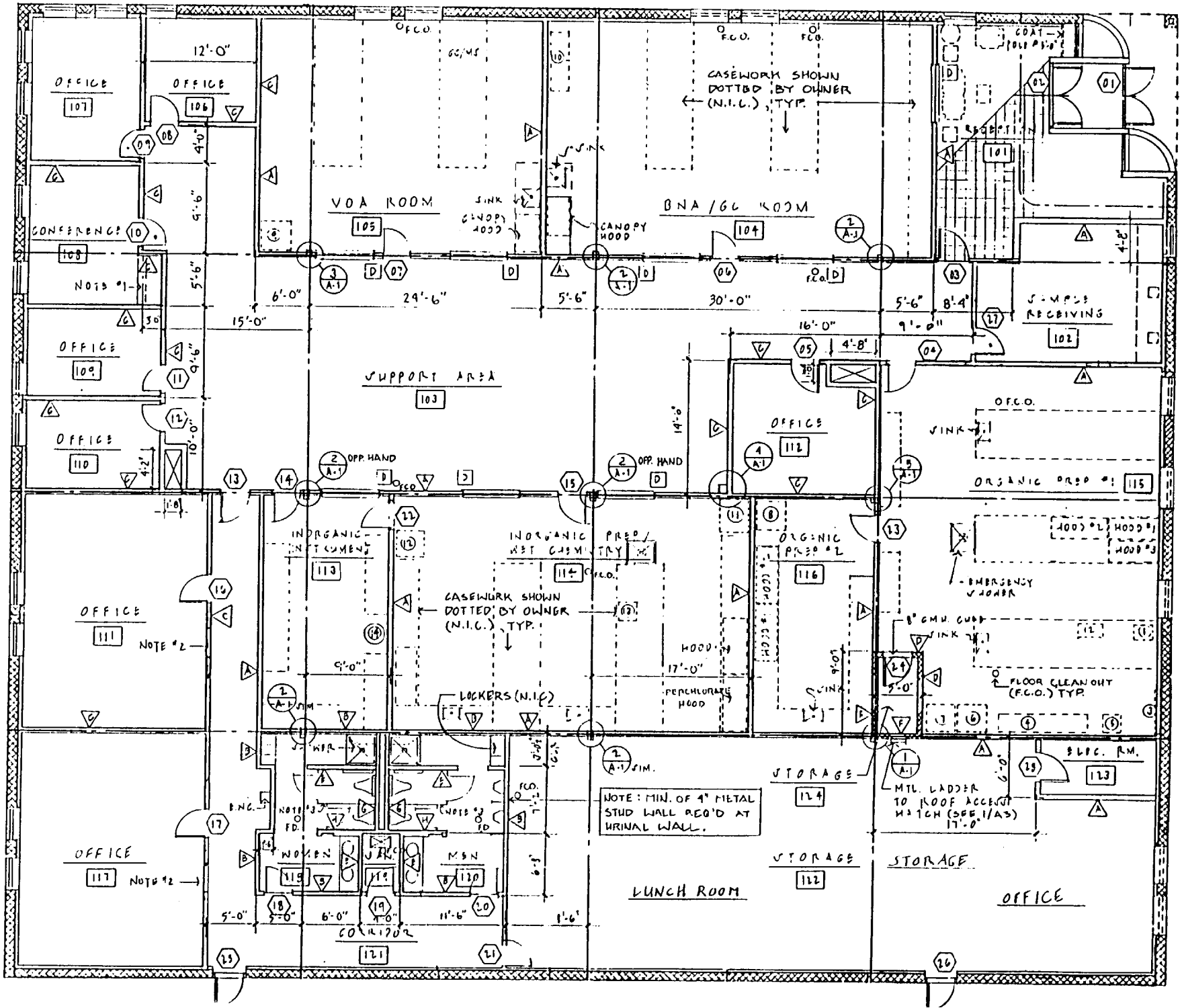
INORGANIC INSTRUMENTATION CONTINUED

ID	Quant.	Manfacturer	Model	Installation Date
TCLP/Rotary Agitator	2	Associated Design	3740	Aug. 1989
TCLP/Rotary Agitator	1	Associated Design	3740	July 1990
TCLP/Rotary Agitator	1	Associated Design	3740	Nov. 1991
Recorder	1	Perkin-Elmer	56	Feb. 1989
Recorder	1	The Recorder Company	4510	Feb. 1989

OTHER INSTRUMENTATION IN LABORATORY

TCLP/Rotary Agitator	8	Associated Design	3740	Aug. 1989
TCLP/Rotary Agitator	11	Associated Design	3740	July 1990
TCLP/Rotary Agitator	11	Associated Design	3740	Nov. 1991

Figure 21-1
FACILITIES DIAGRAM


OFFICE 107
OFFICE 106
12'-0"
CONFERENCE 108
NOTE #1
OFFICE 109
OFFICE 110
OFFICE 111
NOTE #2
OFFICE 117
NOTE #2
VOA ROOM 105
SINK
CANOPY HOOD
BNA/GC ROOM 104
CASEWORK SHOWN DOTTED BY OWNER (N.I.C.) TYP.
SUPPORT AREA 103
SAMPLE RECEIVING 102
OFFICE 112
INORGANIC PREP/WET CHEMISTRY 114
INORGANIC INSTRUMENT 113
ORGANIC PREP #1 115
ORGANIC PREP #2 116
HOOD #1
HOOD #2
HOOD #3
EMERGENCY SHOWER
8" CMU CURB
FLOOR CLEAN OUT (F.C.O.) TYP.
PERCHLORATE HOOD
LOCKERS (N.I.C.)
OPP. HAND
WOMEN 119
JAN. 118
MEN 120
CORRIDOR 121
LUNCH ROOM
NOTE: MIN. OF 4" METAL STUD WALL REQ'D AT URINAL WALL.
STORAGE 124
STORAGE 122
STORAGE
MTL. LADDER TO ROOF ACCESS MATCH (SEE 1/A5)
ELEC. RM. 123
OFFICE
COAT
SINK
F.C.O.

PERSONNEL QUALIFICATIONS AND RESUMES

JOHN F. McGARRY, JR.
PRESIDENT

Mr. McGarry is an experienced entrepreneur and administrator of environmental laboratories. He is a Certified Public Accountant and has been active in the environmental laboratory industry for over seventeen years.

EDUCATION:

UNIVERSITY OF MASSACHUSETTS, AMHERST
M.B.A.

BOSTON COLLEGE
B.S. Accounting

EXPERIENCE:

1988 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Founder and President
1978 - 1987	BOSTON TECHNOLOGIES, INC. Cambridge, Massachusetts & Austin, Texas Founder and President BTI provided environmental and energy consulting services to both industry and government.
1976 - 1978	ENERGY RESOURCES, CO. INC. (ERCO) Cambridge, Massachusetts Chief Financial Officer ERCO was an environmental laboratory and consulting firm with annual sales of $10 million.
1974 - 1976	KPMG PEAT MARWICK Boston, Massachusetts Senior Accountant

ALFRED J. KWOLEK, JR.
QUALITY ASSURANCE/QUALITY CONTROL DIRECTOR

Mr. Kwolek has twelve years of GC/MS and a total of over twenty years of environmental analytical chemistry experience.

EDUCATION:

UNIVERSITY OF RHODE ISLAND
M.S. Environmental Health Sciences
B.A. Biology

EXPERIENCE:

1991 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Quality Assurance/Quality Control Director
1990 - 1991	CEIMIC CORPORATION Narragansett, Rhode Island GC/MS Data Manager
1988 - 1989	CEIMIC CORPORATION Narragansett, Rhode Island VOA Laboratory Manager
1988	FINNIGAN MAT Livingston, New Jersey Manager, Consulting Chemist Program Managed a GC/MS Applications Program
1974 - 1988	RHODE ISLAND DEPARTMENT OF HEALTH Providence, Rhode Island Principal Chemist/Supervisor Started as a staff chemist with GC/MS responsibilities and was promoted to principal chemist in the organic laboratory.

MIGUEL MUZZIO
VICE PRESIDENT
LABORATORY DIRECTOR

Dr. Muzzio has ten years experience in the analysis of trace organic compounds using state of the art analytical instrumentation including GC/MS.

EDUCATION:

UNIVERSITY OF RHODE ISLAND
Ph.D. Chemistry

UNIVERSITY OF URUGUAY
B.S. Pharmacy

UNIVERSITY OF URUGUAY
B.S. Chemistry

EXPERIENCE:

1991 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Laboratory Director
1990 - 1991	CEIMIC CORPORATION Narragansett, Rhode Island Organic Laboratory Manager
1988 - 1990	CEIMIC CORPORATION Narragansett, Rhode Island GC/MS Laboratory Manager
1984 - 1988	UNIVERSITY OF RHODE ISLAND Kingston, Rhode Island Research Assistant
1982 - 1984	UNIVERSITY OF URUGUAY Montevideo, Uruguay Research Assistant

HENRY E. LEIBOVITZ
CHROMATOGRAPHY & EXTRACTION LABORATORIES MANAGER

Dr. Leibovitz has over ten years of experience in managing GC Laboratories and in the maintenance and operation of instrumentation for environmental research.

EDUCATION:

UNIVERSITY OF RHODE ISLAND
Ph.D. Biological Sciences

AUBURN UNIVERSITY
M.S. Aquaculture Nutrition

SYRACUSE UNIVERSITY
B.S. Biology

EXPERIENCE:

1991 - Present	CEIMIC CORPORATION Narragansett, Rhode Island GC Laboratory Manager
1983 - 1991	UNIVERSITY OF RHODE ISLAND Kingston, Rhode Island Food and Nutrition Research Center GC Laboratory Supervisor
1981 - 1983	LOUISIANA STATE UNIVERSITY Baton Rouge, Louisiana Research Associate

SHAWN M. DREW
SAMPLE PREPARATION SUPERVISOR

Mr. Drew has over twelve years experience in environmental analysis, including over four years CLP experience.

EDUCATION:

UNIVERSITY OF RHODE ISLAND
B.S. Zoology/Minor Chemistry

EXPERIENCE:

1990 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Organic Preparation Laboratory Supervisor CLP and Other Environmental Preparation Protocols and GPC, GC and IR Analyses
1989 - 1990	CEIMIC CORPORATION Narragansett, Rhode Island Organic Preparation Laboratory Technician CLP and Other Environmental Protocols
1981 - 1989	NATIONAL MARINE FISHERIES SERVICE Narragansett, Rhode Island Laboratory Technician/Supervisor

ERIC E. BAANANTE
GAS CHROMATOGRAPHY (IN-CHARGE)

Mr. Baanante has four years of chromatography experience.

EDUCATION:

UNIVERSITY OF CONNECTICUT
B.S. Chemistry

EXPERIENCE:

1993 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Gas Chromatography, (In-Charge)
1991 - 1992	CEIMIC CORPORATION Narragansett, Rhode Island Chromatography, Staff Chemist
1990	AMERICAN CYANAMID COMPANY Stamford, Connecticut Mineral Processing Chemical Research Assistant

XIANG-DONG DING
CHROMATOGRAPHY SPECIAL PROJECTS

Mr. Ding is a distinguished chromatographer with many publications and research accomplishments in his twenty-five years of chromatography experience.

EDUCATION:

TSINGHUA UNIVERSITY (CHINA)
B.S. Chemistry

EXPERIENCE:

1993 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Chromatography, Special Projects
1991 - 1992	CEIMIC CORPORATION Narragansett, Rhode Island Chromatography, Staff Chemist
1989 - 1991	BARNETT INSTITUTE/NORTHEASTERN UNIVERSITY Boston, Massachusetts Research Associate
1984 - 1989	INSTITUTE OF CHEMISTRY Academia Sinica, China Research Associate
1981 - 1983	BARNETT INSTITUTE/NORTHEASTERN UNIVERSITY Boston, Massachusetts Visiting Scientist
1968 - 1981	INSTITUTE OF CHEMISTRY Academia Sinica, China Research Associate

TIAN-MIN XIE
GC/MS LABORATORY MANAGER

Dr. Xie has over twenty years of experience in the analysis of organic compounds using the most advanced techniques and instrumentation. He also has more than twenty-five scientific publications in the environmental chemistry, marine chemistry and analytical chemistry fields.

EDUCATION:

UNIVERSITY OF GOTHENBURG (SWEDEN)
Ph.D. Analytical Chemistry

BEIJING UNIVERSITY (CHINA)
M.S. Chemistry

EXPERIENCE:

1992 - Present	CEIMIC CORPORATION Narragansett, Rhode Island GC/MS Manager
1987-1991	INDIANA UNIVERSITY Bloomington, Indiana Chemistry Department, Research Associate
1984-1987	ENVIRONMENTAL PROTECTION INSTITUTE Beijing, China Analytical Department, Vice Chief
1981-1984	UNIVERSITY OF GOTHENBURG Sweden Chemistry Department, Guest Researcher
1979-1981	ACADEMY OF SCIENCE Beijing, China Chemical Engineer

YANYANG XU
VOA LABORATORY (IN-CHARGE)

Ms. Xu has over ten years experience in environmental analytical chemistry.

EDUCATION:

UNIVERSITY OF MASSACHUSETTS, AMHERST
M.S. Analytical Chemistry

INSTITUTE OF ENVIRONMENTAL CHEMISTRY (CHINA)
B.S. Environmental Chemistry

WUHAN UNIVERSITY (CHINA)
B.S. Analytical Chemistry

EXPERIENCE:

1992 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Voa Laboratory, (In-Charge)
1991 - 1992	CEIMIC CORPORATION Narragansett, Rhode Island Voa Laboratory, Chemist
1988 - 1991	UNIVERSITY OF MASSACHUSETTS, AMHERST Amherst, Massachusetts Chemistry Department, Teaching Assistant
1986 - 1988	INSTITUTE OF ENVIRONMENTAL CHEMISTRY Beijing, China Research Assistant
1983 - 1985	INSPECTING BUREAU OF IMPORT AND EXPORT COMMODITIES Chengdu, China Analytical Chemist

JIUN-TANG HUANG
BNA LABORATORY (IN-CHARGE)

Mr. Huang is an analytical chemist with expertise on a variety of instrumentation with a specialization in the GC/MS analyses of base-neutrals and acid extractables (BNA).

EDUCATION:

UNIVERSITY OF RHODE ISLAND
M.S. Analytical Chemistry

CHUNG-YUAN CHRISTIAN UNIVERSITY (TAIWAN)
B.S. Chemistry

EXPERIENCE:

1992 - Present	CEIMIC CORPORATION Narragansett, Rhode Island BNA Laboratory, (In-Charge)
1990 - 1992	CEIMIC CORPORATION Narragansett, Rhode Island BNA Laboratory, Chemist
1986 - 1990	UNIVERSITY OF RHODE ISLAND Kingston, Rhode Island Department of Chemistry, Research/Teaching Assistant
1984 - 1986	CHUNG-YUAN CHRISTIAN UNIVERSITY, TAIWAN Teaching Assistant

LI-PIN LEE
GC/MS SPECIAL PROJECTS

Mr. Lee is a trained organic analytical chemist with over eight years experience in GC/MS, including five in environmental applications of GC/MS.

EDUCATION:

WORCESTER POLYTECHNIC INSTITUTE
Ph.D. (ABD) Organic Analytical Chemistry

UNIVERSITY OF FLORIDA
M.A. Agriculture

UNIVERSITY OF NEBRASKA
M.S. Organic Chemistry

NATIONAL CHUNG-HSING UNIVERSITY (TAIWAN)
B.S. Agricultural Chemistry

EXPERIENCE:

1992 - Present	CEIMIC CORPORATION Narragansett, Rhode Island GC/MS Special Projects
1990 - 1991	CEIMIC CORPORATION Narragansett, Rhode Island GC/MS Supervisor
1989 - 1990	CEIMIC CORPORATION Narragansett, Rhode Island GC/MS Operator
1988 - 1989	ALPHA ANALYTICAL LABORATORIES Warwick, Rhode Island GC/MS Supervisor
1985 - 1988	WORCESTER POLYTECHNIC INSTITUTE Worcester, Massachusetts GC/MS Supervisor

CATHERINE L. MARSH
INORGANIC LABORATORY MANAGER

Dr. Marsh has ten years experience in analytical chemistry and has numerous publications in inorganic analytical chemistry.

EDUCATION:

BROWN UNIVERSITY
Ph.D. Inorganic Analytical Chemistry

BROWN UNIVERSITY
B.S. Chemistry

EXPERIENCE:

1992 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Inorganic Laboratory Manager
1988 - 1992	NAVAL UNDERSEA WARFARE CENTER Newport, Rhode Island Principal Investigator/Research Manager
1986 - 1988	VITRO CORPORATION Newport, Rhode Island Senior Scientist
1982 - 1986	BROWN UNIVERSITY Providence, Rhode Island Research Assistant

AMY C. CALLANAN
CLASSICAL CHEMISTRY (IN-CHARGE)

Ms. Callanan, a degreed chemist has over three years of experience in classical chemistry techniques.

EDUCATION:

MOUNT HOLYOKE COLLEGE
B.A. Chemistry

EXPERIENCE:

1992 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Classical Chemistry, (In-Charge)
1991 - 1992	CEIMIC CORPORATION Narragansett, Rhode Island Classical Chemist
1990 - 1991	BIOTEK, INC. Woburn, Massachusetts Assistant Chemist
1990	BLOCK ISLAND WASTE WATER TREATMENT PLANT New Shoreham, Rhode Island Laboratory Technician

KAREN M. GAVITT
METALS (IN-CHARGE)

Ms. Gavitt, a degreed chemist, whose diverse background includes over three years of experience with inorganic instrumentation including atomic absorption and inductively-coupled plasma.

EDUCATION:

DUQUESNE UNIVERSITY
B.S. Chemistry

EXPERIENCE:

1993 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Metals (In-Charge)
1990 - 1992	CEIMIC CORPORATION Narragansett, Rhode Island Inorganic Instrumentation Chemist
1983 - 1985	FITCH SENIOR HIGH SCHOOL Groton, Connecticut Chemistry Teacher
1981 - 1982	PEACE CORPS VOLUNTEER Institute de Katubue Chemistry Teacher

JAMES LIANG
INORGANIC SPECIAL PROJECTS

Dr. Liang has more than five years of experience in ultra trace determination of metals and non-metals, using spectroscopic methods of analysis.

EDUCATION:

UNIVERSITY OF CONNECTICUT
Ph.D. Analytical Chemistry

HANGZHOU UNIVERSITY (CHINA)
M.S. Analytical Chemistry

HANGZHOU UNIVERSITY (CHINA)
B.S. Chemistry

EXPERIENCE:

1992 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Inorganic Special Projects
1988 - 1992	UNIVERSITY OF CONNECTICUT Storrs, Connecticut Chemistry Department, Research Assistant
1984 - 1987	HANGZHOU UNIVERSITY China Chemistry Department, Faculty

MARGARET J. MARPLE
VICE PRESIDENT
MARKETING MANAGER

Ms. Marple has twenty years experience in all phases of the commercial environmental laboratory business including bench analyses, management and customer service.

EDUCATION:

PENNSYLVANIA STATE UNIVERSITY
Chemistry

EXPERIENCE:

1989 - Present	CEIMIC CORPORATION Pittsburgh, Pennsylvania Marketing Manager
1981 - 1989	NUS CORPORATION (HALLIBURTON) Pittsburgh, Pennsylvania Laboratory Manager of $4 million laboratory Started as supervisor of the inorganic chemistry section and promoted to laboratory manager in 1983.
1972 - 1981	PENN ENVIRONMENTAL CONSULTANTS, INC. Pittsburgh, Pennsylvania Lab Supervisor
1970 - 1972	ENVIRONMENTAL SCIENCES, INC. Pittsburgh, Pennsylvania Laboratory Analyst
1966 - 1969	BITUMINOUS COAL RESEARCH Monroeville, Pennsylvania Researcher

VERONICA A. MORETTI
CLIENT SERVICES

Ms. Moretti, a degreed MIS specialist, has five years of experience in sample and data management and laboratory operations.

EDUCATION:

UNIVERSITY OF RHODE ISLAND
B.S. Management Information Systems

EXPERIENCE:

1992 - Present	CEIMIC CORPORATION Hartford, Connecticut Client Services
1991 - 1992	CEIMIC CORPORATION Narragansett, Rhode Island Operations Supervisor
1989 - 1991	CEIMIC CORPORATION Narragansett, Rhode Island Document Control/CLP Data Reporting
1988 - 1989	CEIMIC CORPORATION Narragansett, Rhode Island Document Control/Sample Custodian
1984 - 1988	UNIVERSITY OF RHODE ISLAND Kingston, Rhode Island Programmer

KRISTINE R. REAMAN
CLIENT SERVICES

Ms. Reaman is experienced in both regulatory reporting and client services.

EDUCATION:

UNIVERSITY OF RHODE ISLAND
B.A. Biology

EXPERIENCE:

1992 - Present	CEIMIC CORPORATION Pittsburgh, Pennsylvania Client Services
1991 - 1992	CEIMIC CORPORATION Narragansett, Rhode Island CLP Data Reporting

MELANIE J. BAANANTE
CLIENT SERVICES

Ms. Baanante has both environmental data reporting and client services experience and education.

EDUCATION:

PLYMOUTH STATE COLLEGE
B.S. Marketing

EXPERIENCE:

1993 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Client Services
1992	CEIMIC CORPORATION Narragansett, Rhode Island Data Reporting
1989 - 1991	TRAVELERS INSURANCE COMPANY Hartford, Connecticut National Accounts Audit Specialist

ROBERT F. CAMARA
CHIEF FINANCIAL OFFICER

Mr. Camara is Ceimic's Chief Financial Officer and has twenty years of financial management experience.

EDUCATION:

PROVIDENCE COLLEGE
M.B.A.

PROVIDENCE COLLEGE
B.S. Business Administration

EXPERIENCE:

1993 - Present	CEIMIC CORPORATION Narragansett, Rhode Island Chief Financial Officer
1983 - 1993	RHODE ISLAND HOSPITAL TRUST NATIONAL BANK Providence, Rhode Island Vice President Corporate Account Manager
1981 - 1982	RHODE ISLAND HOSPITAL TRUST NATIONAL BANK Providence, Rhode Island Credit Analyst - Loan Administration, Credit Department
1977 - 1981	RHODE ISLAND HOSPITAL TRUST NATIONAL BANK Providence, Rhode Island Corporate Service Officer, Cash Management
1973 - 1977	RHODE ISLAND HOSPITAL TRUST NATIONAL BANK Providence, Rhode Island Teller & Head Teller, Community Banking Division

APPENDIX B

MINIRAM PDM-3 MANUAL

MINIRAM PERSONAL MONITOR
MODEL PDM-3
OPERATIONS MANUAL

March 1990

MIE, INC.
213 Burlington Road
Bedford, Massachusetts 01730
(617) 275-5444

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WARRANTY

ONE YEAR LIMITED WARRANTY

MIE warrants to the original Purchaser that the apparatus to be delivered hereunder will be of the kind designated or specified and free of defects in workmanship or material. MIE makes no other express warranty, and disclaims any implied warranty of merchantability or fitness for purpose.

If the apparatus fails to conform to the above warranty, and notice is received by MIE from Purchaser within one year from the date of shipment, MIE will, at its option, either repair the defective part or parts or make available a repaired or replacement part. This warranty extends to all parts and labor involved in the required repair to the extent that said repair was not caused by negligence in operation of the apparatus by the Purchaser. MIE will perform the repair at its plant with all shipping and insurance costs paid by the Purchaser or, upon, mutual consent of the parties, at a site designated by the Purchaser except, in the latter circumstances, the Purchaser will be responsible to reimburse MIE for all costs associated with travel, per diem, and travel time of those MIE individual(s) deemed appropriate to effectuate the repair.

Repair or replacement of the apparatus in the manner and for the time period specified above, is the Purchaser's exclusive remedy and will satisfy all liabilities of MIE to Purchaser arising out of the supply or use of the apparatus, whether based on contract, warranty, negligence or otherwise. In no event will MIE be liable for any incidental or consequential loss or damage from any failure of the apparatus to conform to the contract of sale.

1.0 DESCRIPTION

1.1 Sensing Method

The MINIRAM (Miniature Real-time Aerosol Monitor) Model PDM-3 is an ultra-compact personal-size airborne particulate monitor whose operating principle is based on the detection of scattered electromagnetic radiation in the near infrared. The MINIRAM uses a pulsed GaAlAs light emitting source, which generates a narrow-band emission (half-power width of 80 nm) centered at 880 nm. This source is operated at an average output power of about 2 mW. The radiation scattered by airborne particles is sensed over an angular range of approximately 45° to 95° from the forward direction by means of a silicon-photovoltaic hybrid detector with internal low-noise preamplifier. An optical interference-type filter is incorporated to screen out any light whose wavelength differs from that of the pulsed source.

The MINIRAM is a light scattering aerosol monitor of the nephelometric type, i.e., the instrument continuously senses the combined scattering from the population of particles present within its sensing volume (approximately 1 cm^3) whose dimensions are large compared with the average separation between the individual airborne particles.

1.2 Open Sensing Chamber Sampling Method

Air surrounding the MINIRAM passes freely through the open aerosol sensing chamber as a result of air transport caused by convection, circulation, ventilation, and personnel movement. The MINIRAM requires no pump for its operation, and the scattering sensing parameters have been designed for preferential response to the particle size range of 0.1 to 10 micrometers, ensuring high correlation with standard gravimetric measurements of both the respirable and inhalable size fractions. Optional flow accessories are available for applications requiring specific inertial particle precollection, extractive sampling, concurrent filter collection, etc.

It should be noted that one of the advantages of direct light scattering aerosol sensing is that the rate at which air passes through the sensor does not influence the indicated concentration because the detection is performed directly on every parcel of air traversing the fixed sensing volume. Therefore, flow velocity through a real-time sensor such as the MINIRAM influences only the response time. So, it should not surprise the first-time user when, upon pressing the MEAS key of the MINIRAM, no pump noise is heard, and this silence will be accompanied by a readout message of "GO" on the liquid-crystal display indicating that the MINIRAM has, indeed, been activated.

1.3 MINIRAM Electronics

The MIE MINIRAM is a very advanced aerosol monitor which incorporates a custom-designed single-chip CMOS microprocessor whose functions are to: process the signal from the light scattering detection circuit, control the measurement sequence program, compute concentration averages, keep record of elapsed time, perform automatic zero correction, control auto-ranging, drive the liquid-crystal-display, store average concentration values as well as timing and identification information, sense battery and overload conditions, sequence playback of stored information, and provide alarm signals.

The MINIRAM derives its power from a set of internal rechargeable Ni-Cd batteries which can provide continuous monitoring operation for over 8 1/2 hours, or retain stored information for up to approximately 6 months. The battery set is packaged as a separable module which allows easy field replacement when recharging is not feasible. The MINIRAM can be run without time limit from an A.C. line using the charger provided with the instrument.

During the normal monitoring operation, the liquid-crystal-display indicates the aerosol concentration in the units of milligrams per cubic meter, and the displayed reading is updated every 10 seconds. When operating in the measurement or monitoring mode, other functions can be displayed momentarily, i.e., as long as a corresponding touch switch is pressed. All external controls are performed by pressing one or more of 8 sealed touch switches on the MINIRAM panel. Stored information playback can be accomplished either by means of the MINIRAM's own display or through the digital output jack. The MINIRAM has two output connectors. One provides a continuous, real-time analog signal output proportional to the aerosol concentration. This signal can be used for continuous recording (e.g., on a strip chart recorder), telemetry, or control purposes, etc. The other connector provides, during the measurement mode, either an ASCII digital output of the 10 second averages, or a switched output for alarm purposes (depending on the user-selected function).

1.4 Modes of Use and Application

The MINIRAM measures the concentration of any airborne particles, both solid and liquid, and the display indicates this level in the units of milligrams per cubic meter, based on its factory calibration, against a filter-gravimetric reference, using a standard test dust (Arizona road dust). The MINIRAM can be used to measure the concentration of all forms of aerosol: dusts, fumes, smokes, fogs, etc.

Its small size and weight, and concentration averaging features permit its use as a personal exposure monitor, attached to a belt, shoulder strap, hard hat, etc. Alternatively, it can be used as an area monitor for both indoor and ambient air situations. Test chamber monitoring, visibility measurements, cloud detection (e.g., radio/drop sonde), aerosol dispersion studies, etc. are additional applications of the MINIRAM.

2.0 WHEN YOUR RECEIVE THE MINIRAM ...

Follow these steps when first receiving your MINIRAM:

2.1. Remove the instrument from shipping case.

2.2. Observe display. It should be blank indicating that the MINIRAM is in the minimum power mode.

2.3. Plug charger into A.C. line (standard charger is for 120V, 60 Hz; optional version available for 220V, 50 Hz).

2.4. Connect charger plug into corresponding MINIRAM receptacle.

2.5. Leave charger connected to MINIRAM for a minimum of 8 hours before using instrument without the charger.

2.6. You can operate the MINIRAM immediately after the charger has been connected. Follow operating instructions described in the next section of this manual.

3.0 OPERATING INSTRUCTIONS

Refer to Figure 1 for the location of control switches, display, and connector jacks. Refer to Figure 2 for the display timing sequences.

3.1 Initial Condition

Assuming that the batteries of the MINIRAM have been recharged (see section 2.0), the display may indicate one of the following conditions:

- Blank display: Means the MINIRAM had not been in the measurement mode for 48 hours or more, and is in the minimum power off mode.
- "OFF" display: MINIRAM has been in the off mode for less than 48 hours.
- Concentration display that changes or "blinks" once every 10 seconds: the MINIRAM is in the measurement mode.

3.2 To start Measurement Cycle

- If the MINIRAM shows a blanked display (see above), press OFF and wait until the display reads "OFF" (approximately 5 seconds after pressing OFF), before pressing MEAS to initiate measurement cycle.
- If the MINIRAM shows "OFF" (see above), press MEAS directly to initiate measurement cycle (there is no need to press OFF first, in this case).

The functions performed by pressing each MINIRAM touch switch are as follows:

3.3 MEAS

To start the monitoring operation of the MINIRAM, Press MEAS (see automatic timing sequence of Figure 2). The first readout displayed is either "GO" (or "CGO" if TIME is also pressed, section 3.4), followed by the last concentration reading or ".00". Approximately 36 seconds after pressing MEAS the first new 10-second averaged concentration reading is displayed. All subsequent readings are concentration values in milligrams per cubic meter, updated every 10 seconds. Figure 3 shows a typical digital printout of a sequence of 10-second measurements (second data block).

The MINIRAM will now run in the measurement mode for 500 minutes (8 hours and 20 minutes), after which it will stop, displaying the OFF reading, retaining in storage the concentration average and elapsed time information. Once the MEAS mode has been entered this sequence can only be interrupted by pressing OFF; pressing ZERO, TWA, SA, TIME or ID# only affects the display during the time these keys are pressed, without affecting the measurement cycle. Pressing PBK during this cycle has no effect.

The instrument normally operates in the .00 to 9.99 mg/m^3 range. Whenever a 10-second concentration exceeds 9.99 mg/m^3 the MINIRAM display automatically switches to the .0 to 99.9 mg/m^3 range and remains in that range as long as the measured 10-second concentration exceeds 9.99 mg/m^3, otherwise the MINIRAM reverts to its lower range display.

3.4 MEAS and TIME

If both MEAS and TIME are pressed at the same time (press TIME first and while depressing it actuate MEAS) the MINIRAM will display "CGO" (for Continuous "GO"), and will then operate as above (i.e., pressing MEAS only), except that after the first 8.3 hour run it will restart automatically and continue to measure for an indefinite number of 8.3 hour runs, (with the battery charger) until the OFF key is pressed, or until the batteries are exhausted at which time the MINIRAM shuts off automatically, displaying the "OFF" reading. Concentration averages and timing information for the last seven 8.3 hour runs will remain in storage at any given time.

3.5 OFF

When this key is pressed the MINIRAM will discontinue whatever mode is underway displaying "GCA"* followed by the display segments check ("8.8.8=") and finally "OFF" (see timing diagram of Figure 2). The MINIRAM will then remain in this reduced power condition (displaying "OFF") for a minimum of 10 minutes or a maximum of 48 hours or until the MEAS key is pressed to resume the measurement cycle.

If OFF is pressed during a measurement run the display will read "OFF" for 48 hours (unless another key is pressed during that period), after which the display will be blanked. If OFF is pressed while the display is blank, the MINIRAM will display the "OFF" reading for only 10 minutes, after which the display will be blanked again unless another key is pressed during that period.

Every time the OFF key is pressed, during a measurement cycle, the MINIRAM will store the concentration average and elapsed monitoring time up to the time of that OFF command. The duration of the off period (up to 48 hours), i.e., between two consecutive measurement cycles, is also stored for each of up to 7 cycles.

If the MINIRAM is not reactivated (i.e., pressing MEAS) within 48 hours of the OFF Command, it automatically switches to a minimum power level, with blanked display; however, all data remains stored in memory for up to approximately 6 months without battery recharging (indefinitely, with charger).

<u>OFF must be keyed before any other operating mode can be entered</u>: setting ID#, zero referencing, playing back stored data, or changing the program code. Display functions, however, can be activated during the measurement mode.

3.6 TIME

During the measurement mode, if TIME is pressed the display will show the elapsed time, in minutes, to three significant figures, from the start of the last measurement run. The MINIRAM will automatically return to concentration display after the TIME key is released.

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* "GCA" is displayed and printed out by the MINIRAM although the instrument is manufactured exclusively by MIE, Inc.

3.7 TWA

This key stands for Time-Weighted-Average. During the measurement mode, if TWA is pressed the display will indicate the average concentration in milligrams/m^3 up to that instant, from the start of the last run. This average is computed by the MINIRAM applying the equation:

$$TWA = \frac{1}{t}\int_0^t C\,dt$$

where t is the elapsed run time and C is the instantaneous concentration at time t. The value of TWA is updated every 10 seconds. After releasing the TWA key the MINIRAM display returns to the 10-second concentration display.

3.8 SA

This key stands for Shift-Average. During the measurement mode, pressing SA will provide a display of the aerosol concentration, up to that moment, averaged over an 8-hour shift period. This average is computed by the MINIRAM applying the equation:

$$SA = \frac{1}{480\ \text{min.}} \int_0^t C\,dt$$

The shift-average value corresponds to the exposure from the start of the measurement cycle. Thus, for example, if the MINIRAM has been measuring for 3 hours, and the time-weighted average over that period has been 6 mg/m^3 (TWA reading), the shift average value at that time, (SA reading) would be 2.25 mg/m^3, which is equivalent to an 8-hour exposure at an average concentration of 2.25 mg/m^3.

The value of SA is updated every 10 seconds. When releasing the SA key the MINIRAM display returns to the 10-second concentration display.

3.9 PBK

With the MINIRAM in the off mode (i.e., not in the measurement mode), the stored information can be played back by pressing PBK. If the PBK key is initially pressed the display will indicate "P" for one second. If PBK continues to be pressed for more than 1 second, then the stored data is automatically played back through the MINIRAM display: First, the identification number is displayed with the ID indicator bar on; next the shift or run number (7 through 1, i.e., starting with the last run) is shown (with the OVR indicator bar on as identification); followed by the sampling (i.e., measurement) time in minutes, for that run; followed by the off-time between the last and next run (in tens of

minutes); finally, the average in mg/m^3.* This sequence is repeated seven times. An average reading of 9.99 indicates that a significant overload condition occurred during that run. The total time required for the complete automatic playback on the MINIRAM display is approximately 70 seconds.

If PBK is pressed for less than one second "PA" will be displayed, and the stored data will be fed out through the digital output jack of the MINIRAM for printout, magnetic storage, telemetry, etc. A printout consists of 8 lines of data. Figure 3 shows a typical stored data printout (see data block labeled "Playback of Stored Data"). The first 7 lines show the data for the last 7 measurement periods, and the last line shows the identification number (I), the programmable selection code (F), and the zero value for that data block (Z). In addition a check sum is printed out on a 9th line for modem/computer data transfer purposes. The first 7 data lines are subdivided into 4 columns. The first column identifies the measurement period (starting with the last or 7th); the next column lists the corresponding duration of each measurement period, in minutes; the third column lists the off time between consecutive measurement periods, in minutes divided by 10; and the last column lists the average concentration values for each period in mg/m^3.*

Either time-weighted, or shift average values can be printed, depending on the selected programmable code (see section 4.2). The example shown on Figure 3 (F=0012) indicates that the TWA values are listed. Although the printout heading will indicate "PDM-2 LISTING" (as shown in Figure 3), this format applies equally to the MINIRAM model PDM-3.

The speed of the digital transfer to a printer or other digital device can be user selected through the programmable selection code (see section 4.2). For a 300 baud rate the transfer time for the stored data block is approximately 45 seconds. See sections 10.0 and 11.0 for instructions on how to connect the MINIRAM to a printer or other digital recording/processing device.

3.10 ZERO

The interior walls of the MINIRAM sampling chamber reflect a small amount of the light from the infrared source into the detector. This background level is referred to as the "zero value", and is automatically subtracted from all aerosol concentration readings during the measurement mode. The result is that the displayed readings depend only on the actual dust concentration present within the sensing chamber.

The zero value varies from instrument to instrument as well as with different sensing chambers. It will increase somewhat as the chamber inner walls and windows become contaminated with dust. A zero update should be performed after cleaning the sensing chamber (see section 12.0).

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* Either the TWA or the SA values, depending on selected user-programmable code (see Section 4.2).

Pressing ZERO during a measurement period provides momentary display of the stored zero concentration value used by the MINIRAM to correct all digital concentration readings (the analog output signal is not zero-corrected). To update the ZERO value the MINIRAM must be in its off condition (press OFF in case of doubt). Then, press ZERO and wait until the display again indicates "OFF".

The average of 4 consecutive 10-second zero level measurements will then be stored by the MINIRAM as the new ZERO reference value. (See timing diagram in Figure 2 and digital printout obtained during a typical zero check on Figure 3). When operating the MINIRAM in high particle concentration environments (>5 mg/m^3) the zero value update should be performed approximately every 8 hours. At aerosol concentrations below approximately 1 mg/m^3 this update may only be required once a week, or even less frequently. The zero update should be performed either within a clean-air environment (ideally, a clean room or clean-bench) or using one of the accessories provided by MIE for that purpose: either the Z-Bag (standard accessory, see Section 16.3), or the Zero Check Module PDM-1FZ (optional accessory, see Section 17.2). The latter should be used for zeroing only when subsequent measurements are at concentrations greater than approximately 0.5 mg/m^3, or if the PDM-1FZ is left on the MINIRAM for active air sampling (see Section 17.2). Air conditioned offices (without smokers) usually have concentrations below approximately 0.05 mg/m^3 and can thus be used for zeroing purposes, if a Z-Bag is not available (see Section 16.3 for instructions on the use of the Z-Bag). When measurements are performed under essentially clean air conditions, e.g., in the same environment where the zero check was performed, the MINIRAM readings will indicate 0.00 mg/m^3 with small random fluctuations around that value. Positive values (e.g., 0.02) will thus be indicated on the LCD display. Negative values (e.g., -0.02) are suppressed and are also indicated as 0.00. The digital output, however, does include such negative values and these will be printed out by a digital printer (see sections 10.0 and 11.0).

3.11 ID#

Pressing ID# during a measurement period provides momentary display of the identification number stored within the MINIRAM memory.

The ID# key, in combination with other keys, is used for several additional programming functions described in the next section (4.0).

4.0 PROGRAMMABLE FUNCTIONS

4.1 ID# Selection

In order to change the instrument identification number the MINIRAM must first be in the off mode (i.e., press OFF). Then press the ID# key, and the presently stored number (between 1 and 999) will be displayed, as well as the ID indicator bar. To increment the identification number press the ▲ key (same key as TWA), and to decrement the number press the ▼ key (same key as SA). Any number between 1 and 999 can thus be selected and will remain in storage until

the batteries are disconnected, or if the MINIRAM is not recharged over a 6-month period.

Pressing the OFF key after the above identification number selection will remove the MINIRAM from the ID# selection routine and lock-in that number until a new number is selected. A complete ID# lock-out (i.e., a routine to preclude panel-control change of that number) can be accomplished by a separate programmable code selection (see section 4.2).

4.2 Programmable Selection Code

The programmable code allows the user to panel-select several alternate functions and operating modes.

The program codes to select specific alternate operating modes are:

1 selects the alarm instead of ASCII digital output

2 selects the ID# lock-out

4 selects the TWA instead of the SA to be stored for playback

8 selects a 1-second pause after each printer carriage return (for slow printers)

32 selects 110 baud digital output rate instead of 300 baud

64 selects 600 baud digital output rate instead of 300 baud

These numbers are entered as a sum, e.g., to implement ID# lock out, TWA storage, and 1-second carriage return delay, the code number would be 14 (2+4+8).

To enter the desired code (e.g., 14) follow these steps:

- Press OFF key and wait until "OFF" is displayed.
- Press ID# key and set program code to desired number (e.g., 14) by means of the ▲ and ▼ keys.
- Press TIME key (this will show previously entered code).
- Press ID# key again to lock in the new program code which will then be displayed.
- The preceding steps will cause the ID# to become equal to the programmable selection code. To restore the desired ID# (without affecting the selected code number which is now locked in), use the ▲ and ▼ keys again to select the ID# for the instrument as described in section 4.1.

- Press OFF to exit the ID# selection routine.
- To look at the programmed code number, at any time, start from the off condition; press ID#, then press TIME ("F" will then be displayed momentarily), after which the code number will be displayed. Press OFF to exit the code number routine.

If no specific alternate code is entered the MINIRAM will operate in its standard mode (equivalent to code 12) consisting of the following:

- ASCII digital output
- Panel-selectable ID number (preset to 999)
- Time-Weighted Average (TWA) values in memory storage
- 7-bit ASCII resolution
- 300 baud digital output
- Printer carriage return followed by a 1 second delay

4.3 ID# Lock-out

If the ID# lock-out code has been selected (i.e., a 2 as part of the sum, as described in section 4.2) then both the ID# and the programmable code can only be displayed (and printed out), but neither of the two can then be changed by means of the panel keys. In this case, in order to change the ID# if the lock-out code has been selected, or too alter the programmable code, the battery must be unplugged momentarily. Disconnecting the battery, however, causes the MINIRAM to lose all stored data, and cancels all alternate program codes which may then be restored following the procedure described in section 4.2.

4.4 Alarm Level Adjustment

If the selected program code includes a 1, the MINIRAM will not provide an ASCII digital output but instead a switched output (at the digital output connector) which will close every time the measured 10-second concentration value exceeds a presettable threshold concentration level. If a 1 has been included in the code, then the ID# divided by 10 becomes the alarm level in milligrams/m^3. This level can be adjusted following the ID# selection procedure of section 4.1, that is using the ▲ and ▼ keys to increment or decrement the number. For example, if an alarm level of 12.5 mg/m^3 is desired (and starting from the off mode), press ID#, adjust displayed number to 125 with the ▲ and ▼ keys, and press OFF. This number (e.g., 125) then becomes the ID# as well. It is not possible to enter a separate alarm level and ID# number.

5.0 OVERLOAD, ERROR CODES AND TROUBLESHOOTING

5.1 Bar Displays

There are three bar indicators on the MINIRAM display, identified as OVR, ID, and BAT. If the OVR bar is displayed at any time during operation in the measurement mode the MINIRAM detection circuit has been overloaded. A momentary overload can be caused by the insertion of an object into the sensing chamber, sudden exposure to sunlight, etc. If the cause of overload is eliminated, the OVR bar will disappear during the next 10-second display period, unless the overload persists for more than a total of 1 1/2 minutes over an 8 1/3 hour measurement cycle.

The ID bar display is activated only for display identification purposes and not for error conditions.

The BAT bar is displayed when the battery voltage becomes insufficient, indicating that the charger should be plugged into the MINIRAM.

5.2 Error Codes

The MINIRAM will display and output (at the digital output jack) error code numbers along with the corresponding overload indicator bars on the LCD readout. These codes will appear only if the problem persists for more than about 30 seconds.

The error code numbers are as follows:

.0.1: low battery condition

.0.2: RAM (digital processing)

.0.3: A/D (signal) overload

If an overload condition persists for more than approximately 1 1/2 minutes the selected concentration average value (SA or TWA) automatically registers 9.99 and that number will be indicated (or digitally transmitted) upon data playback, signifying an invalid measurement cycle. The OVR bar will then remain on for the rest of that run.

5.3 Basic Troubleshooting

1. No response when OFF key is pressed, display remains blank

   a) Batteries exhausted, recharge battery pack. If after charging, unit still does not function, check the following:
   b) Measure output of battery charger. A volt meter should read about 24.5 Va.c.

c) If charger is ok, remove battery pack and slightly separate 2 gray connectors. Attach voltmeter + lead to red wire and - lead to black wire. Voltmeter should read about 8.5 Vd.c. while plugged into the charger.
d) If battery pack is ok check the fuse on the circuit board. Fuse is located 3/8 inch behind analog output jack and is designated F1 on the circuit board. Leaving the - lead of the voltmeter connected to the battery pack use + lead to check voltage on both sides of fuse. Voltage should be the same as in C above. If not, fuse must be replaced. This is preferably done at the factory.

2. Unit constantly displays .0.3-

This indicates electronic component failure. Unit should be sent back to MIE for repair and recalibration.

3. Improper Display segments appear

Usually an indication that the circuit board and/or display board has been contaminated. This may be corrected by removing the battery pack and cleaning affected areas with a small brush. Do Not Use any cleaning fluids or solvents on circuit boards. If brushing does not correct problem unit should be sent to MIE for repair.

4. Pressing TWA, ID, TIME keys, etc. during MEAS mode causes unit to shut off

a) Keypad failure: Unit should be sent for repair
b) Display board contamination: clean board as in 3 above

6.0 SENSING CHAMBER REMOVAL AND INSERTION

During normal operation of the MINIRAM the removable sensing chamber (see Figure 1) must be properly inserted, i.e., pushed all the way into the MINIRAM towards the display/control panel end of the instrument. When this chamber is properly positioned the surface on the opposite end from the display/control panel will be approximately flush with the body of the MINIRAM.

To remove the sensing chamber, gently push it away from the display/control panel end, using both thumbs, sliding it out of its channel. This will expose the shouldered metal button with its small spring-loaded plunger, and the two lenses (illumination and detection lenses). Touching of these lenses should be avoided to prevent their soiling. Lens tissue should be used if cleaning of these lenses becomes necessary.

The removable sensing chamber has two small glass windows which should be kept clean (see section 12.0 on routine maintenance).

The sensing chamber is partially closed at one of its open ends. This end is inserted first when sliding the chamber back into the MINIRAM channel. A

small shouldered slot is provided on the underside of the removable sensing chamber for the metal button that serves to retain the chamber.

To reinsert the sensing chamber simply slide it back into position making sure that the chamber is moved parallel to the MINIRAM body. Ensure complete insertion, as mentioned above.

7.0 BATTERY PACK

7.1 Battery Pack Replacement

The battery pack of the MINIRAM (MIE Part No. PDM-1-101-1) constitutes an intrinsically safe sealed module that can be removed and replaced. To do so, remove the four central screws from the back of the MINIRAM case (not the two corner screws), and gently lift the battery pack up and out, and gently pull apart the battery connector, freeing the battery pack. Reverse order of steps when installing another pack.

CAUTION: ALL STORED DATA WILL BE LOST WHEN DISCONNECTING BATTERY

After reconnecting battery pack, the ID resets to 999 and an automatic zero reference check is performed by the MINIRAM.

Separate battery packs can be used whenever a.c. line power is unavailable to recharge the pack within the MINIRAM. These spare parts can be recharged independently from the MINIRAM by plugging the charger into the charge receptacle which is an integral part of the battery pack (see figure 1).

7.2 Battery Charging

When the MINIRAM battery pack is discharged (see Section 5.0) the MINIRAM batteries should be recharged for a minimum of 14 hours, using only the charger provided with the MINIRAM (Model PDM-1-157-1). The charger can be left connected for an indefinite time to the MINIRAM without danger of overcharging. It is advisable to occasionally discharge the batteries completely (see Section 3.4) and then recharge them as described above, in order to maintain their full capacity.

8.0 CALIBRATION ADJUSTMENT

Although every MINIRAM has been factory-calibrated using a representative dust (see section 1.4), the user may wish to change the calibration constant of the instrument for a specific type of aerosol. Such a calibration should be performed by obtaining a concurrent filter collection (e.g., by means of a personal filter sampler), sampling from the same environment within which the MINIRAM is placed. The average concentration obtained by the MINIRAM (i.e. TWA reading) at the end of the test should be compared with the filter-gravimetric-determined concentration. The ratio of the two concentration values can then be used to correct the MINIRAM calibration. The comparison run should be replicated several times (to minimize errors) to obtain an average ratio.

To change the MINIRAM calibration proceed as follows:

8.1 Place MINIRAM in a clean environment (e.g. air conditioned office).

8.2 Remove battery pack (follow procedure of section 7.0).

8.3 Disconnect battery connector (remember that all stored data will thus be lost/erased from MINIRAM memory).

8.4 While leaving battery pack lying next to MINIRAM, re-connect the two units (i.e. plug in connector).

8.5 Immediately observe MINIRAM display. It will be performing a slow segment-by-segment display checkout. As soon as it displays ".00", press OFF, thus interrupting the initial automatic zero check (see section 7.0). Wait until the display indicates "OFF" and then press MEAS and wait approximately 36 seconds.

8.6 Observe 10-second readings (typically in the range of 1 to 3 mg/m^3) and record manually a few consecutive readings. Calculate the average of these values.

8.7 Identify small potentiometer screw (visible through an opening in the foil shield of the open MINIRAM) opposite the digital output jack. Adjust this potentiometer, using a fine screw driver, until the average MINIRAM reading is increased or decreased (with respect to the average obtained in 8.6) by the desired ratio (e.g. as determined by previous gravimetric comparison runs).

8.8 Shut off MINIRAM, reposition and secure battery pack, and re-zero instrument as usual. All subsequent concentration readings are now corrected by the desired ratio.

If an optional Reference Scatterer (MIE model PDM-RS) is available, insert it in the MINIRAM instead of the normal sensing chamber and follow the same procedure (i.e., follow steps 8.1 through 8.8).

9.0 ANALOG RECORDER CONNECTION

The analog output of the MINIRAM is a negative voltage of 0 to 1.5 V. A high input impedance recorder (100KΩ), or other signal processing device can be connected to that output. The 0 to -1.5V range corresponds approximately to 0 to 100 mg/m^3 as displayed by the MINIRAM.

This analog output (as opposed to the digital output and readings) is not zero-corrected, and thus a zero concentration results in a bias level of the order of several millivolts.

It is advisable to connect a capacitor in parallel with (i.e. across) the analog output (e.g. 100 microfarads or larger) in order to obtain a steady output signal. The internal time constant of the analog output of the MINIRAM is only 0.2 seconds which, in the absence of an external capacitor, results in excessive signal fluctuations.

Two miniature plugs are provided with the instrument to connect to the analog and/or digital output jacks (both can be used concurrently).

10.0 USE OF OPTIONAL MIE DIGITAL PRINTER

The MINIRAM can be connected to the MIE model DP-2-80C digital printer, an optional accessory designed for direct coupling to the MINIRAM. This printer can be used both to print out the continuous concentration data (updated every 10 seconds) in the normal measurement mode, and to print out the data stored in the MINIRAM memory as described in section 3.9.

An example of the printout formats when using the printer in combination with the MINIRAM is presented in figure 3. The DP-2-80C, a very compact impact dot matrix printer operates with the MINIRAM using the PDM-DI interconnecting cable connected to the output jack. When using the MINIRAM with this printer, the output data rate should be left at 300 baud (the normal MINIRAM default value), as described in section 4.2.

The following are specific operation procedures for use of the printer in combination with the MINIRAM. Other operating and maintenance information is contained in the instruction manual that accompanies the printer.

10.1 Printer Connection

Plug printer cable (MIE model PDM-CB) into the MINIRAM digital output receptacle and press OFF. Turn on the printer power switch (on its right side) and the two green lights on the front will be on if printing paper is in the unit. The ribbon cartridge should have been previously loaded. Refer to the printer User's Manual for details.

10.2 Printer Test

In order to test whether the DP-2-80C printer is operating correctly, hold down the LINE FEED button while turning the printer on. Once the printer is on, release the LINE FEED button and the printer will then print out all of its characters. To stop this operation press SELECT.

10.3 Printout of Stored Data

Plug printer connector into the MINIRAM digital output receptacle. Turn off printer power switch. Press OFF on MINIRAM and wait until it reads "OFF". Turn on printer power switch. Press PBK on MINIRAM for less than one second (see section 3.9) and the LCD display should then indicate "PA". The printer will then print out the stored data block.

10.4 Printout of Zero or of Measurement Data

Interconnect MINIRAM and printer as indicated before and switch on printer power. Press OFF on the MINIRAM. Press either ZERO or MEAS on MINIRAM (depending on which information should be printed out). Printer will print out zero data approximately 72 seconds after pressing ZERO on MINIRAM (see figure 2). The first line of measurement data will be printed out approximately 126 seconds after pressing MEAS, and thereafter every 100 seconds (each line contains ten 10-second measurements). The printer power can be turned off any time during the measurement cycle, and turned on again during a cycle to resume printing. The data line numbers (see figure 3) will then be the current ones as sequenced by the MINIRAM whose output is independent of the operations of the printer.

11.0 DIGITAL OUTPUT CONNECTIONS

A digital printer (other than MIE model DP-2-80C), data logger (MIE PDL-10), or modem may be coupled to the MINIRAM. The data output is in the form of 20 mA current loop, 300 baud (110 or 600 baud by alternate programming) asynchronous ASCII characters. The output load should be less than 50 ohms.

Figure 4 is a diagram showing the connections and components required for a 20 mA loop interconnection to a printer. A similar diagram is shown for standard RS232 interfacing with a printer (see Figure 5). These connections do not apply when using the DP-2-80C printer.

The MINIRAM does not send parity information, but does provide an ASCII check sum which is the sum of all ASCII characters, to insure data integrity.

To use the check sum the host computer must add the ASCII value of all digits, spaces, carriage returns, and line feeds except for the first two carriage returns and line feeds which are sent immediately after pressing the PBK switch. The last eight bits of this sum should then be expressed as a decimal number (0-255) and should agree with the decimal value of the MINIRAM check sum.

12.0 ROUTINE MAINTENANCE

When the MINIRAM is not being operated it should be placed in its carrying case which should then be closed. This will minimize the amount of particle contamination of the inner surfaces of the sensing chamber.

After prolonged operation within, and exposure to particulate-laden air, the interior walls and the two glass windows of the sensing chamber may have become contaminated with particles. Although repeated updating of the zero reference following the procedure of section 3.10 will correct errors resulting from such particle accumulations, eventually this contamination could affect the accuracy of the measurements as a result of excessive spurious scattering, and significant attenuation to the radiation passing through the glass windows of the sensing chamber.

An indication of excessive chamber contamination is provided by the zero level reading (section 3.10), which should not exceed 3 mg/m^3, approximately.

In order to clean a soiled sensing chamber remove that chamber as described in section 7.0 and wash it with soap and water, rinsing thoroughly to remove any residues from the glass windows and interior of the chamber. Do not use solvents of any type. Do not rub interior surfaces of the chamber (coated version). Allow the sensing chamber to dry completely and re-insert into the MINIRAM as indicated in section 6.0.

13.0 PRECAUTIONS AND OPERATING POSITIONS

The interior of the MINIRAM sensing chamber should not be exposed to fluctuations of intense light; flashes of sunlight or bright daylight especially, are to be avoided. Such excessive variable illumination of the scattering detector can result in significant measurement errors that may persist over several 10-second display cycles. In order to operate the MINIRAM under those conditions it is advisable to use the Sunshield accessory (MIE model PDM-SNS, see section 16.2).

Another potential source of error is the presence of reflecting surfaces in close proximity to the sensing chamber openings. Such objects should be kept at least 2 cm (3/4 inch) from the chamber openings.

The removable sensing chamber should not be used as a carrying handle, especially not while operating the MINIRAM; holding this chamber may affect the measurements.

When using the MINIRAM for personal monitoring it should be positioned vertically, i.e., with the display/control panel facing upwards, by either clipping the MINIRAM to the belt, shoulder strap, etc.

In general, an approximate vertical position is to be preferred for any long-term monitoring purposes, in that this position minimizes potential particle deposition within the removable sensing chamber.

Other monitoring positions are:

a) horizontal, resting on belt clip

b) hand held (while ensuring that hand and fingers are away from the openings of sensing chamber)

c) Using the optional MINIRAM table stand

d) Wall mounted using belt clip, or the four battery pack attachment screws on the back of the MINIRAM.

14.0 INTRINSIC SAFETY

The MINIRAM has been designed to satisfy the requirements for intrinsically safe operation in methane-air mixtures. The sealed battery pack incorporates a current-limiting resistor that limits the battery short circuit current to less than 14A. MSHA 2G-3532-0 approval has been granted to the PDM-3.

15.0 SPECIFICATIONS

- Measurement ranges: 0.01 to 10 mg/m^3 and 0.1 to 100 mg/m^3
- Precision and stability (for 10 sec. readings)* : ± 0.03 mg/m^3 (2-sigma)
- Precision and stability of time-averaged measurements*:
  ± 0.02 mg/m^3 (for 1 minute averaging)
  ± 0.006 mg/m^3 (for 10 minute averaging)
  ± 0.003 mg/m^3 (for 1 hour averaging)
  ± 0.001 mg/m^3 (for 8 hour averaging)
- Temperature coefficient: 0.005 mg/m^3 per °C (typical)
- Readout resolution: 0.02 mg/m^3 or 0.1 mg/m^3 depending on automatically selected range (3 digit LCD)
- Digital readout updating time: 10 seconds
- Analog output time constant: 0.2 seconds
- Total measurement period: 8 1/3 hours, or indefinite 8 1/3 hour cycles
- Particle size range of maximum response: 0.1 to 10 μm in diameter
- Measurement display: normally 10-second real time measurement; or momentarily: time-weighted average, or 8-hour equivalent shift average, or elapsed sample time (in minutes), or zero value, or identification number, or programmable code
- Data storage: seven concentration averages, sampling periods in minutes (3 significant figure resolution), off time (10 minute resolution), identification number, zero value, programmable code, and check sum
- Real time outputs: analog (0 to 1.5V full scale), and digital ASCII

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* At constant temperature (typ. 25°C)

- Memory playback: either by own LCD display, or by 110, 300 or 600 baud, ASCII digital output (20 mA current loop, or RS232 terminals may be connected with appropriate interface)
- Nominal battery voltage: 7.5V
- Average battery current drain: 40 mA
- Continuous operating time with full battery charge: 10 hours, approximately
- Operating temperature: 0° to 50°C (32 to 120°F) Storage: -20 to 60°C
- Outside dimensions: main body: 10 x 10 x 4 cm (4 x 4 x 2 inches); sensing chamber cover: 7.7 x 3.8 x 1.5 cm (3 x 1.5 x 0.6 inches)
- Weight: 0.45 kg. (16 oz.)

16.0 STANDARD ACCESSORIES

Accessories provided with each MINIRAM are detailed in the following subsections.

16.1 Battery Charger

The battery charger (MIE model PDM-1-157-1) serves the following functions: recharge or maintain the charge of the nickel-cadmium batteries within the MINIRAM, permit continuous a.c. power line operation, and provide power for the operation of pump of the optional MIE model PDM-1FZ Zero Check Module (see section 17.2). The charger cannot be used to power the MINIRAM without its batteries, however, it can be used to charge a separate or spare battery pack (MIE model PDM-1-101-1, see section 7.0). The output of the MINIRAM battery charger is a low voltage a.c. which is converted to d.c. within the MINIRAM.

The standard battery charger is designed for a 120V/60 Hz input, however, it can be obtained for 220V/50 Hz if so specified.

16.2 Sunshield (MIE model PDM-SNS)

The sunshield accessory serves to protect the MINIRAM sensing elements from excessive ambient light fluctuations (see section 13.0). It should be used whenever the MINIRAM is to be operated outdoors or under fluctuating bright light illumination. It is also advisable to use the sunshield to prevent loose clothing or other objects from touching or entering the open sensing chamber. The use of the sunshield causes only a slight retardation of the air exchange rate between the outside and inside of the sensing chamber, an effect that is negligible except when using the analog output in order to follow rapid fluctuations of particle concentration. The sunshield attaches by its two support tabs to the body of the MINIRAM. The sunshield is included with units ordered after April 1987. It is advisable to use the MINIRAM with the sun shield attached at all times, if possible.

16.3 Z-Bag™ Calibrator

The Z-Bag™ is a convenient kit for zeroing the MINIRAM in the field. It provides a clean-air environment inside a plastic bag into which the MINIRAM is placed for zeroing. The Z-Bag kit consists of a one-way flow rubber bulb for manual air pumping, a filter cartridge, a zippered plastic container, and connecting hardware.

To use Z-Bag for zeroing MINIRAM proceed as follows:

1. Remove rubber bulb filter assembly from Z-Bag. Place Z-Bag on flat surface with red flow fitting facing up. Flatten bag. Remove small plastic cap from flow fitting on bag.
2. Insert ribbed elbow connector (attached to filter cartridge) into red flow fitting of plastic bag, until connector is flush with bottom of red flow fitting.
3. MINIRAM should be in its OFF condition (observe display). If display is blanked, or if MINIRAM is in the MEAS mode, key OFF.
4. Open Z-Bag and place MINIRAM inside, approximately at its center.
5. Key ZERO through the open end of the Z-Bag. Immediately zip closed the Z-Bag and begin to pump hand bulb.
6. Z-Bag should inflate as hand pumping continues, up to a height of about five inches (12 cm). Continue pumping gently to maintain bag interior pressure, until the MINIRAM displays OFF again.
7. Unzip Z-Bag and remove MINIRAM. MINIRAM is now ready for monitoring.
8. Place rubber bulb/filter assembly inside Z-Bag, and plug small plastic cap into flow fitting to close it. Zip close while flattening Z-Bag to store it to ensure cleanliness of the bag interior.

CAUTION: Do not expose Z-Bag to sub-zero freezing temperatures as the plastic zippered bag may crack.

16.4 Carrying Case (MIE model PDM-HC)

The PDM-HC is a convenient and compact hard shell carrying case designed to house a MINIRAM and a battery charger. The inside is foam padded for full protection. The outside dimensions of the PDM-HC-1 are: length - 9 1/2 inches, depth - 7 inches, and height - 3 1/2 inches.

16.5 Other Standard Accessories

Other accessories supplied with the MINIRAM are:

- Output connectors (can be used for the analog, and/or the digital output jacks)
- Hexagonal wrenches for flow accessories
- Instruction Manual

17.0 OPTIONAL ACCESSORIES

Several optional accessories are available from MIE for the MINIRAM, these are described in the following subsections.

17.1 Flow Adapter (MIE model PDM-1F)

The Flow Adapter when used in conjunction with the MINIRAM and any pump or external flow system, allows a sample to be drawn through the instrument sensing chamber. A personal monitoring pump at flow rates of 2 l/minute or less may be used.

To attach the Flow Adapter to the MINIRAM loosen the two thumbscrews and pull the front sealing plate forward. Slide the Adapter over the MINIRAM sensing chamber as illustrated above; secure the Adapter to the MINIRAM by tightening the two allen-head screws through the hold down tabs. Tighten the thumbscrews to seal the two end plates to the MINIRAM sensing chamber.

Typically, this accessory would be used when extracting samples from aerosol chambers, detecting leaks from pressurized ducting, or for isokinetic sampling using probes.

17.2 Zero Check Module (MIE model PDM-1FZ)

The Zero Check Module can be used to zero the MINIRAM when a clean air environment is not available. The Zero Check Module should be used when concentrations in the range above 0.5 mg/m^3 are to be measured (see section 3.10).

In addition, this accessory can be used to draw a sample stream through the MINIRAM sensing chamber (in lieu of a separate pump) by disconnecting the small tube at the sensing chamber inlet fitting.

This accessory consists of a pump, filter and the necessary tubing to circulate clean filtered air through the MINIRAM. The pump may be powered by the MINIRAM battery charger (or a 5-10 VDC power supply). The battery within the MINIRAM cannot be used to operate the Zero Check Module.

To zero the MINIRAM, first attach the Zero Check Module following the same procedure described for attaching the basic Flow Adapter (see section 17.1). Connect the battery charger to the Zero Check Module and to an A.C. source. Allow at least one minute of operation to purge the sample chamber with clean air. Press the ZERO button on the MINIRAM and continue operating the Zero Check Module until the final average zero reading is displayed (see section 3.10).

NOTES:
When using any of the optional accessories that are attached on and around the sensing chamber (models PDM-1F, -1FZ, and -SNS) to perform measurements at concentrations below 0.5 mg/m^3, it is advisable to zero check the MINIRAM with the accessory in place,

making sure that its mounting and sealing screws are properly tightened.

Use an external pump or pressurized air source (well filtered) to drive clean air through the sensing chamber to zero the MINIRAM with any of those accessories (except in the case of the Zero Check Module). To zero check the MINIRAM when using the Sunshield place instrument with the attached sunshield in a clean air environment (see Section 3.10), or using the Z-Bag (see Section 16.3).

17.3 Personal Sampler Adapter (MIE model PDM-2FS)

This accessory, when used with the MINIRAM and a personal sampling pump, permits active sampling of respirable (cyclone preselected) particles through the instrument sensing chamber and collection on a filter. The aerosol sample is drawn through a 10 mm nylon cyclone (with a 50% cut point at 3.5 µm when operated at 2 l/minute), through the sensing chamber of the MINIRAM, and then collected on a filter located in the cassette/filter holder for subsequent gravimetric or other analysis.

The model PDM-2FS is compatible with a Millipore 37mm disk filter holder no. M000 037 AO.

To attach the Personal Sampler Adapter to the MINIRAM, follow the same procedure as described for attaching the basic Flow Adapter (see Section 17.1). Connect a length of tubing from the exhaust fitting on the filter holder to a personal sampling pump (not provided with the Adapter).

The use of the Personal Sampler Adapter permits concurrent MINIRAM readings and filter collection to facilitate calibration of the MINIRAM for a specific aerosol, or to determine both concentration and chemical composition of the aerosol.

17.4 Shoulder Strap (MIE model PDM-SS)

The PDM-SS is a leather strap, worn over the shoulder and across the chest, which attaches to the wearer's belt in front and back. The MINIRAM clipped to the mounting loop in the upper chest area allows exposure measurements close to the breathing zone while still permitting comfort and freedom of movement.

17.5 Table Stand (MIE model PDM-TS)

The table stand accessory provides a convenient mounting support for the MINIRAM when it is used for area monitoring. The MINIRAM is simply clipped onto the table stand which holds it in a convenient position.

17.6 Dot Matrix Digital Printer (MIE model DP-2-80C)

This printer is supplied with a special interconnecting cable which is plugged into the digital output jack of the MINIRAM. The DP-2-80C is normally provided for 120V/60 Hz operation. Operation with 220V/50 Hz line can be provided upon customer request.

The use of the DP-2-80C in combination with the MINIRAM is described in Section 10.0. A separate instruction manual for the printer is supplied with that unit.

17.7 Reference Scatterer (MIE model PDM-RS)

The PDM-RS is a specially modified sensing chamber that includes a diffusing optical filter mounted within the sensing region of the MINIRAM. It is designed to scatter a controlled amount of light from the infrared source to the detector, providing a stable and repeatable reading on the MINIRAM display. The reference scatterer is inserted into the MINIRAM instead of the normal sensing chamber, and the readings are obtained operating in the MEAS mode. If the PDM-RS is ordered from MIE concurrently with a MINIRAM the reference scatterer will be factory marked with the calibration reading to be obtained when inserted into that particular MINIRAM whose serial number will also be shown on the PDM-RS tag. The readings displayed by the MINIRAM when inserting the PDM-RS should be within approximately ±5% of the value marked on that reference scatterer.* The readings obtained with the reference scatterer may show a small warm-up drift (i.e. gradual change) during the initial 5 to 10 minutes after pressing MEAS.

If the reference scatterer is ordered separately from the MINIRAM, the user will then determine the calibration reading obtained on the MINIRAM and mark it (together with the MINIRAM serial number) on the PDM-RS tag.

Because of small differences in the optical configuration of each reference scatterer, the readings obtained with a given reference scatterer are unique to a given MINIRAM. The response to a given population of airborne particles, however, is the same for all factory calibrated MINIRAMs, within approximately ± 5%.

17.8 Cable (MIE model PDM-CB)

The PDM-CB cable is used to connect the digital output of the MINIRAM with the input of the 80 column digital printer MIE model DP-2-80C.

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* Prior to the use of the reference scatterer the MINIRAM should be zeroed with a clean standard sensing chamber as described in Section 3.10.

17.9 Portable Data Logger (MIE model PDL-10)

This data logger can be used to record, average, peak detect, etc. concentration levels measured by the PDM-3. A separate instruction manual is provided for the PDL-10.

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3. Typical MINIRAM Model PDM-3 Digital Printout Format

4. 20 mA Loop Connection

5. RS-232 Connection

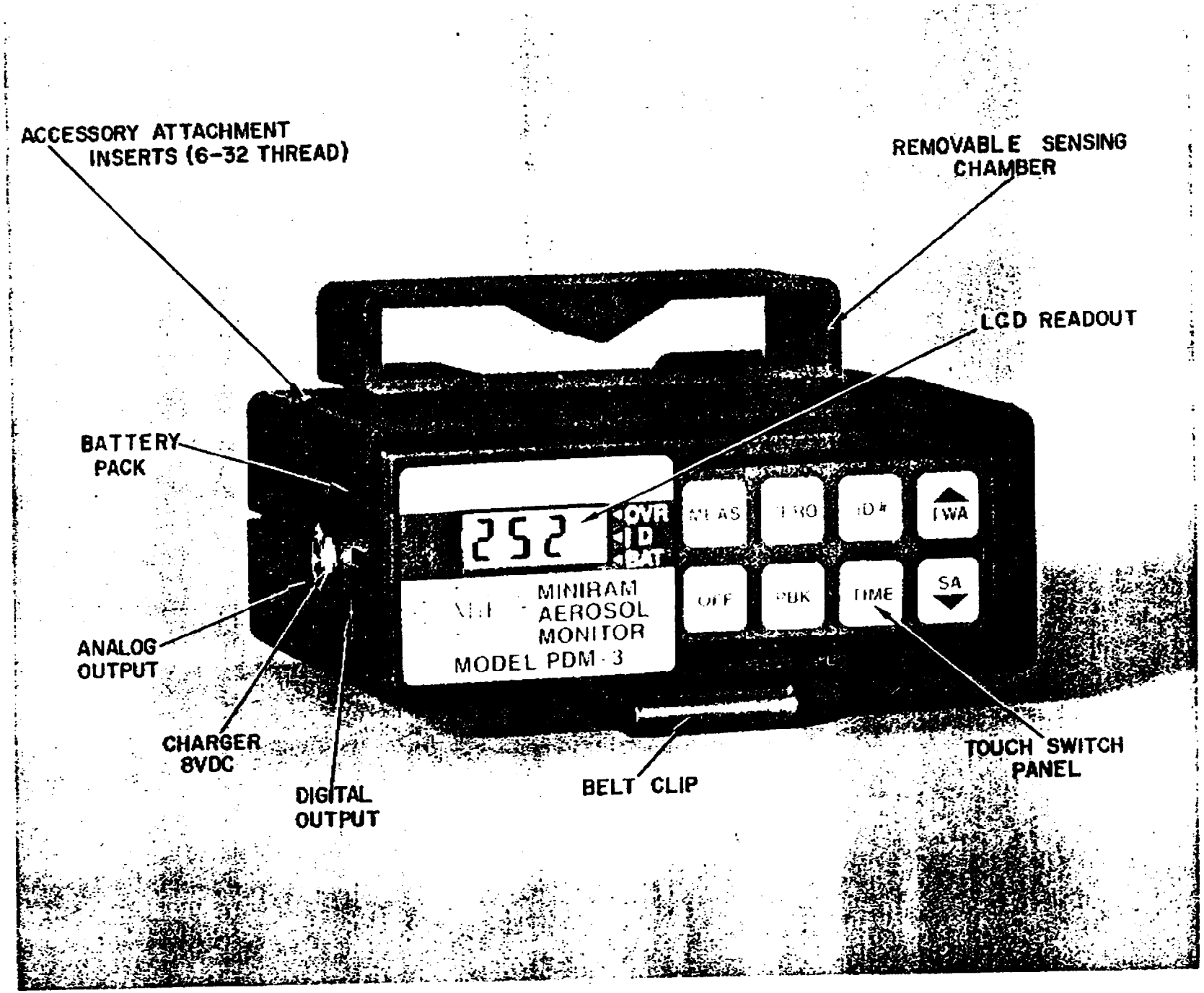

Figure 1. Main View of MINIRAM

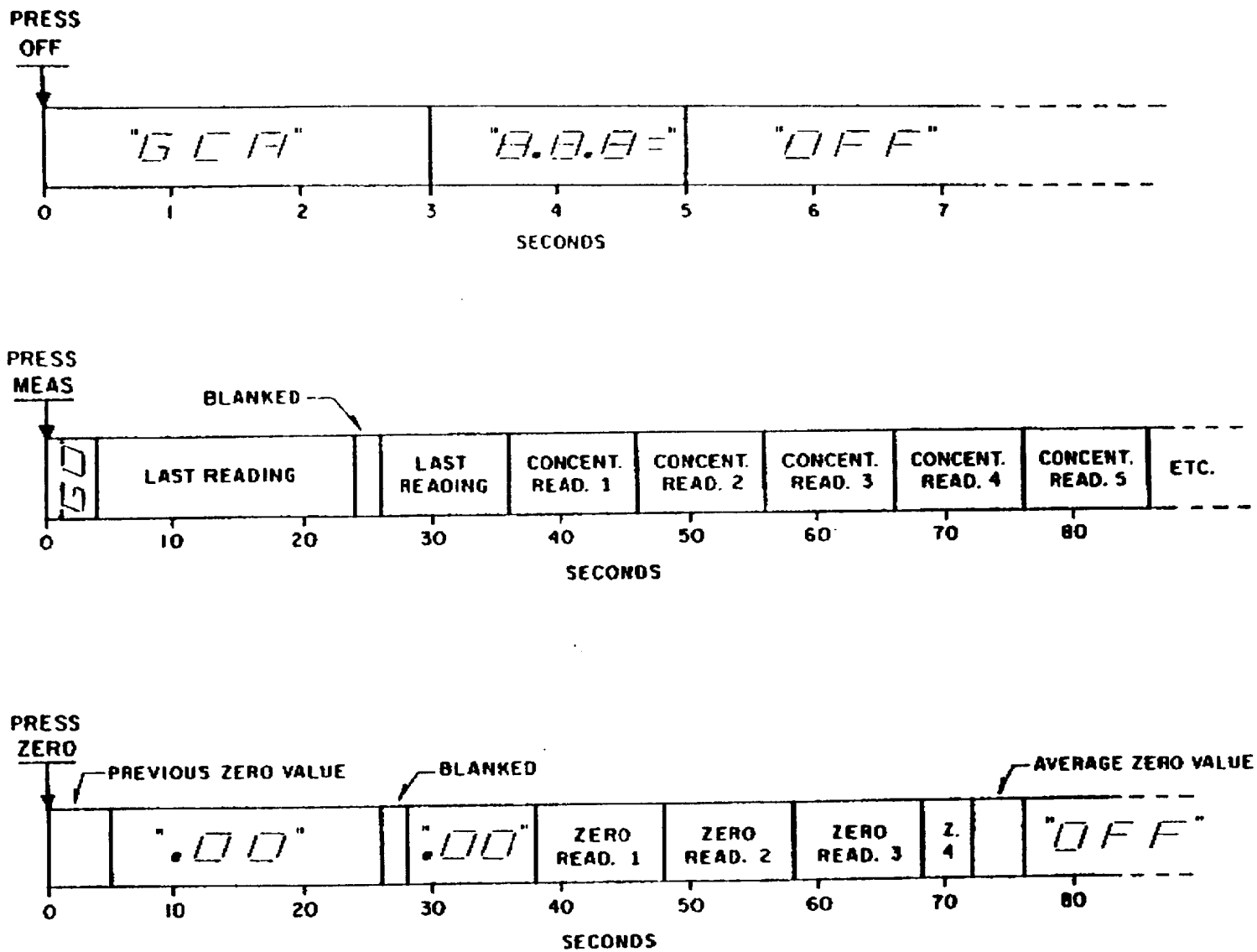

Figure 2. Timing Diagram of MINIRAM model PDM-3 when pressing OFF, MEAS, or ZERO (typical times)

Average Zero Value

00.62 00.62 00.66 00.57 00.61

Zero Check

0000 02.05 02.05 02.04 02.05 02.04
02.05 02.04 02.05 02.04 02.05
0001 02.04 02.05 02.05 02.05 02.04
02.05 02.05 02.05 02.04 02.05
0002 02.05 02.04 02.05 02.05 02.04
02.05 02.05 02.05 02.05 02.04

Line Number

Continuous 10-Second Printout of Concentration (in mg/m^3)

GCA TECHNOLOGY DIV.
BEDFORD MA USA
617-275-5444
PDM-2 LISTING

SHIFT #	ON MINS	OFF MIN/10	CONC MG/M3
0007	0004	0000	02.04
0006	0012	0000	01.61
0005	0006	0000	01.61
0004	0004	0000	00.01
0003	0006	0000	00.00
0002	0000	0000	00.02
0001	0000	0001	00.00

I= 0003 F= 0012 Z= 00.61
0057

ID Number

Playback of Stored Data

Check Sum

Programmable Selection Code

Zero Value

Figure 3. Typical MINIRAM Model PDM-3 Digital Printout Format

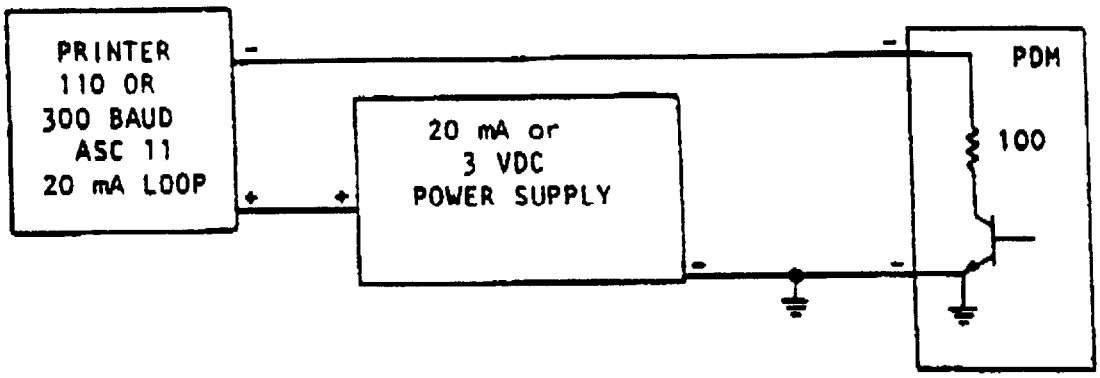

Figure 4. 20 mA Loop Connection

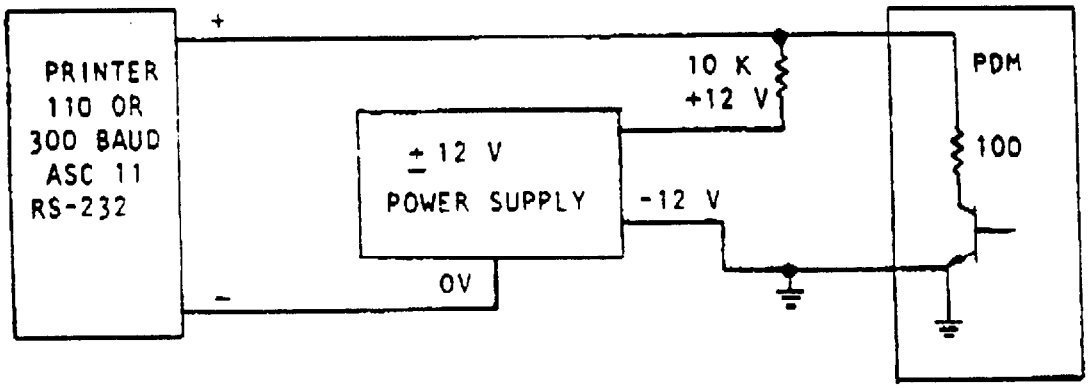

Figure 5. RS-232 Connection

Attachment B

Health and Safety Plan

HEALTH AND SAFETY PLAN

CLIENT:	UNITED STATES NAVY NAVAL FACILITIES ENGINEERING COMMAND
SITE NAME:	PORTSMOUTH NAVAL SHIPYARD
PROJECT/TASK ID#:	14-0000005-023-007
SITE ADDRESS:	Portsmouth Naval Shipyard Kittery, Maine

PROJECTED MOBILIZATION DATE: 7/26/93
***PLAN EXPIRATION DATE:** 10/26/93

HASP APPROVALS:

	Name	Signature	Date
PROJECT MANAGER	Harold Hatfield	Harold Hatfield	7/26/93
IH REVIEW	Bryan Del Monte		
FIELD SUPERVISOR/ SITE SAFETY OFFICER	Michael D'Eufemia	Michael D'Eufemia	7-26-93
REGIONAL HEALTH AND SAFETY MANAGER	Henry Robinson		

***PLAN EXPIRATION DATE:**

- Plan expiration date will be 3 months after the approval date.
- If this Plan is required to be used after the expiration date, then a Health and Safety review is necessary.

HEALTH AND SAFETY PLAN

CLIENT: UNITED STATES NAVY
NAVAL FACILITIES ENGINEERING COMMAND

SITE NAME: PORTSMOUTH NAVAL SHIPYARD

PROJECT/TASK ID#: 14-0000005-023-007 (MDJ) 7-26-93

SITE ADDRESS: Portsmouth Naval Shipyard
Kittery, Maine

PROJECTED MOBILIZATION DATE: 7/26/93
***PLAN EXPIRATION DATE:** 10/26/93

HASP APPROVALS:

	Name	Signature	Date
PROJECT MANAGER	Harold Hatfield		
IH REVIEW	Bryan Del Monte	Bryan B Del Monte	7/22/93
FIELD SUPERVISOR/ SITE SAFETY OFFICER	Michael D'Eufemia		
REGIONAL HEALTH AND SAFETY MANAGER	Henry Robinson		

***PLAN EXPIRATION DATE:**

- Plan expiration date will be 3 months after the approval date.
- If this Plan is required to be used after the expiration date, then a Health and Safety review is necessary.

HEALTH AND SAFETY PLAN

CLIENT:	UNITED STATES NAVY NAVAL FACILITIES ENGINEERING COMMAND
SITE NAME:	PORTSMOUTH NAVAL SHIPYARD
PROJECT/TASK ID#:	14-0000005-023-007 (mod) 7-26-93
SITE ADDRESS:	Portsmouth Naval Shipyard Kittery, Maine

PROJECTED MOBILIZATION DATE: 7/26/93
***PLAN EXPIRATION DATE:** 10/26/93

HASP APPROVALS:

	Name	Signature	Date
PROJECT MANAGER	Harold Hatfield		
HI REVIEW	Bryan Del Monte		
FIELD SUPERVISOR/ SITE SAFETY OFFICER	Michael D'Eufemia		
REGIONAL HEALTH AND SAFETY MANAGER	Henry Robinson	Henry L. Robinson	7/21/93

***PLAN EXPIRATION DATE:**

- Plan expiration date will be 3 months after the approval date.
- If this Plan is required to be used after the expiration date, then a Health and Safety review is necessary.

HEALTH AND SAFETY PLAN

DISCLAIMER

This site Health and Safety Plan has been written for the use of McLaren/Hart and its employees. It may also be used as a guidance document by properly trained and experienced subcontractors. However, McLaren/Hart does not guarantee the health or safety of any person entering this site.

Due to the potentially hazardous nature of this site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards which may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury at this site. The health and safety guidelines in this plan were prepared specifically for this site and should not be used on any other site without prior research by trained health and safety specialists.

McLaren/Hart claims no responsibility for use of the plan by others. The Plan is written for the specific site conditions, purpose, dates, and personnel specified and must be amended if these conditions change.

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SECTION 1.0

GENERAL INFORMATION

1.1 Introduction:

HEALTH AND SAFETY is an essential element of each project conducted or managed by McLaren/Hart. Our extensive programs and procedures provide for the health and safety of our clients and our own employees, the prevention of property damage, as well as protection of the environment and a reduced health and safety risk.

- **Employee Training** - Our programs are managed by health and safety professionals who have the appropriate levels of training and certification. All McLaren/Hart staff engaged in hazardous waste activities are required to have received 40 hours of training under OSHA 29 CFR 1910.120 Hazardous Waste Operation and Emergency Response regulations. Training is supplemented each year with an eight-hour refresher course. Supervisor training, First Aid, CPR, and site-specific training are also conducted regularly.

- **Corporate Programs** - McLaren/Hart provides training, health and safety audits, medical surveillance, and a drug-free workplace policy to assure compliance with regulatory requirements and that health and safety policies and procedures are understood and implemented in a responsible manner.

This site Health and Safety Plan (HASP) addresses those activities associated with the scope of work stated in the plan and will be implemented by the Site Safety Officer (SSO) during site work. Compliance with this HASP is required of all persons and third parties who enter this site. Assistance in implementing this plan can be obtained from the Site Safety Officer and Project Manager, and/or the Regional Health and Safety Manager (RHSM). The content of this HASP may change or undergo revision based upon additional information made available to health and safety (H&S) personnel, monitoring results or changes in the scope of work. Any changes proposed must be reviewed by H&S staff and are subject to approval by the RHSM and Project Manager.

1.2 Site Personnel:

Personnel authorized to enter the subject site while operations are being conducted must be approved by the McLaren/Hart Regional Health and Safety Manager. All non McLaren/Hart personnel site entry authorization requires confirmation of conformance with OSHA 29 CFR 1910.120 training and medical examination requirements and/or other applicable regulations and review/sign-off of this HASP.

See Attachment 1 for Personnel Responsibilities and Qualifications.

FIELD SUPERVISOR/ SITE SAFETY OFFICER	Michael D'Eufemia	(518) 869-6192
	Name	Telephone No.

REFERENCES:

The Health and Safety Plan (HASP) is prepared in accordance to OSHA CFR 1910.120 regulations pertaining to personnel involved in activities at hazardous waste sites or emergency response operations. Specific document references were obtained from the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.

1.3 Additional Authorized Site Personnel

Personnel authorized to enter the Portsmouth Naval Shipyard (PNS), facility while operations are being conducted must be approved by the Regional Health and Safety Manager (RHSM) or the Site Safety Officer (SSO). Authorization will involve completion of appropriate training courses and medical examination requirements as required by OSHA 29 CFR 1910.120 and/or other applicable regulations and review and sign-off of this HASP. All personnel must utilize the buddy system or trained escort, and check in with the Site Safety Officer.

Additional McLaren/Hart Personnel Authorized to Perform Work On-site (not previously listed in Section 1.2):

Name	Medical Surveillance and Training Dates						RHSM/ SSO Initials
	Medical Exam	Initial Training	Site Supervisors Training	Refresher Training	Respirator Fit Test and Training	Additional	
Michael D'Eufemia	6/3/93	7/14/89	-	6/25/92*	1/11/93		
Charles Kavanaugh	11/10/92	10/19/90	-	10/23/92	1/29/93		

* Employee scheduled for 8-hour refresher on August 16, 1993.

1.4 Site Personnel Sign-off Sheet

The following personnel have read, understand, and agree to abide by the provisions of this Health and Safety Plan which has been prepared specifically for the Portsmouth Naval Shipyard (PNS) (See Section 1.2).

PORTSMOUTH NAVAL SHIPYARD

Name (Printed)	Representing	Signature	Date
Michael D'Eufemia	McLaren/Hart	Michael D'Eufemia	8-2-93
Charlie C. Kavanaugh	McLaren/Hart	Charlie C. Kavanaugh	8-2-9

SECTION 2.0

PROJECT INFORMATION

2.1 Site Description:

The Portsmouth Naval Shipyard is composed of four islands located in the Piscataqua River within the town limits of Kittery, Maine. The Piscataqua River is a tidal estuary which forms the boundary between New Hampshire and Maine.

The shipyard is engaged in the conversion, overhaul, and repair of submarines for the U.S. Navy. The shipyard has a long history dating back to 1690 when the first warship launched in North America, the **Falkland**, was built. The Portsmouth Naval Shipyard was first established as a government facility in 1800. The shipyard served as a repair and building facility for ships during the Civil War. The first government-built submarine was designed and constructed at the yard from 1917 to the present. The shipyard has continued servicing submarines to this day.

The shipyard is now composed of 376 buildings on 278 acres of land. As the workload at the shipyard expanded, fill material was used to create made-land adjacent to the original islands. Today, continuous land surface extends between three of the original four islands and much of the facility is built on fill overlying former tidal flats. Figure 1 (Attachment 2) shows the present day site layout.

See Attachment 2 for Site Map

2.2 Purpose of Site Work:

The purpose of the site work is to perform background surface soil sampling as part of a Media Protection Study (MPS) in accordance with the Resource Conservation and Recovery Act (RCRA) and in response to the Hazardous and Solid Waste Amendments of 1984 (HSWA) Permit issued by the United States Environmental Protection Agency (USEPA).

The objectives of the background surface soil sampling are:

- To identify and establish the concentrations of Target Compound List and Target Analyte List (TCL and TAL) substances present in background surface soils at and adjacent to the Portsmouth Naval Shipyard.
- To evaluate whether any of the substances found present at or above quantitation limits may have impacted human health or the environment.

2.3 Scope of Work (by task number in order of execution):

1. Sixteen (16) sampling locations will be selected. One surface soil sample will be collected for laboratory analysis at each sampling location. Preferably, each sample will consist of a one-foot thick interval measured from the ground surface. The sample will be collected with a hand auger.

SECTION 3.0

HEALTH AND SAFETY HAZARD ANALYSIS

3.1 Hazard Analysis:

Non-chemical hazards are associated with:

1. Tripping and falling (uneven terrain).

Chemical hazards are associated with:

1. Background surface soil sample collection (heavy metals or pesticides).

The overall hazard is:

__X__ Low
_____ Moderate
_____ High

3.2 Non-Chemical Hazard Summary:

See Table 3-1 for summary assessment of non-chemical hazards.

3.3 Site Contaminant Source(s) and Data:

See Table 3-2 for list of known/probable contaminants.

3.4 Chemical Hazard Summary:

See Table 3-3 for summary assessment of chemical hazards.

TABLE 3-1

ASSESSMENT OF NON-CHEMICAL HAZARDS

Non-Chemical Hazard	Yes	No	Task No.(s)	Non-Chemical Hazard	Yes	No	Task No.(s)
1. Electrical (overhead lines)		X		16. Shoring		X	
2. Electrical (underground lines)		X		17. Scaffolding		X	
3. Gas/Water lines		X		18. Biologic		X	
4. Drilling Equipment		X		19. Holes/Ditches		X	
5. Excavation Equipment		X		20. Steep Grades		X	
6. Machinery		X		21. Slippery Surfaces		X	
7. Heat Exposure	X		1	22. Uneven Terrain	X		1
8. Cold Exposure		X		23. Unstable Surfaces		X	
9. Oxygen Deficiency		X		24. Elevated Surfaces		X	
10. Confined Spaces		X		25. Lighting		X	
11. Noise		X		26.			
12. Ionizing Radiation		X		27.			
13. Non-ionizing Radiation		X		28.			
14. Fire		X		29.			
15. Explosive Atmospheres		X		30.			

TABLE 3-2

PROBABLE CONTAMINANTS

Contaminant	Source of Contamination	Media of Concern
Lead	Unknown	Soil
Pesticides	Possible former spraying program	Soil
Polycyclic Aromatic Hydrocarbons	Asphalt pavement	Soil

TABLE 3-3
ASSESSMENT OF CHEMICAL HAZARDS

Task No.	Chemical Name (or class)	PEL/TLV[a]	Other Pertinent Limits[a] (Specify)	Potential Exposure Pathways	Acute Health Effects	Chronic Health Effects[a]
1	Lead	0.50 mg/m^3	IDLH 700 mg/m^3	Inhalation, Ingestion, Skin/eye contact	Weak, lassitude, insomnia, comma, facial pallor, pale eyes, constipation, fatigue, sleep disturbance, headache, abdominal pains	Anemia, pale skin, decreased hand-grip strength, abdominal pain, kidney damage
1	Pesticides	DDT 1.0 mg/m^3	DDT 0.5 mg/m^3 NIOSH REL	Absorption, Inhalation, Ingestion, Skin/eye contact	Pares tongue, lips & face, apprehension, headache, fatigue, dizziness, confusion	CNS, kidneys, liver, irritation of eyes and skin (human carcinogen)
1	Coal Tar Pitch Volatiles, as benzene solubles	0.2 mg/m^3	0.01 mg/m^3 TWA, NIOSH REL	Inhalation, Skin contact	dermatitis, bronchitis	Damage to respiratory system, bladder, kidneys and skin (human carcinogen)

[a]
- TWA = Time Weighted Average.
- PEL = OSHA Permissible Exposure Limit; represents the maximum allowable 8-hr. TWA exposure concentration.
- TLV = ACGIH Threshold Limit Value; represents the maximum recommended 8-hr. TWA exposure concentration.
- Exc = Cal-OSHA Excursion Limit; represents the maximum exposure concentration allowed for a specified excursion duration provided the PEL and Ceiling limits are not exceeded.
- STEL = ACGIH or OSHA Short-term Exposure Limit; represents the maximum allowable 15 minute TWA exposure concentration.
- Ceiling = OSHA and Cal-OSHA Ceiling Limit; represents the maximum exposure concentration above which an employee shall not be exposed during any period without respiratory protection.
- LEL = Lower Explosive Limit; represents the minimum concentration of combustible vapor in air that will ignite, if an ignition source is present (expressed in % by volume).
- IDLH = Immediately Dangerous to Life and Health; represents the concentration at which one could be exposed for 30 minutes without experiencing escape-impairing or irreversible health effects.
- CNS = Central Nervous System.
- NIOSH REL = National Institute for Occupational Safety & Health Recommended Exposure Limits.

SECTION 4.0
HEALTH AND SAFETY FIELD IMPLEMENTATION

4.1 Personal Protective Equipment (PPE) Requirements:

PPE may be upgraded or downgraded by the site industrial hygienist, RHSM, or qualified Site Safety Officer based upon site conditions and air monitoring results. Reference to required PPE will be by Level of Protection (A-D). A summarized description of minimum required PPE by level of protection is indicated below:

LEVEL A - Self-contained breathing apparatus (SCBA) or supplied air respirator (SAR) with escape SCBA; totally-encapsulating suit; chemical-resistant boots and gloves; two-way radio communications.

LEVEL B - SCBA or SAR with escape SCBA; chemical-resistant suit, boots, gloves.

LEVEL C - Air purifying respirator (half or full face); chemical resistant suit, boots, gloves

LEVEL D - Coveralls, chemical-resistant boots, safety glasses

See Table 4-1 for PPE requirements.

4.2 Monitoring Equipment Requirements:

Monitoring is conducted by the Site Safety Officer or designee. Conduct contaminant source monitoring initially. Complete breathing zone monitoring if source concentrations are near or above contaminant action level concentrations. *See Table 4-2 for monitoring protocols and contaminant action levels.* Log direct reading monitoring every 15-30 minutes and record results on Direct Reading Report form. Calibrate monitoring instruments daily or in accordance with manufacturers' specifications. Record calibration data on the Instrument Calibration Log. *See Attachment 4 for Direct Reading Report and Instrument Calibration Log.*

TABLE 4-1

PERSONAL PROTECTIVE EQUIPMENT (PPE) REQUIREMENTS

Task No.(s)	Level of Protection	Level if Upgrade	PPE[a] Suit	PPE[a] Gloves	PPE[a] Feet	PPE[a] Head	PPE[a] Eye	PPE[a] Ear	PPE[a] Respirator	Additional PPE[a] for Upgrade
1	Level D	Level C	STD	Nitrile	Steel Toe PVC	-	Glasses	-	-	Full APR OV/AG Tyvek
1	Level C	Stop Work	Tyvek	Nitrile	Steel Toe PVC	-	Glasses	-	Full APR	Stop Work

a Personal Protective Equipment (PPE):

SUIT:
Std = Standard work clothes
Tyvek = Uncoated Tyvek disposable coverall
PE Tyvek = Polyethylene-coated Tyvek
Saranex = Saranex-laminated Tyvek
PVC Suit = PVC rain gear

GLOVES:
Work = Work gloves (canvas, leather)
Neo = Neoprene gloves
PVC = PVC gloves
N = Nitrile gloves
V = Vinyl gloves
L = Latex gloves

a Personal Protective Equipment (PPE):

FEET:
Steel = Steel-toe boots
Steel+ = Steel-toe PVC boots
Booties = PVC booties

HEAD:
HH = Hardhat

EYE:
Glasses = Safety glasses
Goggles = Goggles
Shield = Face shield

EAR:
Plugs = Earplugs
Muff = Ear muff

a Personal Protective Equipment (PPE):

RESPIRATOR:
APR = Air purifying respirator
Full APR = Full face APR
Half APR = Half face APR
SAR = Airline supplied air respirator
SCBA = Self contained breathing apparatus
Escape = Escape SCBA
OV = Organic Vapor cartridge
AG = Acid gas cartridge
OV/AG = Organic vapor/Acid gas cartridge
AM = Ammonia cartridge
Dust/mist = Dust/mist pre-filter and cover for cartridge
HEPA = High efficiency particulate air filter cartridge

OTHER:
* = Use if contact with wet soil or water
** = *Optional use except if specific hazard present*

TABLE 4-2
MONITORING PROTOCOLS AND CONTAMINANT ACTION LEVELS

					Breathing Zone Action Level Concentrations	
Task No.	**Location**	**Contaminant**	**Monitoring Equipment**	**Monitoring Protocol**	**Monitored Level* for Mandatory Respirator Use**	**Monitored Level for Mandatory Work Stoppages****
1	PNS	Lead	Miniram	Continuous while sampling/ Intermittent during sample preparation	9.0 mg/m^3***	15.0 mg/m^3
1	PNS	Pesticides	Miniram	Intermittent or continuous monitoring in workers breathing zone	10.0 mg/m^3***	15.0 mg/m^3

NOTE: Monitored Lead Level for Mandatory Respirator Use - Calculation:

Previous Background Lead Concentration (high) (mg/kg) ÷ 10^6 x Total Suspended Particulates (mg/m^3) = OSHA PEL (0.05 mg/m^3)

$1{,}100\ mg/kg \div 10^6 \times TSP = 0.05\ mg/m^3$

TSP = 45.0 (NOTE: 20% of this value is utilized for conservatism)

* Monitoring performed at operator's breathing zone.
** Call the Regional Environmental Health and Safety Coordinator for consultation.
*** Level must be achieved through two readings taken 10 min. apart where both exceed 9.0 mg/m^3 for lead and 10.0 mg/m^3 for pesticides. Mandatory work stoppage level must also be two confirmed readings taken 10 min. apart.

Miniram = Total Dust Monitor
PNS = Portsmouth Naval Shipyard

4.3 Site Zones/Delineation:

Exclusion Zone: **(Not Applicable)**

____ Areas within barricades, cones and/or caution tape
____ Within 40-ft radius of drill rig operations
____ Within 40-ft radius of heavy equipment operations
____ Within 10-ft radius of hand augering location
____ Within 10-ft radius of groundwater monitoring well locations
____ Other (describe):

Contamination Reduction Zone: At perimeter of Exclusion Zone.

Support Zone: Outside of Contamination Reduction Zone.

4.4 Site Communication:

____ By two way radio
__X__ By telephone
____ By pager
__X__ By other means (describe): Predetermined hand signals

SECTION 5.0

SITE OPERATING PROCEDURES

5.1 Initial Site Entry Procedures:

- Locate nearest available telephone or ensure alternative communications equipment is working.
- Post Emergency Information Confirm and post emergency phone numbers and hospital route.
- Designate at least one vehicle for emergency use.
- If toilet facilities are not located within a 5-minute walk from the decontamination facilities, either provide a chemical toilet and hand washing facilities or have a vehicle available (not the emergency vehicle) for transport to nearby facilities.
- Prior to working on-site, conduct an inspection for physical and chemical hazards.
- Note any specialized protocols particular to work tasks associated with the project.

5.2 Daily Operating Procedures:

- Brief all personnel on details of Attachment 10.
- Hold daily Tailgate Safety Meetings prior to work start.

  See Attachment 5 for Tailgate Safety Meeting Form.
- Use monitoring instruments and follow designated protocol and contaminant action levels.
- Use personal protective equipment (PPE) as specified.
- Remain upwind of operations and airborne contaminants, if possible.
- Establish a work/rest regime when ambient temperatures and protective clothing create a potential heat stress hazard.
- Do not carry cigarettes, gum, etc. into contaminated areas.
- Refer to Site Safety Officer for specific concerns for each individual site task.
- **ALWAYS EMPLOY THE BUDDY SYSTEM.**
- Be alert to your own physical condition. Watch buddy for signs of fatigue, exposure, etc.
- *All accidents, no matter how minor*, must be reported immediately to the SSO.

5.3 Decontamination (Decon) Procedures (Personnel and Equipment):

- Personnel decontamination procedures will be required when Level C or higher levels of protection are used by personnel.

  See Attachment 6 for equipment needed to perform decontamination and procedures to be used for decontamination of personnel.

- Dry wipe samples prior to packaging.
- Brush clean the sampling equipment and rinse with distilled water or other cleaning solution.
- Wipe clean the monitoring equipment.
- Hand auger buckets will be washed in TSP solution and rinsed in distilled water.
- Decontamination will be performed in a manner that minimizes waste generation.
- Containment systems will be set up as necessary for collection of decon solutions.
- Spent decon solutions will be containerized in drums or portable tanks and disposed of as waste, if applicable.
- Do not walk through areas of obvious or known contamination and do not handle or touch contaminated materials directly.
- Make sure all PPE has no cuts or tears prior to donning.
- Fasten all closures on suits, covering with tape if necessary.

5.4 Additional Health and Safety Protocols:

- For confined space entry operations follow all requirements of OSHA 29 CFR 1910.146.
- Be alert for Heat Stress as per attachment 6.

SECTION 6.0

EMERGENCY RESPONSE PLAN

6.1 Emergency Incident Procedures:

If an emergency incident occurs, take the following action:

Step 1: Notify the Site Safety Officer and facility.

Step 2: As necessary, request assistance from outside sources and/or allocate personnel and equipment resources for response.

Step 3: Survey and assess existing and potential hazards.

Step 4: As appropriate, evacuate site with site specific evacuation procedures.

Step 5: Prepare incident report.

6.2 Emergency Injury Procedures:

If an injury occurs, take the following action:

Step 1: Get first aid and/or medical attention for the injured person immediately.

Step 2: Notify the Site Safety Officer and Field Supervisor.

Step 3: The Site Safety Officer will assume charge during a medical emergency.

Step 4: Depending on the type and severity of the injury, notify the Regional Health and Safety Manager and the injured person's Human Resources office.

Step 5: If external emergency assistance is necessary, prevent access to the area until off-site responders arrive. The SSO will transfer control to the responding agency.

Step 6: Prepare the incident report. Within 24 hours of the incident, the Site Safety Officer is responsible for its preparation and submittal to the Regional Health and Safety Manager who will notify the Corporate Human Resources office and undertake the necessary incident investigation.

6.3 Emergency Telephone Numbers: TO BE POSTED ON SITE

TITLE	NAME	TELEPHONE NUMBER
Regional Environmental Health & Safety Manager	Henry Robinson	(908) 647-8111
Health & Safety Manager (Albany)	Michael D'Eufemia	(518) 869-6192
Client Contact	Deborah Carlson	(215) 595-0567
Site Contact	James Tayon	(207) 438-3832
Project Manager	Harold Hatfield	(518) 869-6192
Site Safety Officer	Michael D'Eufemia	(518) 869-6192
Regional Human Resources Dept.	Audrey Hausmann or Patty Benz	(215) 521-8585
Corporate Human Resources Dept.	Mary Lynn Hollingsworth or Sharon Clark	(916) 638-6840
Police Department	Shipyard	(207) 438-2444
Fire Department	Shipyard	(207) 438-2333
Local Hospital	Portsmouth	(207) 433-4042
Local Ambulance/Rescue	Shipyard	(207) 438-2555

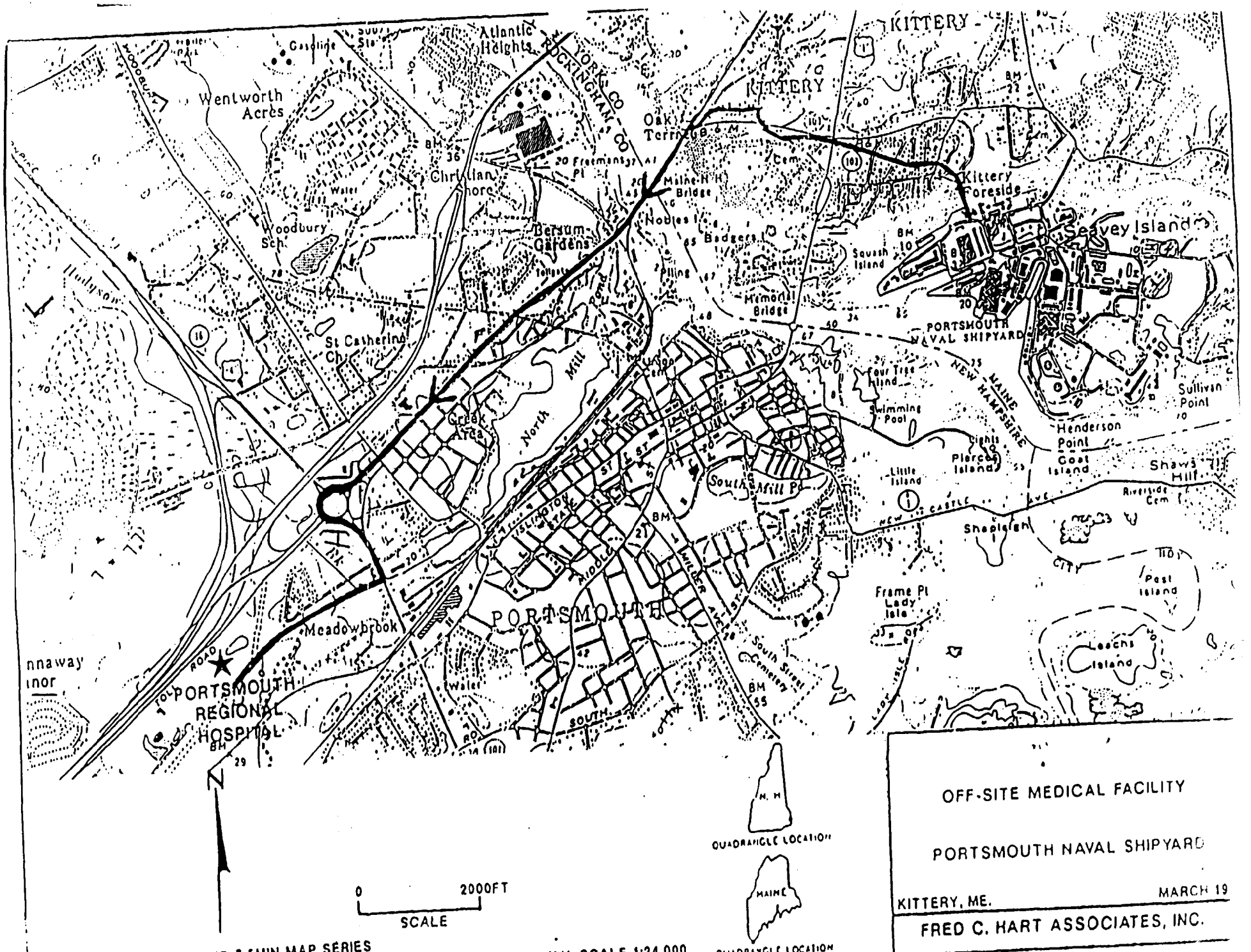
6.4 Hospital Name/Address/Route:

Name: Portsmouth Hospital

Address: 333 Borthwick Avenue
Portsmouth, New Hampshire 03801

Route: Out Gate 1, up Walker Street, over overpass, bear left to Route 1, next left under bridge onto Interstate bridge, to rotary (3/4 around), right onto bypass, at second set of lights take right onto Borthwick.

See hospital route map on next page.



FROM: USGS TOPOGRAPHIC 7.5MIN MAP SERIES
DRANGLE N.H.&ME. AND KITTERY QUADRANGLE,ME.&N.H. SCALE 1:24,000

ATTACHMENT 1

PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS

PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS

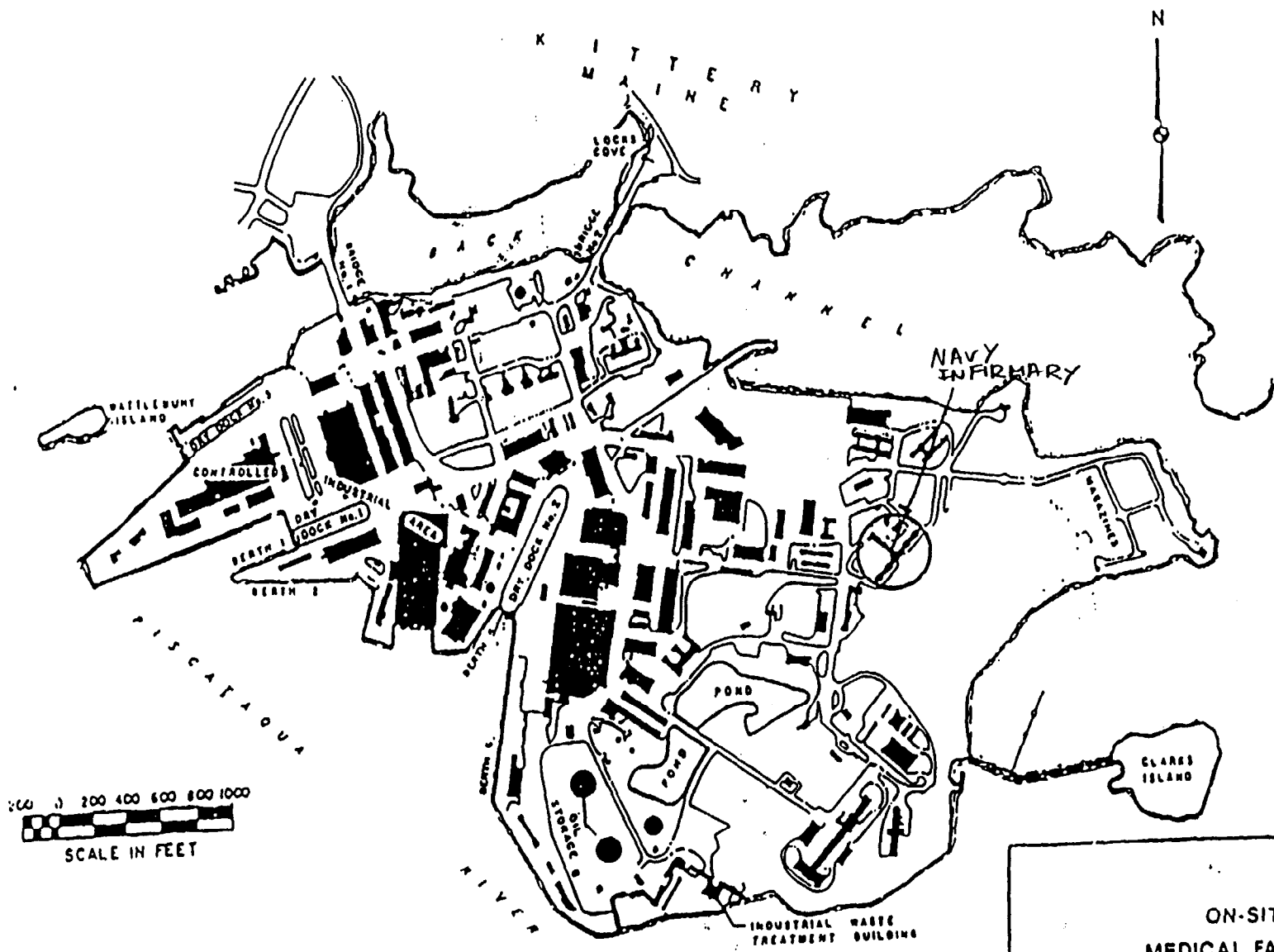
TITLE	GENERAL DESCRIPTION	SPECIFIC RESPONSIBILITIES	REQUIRED TRAINING AND MEDICAL SURVEILLANCE
Project Manager	• Reports to upper-level management. • Has authority to direct response operations. • Assumes total control over site activities.	• Prepares and organizes the background review of the job at hand, the Work Plan, the site Health and Safety Plan, and the field team. • Obtains permission for site access and coordinates activities with appropriate officials. • Ensures that the work plan is completed and on schedule. • Briefs the field teams on their specific assignments. • Uses the Site Safety Officer to ensure that safety and health requirements are met. • Prepares the final report and support files on the response activities. • Serves as the liaison with public officials.	• 40-hr. Hazardous Waste Training including 8-hr. update (29 CFR 1910.120) • Hazardous Waste Management and Supervisor Training (29 CFR 1910.120) • Respirator use training (if on-site work) • Medical surveillance participant (if on-site work)
Site Safety Officer /Alternate Site Safety Officer	• Advises the Field Supervisor on all aspects of health and safety on-site. • Recommends stopping work if any operations threaten worker or public health or safety. • Continually inspect work site safety.	• Coordinates safety and health program activities. • Monitors site personnel for signs of stress, such as cold exposure, heat stress and fatigue. • Monitors on-site hazards and conditions. • Participates in preparation of and implements the site Health and Safety Plan. • Ensures that protective clothing and equipment are properly stored and maintained. • Knows emergency procedures, evacuation routes, and the telephone numbers of the ambulance, local hospital, poison control center, fire department, and police department. • Notifies, when necessary, local public emergency officials. • Coordinates emergency medical care.	• 40-hr. Hazardous Waste Training including 8-hr. update (29 CFR 1910.120) • Hazardous Waste Management and Supervisor Training (29 CFR 1910.120) • Respirator use training. • Medical surveillance participant

PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS

TITLE	GENERAL DESCRIPTION	SPECIFIC RESPONSIBILITIES	REQUIRED TRAINING AND MEDICAL SURVEILLANCE
Field Supervisor	• Responsible for field team operations and safety. • Reports to Project Manager.	• Manages field operations. • Executes the Work Plan and schedule. • Enforces safety procedures • Coordinates with the Site Safety Officer in determining protection level. • Enforces site control. • Documents field activities and sample collection. • Serves as liaison with public officials.	• 40-hr. Hazardous Waste Training including 8-hr. update (29 CFR 1910.120) • Hazardous Waste Management and Supervisor Training (29 CFR 1910.120) • Respirator use training. • Medical surveillance participant
Team Members	• Reports to Field Supervisor. • Contains at least two people. • For drilling purposes, Team Members consist of a geologist, drilling foreman and helpers.	• Safely completes the on-site tasks required to fulfill the Work Plan. • Complies with site Health and Safety Plan. • Notifies the Site Safety Officer or Field Supervisor of unsafe conditions	• 40-hr. Hazardous Waste Training including 8-hr. update (29 CFR 1910.120) • Respirator use training. • Medical surveillance participant

ATTACHMENT 2

SITE MAP



ON-SITE
MEDICAL FACILITY
PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME. MARCH 1989

FRED C. HART ASSOCIATES, INC.

ATTACHMENT 3

DIRECT READING REPORT AND

INSTRUMENT CALIBRATION LOG

NOTE: Copies of the completed forms must be returned to the HSM within five (5) days of calibration and air monitoring activities

DIRECT READING REPORT

CLIENT:	JOB #:	PM:	DATE:
SITE NAME AND LOCATION:	WEATHER CONDITIONS (WIND SPEED, DIRECTION, TEMP., HUMIDITY):		
M/H EMPLOYEE:	EMPLOYEE TITLE:		

DIRECT READING DATA

LOCATION	TASK DESCRIPTION	TIME	INSTRUMENT TYPE	SUBSTANCE/AGENT	CONCENTRATION	SOURCE:(S)

COMMENTS:

J430.frm

McLaren Hart
ENVIRONMENTAL ENGINEERING CORPORATION

INSTRUMENT CALIBRATION LOG

Client Name and Site:	Project Manager:	Task Number:

Calibration Event:

Person Calibrating:	Date:
Instrument Type:	Calibration Gas:
Model:	Calibration Gas Concentration (ppm):
Serial #:	Reading (ppm):
Calibrator Model:	Adjusted Reading (If Necessary):
Comments:	

Person Calibrating:	Date:
Instrument Type:	Calibration Gas:
Model:	Calibration Gas Concentration (ppm):
Serial #:	Reading (ppm):
Calibrator Model:	Adjusted Reading (If Necessary):
Comments:	

Person Calibrating:	Date:
Instrument Type:	Calibration Gas:
Model:	Calibration Gas Concentration (ppm):
Serial #:	Reading (ppm):
Calibrator Model:	Adjusted Reading (If Necessary):
Comments:	

Person Calibrating:	Date:
Instrument Type:	Calibration Gas:
Model:	Calibration Gas Concentration (ppm):
Serial #:	Reading (ppm):
Calibrator Model:	Adjusted Reading (If Necessary):
Comments:	

Person Calibrating:	Date:
Instrument Type:	Calibration Gas:
Model:	Calibration Gas Concentration (ppm):
Serial #:	Reading (ppm):
Calibrator Model:	Adjusted Reading (If Necessary):
Comments:	

Comments:

NOTE: Return to HSM Upon Completion of Site Work.

ATTACHMENT 4

TAILGATE SAFETY MEETING FORM

NOTE: Copies of completed forms must be returned to the HSM within five (5) days of each meeting

TAILGATE SAFETY MEETING

McLaren Hart

DATE: _____ TIME: _____ JOB #: _____

CLIENT: _____ PROJECT MGR.: _____

SITE LOCATION: _____

TYPE OF WORK: _____

_____

SAFETY TOPICS PRESENTED

PROTECTIVE CLOTHING/EQUIPMENT: _____

_____

CHEMICAL HAZARDS: _____

ACTION LEVELS: _____

PHYSICAL HAZARDS: _____

EMERGENCY PROCEDURES: _____

_____

HOSPITAL/CLINIC: _____

PHONE NO.: _____

SPECIAL EQUIPMENT: _____

OTHER: _____

ATTENDEES

PRINT NAME/COMPANY NAME	SIGNATURE

MEETING CONDUCTED BY: _____ SUPERVISOR: _____

DISTRIBUTION: [ ] PROJECT FILE [ ] OTHER: _____

J431.FRM

ATTACHMENT 5

DECONTAMINATION EQUIPMENT AND

PERSONNEL DECONTAMINATION PROCEDURES

DECONTAMINATION EQUIPMENT

LEVEL D

Station 1: Equipment Drop
- a. Various Size Containers
- b. Plastic Liners
- c. Plastic Drop Cloths

Station 2: Outer Garment, Boots, and Gloves Wash and Rinse
- a. Containers (20-30 Gallons)
- b. Decon Solution
- c. Rinse Water
- d. Long-Handled, Scrub Brushes (2-3)

Station 3: Outer Boot and Glove Removal
- a. Containers (20-30 Gallons)
- b. Plastic Liners
- c. Bench or Stools

Station 4: SCBA Cylinder Change
- a. SCBA Cylinders or Masks and Cartridges Depending Upon Level
- b. Tape
- c. Boot Covers
- d. Gloves

Station 5: Boot, Gloves, and Outer Garment Removal
- a. Containers (20-30 Gallons)
- b. Plastic Liners
- c. Bench or Stools

Station 6: SCBA Removal
- a. Plastic Sheets
- b. Basin or Bucket
- c. Soap and Towels
- d. Bench or Stools

Station 7: Field Wash
- a. Water
- b. Soap
- c. Tables
- d. Wash Basin or Bucket

LEVEL C PERSONNEL DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down station may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves and splash suit with decon solution or detergent water. Rinse off using copious amounts of water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Respirator Cartridge or Mask Change	4. If worker leaves Exclusion Zone to change respirator cartridge (or mask), this is the last step in the decontamination procedure. Worker's respirator cartridge is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty.
Station 5:	Boot, Gloves, and Outer Garment Removal	5. Boots, chemical-resistant splash suit, inner, gloves removed and deposited in separate containers lined with plastic.
Station 6:	Respirator Facepiece Removal	6. Respirator facepiece is removed. Avoid touching face with fingers. Respirator facepiece deposited on plastic sheet.
Station 7:	Field Wash	7. Hands and face are thoroughly washed. Shower as soon as possible.

LEVEL B PERSONNEL DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down station may be set up within this area.
Station 2:	Outer Garment, Boots,and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves and chemical resistant splash suit with decon. Rinse solution or detergent water. Rinse off using copious amounts of water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	SCBA Cylinder Change	4. If worker leaves exclusion zone to change SCBA cylinder, this is the last step in the decontamination procedure. Worker's SCBA cylinder is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty.
Station 5:	Boot, Gloves, and Other Garment Removal	5. Boots, chemical-resistant splash suit, inner gloves removed and deposited in separate containers lined with plastic.
Station 6:	SCBA Removal	6. SCBA backpack and facepiece is removed. Avoid touching face with finger. SCBA deposited on plastic sheets.
Station 7:	Field Wash	7. Hands and face are thoroughly washed. Shower as soon as possible.

SAMPLING ACTIVITIES

Quality Control/Decontamination Procedures

All soil sampling equipment will be decontaminated between sampling locations according to EPA procedures specified in Part II, Section V. of EPA Region II CERCLA Quality Assurance Manual, Final Copy Revision I, October 1989. Decontamination steps will include:

- Wash and scrub with low-phosphate detergent
- Tap water rinse
- Rinse with 10% ultrapure nitric acid for everything except carbon steel (1% ultrapure nitric acid for carbon steel)
- Tap water rinse
- Rinse with pesticide-grade isopropanol, per ASTM Technical Publication #925, May 1986
- Thorough rinse with deionized water
- Air dry
- Wrap in aluminum foil for transport - shiny side out

Sample holding times and preservation methods will be in accordance with Section II.C. and Appendix IV of the before-mentioned document. Chain-of-custody procedures will be maintained according to Section III.A. of the before-mentioned document.

ATTACHMENT 6

HEAT STRESS

HEAT STRESS

Background

Heat stress is one of the most common stresses encountered in work at hazardous waste Sites. This is especially true when work tasks require the wearing of impervious personal protective equipment. Heat stress can occur in environments where the ambient temperature is as low as 75°F(24°C) depending on humidity, solar load, work schedules and use of personal protective equipment.

The goal of heat stress management is to maintain the body temperature of employees below 100.4°F(38°C). The key to a successful program is to recognize when a potential heat stress condition exists, carefully monitor employees and work conditions and schedules and control heat build up by work rotation, employee selection and training, provision of fluids and cooling aids ranging from a shaded rest area to vortex cooled suits depending on the severity of conditions.

Preparation for prompt response to the occurrence of heat stress symptoms is essential. Appropriate levels of response range from observed rest in a cool area to immediate medical attention. The location of and access to necessary support services including emergency medical care should be firmly established prior to work in potential heat stress environments.

Recognition

Individual employees vary greatly in their ability to withstand heat stress. The most important factors related to ability to work in heat stress environments include physical conditioning, general health status, acclimatization to heat environments, weight, job demands, and age.

Acclimatization is a process in which the body gradually becomes better able to withstand heat stress through more effective sweating without extreme loss of body salts, while maintaining lower heart rates and body temperature. The acclimatization process usually takes from several days to a week to take effect. Acclimatization can be lost within one week's absence from the work environment.

Reactions to heat stress progress from discomfort to inefficiency, physiological risk, collapse and pain as exposure increases. It is important to be alert to the appearance of heat stress symptoms among exposed employees. Initial symptoms include confusion, altered behavior (including sudden fits of anger) and affected judgements. The onset of these symptoms is often unrecognized by the victims of heat stress.

ATTACHMENT 7

OSHA 200 FORM 8 INSTRUCTION

Bureau of Labor Statistics
Log and Summary of Occupational
Injuries and Illnesses

U.S. Department of Labor

For Calendar Year 19 _____ Page ____ of ____

NOTE: This form is required by Public Law 91-596 and must be kept in the establishment for 5 years. Failure to maintain and post can result in the issuance of citations and assessment of penalties. *(See posting requirements on the other side of form.)*

RECORDABLE CASES: You are required to record information about every occupational death; every nonfatal occupational illness; and those nonfatal occupational injuries which involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid). *(See definitions on the other side of form.)*

Company Name

Establishment Name

Establishment Address

Form Approved
O.M.B. No. 1220-0029
See OMB Disclosure Statement on reverse.

Case or File Number	Date of Injury or Onset of Illness	Employee's Name	Occupation	Department	Description of Injury or Illness	Extent of and Outcome of INJURY: Fatalities	Nonfatal Injuries: Injuries With Lost Workdays				Injuries Without Lost Workdays	Type of Illness (CHECK Only One Column for Each Illness *(See other side of form for terminations or permanent transfers.)*)							Fatalities	Nonfatal Illnesses: Illnesses With Lost Workdays				Illnesses Without Lost Workdays
Enter a nonduplicating number which will facilitate comparisons with supplementary records.	Enter Mo./day.	Enter first name or initial, middle initial, last name.	Enter regular job title, not activity employee was performing when injured or at onset of illness. In the absence of a formal title, enter a brief description of the employee's duties.	Enter department in which the employee is regularly employed or a description of normal workplace to which employee is assigned, even though temporarily working in another department at the time of injury or illness.	Enter a brief description of the injury or illness and indicate the part or parts of body affected. Typical entries for this column might be: *Amputation of 1st joint right forefinger; Strain of lower back; Contact dermatitis on both hands; Electrocution—body.*	Injury Related: Enter DATE of death. Mo./day/yr.	Enter a CHECK if injury involves days away from work, or days of restricted work activity, or both.	Enter a CHECK if injury involves days away from work.	Enter number of DAYS *away from work.*	Enter number of DAYS of *restricted work activity.*	Enter a CHECK if no entry was made in columns 1 or 2 but the injury is recordable as defined above.	Occupational skin diseases or disorders	Dust diseases of the lungs	Respiratory conditions due to toxic agents	Poisoning (systemic effects of toxic materials)	Disorders due to physical agents	Disorders associated with repeated trauma	All other occupational illnesses	Illness Related: Enter DATE of death. Mo./day/yr.	Enter a CHECK if illness involves days away from work, or days of restricted work activity, or both.	Enter a CHECK if illness involves days away from work.	Enter number of DAYS *away from work.*	Enter number of DAYS of *restricted work activity.*	Enter a CHECK if no entry was made in columns 8 or 9.
(A)	(B)	(C)	(D)	(E)	(F)	(1)	(2)	(3)	(4)	(5)	(6)	(7) (a)	(b)	(c)	(d)	(e)	(f)	(g)	(8)	(9)	(10)	(11)	(12)	(13)
					PREVIOUS PAGE TOTALS →																			
					TOTALS (instructions on other side of form.) →																			

Certification of Annual Summary Totals By _____ Title _____ Date _____

FOLD

OSHA No. 200

*U.S.GPO:1990-262-256/15419

OSHA No. 200

POST ONLY THIS PORTION OF THE LAST PAGE NO LATER THAN FEBRUARY 1.

OMB DISCLOSURE STATEMENT

We estimate that it will take from 4 minutes to 30 minutes to complete a line entry on this form, including time for reviewing instructions; searching, gathering and maintaining the data needed; and completing and reviewing the entry. If you have any comments regarding this estimate or any other aspect of this recordkeeping system, send them to the Bureau of Labor Statistics, Division of Management Systems (1220-0029), Washington, D.C. 20212 and to the Office of Management and Budget, Paperwork Reduction Project (1220-0029), Washington, D.C. 20503.

Log and Summary of Occupational Injuries and Illnesses

Each employer who is subject to the recordkeeping requirements of the Occupational Safety and Health Act of 1970 must maintain for each establishment a log of all recordable occupational injuries and illnesses. This form (OSHA No. 200) may be used for that purpose. A substitute for the OSHA No. 200 is acceptable if it is as detailed, easily readable, and understandable as the OSHA No. 200.

Enter each recordable case on the log within six (6) workdays after learning of its occurrence. Although other records must be maintained at the establishment to which they refer, it is possible to prepare and maintain the log at another location, using data processing equipment if desired. If the log is prepared elsewhere, a copy updated to within 45 calendar days must be present at all times in the establishment.

Logs must be maintained and retained for five (5) years following the end of the calendar year to which they relate. Logs must be available (normally at the establishment) for inspection and copying by representatives of the Department of Labor, or the Department of Health and Human Services, or States accorded jurisdiction under the Act. Access to the log is also provided to employees, former employees and their representatives.

Changes in Extent of or Outcome of Injury or Illness

If, during the 5-year period the log must be retained, there is a change in in extent and outcome of an injury or illness which affects entries in columns 1, 2, 6, 8, 9, or 13, the first entry should be lined out and a new entry made. For example, if an injured employee at first required only medical treatment but later lost workdays away from work, the check in column 6 should be lined out, and checks entered in columns 2 and 3 and the number of lost workdays entered in column 4.

In another example, if an employee with an occupational illness lost workdays, returned to work, and then died of the illness, any entries in columns 9 through 12 should be lined out and the date of death entered in column 8.

The entire entry for an injury or illness should be lined out if later found to be nonrecordable. For example: an injury which is later determined not to be work related, or which was initially thought to involve medical treatment but later was determined to have involved only first aid.

Posting Requirements

A copy of the totals and information following the fold line of the last page for the year must be posted at each establishment in the place or places where notices to employees are customarily posted. This copy must be posted no later than ***February 1 and must remain in place until March 1.***

Even though there were no injuries or illnesses during the year, zeros must be entered on the totals line, and the form posted.

The person responsible for the ***annual summary totals*** shall certify that the totals are true and complete by signing at the bottom of the form.

Instructions for Completing Log and Summary of Occupational Injuries and Illnesses

Column A – CASE OR FILE NUMBER. Self-explanatory.

Column B – DATE OF INJURY OR ONSET OF ILLNESS.
For occupational injuries, enter the date of the work accident which resulted in injury. For occupational illnesses, enter the date of initial diagnosis of illness, or, if absence from work occurred before diagnosis, enter the first day of the absence attributable to the illness which was later diagnosed or recognized.

Columns C through F – Self-explanatory.

Columns 1 and 8 – INJURY OR ILLNESS-RELATED DEATHS.
Self-explanatory.

Columns 2 and 9 – INJURIES OR ILLNESSES WITH LOST WORKDAYS.
Self-explanatory.

Any injury which involves days away from work, or days of restricted work activity, or both must be recorded since it always involves one or more of the criteria for recordability.

Columns 3 and 10 – INJURIES OR ILLNESSES INVOLVING DAYS AWAY FROM WORK. Self-explanatory.

Columns 4 and 11 – LOST WORKDAYS––DAYS AWAY FROM WORK.
Enter the number of workdays (consecutive or not) on which the employee would have worked but could not because of occupational injury or illness. The number of lost workdays should not include the day of injury or onset of illness or any days on which the employee would not have worked even though able to work.
NOTE: For employees not having a regularly scheduled shift, such as certain truck drivers, construction workers, farm labor, casual labor, part-time employees, etc., it may be necessary to estimate the number of lost workdays. Estimates of lost workdays shall be based on prior work history of the employee AND days worked by employees, not ill or injured, working in the department and/or occupation of the ill or injured employee.

Columns 5 and 12 – LOST WORKDAYS––DAYS OF RESTRICTED WORK ACTIVITY.
Enter the number of workdays (consecutive or not) on which because of injury or illness:
(1) the employee was assigned to another job on a temporary basis, or
(2) the employee worked at a permanent job less than full time, or
(3) the employee worked at a permanently assigned job but could not perform all duties normally connected with it.

The number of lost workdays should not include the day of injury or onset of illness or any days on which the employee would not have worked even though able to work.

Columns 6 and 13 – INJURIES OR ILLNESSES WITHOUT LOST WORKDAYS. Self-explanatory.

Columns 7a through 7g – TYPE OF ILLNESS.
Enter a check in only *one* column for each illness.

TERMINATION OR PERMANENT TRANSFER—Place an asterisk to the right of the entry in columns 7a through 7g (type of illness) which represented a termination of employment or permanent transfer.

V. **Totals**

Add number of entries in columns 1 and 8.
Add number of checks in columns 2, 3, 6, 7, 9, 10, and 13.
Add number of days in columns 4, 5, 11, and 12.
Yearly totals for each column (1-13) are required for posting. Running or page totals may be generated at the discretion of the employer.

If an employee's loss of workdays is continuing at the time the totals are summarized, estimate the number of future workdays the employee will lose and add that estimate to the workdays already lost and include this figure in the annual totals. No further entries are to be made with respect to such cases in the next year's log.

VI. **Definitions**

OCCUPATIONAL INJURY is any injury such as a cut, fracture, sprain, amputation, etc., which results from a work accident or from an exposure involving a single incident in the work environment.
NOTE: Conditions resulting from animal bites, such as insect or snake bites or from one-time exposure to chemicals, are considered to be injuries.

OCCUPATIONAL ILLNESS of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases which may be caused by inhalation, absorption, ingestion, or direct contact.

The following listing gives the categories of occupational illnesses and disorders that will be utilized for the purpose of classifying recordable illnesses. For purposes of information, examples of each category are given. These are typical examples, however, and are not to be considered the complete listing of the types of illnesses and disorders that are to be counted under each category.

7a. **Occupational Skin Diseases or Disorders**
Examples: Contact dermatitis, eczema, or rash caused by primary irritants and sensitizers or poisonous plants; oil acne; chrome ulcers; chemical burns or inflammations; etc.

7b. **Dust Diseases of the Lungs (Pneumoconioses)**
Examples: Silicosis, asbestosis and other asbestos-related diseases, coal worker's pneumoconiosis, byssinosis, siderosis, and other pneumoconioses.

7c. **Respiratory Conditions Due to Toxic Agents**
Examples: Pneumonitis, pharyngitis, rhinitis or acute congestion due to chemicals, dusts, gases, or fumes; farmer's lung; etc.

7d. **Poisoning (Systemic Effect of Toxic Materials)**
Examples: Poisoning by lead, mercury, cadmium, arsenic, or other metals; poisoning by carbon monoxide, hydrogen sulfide, or other gases; poisoning by benzol, carbon tetrachloride, or other organic solvents; poisoning by insecticide sprays such as parathion, lead arsenate; poisoning by other chemicals such as formaldehyde, plastics, and resins; etc.

7e. **Disorders Due to Physical Agents (Other than Toxic Materials)**
Examples: Heatstroke, sunstroke, heat exhaustion, and other effects of environmental heat; freezing, frostbite, and effects of exposure to low temperatures; caisson disease; effects of ionizing radiation (isotopes, X-rays, radium); effects of nonionizing radiation (welding flash, ultraviolet rays, microwaves, sunburn); etc.

7f. **Disorders Associated With Repeated Trauma**
Examples: Noise-induced hearing loss; synovitis, tenosynovitis, and bursitis; Raynaud's phenomena; and other conditions due to repeated motion, vibration, or pressure.

7g. **All Other Occupational Illnesses**
Examples: Anthrax, brucellosis, infectious hepatitis, malignant and benign tumors, food poisoning, histoplasmosis, coccidioidomycosis, etc.

MEDICAL TREATMENT includes treatment (other than first aid) administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does NOT include first-aid treatment (one-time treatment and subsequent observation of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care) even though provided by a physician or registered professional personnel.

ESTABLISHMENT: A single physical location where business is conducted or where services or industrial operations are performed (for example: a factory, mill, store, hotel, restaurant, movie theater, farm, ranch, bank, sales office, warehouse, or central administrative office). Where distinctly separate activities are performed at a single physical location, such as construction activities operated from the same physical location as a lumber yard, each activity shall be treated as a separate establishment.

For firms engaged in activities which may be physically dispersed, such as agriculture; construction; transportation; communications; and electric, gas, and sanitary services, records may be maintained at a place to which employees report each day.

Records for personnel who do not primarily report or work at a single establishment, such as traveling salesmen, technicians, engineers, etc., shall be maintained at the location from which they are paid or the base from which personnel operate to carry out their activities.

WORK ENVIRONMENT is comprised of the physical location, equipment, materials processed or used, and the kinds of operations performed in the course of an employee's work, whether on or off the employer's premises.

Bureau of Labor Statistics
Supplementary Record of
Occupational Injuries and Illnesses

U.S. Department of Labor

This form is required by Public Law 91-596 and must be kept in the establishment for *5 years*. Failure to maintain can result in the issuance of citations and assessment of penalties.

Case or File No.

Form Appr.
O.M.B. No. 1220-

Employer

1. Name

2. Mail address *(No. and street, city or town, State, and zip code)*

3. Location, if different from mail address

Injured or Ill Employee

4. Name *(First, middle, and last)*

Social Security No.

5. Home address *(No. and street, city or town, State, and zip code)*

6. Age

7. Sex: *(Check one)* Male ☐ Female ☐

8. Occupation *(Enter regular job title, not the specific activity he was performing at time of injury.)*

9. Department *(Enter name of department or division in which the injured person is regularly employed, even though he may have been temporarily working in another department at the time of injury.)*

The Accident or Exposure to Occupational Illness

If accident or exposure occurred on employer's premises, give address of plant or establishment in which it occurred. Do not indicate department or division within the plant or establishment. If accident occurred outside employer's premises at an identifiable address, give that address. If it occurre a public highway or at any other place which cannot be identified by number and street, please provide place references locating the place of injury a accurately as possible.

10. Place of accident or exposure *(No. and street, city or town, State, and zip code)*

11. Was place of accident or exposure on employer's premises? Yes ☐ No ☐

12. What was the employee doing when injured? *(Be specific. If he was using tools or equipment or handling material, name them and tell what he wa doing with them.)*

13. How did the accident occur? *(Describe fully the events which resulted in the injury or occupational illness. Tell what happened and how it happe Name any objects or substances involved and tell how they were involved. Give full details on all factors which led or contributed to the accident. Use separate sheet for additional space.)*

Occupational Injury or Occupational Illness

14. Describe the injury or illness in detail and indicate the part of body affected. *(E.g., amputation of right index finger at second joint; fracture of rib lead poisoning; dermatitis of left hand, etc.)*

15. Name the object or substance which directly injured the employee. *(For example, the machine or thing he struck against or which struck him; the vapor or poison he inhaled or swallowed; the chemical or radiation which irritated his skin; or in cases of strains, hernias, etc., the thing he was lifting, pulling, etc.)*

16. Date of injury or initial diagnosis of occupational illness

17. Did employee die? *(Check one)* Yes ☐ No ☐

Other

18. Name and address of physician

19. If hospitalized, name and address of hospital

Date of report	Prepared by	Official position

OSHA No. 101 (Feb. 1981)

ATTACHMENT 8

U.S. DEPARTMENT OF ENERGY 5484.X FORM AND INSTRUCTIONS

EXHIBIT 2
INSTRUCTIONS FOR COMPLETING DOE F 5484.X

To be used for all occurrences reportable under DOE 5484.1A Environmental Protection, Safety, and Health Protection Information Reporting Requirements. Return completed DOE F 5484.X forms to the site safety office within 5 business days of the end of the calendar month.

General Information

1. Indicate the reporting organization (DOE Office or DOE Contractor) that experienced the accident/incident. Also, enter the seven-character Organization Code that has been assigned to that specific reporting contractor.
2. Enter the case number. All cases for a given reporting organization will be numbered in sequence, regardless of accident type, with the first two digits representing the year; (e.g., The tenth accident in 1987 is 87010). Check the YES box to indicate a revision.
3. Multiple-case accidents are those that result in more than one recordable case (a combination of two or more persons, vehicles, or property damage cases from the same accident). Report each injury/property damage/vehicle case resulting from a single accident on a separate DOE F 5484.X form, with an identical multiple case accident number to show relationship to the common accident/incident; (e.g., If the first multiple-case accident of the year resulted in two separate employees being injured in a one-car rollover of a DOE vehicle, each injury case would be reported on a separate 5484.X form and assigned sequential case numbers 87005 and 87006. The vehicle accident report would be shown on a third form as number 87007. The same multiple-case number "01" should be entered on line 4 of each of the three forms. Number each additional multiple accident sequentially).
4. Check appropriate accident type: I, P, V, or O. Include in vehicle type, all transportation accidents; e.g., vehicle, aircraft, marine, and railroad. Any reportable incident other than Injury/Illness, Property Damage, or Vehicle should be reported as "Other".
5. Indicate the Investigation Type: A, B, or C. The Non-recordable box is used when a previously reported case has been revised to non-recordable status; (e.g., found to be not work-related, first-aid case only, under $500 loss for Vehicle, under $1000 loss for Property Damage, etc.).
6. Enter the DEPARTMENT, DIVISION or ID code as desired. This input field is available for structuring subgroups within a reporting organization.
7. Enter the date of accident, MMDDYY.
8. Enter the time of accident, using MILITARY time.
9. Check the appropriate box, INDOORS or OUTDOORS.
10. Check the appropriate box, on Employer's Premise, YES or NO.
11. Enter the SPECIFIC LOCATION of accident. (e.g. Laboratory, Test Area 10, Office Area 615)

Employee Information

12. Check the appropriate box, Injured/Ill EMPLOYEE or OPERATOR of Equipment/Vehicle.
13. Enter the NAME of the employee or operator.
14. Enter the SOCIAL SECURITY number or other employee ID number.
15. Enter the AGE of employee/operator.
16. Check the appropriate box, FEMALE or MALE.
17. Enter the generic JOB TITLE. (e.g. Engineer, Welder, Security Guard, Pipe Fitter)
18. Check the appropriate box for LENGTH of EMPLOYMENT.
19. Check the appropriate box for LENGTH of JOB/EQUIPMENT EXPERIENCE.

Injury/Illness

(If "Injury/Illness" was checked in No. 4, complete this section; otherwise proceed to No. 26.)

20. Check the appropriate box (Reference: OSHA log). Injury code #10 or one of the illness codes 21 through 29; (Refer to the OSHA Log).
21. Enter the number of WORKDAYS LOST. If continuing, enter best estimate of expected days away.
22. Enter the number of RESTRICTED WORKDAYS. If continuing, enter best estimate of expected restricted days.
23. Check YES or NO if the accident/incident resulted in death. If YES, enter death date.
24. Check the appropriate box, YES or NO, whether transferred or terminated because of injury disability.
25. Check the appropriate box, YES or NO, whether the employee has returned to full work.

Property/Vehicle Damage

26. If "Property Damage" was checked in No. 4, indicate the appropriate box and proceed to the dollar loss section (No. 30).
27. If "Vehicle" was checked in No. 4, indicate whether the vehicle is Government-owned, or is a privately-owned vehicle driven by a Government employee. Government vehicles should include those owned, leased, or rented by the Federal Government; also any contractor-operated, privately-owned vehicles used in DOE contract work for which cost reporting to DOE is required. In addition, check the type of vehicle or conveyance involved.
28. Check the appropriate box for each question concerning SEAT BELTS.
29. Check YES or NO whether the vehicle accident resulted in a death or recordable injury to any person.
30. Enter the TOTAL ACCIDENT DAMAGE LOSS; separate the loss between DOE and non-DOE property or vehicle damage; (round to the nearest dollar amount).
31. Enter CLAIMS against DOE for damage to non-DOE vehicle/property; also include the amount actually paid by DOE, if and when available. Enter the dollar loss, if any, to DOE vehicles/property that should be reimbursable; also enter the amount actually paid to DOE, if and when available. Do not delay the report if exact losses are unknown. Submit a revised report to show final amounts; (round to the nearest dollar amount).
32. Check the appropriate box, YES or NO, if dollar amounts are final.

Equipment/Hardware/Vehicle Involved

33. Give the generic or brand name, model and, as applicable, the identification number of the equipment/hardware/vehicle involved. Identification should be adequate to alert other of potential hazards associated with a specific equipment model.
34. Check the appropriate box, YES or NO, if equipment design or defect contributed to the accident cause or severity.

ATTACHMENT 9

MATERIALS TO BE USED ON-SITE

MATERIALS TO BE USED ON-SITE

Material	Manufacturer	Amount to be used on site	Amt. of time material will be stored on site	Type of Packaging	Is container returnable	Intended Use of Material
ISOPROPYL ALCOHOL	GENERIC	0.5 GAL.	N/A	PLASTICS	NO	DECONTAMINATION
1% NITRIC ACID	GENERIC	0.5 GAL.	N/A	GLASS BOTTLE	NO	DECONTAMINATION
10% NITRIC ACID	GENERIC	0.5 GAL.	N/A	GLASS BOTTLE	NO	DECONTAMINATION
TAP WATER	GENERIC	16 GALS.	N/A	PLASTIC	NO	DECONTAMINATION
DEIONIZED WATER	GENERIC	8 GALS.	N/A	PLASTIC	NO	DECONTAMINATION

Remarks: _____

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854

MSDS # 524
ISOPROPYL ALCOHOL
Revision D
Issued: October 1982
Revised: September 1985

From Genium's MSDS Collection, to be used as a reference.

SECTION 1. MATERIAL IDENTIFICATION

MATERIAL NAME: ISOPROPYL ALCOHOL
OTHER DESIGNATIONS: Isopropanol, 2-Propanol, sec-Propyl Alcohol, Dimethyl Carbinol, Isohol, Petrohol, IPA
C_3H_8O, CAS # 0067 63 0
MANUFACTURER/SUPPLIER: Available from several sources, including:
Allied Corporation
PO Box 2064R
Morristown, NJ 07960 (201) 455-4400 - (800) 631-8050

3 1 0

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	HAZARD DATA
ISOPROPYL ALCOHOL * Current OSHA PEL and ACGIH TLV (1985-86). The ACGIH STEL is 500 ppm, 1225 mg/m^3. NIOSH has recommended a 15-minute ceiling of 800 ppm. NOTE: NTP and IARC list CAS #0067-63-0," isopropyl alcohol manufacture (strong acid process)" as a human carcinogen. We believe this refers to the process and not necessarily the product. Check with your suppliers.	ca 100	8-hr TWA: 400 ppm or 980 mg/m^3* Human, Eye: 20 ppm Primary irritation dos Human, Inhalation: 400 ppm: IRR Man, Oral LDLo: 8600 mg/kg Rat, Oral: 5840 mg/kg

SECTION 3. PHYSICAL DATA

Boiling point, 1 atm	180°F, (82°C)	Specific gravity (H_2O=1)	0.786
Vapor pressure @ 20°C, mmHg	33	Melting point	-127.3°F (-88.5°C)
Vapor density (Air=1)	2.07	% Volatile by volume, 20°C	ca 100
Viscosity, 20°C, cps	2.4	Evaporation rate (CCl_4=1)	2.6
Solubility in water	Completely soluble	Molecular weight	60.11

APPEARANCE & ODOR: Clear, colorless liquid with a slight non-residual alcohol type odor. Threshold odor concentration, 100% recognition by test panel, is 28.2 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Uppe
53°F (11.7°C) closed cup	750°F (399°C)	% by volume	2.0	12.0

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, alcohol foam. Use water spray to cool fire-exposed tan containers. A fine water mist may be used to smother fire or to disperse vapors. Do not use a solid strea of water since the stream will scatter and spread the fire.
Isopropyl alcohol is an OSHA Class IB flammable liquid. It is a dangerous fire hazard and a moderate explosion hazard when exposed to heat, flames or oxidizers. At 20°C, the vapor space (saturated) above isopropyl alcohol contains about 4.3 volume % of vapor. Vapors are heavier than air and may travel a considerable distance to an ignition source and flashback. Firefighters should wear self-contained breathi apparatus and full protective clothing when fighting fires involving this material.

SECTION 5. REACTIVITY DATA

This material is stable in closed containers at room temperature under normal storage and handling conditions. It does not polymerize. Isopropyl alcohol is incompatible with acetaldehyde, chlorine, ethyle oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxi hypochlorous acid, isocyanates, nitroform, phosgene, oleum, perchloric acid, and strong oxidizing agents. Do not store isopropyl alcohol in aluminum containers.

Thermal-oxidative degradation products can include carbon monoxide.

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Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 7

NITRIC ACID
(Revision C)
Issued: October 1980
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: NITRIC ACID

Description (Origin/Uses): Used to dissolve noble metals, for etching and cleaning metals, to make organic nitrates and nitrocompounds, to destroy residues of organic matter, and in explosives.

Other Designations: Red Fuming Nitric Acid; HNO_3; CAS No. 7697-37-2

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

NFPA: 0 / 3 / 0 / oxy

HMIS			
H	3	R	1
F	0	I	4
R	1	S	4
PPG*		K	0

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Nitric Acid, CAS No. 7697-37-2	*	**OSHA PEL** 8-Hr TWA: 2 ppm, 5 mg/m³ **ACGIH TLVs, 1987-88** TLV-TWA: 2 ppm, 5 mg/m³ TLV-STEL: 4 ppm, 10 mg/m³ **Toxicity Data**** Mouse, Inhalation, LC_{50}: 67 ppm/4 Hrs

*Contact your supplier to determine the percent by weight of nitric acid in the purchased product. Water is the other component of the product.
**See NIOSH, *RTECS* (QU5775000, QU5900000), for additional data with references to reproductive effects.

SECTION 3. PHYSICAL DATA

Boiling Point: Ca 251°F (122°C)*
Specific Gravity (H_2O = 1): 1.4*
pH: Very Acidic
Water Solubility (%): Complete
Molecular Weight: 63 Grams/Mole
Melting Point: Ca -30°F (-34°C)*

Appearance and Odor: A water white to slightly yellow liquid that darkens to a brownish color on aging and exposure to light; characteristic nitrogen dioxide (NO_2) odor.

*These properties are for the approximately 68%-by-weight nitric acid that is commercially available.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
*	*		*	*

Extinguishing Media: *Nitric acid does not burn. Use extinguishing agents that will put out the surrounding fire. Use a water spray to dilute nitric acid during fires and to absorb liberated oxides of nitrogen.

Unusual Fire or Explosion Hazards: Although nitric acid does not burn, it is a strong oxidizing agent that can react with combustible materials to cause fires. Also, it can react with metals to liberate extremely flammable hydrogen gas. If this happens, direct fire-fighting procedures at this evolved hydrogen gas.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Choose protective equipment carefully (see sect. 5, Conditions to Avoid).

SECTION 5. REACTIVITY DATA

Nitric acid is stable in closed containers at room temperature under normal storage and handling conditions. It cannot undergo hazardous polymerization.

Chemical Incompatibilities: Nitric acid reacts explosively with metallic powders, carbides, hydrogen sulfide, and turpentine. Contact with organic materials such as wood, paper, sawdust, or alcohol, etc., may cause fires. Combustible materials can attain an increased flammability after being exposed to nitric acid even if they do not immediately catch fire.

Conditions to Avoid: Avoid any contact with incompatible chemicals. Because it is so reactive, always establish another material's compatibility with nitric acid before mixing the two materials. This applies to the selection of safety and handling equipment, because nitric acid can attack some forms of coatings, plastics, and rubber.

Hazardous Products of Decomposition: Various nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO_2), nitrous oxide (N_2O), as well as nitric acid mist or vapor, can be produced by the decomposition reactions that can affect the nitric acid during fires.

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ATTACHMENT 10

McLAREN/HART RESPIRATOR PROGRAM

HEALTH AND SAFETY POLICY AND PROCEDURE

HS 12.0 RESPIRATORY PROTECTION PROGRAM

1.0 SUBJECT: Respiratory Protection Program

2.0 EFFECTIVE DATE: November 1988

3.0 APPLICABILITY: All McLaren/Hart, ChemRisk, and Western Laboratory Employees, and Contractors as delineated in the Site Safety Plan.

4.0 APPLICABLE REGULATIONS:

A. Federal

1.0 OSHA
OSHA Regulation 29 CFR 1910.134
OSHA Regulation 29 CFR 1910.120

B. State

1.0 California
Cal-OSHA Title 8 General Industry Safety Orders Group 16 Article 107 Section 5144
Cal-OSHA Title 8 General Industry Safety Orders, Article 4, Section 1531

C. Guidance Documents

ANSI Standard Z88.6 - 1984

5.0 DOCUMENTS ATTACHED:

Employee Respirator Authorization Form; Maintenance Record Form; Recordkeeping Checklist; Respirator User Certification Card;

Appendices:
OSHA Regulation 29 CFR 1910.134; OSHA Regulation 29 CFR 1910.120; ANSI Standard Z-88.2-1969, 1980; Cal-OSHA Title 8 General Industry Safety Orders Group 16, Article 107, Section 5144; Cal-OSHA Title 8 General Industry Safety Orders, Article 4, Section 1531

WP1HS12.P12

The employee shall use the respirator as required by the Project's specific Site Safety and Health Plan.

G. **Contractors: McLAREN/HART WILL NOT SUPPLY CONTRACTORS WITH RESPIRATORY PROTECTIVE EQUIPMENT.** Contractors must comply with all applicable regulations and the site specific health and safety plan.

9.0 PROCEDURES:

A. Respirator Approval

1.0 Only respirators that meet the approval requirements of the National Institute for Occupational Safety & Health (NIOSH) or Mining Health & Safety Administration (MHSA) may be used to control harmful exposures as required by the OSHA (29 CFR 1910.134 and 29 CFR 1910.120) and Cal-OSHA (Title 8 GISO Article 107, Section 5144, and Article 4, Section 1531).

2.0 Approved respirators are to be used only to protect against those substances for which they are designed.

3.0 The REHSM or designated Industrial Hygienist will approve respirator protection on a project specific basis.

4.0 Only personalized respirators shall be used, i.e., the respirator the individual was fit-tested with.

5.0 Note: McLaren/Hart does not perform construction activities during asbestos jobs. Thus, McLaren/Hart's projects involving asbestos contaminated sites are handled in such a manner that employees activities are not regulated by 29 CFR 1926.58.

B. Respirator Selection

1.0 Respirators are classified and selected on the basis of their design to protect the wearer from specific air contamination hazards. The selection takes into consideration the physical, chemical, and physiological properties of the contaminant and the concentration expected to be encountered. Selection of respirators shall be made according to the guidance of American National Standards Practices for Respiratory Protection Z88.2-1969, 1980.

2.0 Potential air contamination hazards are determined by the REHSM or designated Industrial Hygienist, on the basis of site

5.0 Other required respirators will be assigned by the REHSM or designated Industrial Hygienist.

6.0 If a full face respirator is required to be worn and an employee must wear corrective lenses, McLaren/Hart will provide eye glass inserts (short temple bar) at no cost to the employee.

C. Respirator Fit-testing (NEGATIVE PRESSURE ONLY)

1.0 Respirators will be assigned to the employee only by the REHSM or designated Industrial Hygienist and only when the employee has completed the McLaren/Hart's Respiratory Protection Training Module. (See McLaren/Hart's Training Policy and Program, HS 4.0)

2.0 One of the most important elements of an effective respirator program is the fit-testing process. The Federal OSHA and Cal-OSHA respirator standards require that the fit of respirators be determined when the respirators are issued and that the employees check the fit each time they don the respirator. Adherence to these procedures is essential to assure the respirator's effectiveness.

3.0 Any employee who is assigned a respirator will be given the opportunity to wear the respirator in a contaminant-free environment prior to entering a job site and be qualitatively fit-tested. The qualitative fit-test (delineated within) is used to determine the fit of the respirator to the face of the individual employee. A more detailed quantitative fit-test may be conducted instead.

4.0 Quantitative or qualitative fit-testing shall be performed by the REHSM or designee at the time of initial fitting and annually thereafter for each worker wearing a negative-pressure respirator.

5.0 Qualitative fit-testing with irritant smoke or isoamyl acetate, will be performed by the REHSM or designated Industrial Hygienist.

6.0 Field fit-testing will be enforced by the Site Safety Officer. The Site Safety Office is recommended to assist in respirator fit-testing, of all field employees to ensure proper fit prior to work commencement.

f) place appropriate cartridges on mask; don only with appropriate cartridges;

g) don the respirator;

h) perform a positive/negative pressure check, if the worker is unable to obtain a respirator fit, do not don the respirator. Immediately inform the SSO or REHSM.

3.0 All employees performing jobs which require respiratory protection will be informed that it is mandatory for them to wear the specified respirator by:

a) The project specific Site Safety and Health Plan.

b) Written standard procedures for the proper selection, maintenance, and use of respiratory protection equipment in accordance with 29 CFR 1910.134, 29 CFR 1910.120, Cal-OSHA Title 8 GISO Article 107, Section 5144 and Article 4, Section 1531 and/or other applicable state standards.

E. Respirator Inspection

1.0 Employees inspect their respirators prior to each use for proper function, including checking inhalation valves, exhalation valves, face piece, wear, and condition of headstraps.

F. Respirator Maintenance

1.0 Respirators shall be cleaned and disinfected after each use. Each McLaren/Hart employee who is assigned a respirator shall be responsible for cleaning his/her air purifying respirator. Other respiratory protection equipment maintenance will be performed by the Site Safety Officer or designated equipment person.

2.0 Respirators issued for the exclusive use of one worker shall be cleaned after each day's use, or more often, if necessary.

3.0 Those used by more than one worker shall be thoroughly cleaned and disinfected after each use. This procedure is as follows:

a) Respiratory equipment shall be washed with detergent in warm water using a brush or wiped thoroughly with a chem-wipe followed by the use of a spray cleaner.

a) Air purifying respirators (half-mask and full facepiece)

· Rubber facepiece - check for:

- excessive dirt (clean all dirt from facepiece)

- cracks, tears, or holes (obtain new facepiece)

- distortion (allow facepiece to "sit" free from any constraints and see if distortion disappears; if not, obtain new facepiece),

- cracked, scratched, or loose-fitting lenses (contact respirator manufacturer to see if replacement is possible; otherwise obtain new facepiece).

· Filter element(s) - check for:

- proper filter for the hazard

- approval designation

- missing or worn gaskets (contact manufacturer for replacement)

- worn threads - both filter threads and facepiece threads (replace filter or facepiece, whichever is applicable)

- cracks or dents in filter housing (replace filter), and

- missing or loose hose clamps (obtain new clamps)

b) Each cartridge may be used for a maximum of 8 hours of filtering time in a contaminated atmosphere. After eight hours of filtering use or at the end of a work shift (whichever comes first) the cartridges should be properly disposed of.

G. Program Evaluation

1.0 Random inspections are conducted by a qualified individual, such as the REHSM, Industrial Hygienists, or CEHSM, as appropriate

3.0 Demonstration and practice in correct fitting, adjusting, and use as recommended by the manufacturer. Fit-testing involves initial testing performed by a qualified person followed by positive and negative pressure testing each time a respirator is worn.

4.0 Respirators are used only for protection from the substances for which they are designed.

5.0 Instruction in checking of valves, securing and removal of prefilters and cartridges, and maintenance and storage of respirators is given.

6.0 Discussion of the engineering and administrative controls being used and the need for respirators to provide respiratory protection.

12.0 RECORDKEEPING REQUIREMENTS:

A. The following records shall be maintained by each REHSM or designee:

1.0 Medical surveillance records;

2.0 Exposure measurements;

3.0 Training records;

4.0 Fit-testing records;

5.0 Cleaning and maintenance records.

McLaren

RESPIRATORY AUTHORIZATION

I. REQUEST FOR RESPIRATOR

DATE: _____

EMPLOYEE NAME: _____ EMPLOYEE NO.: _____ RESP. NO.: _____

LOCATION: _____ PROJECT MANAGER: _____

RESPIRATOR REQUIRED FOR (Check all that apply):

- ☐ EMERGENCY SITUATIONS
- ☐ ROUTINE OPERATIONS
- ☐ CHEMICAL WASTE
- ☐ CONTAMINATED EQUIPMENT
- ☐ OTHER: _____

TYPE OF RESPIRATOR(S): ☐ AIR PURIFYING ☐ SCBA ☐ AIR SUPPLIED

ESTIMATED TIME RESPIRATOR WILL BE WORN: HOURS _____ PER DAY _____ PER WEEK _____ PER MONTH _____

OPERATION(S) REQUIRING RESPIRATOR (Check all that apply):

- ☐ ERT
- ☐ MAINTENANCE OPERATIONS
- ☐ LAB. WORK
- ☐ SPRAY PAINTING
- ☐ WELDING/BRAZING
- ☐ CHEMICAL WASTE HANDLING
- ☐ OTHER: _____

POSSIBLE EXPOSURES TO (Check all that apply):

- ☐ ARSENIC
- ☐ ARSINE
- ☐ ASBESTOS
- ☐ ACID MIST
- ☐ ACID GASES
- ☐ BERYLLIUM
- ☐ CADMIUM
- ☐ CAUSTIC MIST VAPORS
- ☐ LEAD
- ☐ NUISANCE DUST
- ☐ PHOSPHINE
- ☐ ORGANIC VAPORS
- ☐ OTHER: _____

II. TRAINING

INSTRUCTION CONDUCTED (Check when completed):

- ☐ INSPECTION OF RESPIRATOR
- ☐ PROPER CARTRIDGE SELECTION
- ☐ PROPER FITTING AND ADJUSTMENT
- ☐ PROPER FIT TEST
- ☐ PROPER CLEANING AND ADJUSTMENT
- ☐ OTHER: _____

III. FIT TEST

TYPE OF FIT TEST: ☐ QUALITATIVE ☐ QUANTITATIVE

QUALITATIVE TEST MATERIAL: ☐ IRRITANT SMOKE ☐ AMYL ACETATE ☐ OTHER: _____

PROPER FIT OBTAINED

RESPIRATOR MFR _____ MODEL NO. _____

SIZE _____ RESPIRATOR TYPE _____

CARTRIDGE _____ CARTRIDGE NO(S). _____

THE ABOVE TRAINING AND FIT TESTING HAS BEEN COMPLETED IN ACCORDANCE WITH MCLARENS RESPIRATORY PROTECTION PROGRAM (HS 12.0)

SIGNATURE (Fit tester and trainer): _____ DATE: _____

IV. MEDICAL APPROVAL

☐ APPROVED ☐ NOT APPROVED

SIGNATURE AND TITLE: _____ DATE: _____

V. ACKNOWLEDGMENT

"I have been informed and trained in the above items and understand the type, model and size of the respirator I am certified to u

SIGNATURE OF EMPLOYEE: _____ DATE: _____

CERTIFICATION CARD ISSUED: _____ DATE ISSUED: _____ EXPIRATION DATE: _____