

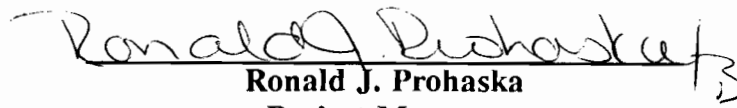
**WORK PLAN
FOR
PFOHL BROTHERS LANDFILL
CHEEKTOWAGA, NEW YORK**

Submitted to:

**New York State
Department of Environmental Conservation
(NYSDEC)**

Prepared by:

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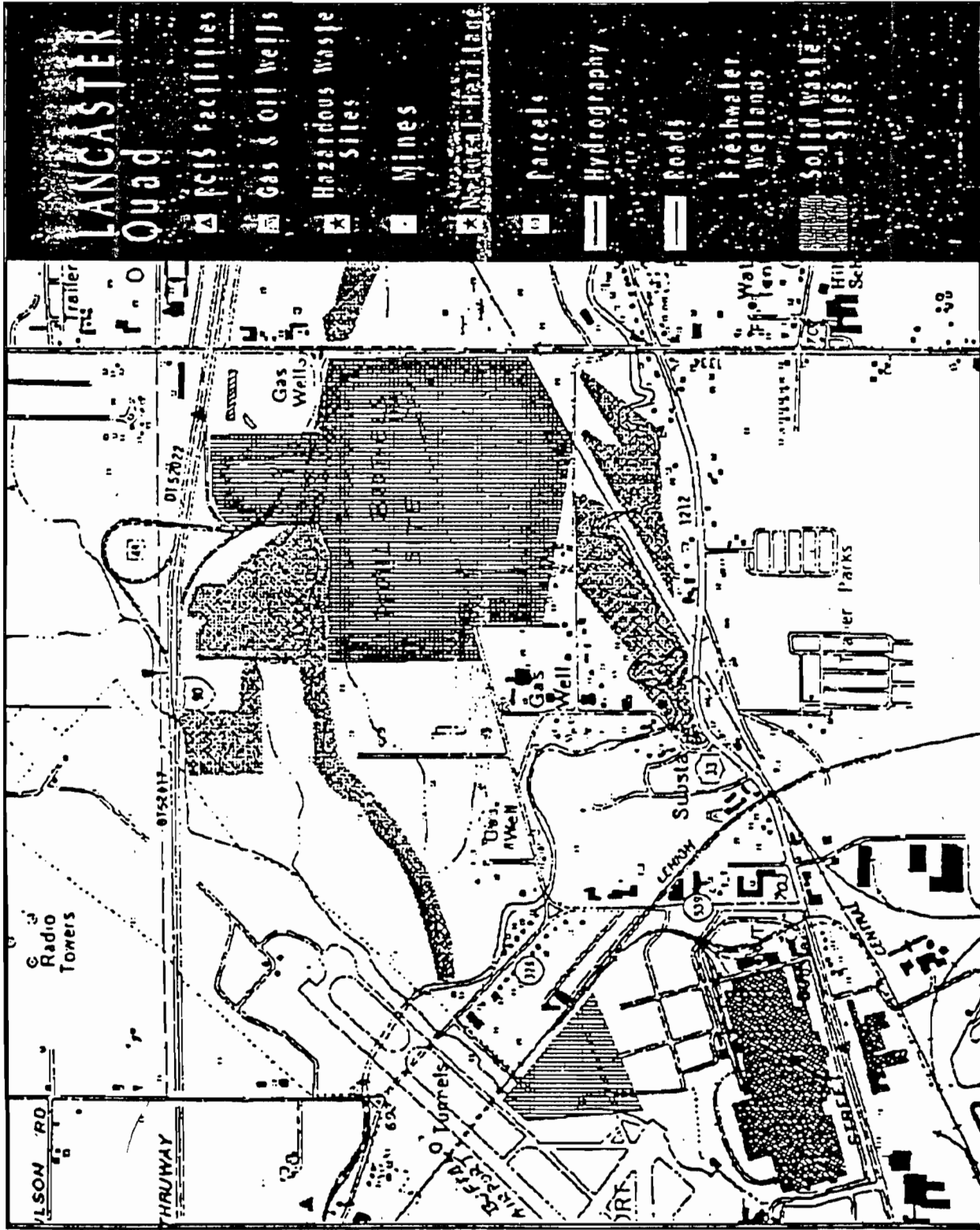
1.0 INTRODUCTION

The Pfohl Brothers Landfill (NYDEC Site No. 9-15-043), located in Cheektowaga, Erie County, New York (See Figure 1), is approximately 120 acres in area and is bound by public roads and right of ways. The landfill is bound to the east by Transit Road, to the west by New York State Electric and Gas (NYSEG) utility lines, to the north by land adjacent to the New York State (NYS) Thruway (Route 90), and to the south by Pfohl Road.

The site accepted municipal and industrial waste from surrounding townships and companies from 1932 to 1971. The landfill is inactive and is located in a commercial/residential area northeast of Buffalo International Airport.

Through site investigation and from generators, some of the industrial waste dumped on site was identified as waste paint and thinners, pine tar pitch, oils, phenol tar containing chlorinated benzenes, and polychlorinated biphenyls (PCBs).

The landfill has been divided into three (3) areas designated as Areas A, B and C. Work in the areas under this contract will be performed in Area B, situated between Transit Road and Aero Drive, and Area C, situated south of Aero Drive and west of Transit Road.



PFOHL BROTHERS SITE - GEN. LOCATION

FIG. 1

2.0 SCOPE OF WORK

The work required for the remedial action at the Pfohl Brothers site includes:

- Mobilization and site preparation, including:
 - Construction of the support zone
 - Construction of the decontamination pads
 - Construction of the temporary waste storage pads
 - Installation of the truck scale
 - Construction of the access roads
 - Installation of the meteorological station
 - Installation of the storm water management controls
- Test trenching along the existing berm between test pit TP-19 and TP-23 and other areas as per the engineer's direction.
- Excavation, removal, staging, and segregation of drums and visibly contaminated soil in Area C of TP-19.
- Construction of the on-site encapsulation cell and encapsulation of selected wastes.
- Excavation of tars in Area C and subsequent placement in on-site cell.
- Removal and staging of drums and visibly contaminated soil in Area B.
- Retrieval, sampling, staging and characterization of drums found within 100-year flood plain.
- Sampling and analysis of drums and contaminated soil.
- Transportation and disposal of waste to approved off-site disposal facility.
- Perform air monitoring during all hazardous site activities.
- Collection and analysis of soil samples.
- Handling and disposal of drums staged in Area B.
- Removal and disposal of drums from the bottom of Aero Creek.

3.0 TECHNICAL APPROACH

3.1 MOBILIZATION AND SITE PREPARATION

OHM will mobilize all personal, equipment, and materials from our Clarence Center, New York Division office. Initially the site management team, equipment operators, and recovery technicians with the necessary equipment and supplies will mobilize to the site to prepare the site for future drum and contaminated soil removal activities. The following discussion describes OHM's proposed site layout and how we intend to perform the work.

3.1.1 Clearing and Grubbing

The OHM will clear and grub all areas necessary to construct access roads, decontamination pads, staging areas, support zone, ditches, dikes, utilities and other construction facilities, and for the excavation and retrieval of drums and contaminated tars or soils.

Clearing is defined as the removal of trees, brush, down timber, rotten wood, rubbish, and other vegetation, concrete, pipe and objectionable material from areas within 5 feet of the limits of the completed work.

Grubbing is defined as the removal of stumps, roots, brush, organic materials and debris to a depth of 0.5 feet below and planned subgrade or slope surface, or as directed by the Engineer.

OHM will initially clean and grub those areas necessary to construct the support area, access roads, decontamination pads, truck scale, and staging areas. The removal of trees and brush will be performed with chain saws and brush hogs, respectively. All cleaned material will be sent through a chipper and spread across unused portions of the site. The maximum thickness of the spread material will be one foot. Grubbing will only take place in areas which require excavation for drum removal, contaminated soil removal, or construction.

Additional cleaning and grubbing will be performed as necessary during future removal activities.

3.1.2 Construct Support Zone and Access Roads

The support zone area and access roads will be cleared and graded with a dozer. A layer of geotextile fabric will be placed on the cleared ground. A six inch base of 1¾" stone followed by a 6" layer of ¾" stone will be placed and compacted with the weight of the machinery.

OHM intends to construct access roads in Area C to and along the perimeter of the tar burial area and out to the major test trenching area.

For Area B, OHM will have access roads leading to the support zone, staging pads (soil and drums), and the large drum cluster area. Figure 2 is a map of the proposed site layout.

3.1.3 Staging of Support Trailers

The following trailers will be mobilized to the site and staged, blocked and secured for the anticipated 8-month project:

- Engineer/Department Office Trailer
- OHM Office Trailer
- Security and Communication Trailer
- Personnel Decontamination/Shower Trailer
- First Aid/Break Trailer

Sanitary facilities will be obtained through the use of portable toilets.

3.1.4 Utilities

OHM will provide all necessary utilities to the site for proper execution and satisfactory completion of this Contract. This includes furnishing, operating and maintaining the following utilities and their removal on completion of the project:

- Electricity
- Telephone service
- Potable water supply
- Sanitary facilities
- Non potable water supply

Electricity will be installed and connected to all on site trailers, the two (2) decontamination pads and the truck scale. Electricity and lighting will be in accordance with Federal, State and local regulations as well as local utility company requirements. All work shall be in accordance with the National Electric Code.

All temporary electric service for the project site will be provided where required. OHM will coordinate electric service installation with the local utility company and will be responsible for installation, service and shut-off charges.

Site electric service will originate at a source adjacent to the project site; on-site generators will not be used as a primary source of electric supply. If on-site generators are used they will be designed to eliminate any explosive hazard.

Telephone service will be provided to the engineer/NYDEC office trailer, OHM's office trailer, and to the security trailer. OHM will make all arrangements and pay all costs for providing separate telephone and facsimile machine lines. Separate telephone lines will be provided, one for use by the Engineer, and one for use by the Department. A single facsimile line shall be provided for the use of the Engineer and the Department. OHM will have 3 phone lines and 1 facsimile line to our trailer and one phone line will be installed at the security trailer.

OHM will connect to the water main on Aero Road for water to the support area. Water for dust control and the decontamination pads will be obtained from this source also. Temporary covered pools will be utilized to store water for dust control and decontamination activities.

OHM will utilize Porta Johns as sanitary facilities during the duration of the project. They will be placed in the support zone and other strategic clean areas around the site.

3.1.5 Decontamination Pads

OHM will construct a separate concrete decontamination pad in Area B and in Area C just prior to entering Pfohl Road (Figure 2). Each decon pad will be equipped with a drain system and holding tank on a properly graded area that has no deleterious material.

OHM has designed the decontamination pads to include the following:

- Adequate dimensions to contain wash water and debris from the largest sized vehicles to be utilized in this Contract.
- Splash walls to contain over spray.
- An above ground holding tank with secondary containment to temporary store spent wash water.
- A 3000 psi pressure cleaner to clean the wheels and undercarriage of each truck or piece of equipment

A non-shrink epoxy coating application will be used on all concrete surfaces exposed to contaminants. Epoxy coating, to be used as protective coating of the decontamination pad, will be 100% solid, 100% non-reactive, moisture insensitive and a non-shrink product which is designed for durability, chemical resistance, to mild inorganic and organic acids, alkalis and solvents. Coating product shall be EVA-POX all purpose coating No. 9 as manufactured by Epoxy Industries, Inc, Ravena, New York or pre-approved equal.

OHM will clean the decontamination pad after daily use. No contamination shall be left behind. The decontamination pad will remain on-site following completion of the project.

Washwater from the equipment decontamination pad will drain into the sump adjacent to the concrete wash pad. The water shall be pumped from the sump to a temporary holding tank and disposed in accordance with Federal and State including RCRA regulations.

Washwater from the personnel decontamination facility, floor drains, and laundry (present on site) will be piped to a temporary holding tank and disposed of at the Contractor's expense and in accordance with Federal and State regulations.

3.1.6 Weigh Station

OHM will provide a calibrated truck scale with ticket printer and digital weight indicator for weighing trucks prior to and after each load is loaded onto the truck. The scale will be installed according to all specifications and certified monthly by a licensed firm. The facility will meet all applicable requirements.

The scale will be placed in a location adjacent to the support zone and shall have sufficient capacity to measure all quantities for payment (see Figure 2).

3.1.7 Meteorological Station

OHM will furnish and maintain a portable meteorological station for the continuous observation and recording of wind speed, wind direction, ambient air temperature, atmospheric pressure, atmospheric humidity, incoming radiation, and atmospheric precipitation. The equipment and its placement shall be in conformance with USEPA Ambient Monitoring guidelines for Prevention of Significant Deterioration (PSD) standards for horizontal wind speed and direction as specified on PSD regulations promulgated by EPA under the Clean Air Act Amendments of 1977. The station shall also include a continuous readout temperature gauge and a rainfall gauge. The station shall also be capable of continuously indicating and recording relative humidity and barometric pressure.

The meteorological station will be positioned by the Safety Officer and provide representative data on the overall atmospheric diffusion conditions at the site. Visual wind direction indicators will be established in a central location at each active work area.

The calibration, audit, data reduction and document control of meteorological equipment and meteorological data shall be performed by OHM. Hourly averages of all meteorological parameters during the entire air monitoring program will be tabulated, verified and archived.

3.1.8 Staging Areas

OHM will construct two (2) separate staging areas in Area B. One staging area will be for drums and the other for contaminated soil.

Each staging area will be constructed with a 4 inch maximum thickness of 3,000 psi reinforced concrete with a 6 inch curb. The slab will be sloped so it will drain to a sump for the removal of rain water. Staging areas shall be lined with a sealed 40 mil high density polyethylene liner. All material placed on the staging pads will be covered and secured with a 10-mil-thick liner. The size and location of each pad will be determined by field supervisor. See Figure 2 for the proposed location of the staging areas.

3.2 INITIAL SITE ASSESSMENT

OHM will perform an initial site inspection. During the inspection OHM will perform the following:

- A site map will be used to indicate all drum cluster locations on site.
- Major surface drums areas will be located and marked in the field with stakes and survey tape.
- The site will be surveyed and all surface drums discovered within the 100 year flood plain will be staked for future removal activities. These drums will also be noted on the site map for tracking purposes.
- Initial on-site and perimeter air monitoring and radiation survey will be performed.

In addition, the following items will be reviewed and a determination made if any immediate action is required to mitigate further problems:

- Excavation/overpacking of any leaking drums or containers.

- Additional berms to be constructed to contain potential groundwater contamination

At the completion of the initial inspection, all parties will meet to review the collected information. The information obtained will allow the work plan to be better defined or altered to meet the site requirements.

3.3 TEST TRENCHING

Prior the excavation of any drum, tars, or soils, test trenching will be performed to determine the extent of horizontally impacted soils. A trackhoe will excavate a 2 foot wide trench at locations, to a depth determined by the on site engineer.

The excavation material will be staged on 10 mil plastic. A sample will be collected for chemical analysis. If determined contaminated, the material will be hauled to the contaminated soil staging area. If clean, it will be used as backfill. Since no one will be working within the limits of the trench, OHM will not perform shoring or dewatering of the trench.

Upon approval of the engineer OHM will backfill the excavation using excavated fill, site fill, or imported fill. When the trenches are left open overnight a clearly identified orange snow fence (safety fence) will be installed around the perimeter of the excavation. The work area will be isolated by constructed berms to prevent surface water contamination.

3.4 DRUM REMOVAL OPERATION

The following describes OHM's plan to remove all surface and buried drums on the property.

3.4.1 Drum Search and Location

Prior to the reconnaissance, OHM will review the NYSDEC Drum Investigation Report to identify previously identified drum locations. OHM crew members will establish and divide the site into quadrants. Technicians will walk the entire site by quadrant, marking exposed drums with paint and/or flags for inventory and future removal operations. All of the locations will then be noted on the quadrant site map. Air monitoring will be required during all stages of the drum search tasks.

3.4.1.1 Drum Removal, Areas B and C

Utilizing a track excavator equipped with a drum grapppler, operated by trained operators having a minimum 500 hours of operating experience, OHM will safely remove all surface and subsurface drums. OHM has estimated that this activity will be performed simultaneously in Areas B and C. Based upon our vast experience using this type of drum handling technique, this method has proven to be the safest and most reliable means for handling drums which are in various states of physical condition. OHM expects to encounter drums that, upon exposure, will be leaking unknown compounds. Experienced grapppler operators can expeditiously remove the distressed drum to the interim containment pan for immediate content transfer or overpacking. Using this method, drums do not have to be completely exposed for drum removal as the operator can approach the drums so that the grapple will encompass the drum using just enough pressure on drum surfaces to allow a more stable extraction, reducing the probability of content release as opposed to slings/choakers, or drum grabbers, which tend to tear or rip drums during the removal process in addition to requiring additional personnel to be at the excavation face, increasing employee risk. Additionally, sling/choaker and drum grabber extraction is best suited for upright drums where a grapppler can be positioned to safely remove drums in any position or configuration they are encountered.

3.4.1.2 Spill Prevention

As stated above, retrieved drums will be immediately removed to the containment pan adjacent to the work area. There the drums will be logged as required in specification section 00503.5. The containment pan will be constructed of 1/4" carbon steel plate measuring 6 foot by 6 foot with 1 foot deep sides and elevated floor. The containment pan will comfortably fit 4 drums or overpacks. See Figure 3.

3.4.2 Encountered Contaminated Soils During Drum Removal Activity

Contaminated soil encountered during the drum removal activity will be placed on 10 mil plastic near the excavation and will be transferred to the contaminated soil staging area as soon as possible. Any contaminated soil left near the excavation overnight will be covered with 10 mil plastic. Confirmatory soil samples from the bottom of the excavation will be collected and analyzed prior to backfilling under the direction of the on site engineer. A 24 hour laboratory turn around time will be requested to facilitate backfilling. With the engineer's approval, OHM will backfill the drum removal excavation as quickly as possible to reduce the potential for contaminated water removal. Any excavation left open overnight will be covered with 10 mil plastic. An orange safety fence will be installed around the excavation and bermed perimeter.

3.4.3 Drum And Soil Sampling

All sampling will be carried out using Level B protection. Drum sampling will only take place at the Drum Staging Area. Drums will be numbered sequentially, all drum markings, labels, size, condition, type of drum, and overpacking will be documented on a DRUM INVENTORY LOG. When the drum is ready to be sampled, the sample technician will determine the drum content, color, state of content(s) and volume, and record this information on the drum inventory log. A composite sample of each drum will be taken at this time. Refer to Section 4.2, Drum Sampling, and Section 4.3, Soil Sampling, for specific sampling procedures.

Samples will be brought to the on-site laboratory (or to an off-site fixed base lab) for compatibility and hazard categorization. Samples identified as compatible will be bulked and subsequent samples will be collected and sent to an approved laboratory for full disposal analysis.

3.4.4 Compatibility and Disposal Analysis

To properly classify and dispose of waste on a cost-effective basis, OHM will perform compatibility analysis on all samples obtained.

Compatibility testing is performed to separate and classify the drum material into compatible groups. These tests will include, as a minimum:

- (a) General Characterization
 - Air Reactivity
 - Phase Determination
- (b) General Liquid Characterization
 - Flame Ignitability Test
 - Bieltstien's Test
 - Water Solubility and Reactivity
- (c) Inorganic Liquid Characterization
 - Inorganic Oxidizers
 - Peroxides
 - pH
 - Sulfur/Cyanide
- (d) Organic Liquid Characterization
 - Organic Oxidizers
 - Peroxides

(e) Solids Characterization

- Physical (appearance and characteristics)
- Ignitability
- Reactivity (air and water)
- pH
- Solubility
- Oxidizers
- Peroxide
- Sulfur/Cyanide

(f) Radiation Scan

- Alpha-Beta-Gamma scan using radiation detector to be performed on all samples prior to compatibility testing.

Samples from each wastestream (10 samples maximum) will be composited together and sent off site for full disposal analysis. Once disposal analysis have been completed waste disposal profiles will be completed and sent to the disposal facility for their approval.

Compatibility testing of drummed material is discussed in greater detail in Section 5.4 of this workplan.

3.4.5 Drum Handling Characterization

Drum contents will be analyzed, at a minimum, for the following RCRA characteristics, as per Section C-1.4 of Technical Specifications:

- Ignitability
- Corrositivity
- Reactivity
- TCLP
- PCBs
- Halogenated organics (%)
- Solids (%)

The Site Engineer may require additional analyses for dioxin and furan isomers, using Method 8280, SW-846.

All analytical methods shall be in accordance with EPA/SW-846, 3rd ed. (located in NYSDEC ASP). Each report shall contain a summary of the contents, results, and all relevant circumstances of the work; the following deliverables are to be included:

- Parameter requested and methodology chosen
- Dates collected, extracted/digested, analyzed
- Chain-of-custody

- Sample results
- Duplicate results
- Blank results
- Spike and spike duplicate results
- Surrogate recoveries
- Method detection and reporting/quantitation limits
- Clean-up procedures, and
- Range of standards and correlation coefficient.

The laboratory shall make every effort to minimize matrix interferences.

Up to 30 drums, to be selected by the Engineer or other Department on-site representative, shall be analyzed for the following parameters:

- Volatiles (GC/MS) and library search
- Semi-volatiles (GC/MS) and library search
- Pesticides (GC)
- Metals (23)
- All dioxin/furan isomers, as required.

Analytical methodology shall be in accordance with NYSDEC 1989 ASP Superfund CLP.

3.4.5.1 Drum Handling Disposal

All wastes contaminated with dioxin isomers and/or furan isomers will be encapsulated in the on-site constructed encapsulation cell. Dioxin contaminated waste will be segregated from all other wastes before encapsulation and will be separated in a specific designated waste cell.

Upon receipt of the complete analytical data from the outside lab, OHM will characterize the waste as per 40 CFR and any applicable state regulations. Once the classifications have been approved by NYDEC, preparations for removal will take place.

The chemical content and classifications will be used to determine the proper disposal technology for each wastestream. Once the disposal method is specified, profiles will be generated to DEC approved disposal facilities and given to the DEC for approval and signature. The profiles will be matched with the corresponding samples and sent to the proper facility(s). After review and approval by the disposal facility, arrangements for shipment will be made.

All shipments will utilize either a NYS uniform hazardous waste manifest or a disposal state manifest, and will be in accordance with all DOT and state transportation requirements.

Depending on the results of the analysis and the number of compatible drums in each wastestream, OHM intends on handling the drums in one of the following methods:

3.4.5.2 Overpacking of Drums

85 gallon or other size overpack containers will be readily on hand at the point of drum retrieval and at the drum staging pad. Overpacking of drums at the excavation will take place safely and efficiently on the interim drum containment pan using the drum grapppler or other safe means.

3.4.5.3 Liquid Bulking

All compatible liquids will be pumped into a storage tank located within the drum storage area. When consolidation of liquids is complete, vacuum trucks will remove the material and transport it to a licensed disposal facility.

3.4.5.4 Groundwater

Groundwater encountered during excavation will be removed using skid mounted vac unit and/or diaphragm pumps capable of handling 1500 gallons of liquid. Collected groundwater will then be transferred to the holding pool pending final disposition.

3.4.5.5 Soil Bulking

All compatible solid drums will be emptied within the confines of the soil staging pad using in 580 case backhoe or 215 trackhoe with drum grapppler. The solids will be loaded into box trailers for transportation to a licensed disposal facility.

3.4.5.6 Low Level Radiation Drums

OHM will screen all drums and surrounding soils with a Radiation Survey Meter (Model 3007A, Dosimeter Corp.). The meter utilizes a probe (Model 3011, Dosimeter Corp.) for alpha-, beta-, and gamma-ray detection, with a window of 1.5-2.0 mg/cm³; the meter has scales of 0-300, 0-3000, 0-3000 cpm and 0-0.5, 0-5.0, 0-50 mR/hr.

To establish the relative radioactivity of the waste, OHM will perform a radiation survey of the site and surrounding area as to establish the background radiation levels in the local environment.

Any drums that are found to contain low levels of radiation will be repackaged into DOT-approved 90 ft³ metal containers for shipment to the low-level radiation waste, or mixed-waste disposal facility.

3.4.5.7 Empty Drums

Empty drums will be crushed on the containment pad and staged on the containment pad or in roll off boxes pending placement into the on site encapsulation cell. Crushed drums will be covered to reduce possible volatilization and protect against precipitation.

3.5 SOILS EXCAVATION

OHM will excavate contaminated soils from several locations on site and dioxin contaminated tars from one specific area.

3.5.1 Dioxin Tars

OHM will excavate the dioxin tars from the large tar burial area shown on Figure 2. A 215 trackhoe will excavate the tars and load directly into a licensed hazardous waste dump trailer. If the tar requires solidification, it will be mixed with surrounding soils prior to loading. The dump trailer will be decontaminated at the decon pad and will transport the tars directly to the dioxin encapsulation cell located in Area B. When approved by the engineer, the excavation will be sampled. The area will be backfilled when the analytical results indicate that the soils are clean.

3.5.2 Contaminated Soils

OHM will excavate visually contaminated soils as a result of the test trench operations and drum removal operations. The excavated soils will be, depending on location, transferred directly onto the licensed dump trailer or into the bucket of a loader and transported to the dump trailer.

The dump trailer will be used to haul the material to the contaminated soil staging area and place it in 100 cubic yard soil piles. A geiger counter will be used to screen the soils prior to stockpiling. "Hot" soils will be stockpiled separately.

3.5.3 Soil Sampling

OHM will obtain a composite sample from each 100 cubic yard pile and analyze for all the disposal parameters. Based on the results, OHM will complete a waste profile form. The waste profile form and a composite sample of the soil will be sent to the disposal facility for approval.

3.5.4 Soil Loadout

OHM anticipated that 3 different soil waste streams will be generated. The three distinct wastestreams are landfill without treatment, incineration and radiation contaminated soils. The soils for landfilling and incineration will be shipped off site in bulk using a front end loader to load the dump trailers. The soils contaminated with low level radiation will be packaged in 90 ft³ metal shipping containers and shipped to the disposal facility on flat bed trailers.

3.6 ENCAPSULATION CELLS

OHM will investigate Area B for a suitable location for the construction of the two (2) encapsulation cells. The cell location will not contain any deleterious debris or refuse. Test pits will be performed in the area to confirm the presence of any unsuitable materials in the underlying soils. Test pits will be backfilled and compacted prior to construction of the cells. The proposed location of the cells will be subject to Engineer's review and approval. The size of the dioxin/furan cell will be determined by the site engineer. The drum cell size will be determined and constructed after the number of drums have been determined. Figure 2 shows the proposed locations for the cells.

3.6.1 Cell Construction and Backfill

The encapsulation cells will be construction in accordance with the specification. The cell will have a working depth of 4.0 feet.

OHM will remove the organic topsoil layer and excavate soils in the construction area to the appropriate grade to install the cell materials. Excavation of the cells, berm, and anchor trench will be performed by hydraulic excavator. Once the rough grade has been established, the excavation will be fine graded with a grading dozer and compacted.

3.6.1.1 Sand Layer

OHM will place and compact sand to a final thickness of 6" using a small dozer and roller.

3.6.1.2 HDPE Liner

The HDPE liner will be installed by an approved installer and the liner material and construction will meet or exceed all specifications. OHM will supervise all field testing and insure its conformance with the specifications.

3.6.1.3 Clay Material

OHM will supply clay in accordance with the specification. The clay will be obtained from a properly permitted facility. OHM will submit the source for the clay material to the Engineer two (2) weeks prior to importation to the site and will provide the required analytical information for the clay material.

OHM will perform compaction and installation of the clay material in accordance with the specifications. Clay will be placed with a small dozer and compacted with a Sheepsfoot roller in 1 foot lifts to a final compacted depth of 18 inches.

3.6.1.4 Placement of Materials into Cells

Once the cells have been completed and approved by the Engineer, OHM will place dioxin/furan contaminated tars in the cell using a hydraulic excavator to spread evenly the material over the entire cell. The cells will be filled to the limits contained within the HDPE liner. Additional cell(s) will be constructed if necessary, based on the volume of tar encountered.

3.6.1.5 Water Management

OHM will cover all material placed within the cell with a 10 ml liner. All water that enters the cell will be pumped out to our hazardous waste storage pool for ultimate disposal at an approved facility.

3.6.1.6 Capping of Cells

After the cells have been completed, OHM will grade the cells to final grade using on site soils and will install the HDPE liner according to specification. A final layer of soil will be placed over the liner and all distributed areas seeded according to the specification.

3.7 SITE RESTORATION

At the completion of all removal activities and all waste have been properly dispose of off site OHM will begin demobilization activities. All equipment working with contaminated materials will be completely decontaminated and removed off site to our office in Clarence Center, New York. All open excavations will be backfilled with on site fill or imported fill.

All distributed areas will be seeded according to the specifications. OHM will decontaminate the staging pads and the decon pads. The truck scale and all trailers will be demobilized. All utilities will be disconnected from the poles located on the streets. The improved access roads, support zone parking lot, two (2) staging areas, and the two (2) decontamination pads will remain on site for future use.

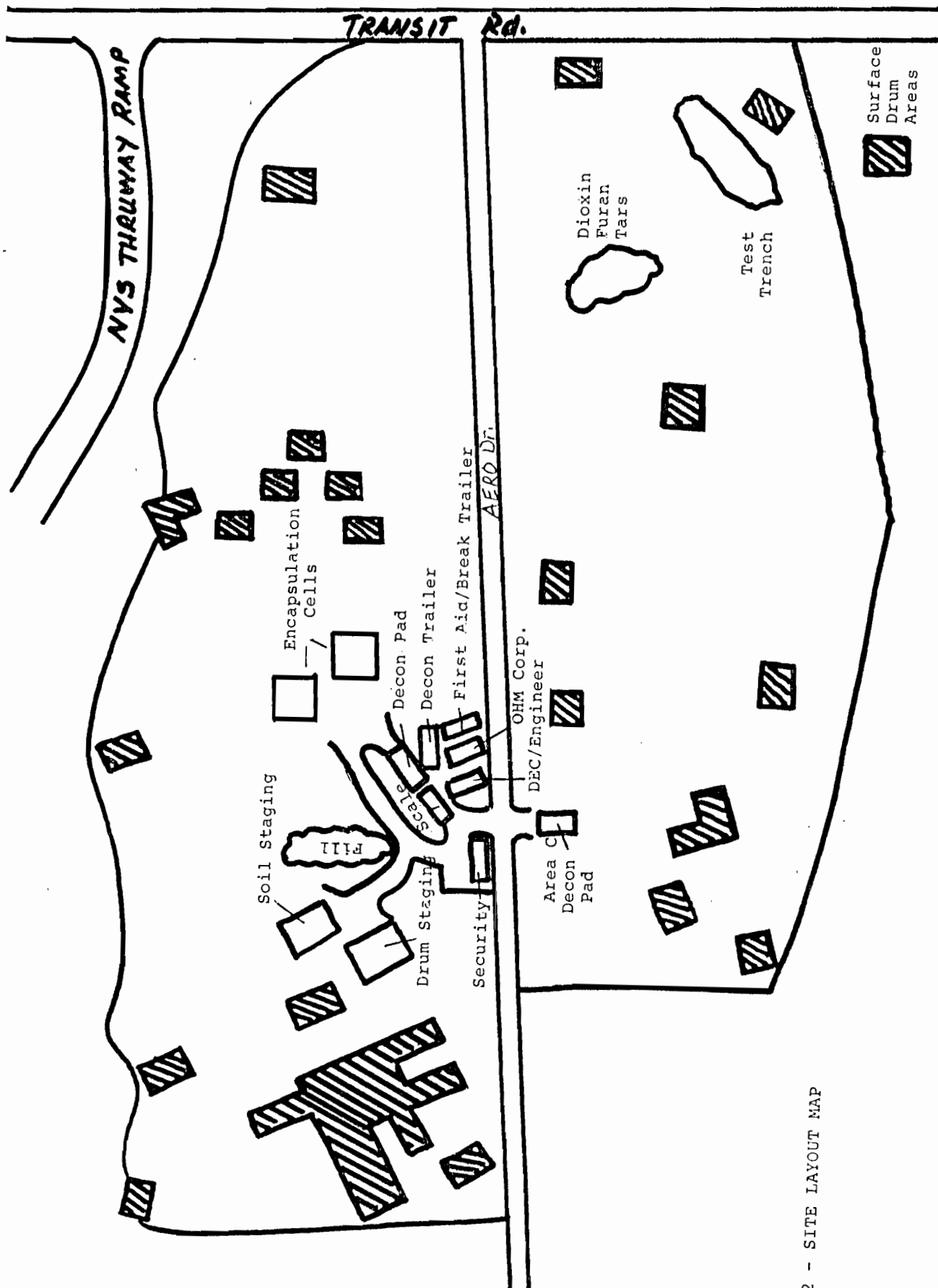


FIGURE 2 - SITE LAYOUT MAP

LIFTING EYES

12" RAISED
FLOOR



- 1/4" STEEL PLATE
- 2" ANGLE AND BOX
- STEEL SUPPORTS
- 6"x6"x1/4" STEEL
- MESH RAISED FLOOR
- DECK

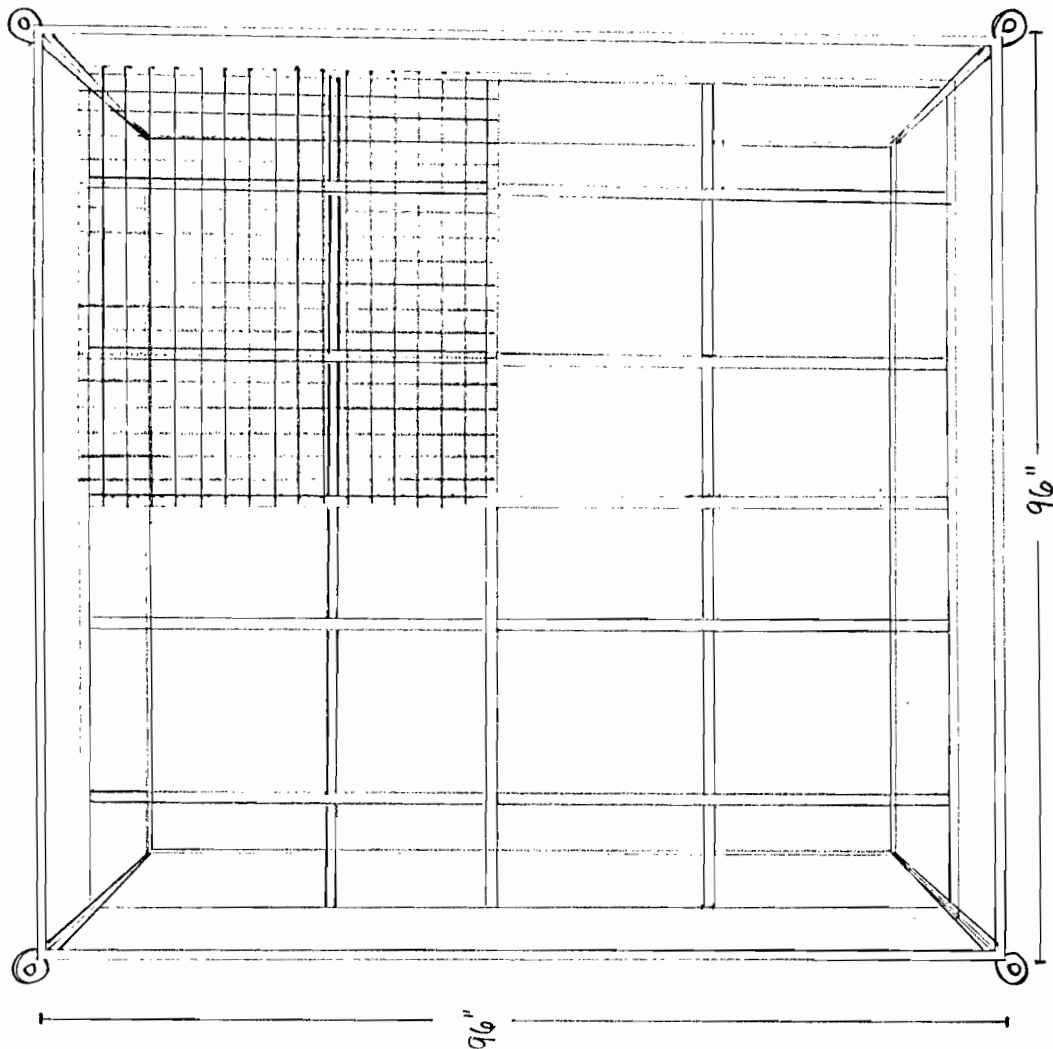


FIGURE 3 - CONTAINMENT PAN

4.0 THE CHEMICAL QUALITY ASSURANCE SAMPLING PLAN

4.1 SAMPLING PERSONNEL

OHM's Northeast Field Technical Services Department employs a staff which is capable of accomplishing all of the relative sampling requirements for the Pfohl Brothers site. These individuals undergo a rigorous 40-hour Sample Technologist training course which is taught in-house by a team of senior level personnel. The individuals are instructed on the use of sampling equipment, decontamination procedures, and field instrumentation calibration procedures necessary to assure a total quality management process from the initial sampling endeavor to the final classification of the wastestream.

OHM personnel are trained in the procedures outlined in the OHM Field Sampling Manual. Segments of the Field Sampling Manual are enclosed in Appendix B of this plan.

In instances where differences occur, the sampling methodologies as per the Final Project Plan will have priority.

4.2 DRUM SAMPLING

OHM has established procedures for the sampling of hazardous material/waste drums. OHM sampling personnel are trained in the procedures and protocols pertinent to drum sampling. Sampling procedures include those pertaining to site preparation, initial site survey, primary staging, radiological survey, drum opening, open drum survey, actual drum sampling, drum inventory log instructions, and drum sampling supplies.

The sampling procedures are described in detail in Chapter 6 of the OHM Field Sampling Manual. This chapter is presented in Appendix B of this plan. Any site-specific requirements for drum sampling will take precedence over the procedures described in our manual.

4.2.1 Staging of Drums and Other Preliminary Steps

The Initial Site Survey for organic vapors, explosivity, and radiation entails a search by an OHM chemist through the drums prior to staging to determine if any require special handling. Examples of drums which require special handling include those lab packed, shock sensitive and explosive, air and water reactive, radioactive materials, biological waste, and nickel or stainless steel drums. These drums are segregated and treated separately.

Primary Staging involves the accurate numbering and layout of drums to allow easy access for samplers and chemists to work. Staging usually involves the drums being placed on visqueen-lined skids which are organized into rows for easy access when sampling and/or maintenance activities. Drums are transported within the site using a grappler attachment to a front-end loader. Empty drums are noted and staged separately. Any leaking drums will be overpacked immediately.

Overpacking of Drums 85-gallon (or other size, if necessary) overpack containers will be readily available to contain drums which are known to leak contents or be of less than satisfactory construction. OHM Sample Technicians are trained and experienced in making this determination. The unsatisfactory drum is layed on its side and rolled along one end into the larger overpack. The overpacked drum is then lifted up and numbered with the original drum number.

Radiological Survey involves the detection of alpha, beta, and gamma radiation with a Geiger counter, or other radiological survey instrument. The site supervisor and corporate health and safety officer shall be contacted immediately when radiation is detected.

Drum Opening is usually performed with a Caterpillar 215 grappler using a brass-tipped punch. The staging area is to be clear of all personnel. Drum opening may be performed by hand only upon consultation with the Health and Safety Officer or on-site chemist.

Open Drum Survey involves re-checking for radiation, especially gamma radiation not previously detected.

OHM shall sample and characterize each drum exhumed from the site. Drums will be segregated based upon the contents of each drum; like or compatible material will be staged for subsequent disposal or encapsulation. Dissimilar material which may be incompatible will be stored in separate locations.

4.2.2 The Sampling Event

Drum sampling of solids, semi-solids, sludges, and/or liquids are collected in appropriate sample containers. Samples are either scooped (solid) or pipetted into the designated sample containers. The drum sample is a representative of the drum contents, and should contain as many layers, in the correct proportion, as within the drum. Extreme care is taken to avoid sample contamination, and a drum inspection log is completed by the sampler immediately before sampling the next drum. All expendables, e.g. sample gloves, paper towels, etc. are placed in a separate designated drum. The sampling pipette is placed in a drum designated for glass waste.

The Drum Inventory Log is filled out upon the initiation of the excavation through the completion of the sampling event. Information necessary for the drum log include: the drum number, project number, date, time, drum contents (or, as indicated on drum label), drum size, material color, pH, estimate of content quantity and number of layers, sample method used, drum markings, and any additional comments. The drum log is QC checked by the Primary Sample Technician, on the day of sampling, upon completion of the sampling event. Any inconsistencies or omissions must be resolved immediately.

4.3 SOIL SAMPLING

Contaminated soils, tars, debris, and/or waters shall be sampled "in place" as they are discovered during excavation/drum removal. OHM has standard techniques for obtaining representative samples for a hazardous waste investigation. The most common type of soil sample is the grab sample. The following procedures for surface soil grab sampling are noted in Section 5.2.1.1 of the OHM Field Sampling Manual (March 1989).

4.3.1 Grab Sampling Procedures

- 1- Determine the number and location of desired samples, including duplicates.
- 2- Dig a 3-4 inch hole with a clean shovel at the first sample location.
- 3- Don clean sample gloves, then scrape the side of the hole with a tongue depressor to expose a fresh surface.
- 4- Discard the first tongue depressor, and use a new one to dig material from the top 2 inches of soil and transfer it to the sample container. Chip the sample with a screwdriver above the sample container if the sample is too hard.
- 5- Seal and label the container. Record pertinent information in the field log.
- 6- Place used expendables in a trash bag. Decontaminate any tools with soap, water, and appropriate solvent rinses.
- 7- Repeat steps 2-6 for each additional sample.

The complete soil sampling procedures are included under Solids Sampling (Section 5.2) of the OHM Field Sampling Manual and are located in Appendix B.

4.3.2 Other Soil Sampling Methods

In addition to the use of the grab sample, other sampling techniques used at OHM include: manual split-spoon, shelly tube, bucket auger, trench side, bulb planter, and topsoil trier sampling. These techniques and the sample equipment are discussed in Section 5.2.3 of Appendix B.

4.3.3 Soil Sampling Considerations

Soil types can vary considerably on a hazardous-waste site. These variations, along with the vegetation, can affect the rate of contaminant migration through the soil. Thus, it is important to maintain a detailed, accurate record throughout the entire sampling operation, which notes the location, depth, and characteristics such as grain size, color, odor, and any readings obtained from field monitoring equipment.

Subsurface conditions are often stable on a daily basis and may demonstrate only a slight seasonal variation, especially with respect to temperature, available oxygen, and light penetration. Changes in any of these conditions can radically alter the rate of chemical reaction or activity of associated microbiological communities within the soil matrix. Therefore, soil samples are to be maintained at, or less than, their at-depth temperature, protected from direct sunlight, sealed tightly in glass bottles, and analyzed as soon as possible.

The physical properties of soil: its grain size, cohesiveness, associated moisture, depths to bedrock and the water table, and other factors, will act to limit the depth from which samples can be collected and the method used to collect them. Information on soil properties can be acquired from published soil surveys which are available from the U.S. Geological Survey (USGS), other Federal, State, and local agencies, and agricultural associations. A comprehensive list of these offices and currently available soil surveys are included in the "NEIC Manual for Groundwater/Subsurface Investigations at Hazardous Waste Sites".

4.3.4 Water Sampling

OHM will obtain composite samples from the water storage pools to analyze for wastewater treatment parameters selected by our off site disposal facilities.

The composite sample will be obtained using a bacon bomb sampler to collect representative samples from the various depths of the pools. The bacon bomb sampler will be fully decontaminated between samples.

4.3.5 Air Monitoring Samples

OHM will obtain 4 perimeter samples (3-downwind and 1-upwind) and one "high risk" sample from an individual working within the exclusion zone twice a week.

Each air sampler will be fully calibrated over a range of operational flow rates with a reference calibration orifice at the beginning and end of the program and quarterly throughout the program. Routine maintenance items will be performed monthly in accordance with the manufacturer's recommendations. If any maintenance item performed, either routine or non-routine, has the potential to affect the instrument calibration, then the instrument will be recalibrated regardless of the next scheduled calibration sequence. Sampler flow calibration will be checked both before and after each sampling session to assure sample collection accuracy. All field data, including operation, calibration and maintenance records for each sampler, will be maintained in the field office.

4.4 DOCUMENTATION PROCEDURES

Accurate documentation of all sample procedures is critical to the sampling process. Types of documents which are considered essential and must be accounted for are notes, maps, drawings, photographs, safety plans, QA plans, log books, data sheets, reports, etc. These link the sample with the project, sampler, time, location, procedures, changes to the work plan, sample history, transfer to the laboratory, and insures tamper-free transit.

Data, calibration, and maintenance records, samples, and documents, must be accounted for and retrievable at any time during an investigation. Chain-of-custody records are necessary to document the sample identity, handling, and shipping procedures.

In both the planning and the operational stages of any job, sufficient time must be allowed for proper technical documentation.

4.5 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Please note that OHM has established QA/QC procedures in place. The two major concerns of the QA/QC plan are QA samples and document control/chain-of-custody. QA samples required include:

- Trip Blanks are used to verify the cleanliness of the sample containers. One trip blank is used for each analyte for each group of water samples sent out.
- Equipment (Field) Blanks are used to verify the cleanliness of the sampling equipment. The piece of equipment in question is used to take a sample of distilled or DI water. One analyte per piece of equipment per day is recommended.

- Duplicates are essentially identical samples collected at the same time, in the same way, and contained, preserved, and transported in the same manner. They are used to verify the reproducibility of the sampling procedure. They are necessary to cover breakage and accidents in the laboratory and for laboratory spikes. Normally, 10 percent of the samples should be duplicates.
- Split Samples are samples that are split with the client or a regulatory agency for independent analysis by another laboratory. Care must be taken to assure accurate splitting. Because the integrity of samples for volatiles may be compromised by the handling involved in physically splitting them, duplicates should be used instead of splitting these samples.
- Document Control/Chain-of-Custody As previously mentioned, strict adherence to document- and data-control procedures are essential components of a quality QA/QC plan.

In both the planning and the operational stages of any job, sufficient time must be allowed for proper technical documentation.

Documentation, labeling, and Chain-of Custody procedures are described in greater detail in Appendix B of this plan.

4.6 SAMPLE CONTAINERS AND PRESERVATION

All sample containers shall be pre-cleaned according to EPA/SW-846. The container size, the preservation procedure, and time required for laboratory analyses, depend on the parameter that the sample is to be analyzed for.

All sample containers are to be properly labeled. Information included on each label are: the name of the project, the field sample number, the date and time of sampling, and the name(s) of sampling personnel. All information is to be written in indelible ink; the labels are to be affixed as to ensure that they do not become separated from their respective containers.

Properly labeled sample containers are to be placed in zip-lock bags, then stored in a cooler. Samples are to be shipped to the appropriate laboratories at the end of each sampling day. The samples shall be maintained at 4 C, if required by sampling protocols.

Please note that OHM has established protocols for the determination of the correct sample container, procedures relating to sample preservation, and labeling requirements, which have been developed as per EPA/SW-846.

4.7 SAMPLE SHIPMENT PROCEDURES

Sample shipment procedures are described in Sections 3.7, 3.8, and 3.9, of the Field Sampling Manual, in Appendix B. Chain-of-Custody procedures will be adhered to at all times. All samples are to be appropriately documented, packaged, marked, labeled, and shipped, in accordance with 49 CFR 100-179 and the International Air Transport Association Dangerous Goods Regulations for Domestic Air Transport.

All sample coolers, containing samples for analysis, are to be labeled "Environmental Sample". The sample cooler(s) shall arrive at the laboratory on the next working morning.

5.0 THE CHEMICAL QUALITY ASSURANCE ANALYSIS PLAN

Huntingdon Analytical Services/Empire Soil Investigations Inc. (HAS/ESI) and Analytical Services Corp. (ASC) have been identified as potential contractors to perform the laboratory analyses of the samples collected at the Pfohl Brothers site. All laboratory analyses, and in particular, all reference to NYSDEC Superfund analytical chemistry, shall be in accordance with the NYSDEC Analytical Services Protocol (ASP), 1991 Edition. HAS/ESI and ASC are responsible for compliance with the contents of the ASP, including all procedures and deliverables that pertain to New York State Superfund; especially specific Contract Laboratory Program (CLP) requirements of NYSDEC ASP:

- Volume 1, Exhibits A (Sections 1 and II), B and C;
- Volume 2, Exhibit D, Parts I-IV;
- Volume 8, Exhibit E, Parts I-VIII.

5.1 CLP REQUIREMENTS

Samples are required to be analyzed for volatiles, semi-volatiles, pesticides/PCB's, and dioxin/furan isomers.

CLP requirements, which are not limited to the following specifics, include:

Volatiles

- Holding time is seven days from the validated time of sample receipt which must be within 24 hours of sample collection. Reference: ASP, Vol. II, D-11-5.
- The percent relative standard deviation (%RSD) for each individual Superfund-TCL compound labeled as Calibration check compounds (CCC) must be less than or equal to ($< / =$) 30%. The %RSD of all other calibration compounds must be $< / =$ 35%. These criteria must be met for the initial calibration to be valid.
- All of the calibration compounds are used to check the validity of the initial calibration. If the percentage difference is $< / =$ 25%, and the % difference for all other calibration compounds is $< / =$ 35%, the initial CLP calibration is assumed to be valid. Corrective action must be taken if these criteria are not valid for any one compound. Reference: ASP, Vol. B, E-25.

- Calculate and report the relative response factor (RRF) and percentage difference (%D) for all compounds. Ensure that the minimum RRF for volatile system performance check compounds (SPCC) is 0.300, and 0.250 for bromoform.

Semi-Volatiles

- Samples must be: 1- Extracted within 5 days 2- Analyzed within 40 days from validated time of sample receipt, which must be within 24 hours of sample collection. Reference: ASP, Vol. 2, D-111-5.
- The % RSD must be $< / = 30.0\%$ for each CCC. The % RSD must be $< / = 35.0\%$ for all other calibration compounds. This criteria must be met for initial calibration to be valid.
- A system performance check must ensure that the minimum average RRF are met before calibration curve is used. Minimum acceptable average RRF for SPCC's is 0.050. The initial calibration is valid only after both %RSD for all calibration compounds and minimum RRF for SPCC have been met. Sample analysis can begin only after these criteria have been met. Reference: ASP, Vol. 8, E-48-49.
- All of the calibration compounds are used to check the validity of the initial calibration. If the percentage difference for each TCL analyte is $< / = 20.0\%$, the initial calibration is assumed to be valid. Otherwise, corrective action must be taken. A new five-point calibration must be generated if the source of problem can be determined. These criteria MUST be met before sample analysis begins.

Pesticides/PCB's

- Samples must be: 1- extracted within 5 days 2- analyzed within 40 days from the validated time of sample receipt which must be within 24 hours of sample collection.

Dioxin/furan isomers

- All deliverable and analytical results obtained using EPA Method 8280/SW 846 shall be reported as required for category B (NYSDEC ASP).

5.2 SOIL ANALYSIS

All excavated contaminated soil staged on site will be analyzed for full NYSDEC Superfund TCL parameters for the these chemical classes:

• Superfund CLP Volatile Organics	NYSDEC ASP Method 91-1
• Superfund CLP Semi-Vol Organics	NYSDEC ASP Method 91-2
• Superfund CLP Pesticides/PCB's	NYSDEC ASP Method 91-3
• Inorganics (Metals)	NYSDEC ASP 200 Series CLP-M
• Inorganics (Cyanide)	NYSDEC ASP 335 Series CLP-M

At the completion of excavation, soil samples will be collected from the bottom of the trench as directed by the Engineer. The soil samples will be analyzed for the above TCL parameters. Tars and soils shall be analyzed for dioxins/furans by SW 846/Method 8280 (NYSDEC ASP Method 91-7) if dioxin/furan contamination is suspected.

Category A Reporting and Deliverables will accompany this set of samples. At the request of the DEC, if anomalies are noted, a full CLP reporting and deliverable package will be presented.

5.3 WATER ANALYSIS

All waters, collected on-site for decontamination purposes or due to the dewatering of the pit during excavation, shall be collected on-site for subsequent disposal as part of the scope-of-work for this project.

All water samples shall be analyzed for the following NYSDEC Superfund TCL parameters:

• Volatile organics	EPA 624
• Semi-volatile organics	EPA 625
• Pesticides/PCB's	EPA 625
• Metals	200 Series
• Cyanide	335 Series

and for the following RCRA hazardous waste characterizations:

- Ignitability
- Corrositivity
- Reactivity
- BTU content
- Halogenated organics (%)
- Solids (%)
- Any additional analysis disposal requirements of the Treatment, storage, and disposal facility (TSDF).

Water samples collected from the dewatering of the dioxin contaminated tar excavation area shall be analyzed for dioxins/furans using SW 846/Method 8280.

5.4 ANALYSIS OF DRUM CONTENTS

Samples obtained from drums, tanks, vats, etc. are compatibility tested to identify hazardous chemicals/waste which require special handling, to isolate incompatible materials (e.g. oxidizers from organics, acids from bases, cyanides from non-cyanide material, etc.) and place into separate wastestreams, and to blend (bulk) similar material into one larger gross wastestream as to reduce transportation and disposal costs.

Section 3.4.4 describes the minimum test that will be performed on each individual sample for compatibility testing. The compatibility testing can be performed by the Chemist on-site, in one of the mobile laboratories.

Upon completion of testing, the hazardous materials are classified into compatibility categories. Field personnel are aided with software which is designed to improve data management. Each containerized material, and any layer within each container, are assigned a wastestream by the Project Chemist with the aid of the Transportation and Disposal (T&D) Coordinator.

This compatibility analysis will either be performed in the field or at our wholly owned subsidiary, Analytical Services Corporation (ASC) in Findlay, Ohio.

Classifications of wastestreams include:

- Acid
- Base
- Liquid
- Solid
- Aqueous
- Organic
- Halogenated organic
- Flammable
- Organic peroxide
- Sulfate
- Cyanide

Additionally, wastes are prior screened for radioactivity, any indications of biological hazards, air and water reactivity.

A maximum of ten (10) samples will be bulked within each wastestream classification and sent to an approved laboratory to analyze, at a minimum, for the following characteristics:

- Ignitability
- Corrositivity
- Reactivity
- TCLP
- PCBs
- Btu
- Percent halogenated organics
- Percent solids
- Dioxin/furan isomers, if required.

Analytical methods must conform with EPA's SW-846, 3rd edition.

Additional testing may be performed as required for acceptance to the TSDF, manifest requirements, and/or other applicable regulatory purposes.

The deliverables package will include, where applicable, the following information:

- Parameter requested and methodology chosen
- Dates collected, extracted/digested, and analyzed
- Chain of custody
- Sample results
- Duplicate results
- Blank results
- Spike and spike duplicates
- Surrogate recoveries
- Method detection and reporting/quantitation limits
- Cleanup procedures
- Range of standards and correlation coefficient.

Up to 30 drums chosen by the NYSDEC engineers will be analyzed for the following parameters:

- Volatiles (GC/MS) and library search
- Semi-volatiles (GC/MS) and library search
- Pesticides (GC)
- Metals (23)
- All dioxin and furan isomers, if required.

5.5 AIR MONITORING SAMPLES

Air samples will be collected and analyzed for:

Organic vapors using NIOSH Method P&CAM 127, using gas chromatography. A blank charcoal tube shall be sent to the laboratory and used as a field blank. The data report for organic vapors shall include:

- Analytical results of samples and field blank
- Laboratory blank analysis
- Calibration procedures and results
- Problems encountered and corrective actions taken.

Nuisance dust using NIOSH Method 0500. Analysis shall be gravimetric. The data report for nuisance dust samples shall include:

- Results reported for all samples
- Pre- and post-sampling filter weights, and
- Daily calibration checks on the laboratory balance.

Air monitoring is discussed in greater detail in the Health and Safety Section of this proposal.

5.6 GENERAL QA/QC REQUIREMENTS

Huntingdon Analytical Services/Empire Soils Investigations Inc. (HAS/ESI) is approved by the NYS Department of Health for solid waste testing. The QA/QC plan for HAS is provided in Appendix D of this plan. Analytical Services Corporation QA/QC Plan is also provided in Appendix D.

6.0 SURFACE WATER MANAGEMENT PLAN

6.1 INTRODUCTION

The Pfohl Brothers Landfill (NYDEC Site No. 9-15-043), located in Cheektowaga, Erie County, New York, is an approximately 120 acres site. The landfill is inactive and is located in a commercial/residential area northeast of Buffalo International Airport. The landfill is bound to the east by Transit Road, to the west by New York State Electric and Gas (NYSEG) utility lines, to the north by land adjacent to the New York State (NYS) Thruway (Route 90), and to the south by Pfohl Road.

The site accepted municipal and industrial waste from surrounding townships and companies from 1932 to 1971. Based on the information obtained through site investigation and from generators, some of the industrial waste dumped on site was identified as waste paint and thinners, pine tar pitch, oils, phenol tar containing chlorinated benzenes, and polychlorinated biphenyls (PCBs).

The landfill has been divided into three (3) areas designated as Areas A, B and C. Work in the areas under this contract will be performed in Area B, situated between Transit Road and Aero Drive, and Area C, situated south of Aero Drive and west of Transit Road.

The following sections contain the Surface Water Management Plan. This plan details the measures to be taken to prevent hazardous water runoff from the work zone. Techniques for water diverting, retaining and preventing soil erosion are also discussed.

6.2. CONTAMINATED RUNOFF PREVENTIVE MEASURES

OHM will implement preventative measures to ensure that contaminated runoff from Area C does not enter the adjacent creek or wetlands. Measures will also be imposed to deny all surface water from running through any open excavation in all areas and then reentering a non-hazardous environment. Any time water comes in contact with an open excavation area, it will be deemed hazardous and contained for proper disposal.

6.2.1 Dikes in Area C

A temporary retention dike will be constructed between the open excavation in Area C and Ellicott Creek. The dike will be constructed of compacted clay having a maximum permeability of 1×10^{-7} cm/sec. The excavating machine and dozer on site will be used in the construction of this temporary dike. In addition, a diversion dike will be placed on the upgrade side of the excavation zone in Area C. This dike will reroute most of the water that would generally run through the area, thereby reducing the volume of hazardous runoff.

The dikes and all excavation activity will be isolated to the north side of Pfohl Road, and the length of the dikes will be dependant on the extent of the excavation zone.

The height of the dikes will be determined by the site topography. An effective elevation will be decided upon which will be sufficient to handle the peak discharge flow of a four inch rainfall in a twenty-four (24) hour period. This method will produce a dike with varying height, being tallest at the point of lowest elevation.

Figure 4 contains the proposed limits of Area C diversion and retention dikes. Figure 5 contains a detailed cross-section of a commonly constructed dike.

6.2.2 Dikes in Excavation Areas

There are three areas on the site other than Area C where diking will be imposed. High concentrations of drums in the western section of Area B will require surface water diversion in that area. Surface water diversion will also be necessary around the dioxin and test trench zone in Area C. These areas will be diked off from the rest of the site as discussed for Area C; however, on-site soils will be used as construction material for these dikes. The determining factor for the height of these dikes will again be a 4 inch, 24 hour rainfall. Proposed diking limits for these areas are also addressed in Figure 4.

Depending on the number of drums encountered in any particular area and the estimated time that pit will be open, there may be other temporary dikes constructed on the site. These again will be constructed of on-site soils as discussed above.

6.2.3 Diversion Trenches

Diversion trenches will be installed on site to assist in rerouting large volumes of sheet flow in high sloping areas. These ditches will reduce the volume the dikes will actually have to divert. The dikes will then only have to handle the volume generated downgradient of the trench and up grade of the berm. One place that this will be important is just west of the Transit Road, which is built up twenty feet higher than the landfill. Other places for trenches may be determined once OHM is on site and sees a problem area.

Proposed trenching boundaries are indicated on Figure 4. A cross section of a diversion trench is detailed in Figure 6.

6.3. EROSION CONTROL

Erosion control measures will be enforced in areas where surface water runoff is jeopardizing the existing soil stability. This may be at intermittent sections of the diversion trenches or where diversion dikes are creating a flow which would not occur naturally. Hay bales will be placed in such areas to slow and spread the flow of water, reducing its impact on soil stability. The hay bales will be placed in a double row and anchored properly with a minimum of two 36 inch stakes per bale. Details of hay bale sections are included in Figure 6.

6.4. DISPOSAL OF HAZARDOUS RUNOFF

Any liquid which passes through an open excavation zone or comes in contact with the drums or excavation area will be considered hazardous. The liquid will be retained in the excavation or retention zone until one of the mobile vacuum units is free to pump it into a 50,000 gallon storage pool reserved for hazardous liquids. The liquid will be stored in the pool until transported by one of the mobile vacuum units to a permitted RCRA facility for disposal. The transportation and disposal of the hazardous liquid will be full accordance with all applicable federal, state, and local regulations.

PLOT SCALE: 1" = 1"



LEGEND



DRUM CLUSTERS
AT SURFACE



TEMPORARY DRAINAGE
DITCH



TEMPORARY BERM

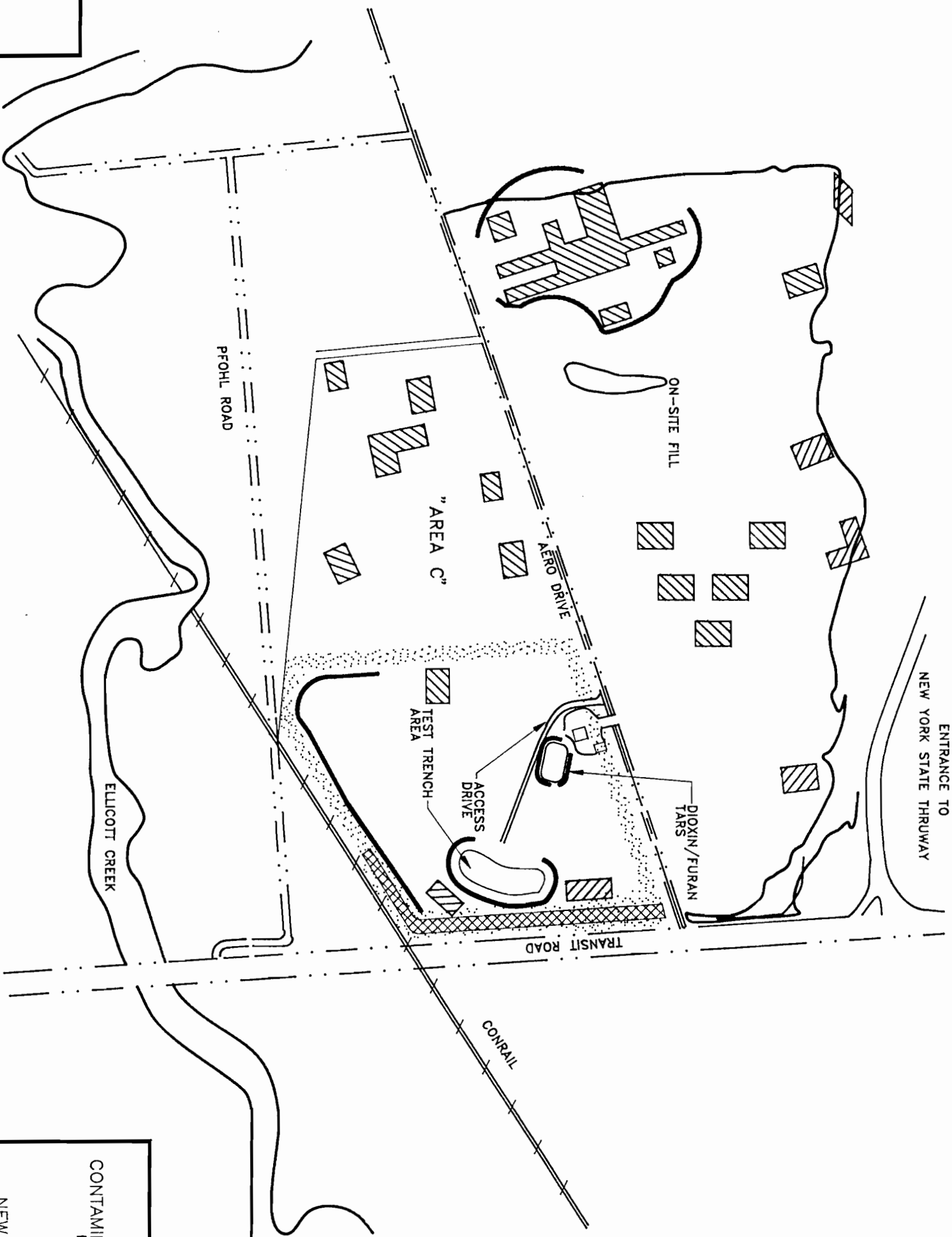


FIGURE 4

CONTAMINATED RUNOFF PREVENTION
PFOHL BROTHERS LANDFILL
CHEEKTOWAGA, NEW YORK

PREPARED FOR

NEW YORK DEPARTMENT OF
ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK



OHM Corporation

3518-A2

DRAWING
NUMBER

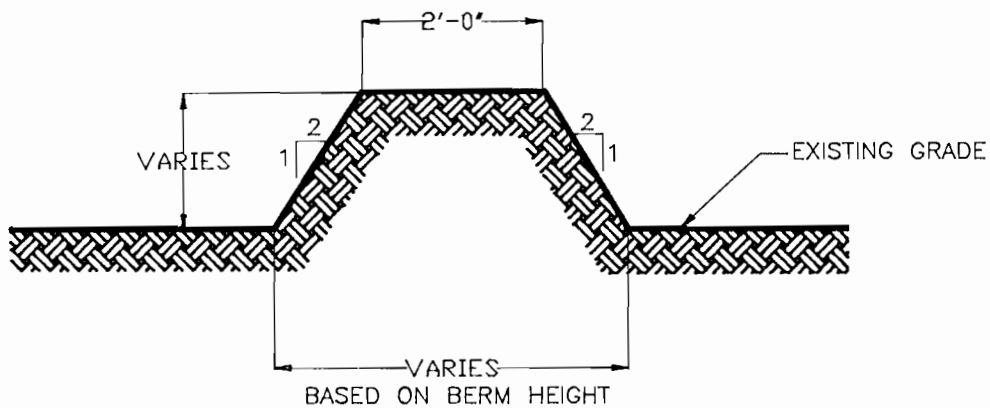
APPROVED BY

CHECKED BY
B. LAMONT 5-19-92

DRAWN BY
W.E. JETTER 5-19-92

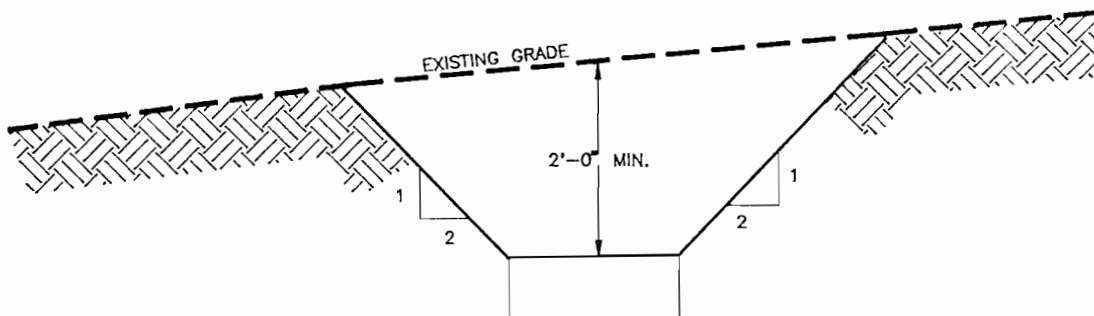
OHM CORPORATION
PRINCETON, NJ

PLOT SCALE: 1"=10'



TEMPORARY BERM SECTION [TYPICAL]

NOT TO SCALE



TEMPORARY DRAINAGE DITCH SECTION [TYPICAL]

NOT TO SCALE

FIGURE 5
SURFACE WATER CONTROL DETAILS

PFOHL BROTHERS LANDFILL
CHEEKTOWAGA, NEW YORK

PREPARED FOR

NEW YORK DEPARTMENT OF
ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK



OHM Corporation

3518--A1

DRAWING
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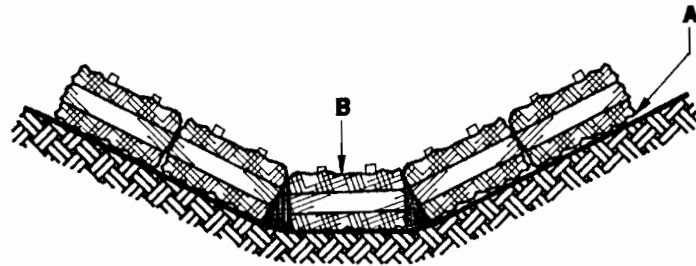
APPROVED BY

CHECKED BY
B. LAMONT 5-19-92

DRAWN BY
W.E. JETTER 5-19-92

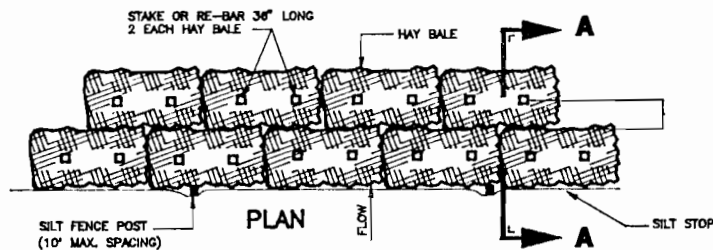
OHM CORPORATION
PRINCETON, NJ

PLOT SCALE: 1"=10'

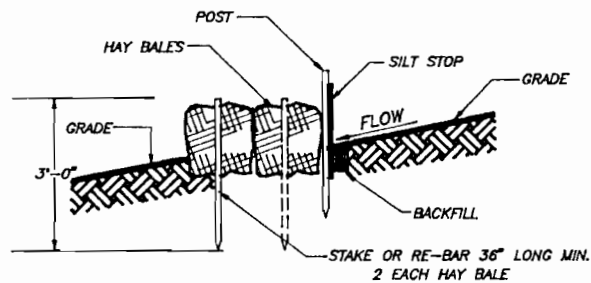


POINT A SHOULD BE HIGHER THEN POINT B

DOUBLE ROW HAY BALE AND SILT STOP IN DRAINAGE WAY EROSION CHECK



DOUBLE ROW HAY BALE AND SILT FENCE NOT TO SCALE



HAY BALE SECTION A-A NOT TO SCALE

FIGURE 6 EROSION CONTROL DETAILS

PFOHL BROTHERS LANDFILL
CHEEKTOWAGA, NEW YORK

PREPARED FOR

NEW YORK DEPARTMENT OF
ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK



OHM Corporation

7.0 SCHEDULE

Figure 7 shows our proposed project schedule and task sequencing. Our schedule is based on the estimated quantities shown on the bid forms. OHM will work 5 days a week, 8 hours a day.

**PFDAL LANDFILL
OPERATION SCHEDULE**

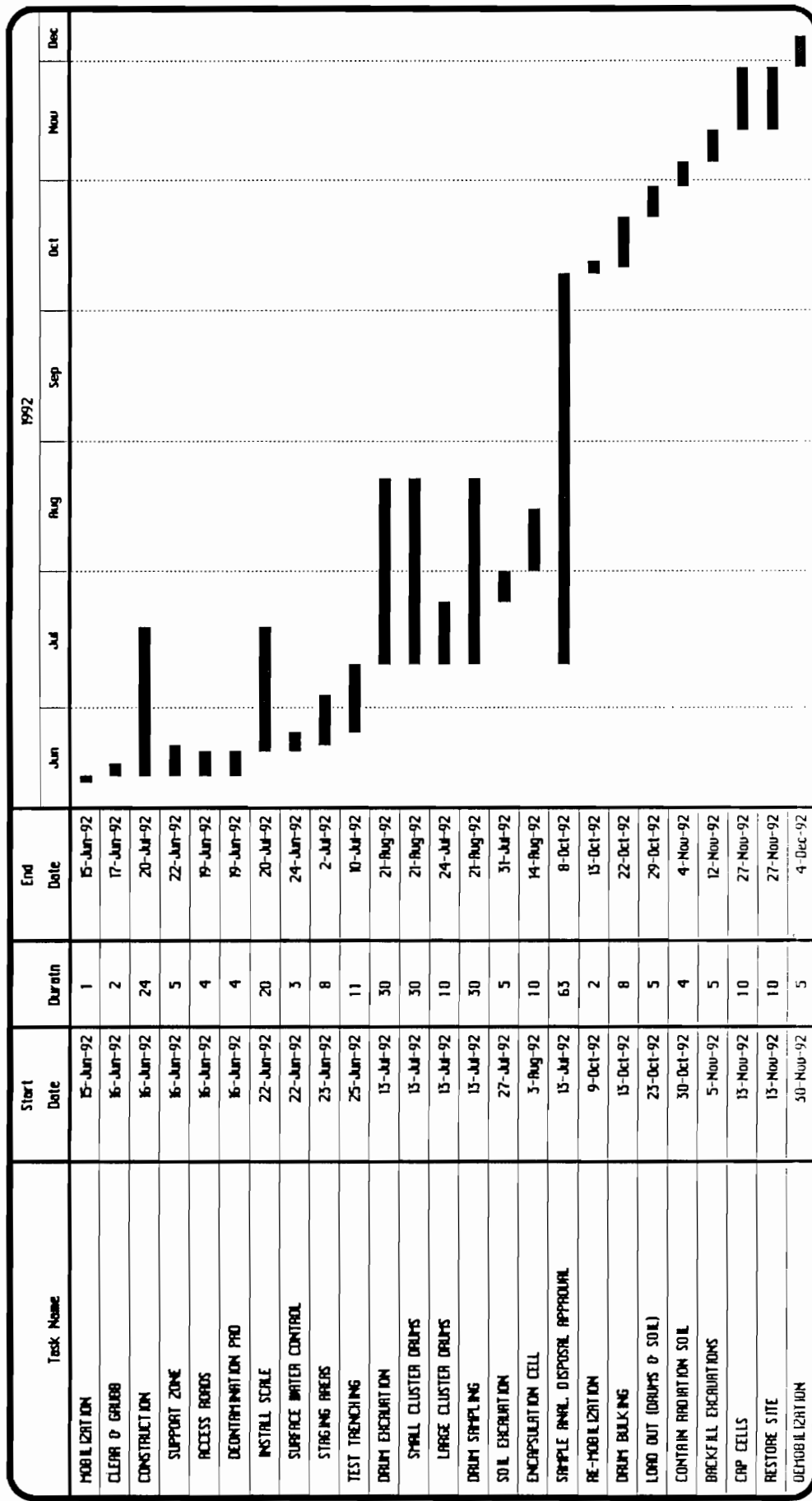


Figure 7

APPENDIX A
OHM PROJECT SUMMARIES

PROJECT SUMMARY

<u>PROJECT TITLE</u>	SPCC Plan Development
<u>LOCATION</u>	Baltimore, Maryland
<u>CLIENT</u>	Manufacturing Facility
<u>PERFORMANCE PERIOD</u>	September 1990 - May 1991

OHM developed a Spill Prevention Control and Countermeasure (SPCC) Plan for a large manufacturing facility in Baltimore, Maryland. The facility houses over 120 above ground storage tanks as well as seven underground storage tanks. OHM began research for the SPCC plan by interviewing plant personnel and obtaining drawings and written procedures. A site walk was performed by OHM personnel to obtain an understanding of facility operations and general site layout. Once this initial data were obtained, OHM personnel reviewed the data and developed an approach for data gathering to take place during a second site visit.

At the second site visit, containment area dimensions were measured and noted, containment and drainage structures were inspected, and further confirmation regarding facility operating procedures was obtained. OHM then returned to the office to complete containment volume calculations. Based on the resultant volumes, review of written procedures and plant drawings, and visual observations during site walks, OHM personnel developed the SPCC plan draft which included a regulatory review, a summary of storm water and sewer outfalls, a review of containment structures and their adequacy/inadequacy, review of standard operating procedures, a review of overflow and spill detection equipment, and recommendations for equipment testing, standard operating procedures, and containment area improvements.

The SPCC plan was reviewed with the client to answer any questions they had and receive any input they felt was necessary for their facility's use of the plan. A final plan was then developed which included the following:

- o Introduction--Included site description, review of applicable regulations (federal, state, and local), plan purpose and scope, and facility spill history.
- o Storage Facilities--Included brief introduction, review of storage areas and materials, and review of facility equipment including corrosion protection, tank testing procedures, internal tank heating coils, level controls, tank foundations, drum storage, and grounding.
- o Transfer Facilities--Included a brief introduction of facility material transfer operations, traffic protection, early departure prevention, pipe support, pipeline corrosion protection, pipeline testing and inspections, out of service pipelines, and DOT and State of Maryland requirements.
- o Spill Prediction--Included brief introduction to spill prediction for each storage and transfer area of the plant as well as conclusions related to the adequacy or inadequacy of each area.
- o Spill Containment--Included a summary of spill containment systems, spill response kit contents and locations, containment materials, and containment structure integrity and inspections.
- o Drainage Control--Included brief introduction, general criteria, storm water collection and transfer, and summary of storm water treatment.
- o Security--Included summary of facility security including fencing; controls, valves, and connections; facility lighting; and actual security staff and equipment (e.g.; security cameras and restricted entry).
- o Administration--Included identification and responsibilities of the spill prevention coordinator, details of spill prevention briefings, standard operating procedures, inspection procedures, recordkeeping requirements, and post-spill submittal requirements.

- o Recommendations--Included recommendations for both procedural and design changes required to comply with SPCC regulations.

The final SPCC plan also included figures, tables and appendices as need to act as a complete reference for facility personnel. The final plan was reviewed, approved, signed and sealed by an OHM professional engineer registered in the State of Maryland.

PROJECT SUMMARY

PROJECT TITLE

Interim Response Action for the Pennsylvania Department of Environmental Resources (PADER)

LOCATION

Altoona, Pennsylvania

CLIENT

PADER

PERFORMANCE PERIOD

August 1989/February 1991

A site investigation was conducted by OHM at PADER's direction and under the Hazardous Sites Clean-up Act (HSCA) (Act 108 of October 18, 1988 by the Pennsylvania legislature). The site contained two disposal pits found in an area north of an operating treatment plant and south of sewage sludge disposal lagoons in different townships.

PADER's investigation determined that the waste pits contained approximately 5,900 cubic yards of contaminated materials, some at high levels of hazardous compounds. The contaminants included benzene, chlorinated benzene and ethanes, vinyl chloride, trichloroethylene (TCE), perchloroethylene (PCE), phenols, polychlorinated biphenyls (PCB's), and various metals. Examination of the site also revealed that contaminants had migrated to the groundwater system.

PADER, under the HSCA, contracted OHM to prepare a technical approach, which included preparation of plans for the excavation and on-site storage of contaminated materials from the waste pits, conduct the response action, and provide community relations support. The objectives of the interim response were:

- o Construction of the on-site storage cells.
- o Preparation of the work area for excavation activities, and verification of the safe handling of the contaminated materials in a manner that prevents the potential for spills to unaffected areas.
- o Provide for the treatment and disposal of contaminated waters and aqueous waste components generated during the pit excavations.
- o Surveying, grubbing, grading, and otherwise preparing the designated area for waste storage and processing.
- o Excavation of contaminated materials from the two waste disposal pits at the site using methods which effectively prevent or minimize the subsequent migration of contaminants to the underlying soils and bedrock.
- o Transporting and placement of excavated materials into an on-site storage facility that meets substantive federal and state requirements for hazardous waste storage.
- o Technical overview, construction quality assurance/quality control, and management of the interim remedial action activities at the site.

This project is 90% complete; at present, OHM is determining the volume of the remaining contaminated material for PADER so that they may evaluate optimum future disposal options.

PROJECT SUMMARY

<u>PROJECT TITLE</u>	Landfill Consolidation and Closure
<u>LOCATION</u>	Wellsville, New York
<u>CLIENT</u>	EBASCO
<u>PERFORMANCE PERIOD</u>	October 1990/December 1990 - Stage 1 August 1991 - Stage 2

OHM was subcontracted by EBASCO, the Construction Manager for ARCO, for landfill consolidation, closure and capping at the Sinclair Refinery Superfund site in Wellsville, New York.

This 12-acre site contained two adjoining landfills. Stage 1 of the project involved excavating over 14,000 cubic yards of landfill contents from one landfill and positioning the contents in the second landfill. A 40-mil HDPE liner was used to provide a temporary cap to the second landfill. In addition, test fill was positioned on top of the existing landfill along with drains, settlement plates and monitoring equipment. Stage 2 of the project was sole sourced to OHM and involved permanent closure and capping of the first, abandoned landfill. Over 12,000 cubic yards of 10⁻⁷ clay was used to cap the abandoned landfill as well as provide a 750-foot river channelization dike. OHM staff size totalled 12 persons during the project which involved interfacing with the construction manager, USEPA and USACE.

Additional services provided by OHM included erosion control which involved installation of geotech membrane, bedding stone and heavy riprap on the river side of the site.

PROJECT SUMMARY

PROJECT TITLE

Closure of a Land Disposal Facility

LOCATION

Lockport, Illinois

CLIENT

Oil Refiner

PERFORMANCE PERIOD

August 1986/February 1988

OHM was contracted to manage and implement the closure of a large land disposal facility in Lockport, Illinois. Construction of a landfill, grout curtain and cutoff wall were the key activities at this site. The project was conducted under a stringent QA/QC plan and was subject to verification of virtually all tasks prior to receiving final approval and project certification.

With the objective of rendering the landfill subsurface as impermeable as possible, OHM performed the following activities:

- o Site preparation
- o Subsurface containment
- o Construction of a lateral containment dike
- o Stratified-liquid removal
- o Waste containment
- o Site restoration

Site preparation included surveying the landfill, establishing the location for the grout curtain and installing pumps to maintain storm-water and ground-water control during construction activities.

During subsurface containment, OHM established a grouting program to seal fractures in bedrock including joints, bedding planes, faults and any other fracture that would provide a pathway for contamination movement in the subsurface. The grouting process consisted of pumping cement mixtures under pressure into the fractures.

Additionally, a clay cutoff wall was installed in a trench around the landfill. A grout seal was emplaced on the rock surface. Above the grout seal the clay was compacted to specified permeability and compaction criteria. The trench above the grouted cutoff wall was then filled with compacted clay to complete the subsurface containment system.

Following completion of the clay cutoff wall, a compacted-clay lateral containment dike was constructed around the landfill. The dike was keyed into the cutoff trench. After construction of this dike, trenches were advanced into areas of the landfill that contained liquids. These liquids, consisting of oil and water, were pumped to OHM's on-site hazardous-waste storage facilities.

Waste materials from various disposal areas at the site, once collected and documented, were taken to a designated, on-site storage and staging area prior to solidification with fly ash and/or lime-cement kiln dust. Field testing of stabilized wastes was conducted to ensure stringent quality control.

Wastes, including stabilized materials, were then spread on the surface of the landfill in lifts not exceeding 1 foot deep. These materials were compacted and the surface of the waste was crowned in accordance with the configuration specifications.

Prior to completing intermediate cover, solid waste residues were placed into the landfill. Small, isolated areas at various locations were used to temporarily store any liquids on a daily basis. These liquids were later disposed at an approved site or treated through OHM's on-site wastewater treatment system. Dry disposables were sealed in plastic bags for ultimate disposal within the landfill and/or at an off-site facility.

Surface containment consisted of a clay cap liner. The clay was placed in uniform loose lifts, not exceeding 9 inches thick, and compacted with equipment traveling over the entire surface.

Following clay cap placement, a geomembrane liner was installed by a subcontractor. The soil surface was first prepared with a roller to remove irregularities, loose earth and abrupt changes in grade. This soil surface was checked daily until liner installation to make certain its integrity was maintained.

Finally, a drainage layer was installed, followed by various site restoration activities. These included adding rip rap and a vegetative cover to facilitate landfill cover protection. Additionally, five gas-venting points were constructed on top of the landfill. As a final step, each waste-management area was decontaminated and backfilled with clean soils.

PROJECT SUMMARY

<u>PROJECT TITLE</u>	Syncon Resins Superfund Site Remediation
<u>LOCATION</u>	Kearny, New Jersey
<u>CLIENT</u>	New Jersey Department of Environmental Protection and Energy (NJDEPE)
<u>PERFORMANCE PERIOD</u>	January 1990/Ongoing

This project is a site remediation being performed at the NJDEPE Syncon Resins Superfund site in central New Jersey. The former manufacturing facility is an inactive paint, varnish, and resin manufacturing facility located in a highly industrialized area in central New Jersey. During 1984, approximately 12,800 drums containing various wastes were removed from the site by OHM followed by a Remedial Investigation/Feasibility Study (RI/FS) performed by an environmental consulting firm. As a result of the study, the subsequent State Record of Decision (ROD), and our proposal for remediation, the state awarded the project to OHM.

The pre-proposal planning involved design changes, subcontract negotiations and awards, and the preparation, submittal and revisions of the following plans including:

- o Environmental Protection Plan.
- o Health and Safety Plan.
- o Material Handling Plan.
- o MBE/WBE/SBE Utilization Plan.
- o Contractor Quality Control Plan.
- o Chemical Quality Management and Sampling Plan.
- o Soil Erosion and Sediment Control Plan.
- o Spill and Discharge Control Plan.
- o Contractor Work Plan.

The scope of services of this project includes site preparation; clearing, grubbing and debris removal; subsurface investigation; design and installation of a water treatment system; 2,000 cubic yards of hot-spot soil removal; cement bentonite barrier wall system; bio-polymer groundwater collection system; 2 million pounds of lagoon sediment removal; site grading; and building and tank decontamination.

Currently, OHM is decontaminating the 12 buildings and 150 tanks located on the property, as well as fabricating the components for the water treatment system. The contaminants are particularly thick and resinous which makes for difficult decontamination.

OHM has subcontracted the installation of the 1,200 linear feet of cement bentonite slurry wall and the 500 linear feet of groundwater collection trench. The installation of the groundwater collection trench was done using a biodegradable slurry to hold the walls of the trench open without the use of steel sheetpiling. Use of this biopolymer is necessary due to the poor soil conditions and the high water table. Subcontractors were also used to form and pour the concrete foundation and fabricate the erect metal building and components for the contaminated water treatment system.

PROJECT SUMMARY

PROJECT TITLE

Interim Closure of a Hazardous Waste Landfill

LOCATION

North Haven, Connecticut

CLIENT

The Upjohn Company

PERFORMANCE PERIOD

October 1989 to April 1990

Upjohn operated a 40-foot high, bermed, RCRA permitted hazardous-waste pile containing approximately 83,000 cubic yards of soft organic sludge. The waste pile was required to be closed due to RCRA requirements. This project encompassed the interim closure effort and included a geosynthetic cap, storm water management facilities, gabion basket perimeter wall, and mechanical and electrical support for groundwater pumping system.

OHM provided significant field engineering to redesign portions of the project. This included 600 linear feet of rock-filled gabion wall constructed on a geogrid reinforced mat foundation on very soft soils. A 1,600-foot long force main was redesigned to be high density polyethylene piping, providing considerable savings verses the originally specified, specially coated, socket-welded steel pipe. Two pump stations were designed and constructed to handle 300 gpm of storm water flow. OHM also provided all electrical and instrumentation requirements. This included a programmable logic controller (PLC) to monitor tidal influences and operate the groundwater pumping system monitoring controls during specific tidal conditions.

PROJECT SUMMARY

PROJECT TITLE

Municipal and Hazardous Landfill Closure and Capping

LOCATION

Byron, Georgia

CLIENT

USEPA with USACE Oversight

PERFORMANCE PERIOD

September 1991/Ongoing

This Superfund project involves closure and capping of the Powersville municipal landfill and adjoining hazardous materials landfill which together cover approximately 12 acres. The municipal landfill contents are comprised of residential/commercial trash and debris while the hazardous landfill contains an unknown quantity of pesticides.

A borrow area was established on property adjoining the landfill site. Over 200,000 cubic yards of fill were excavated from the borrow area for use on both landfills.

Both landfills required survey verification, soil sampling, air monitoring and construction/installation of pre-cast channels, sediment basins, polyethylene drain lines, two drainage layers, gas vent lines, 40 mil HDPE liners, 10 oz. geotextile fabric and a top layer of 20 inches of surface soil done in two, 10-inch lifts. The hazardous landfill has required an additional layer of bentonite claymax incorporated within the cap structure. Perimeter fencing was required to provide limited, controlled access to the site.

Final grading involves contour regrading and construction of terraces to prevent erosion of the cap. The project has involved a staff of nineteen OHM employees working in Levels C and D and interfacing with the USEPA, USACE, and Georgia EPD.

PROJECT SUMMARY

<u>PROJECT TITLE</u>	RCRA Facility Closure
<u>LOCATION</u>	Bay City, Texas
<u>CLIENT</u>	Hoechst Celanese Chemical Group
<u>PERFORMANCE PERIOD</u>	1989

OHM was contracted to perform the RCRA closure of a hazardous-waste facility at the Bay City, Texas, plant.

The project consisted of the following activities:

- o Dewatering of Retention Pond (unspecified volume of water)
- o Fixation/stabilization of approximately 4,500 cubic yards of Retention Pond sludges using fly ash "C"; transport to and placement in the on-site RCRA facility
- o Excavation of approximately 11,250 cubic yards of contaminated soil from the Retention Pond; transported and placed in the RCRA facility
- o Solidification of approximately 25,000 cubic yards of sludge in the Emergency Basin (RCRA facility) using fly ash "C"
- o Excavation of Emergency Pond levee (approximately 17,800 cubic yards); used as construction fill to grade for installation of the low permeability clay cap
- o Construction of a low permeability (1×10^{-7}) landfill cap consisting of approximately 47,500 cubic yards of on-site borrow clay, 6,000 cubic yards of imported sandy loam, and 6,000 cubic yards of on-site borrow topsoil cover
- o Backfilling, from on-site borrow, of the Retention Pond and various ditches to precontaminated soil excavation grade (approximately 18,000 cubic yards of clay)
- o In-place decontamination of approximately 33,000 square feet of surface area present in the Dirty Water Skimmer; tank farm (concrete lined) ditches and concrete culverts

OHM met the challenges of weather-related difficulties, changing sludge conditions, and owner changes to the scope of the project to complete construction of the closure within the contract milestone schedules and budgets.

PROJECT SUMMARY

PROJECT TITLE Landfill Cleanup and Closure

LOCATION Davie, Florida

CLIENT Broward County, Florida

PERFORMANCE PERIOD 1989

This site was previously an incineration facility and was then opened as a sanitary landfill in 1975. The county terminated all disposal in November 1981. In 1982, it was included on the National Priorities List for cleanup under CERCLA due to concern over groundwater contamination.

This project involved stabilization of approximately 82,000 cubic yards of sludge material with Portland cement, with subsequent placement in an existing landfill cell on site. In addition to the sludge, 58,000 cubic yards of other unsuitable material (trash, debris, soils, etc.) was placed in the cell. The cell was then capped to engineered specifications with 2 feet (approximately 30,000 cubic yards) of limerock.

Following the removal of sludge and unsuitable material, approximately 28,000 cubic yards of naturally existing foundation limestone was excavated in an effort to construct a 7-foot-deep nature pond. This excavation was completed primarily below the groundwater table. The excavated limestone was placed in the landfill cell along with the sludge.

The entire site of approximately 12 acres was restored with plans to establish the area as a park. The restoration effort was completed to engineered design using approximately 50,000 cubic yards of fill material in building a new road and gentle slopes around the pond. Subsequent to this construction, approximately 16,000 cubic yards of topsoil were placed over the site, which was then sodded and seeded to specification. After final survey of the site was performed, all work was completed to engineering specifications. OHM also served as a liaison with city, county, and federal agencies.

PROJECT SUMMARY

PROJECT TITLE

Slurry Wall and Cap Construction

LOCATION

Everett, Massachusetts

CLIENT

Confidential Industrial Chemical Manufacturer

PERFORMANCE PERIOD

January 1987 to December 1989

On June 13, 1986, the client proposed to the Massachusetts Department of Environmental Quality Engineering (DEQE) to contain PCB's in the Therminol heater area by in situ methods. The client contracted OHM to assess the feasibility of this method. OHM compared the suggested approach and available site data with other remedial options and judged the slurry wall and cap concept viable if additional design data were obtained. After obtaining said additional data during August 1986, OHM prepared the containment design and submitted it in a "Draft Special Conditions and Technical Specifications Report" dated October 3, 1986. OHM and the client reviewed the design process and concepts with the DEQE on October 14, 1986.

The slurry wall project, scheduled to be constructed immediately after the lagoon closure project was completed, was initially delayed due to two primary reasons:

- o Conflict with other client subcontractors who were demolishing another building, and thus working in our area.
- o Waiting for the DEQE approval of the project.

In March 1987, conditional DEQE approval for the slurry wall installation was received pending submittals of several more reports by OHM:

- o "Special Conditions and Technical Specifications for Slurry Wall and Cap."
- o "Quality Assurance/Quality Control Manual for Slurry Wall and Cap Construction."

Both of these reports were submitted on March 30, 1987. Due to additional state requirements, discussions with the client regarding project kick-off were not held until mid-May. Final state approval was received in late May, 1987 and required the following:

- o Six monitoring wells.
- o Attempted peat separation.
- o Special clay material for mixing the trench backfill.
- o Contaminated soil removal.

A tentative mobilization date of June 16, 1987 was established, but was delayed because the client's union contract negotiations were not finalized. Due to a breakdown in negotiations, the union went on strike. The project's start date was finally established for mid-August, 1987 when, at the client's request, OHM and our subcontractors agreed to cross the picket lines.

The original scope of work included the following activities:

- o Construction of a soil-bentonite slurry wall.
- o Construction of a multi-layer cap over the area contained within the slurry wall.
- o Preparation of as-built drawings, and a final report on the slurry wall and cap construction.

In June, 1987, additional items were added to the original scope, resulting from negotiations with the DEQE. These items included:

- o Installation of four additional wells on a time-and-materials (T&M) basis for a total of six wells.
- o Removal of visibly affected soils above the 5,000 parts per million (ppm) contour by OHM, and drumming on a T&M basis. The client visually decided what other materials were removed.
- o Removing concrete foundations that supported the furnace, tank, and pipe bridge on a T&M basis. OHM provided dumpsters for storage of the concrete prior to disposal. A sealed dumpster was provided as part of the original contract for storage of any peat separated from the trench spoils.
- o Removing underground obstructions on a T&M basis.
- o Removing any utilities or pipes crossing the trench on a T&M basis.
- o Adding additional charges for the finer backfill soils requested by the DEQE for mixing the slurry wall.
- o Removing any floating oils present on groundwater in the slurry trench with absorbent pads.
- o Removing the foundation without draining the slurry trench or creating PCB contaminated water.

The following subcontracted services were used by OHM during the project:

- o Demeter subcontractor.
- o Pad and retaining wall construction; supplier of all backfill and imported soil and gravel.
- o Slurry wall consultant.
- o Driller.
- o Liner installer and supplier.
- o Slurry permeability testing.
- o Soil analysis.

OHM investigated the facility and used site data from other consultant firms to develop the design of the soil-bentonite slurry cut-off wall. The containment method was based upon the following information:

- o PCB's were present in the soil in the Therminol heater area due to the loss of PCB-based oil from the Therminol heater system.
- o PCB oil in the soil was stationary or moving at an insignificant rate.
- o Phthalate plasticizer compounds in the soil were stationary or moving at an insignificant rate.
- o PCB's dissolve in groundwater only to very low concentrations.
- o Groundwater was not transporting detectable quantities of PCB's out of the Therminol heater area.

- o Groundwater, PCB-contaminated plasticizer, and PCB-based oils were less likely to leave the area if a low-permeability wall with an inward gradient is constructed around the site.

Slurry Wall and Cap Installation: OHM installed the slurry wall and cap at the facility between August 12, 1987, and September 30, 1987. The following seven major phases were performed for the project:

- o Excavation of contaminated soils and debris.
- o Installation of the slurry trench.
- o Installation of monitoring wells.
- o Trench spoils.
- o Construction of the retaining wall and concrete cap.
- o Placement of the geotextile and geomembrane.
- o Construction of the final cover cap.

PROJECT SUMMARY

PROJECT TITLE

Arsenic Contaminated Soil Excavation and Packaging for Shipment in Gondola Cars from Factory Lane site in Middlesex, New Jersey

LOCATION

Middlesex, New Jersey

CLIENT

Rhone-Poulenc/Woodward Clyde

PERFORMANCE PERIOD

January 1990

Beginning in January, 1990, OHM was contracted to excavate, loadout and dispose of approximately 500 cubic yards of arsenic contaminated soil from Rhone-Poulenc's Factory Lane site in Middlesex, New Jersey. Due to the nature of the contaminate, OHM researched gondola packaging systems extensively to eliminate the possibility of leakage of the waste during shipment to the disposal facility. Ultimately, a Trak Pak system was chosen and modified by OHM to provide extra protection and eliminate liabilities of Rhone-Poulenc. OHM coordinated gondola inspection with Conrail and chose the cars to be used.

Steps in the gondola preparation and load packaging are summarized below:

- o Clean gondolas
- o Install layer of padding on bottom of gondola
- o Place inner liner and loadout soil while adding layers of Portland cement for moisture
- o Fold liner over pile and seal seam with spray adhesive
- o Install and secure bows and cover tarp where heat shrink ends
- o As an extra measure, install and secure a final cover tarp

All gondola cars were inspected and approved by Conrail before shipment.

OHM received positive feedback from both Conrail and the disposal facility for the manner in which the gondolas were packed.

PROJECT SUMMARY

PROJECT TITLE

Tank Removal

LOCATION

Bridgeport, Connecticut

CLIENT

Wire and Cable Manufacturer

PERFORMANCE PERIOD

1989/Ongoing

OHM was called in to remove ten underground storage tanks (each with a 10-20,000-gallon capacity, 10 feet in diameter, 35 feet in length) containing diisodecyl phthalate, cooling water, and No. 6 fuel oil. A building was constructed during the 1940s over these tanks which made it necessary to first structurally support the building prior to tank removal. This was accomplished by using cribbing and I-beams.

Once the tanks were uncovered, it was discovered that they were encased in concrete. Utilizing a pneumatic hammer, the concrete was broken and the tanks were accessed. Because of their size, the tanks were disassembled, removed in manageable-sized pieces, and decontaminated using a high-pressure washwater technique.

Sheeting and shoring were used to allow contaminated soil excavation to bedrock within the building. The maximum depth of excavation was approximately 21 feet. During excavation, an intercepting trench was installed within each area of excavation for future use by the client. After returning the area to its original grade, new footings were installed, including new columns, and temporary structural supports were removed.

During one of three excavations, an occurrence of high groundwater table and high soil hydraulic conductivity made it necessary for OHM to construct an aquifer dewatering and water treatment system consisting of three double carbon cells with Cleansorb and carbon media. An aquifer dewatering system was installed to lower the groundwater table in order to allow excavation of the tanks. The wastewater was pumped one-quarter of a mile within the building to the treatment plant for treatment and was discharged into the city sewer system. OHM treated and discharged more than 18 million gallons of wastewater in less than 10 weeks.

During the course of the tank removal/wastewater treatment project, it was discovered that a mercury spill had occurred on the roof of one of the client's small add-on buildings. Because of OHM's proven performance on the original project, the client requested that we also clean up this spill.

OHM's first assignment was to assess the situation and set up a sampling grid on site to determine the extent of contamination involved. A cleanup plan was developed and implemented. OHM recommended demolition of the small structure, which entailed removal of the roof, two large air conditioning units, and the brick structure itself. All drainage lines were cleaned and decontaminated, and the treated wastewater was discharged to a nearby pond. All debris was decontaminated and disposed.

Two of the drainage lines could not be high-pressure washed; therefore, removal was necessary. Because of the age and damage of two of the pipes, removal was required. OHM installed 350 feet of 10-inch PVC drainage line and four pre-cast concrete manholes. The area was then backfilled, fine-graded, and asphalt-paved.

PROJECT SUMMARY

PROJECT TITLE

Building decontamination and demolition; shallow and deep excavation of PCB-contaminated soil and the transportation and disposal of same; water treatment; and backfill of excavated areas.

LOCATION

Jamesburg, New Jersey

CLIENT

Steel Manufacturer

PERFORMANCE PERIOD

July 1990/February 1991

A 14-acre PCB-contaminated site, with various locations and levels of PCB contamination, required remediation in two areas. They included a bituminous coating building and a seven-acre storage yard. The EPA level of protection for this project is C and D.

The bituminous coating building was decontaminated using an 8,000-psi pressure washer; the building was demolished, and the contaminated washwater was treated and discharged on site.

The storage yard area involved shallow soil excavation and stockpile (approximately 300 cubic yards per day, with an excavation tolerance of 0.01 feet+). The soil was stockpiled as TSCA and non-TSCA material. Because of the tolerance of excavation during this task, a high level of control in the layout and execution of the work was required. Soil samples were taken, and upon the results, this area was backfilled and restored to its original grade.

Deep excavation was required, entailing a mass excavation to -35 feet, and an excavation within a cofferdam to -58 feet. It was necessary to lower the water table to -60 feet during the cofferdam excavation. This water was then treated and discharged on site.

Upon completion of excavation to -58 feet, this area was backfilled to original grade with clean, imported fill.

All excavated material was sampled and classified as either TSCA or non-TSCA; it was then transported to an off-site disposal facility.

Subcontractors performed demolition, transportation and disposal. Ten thousand tons of TSCA material were transported by rail to Utah, and 10,000 tons of non-TSCA material were transported over the road to a Pennsylvania landfill. A mass excavation was performed from the original grade to -35', and an excavation from -35' to -58' within the cofferdam. A steel-frame, steel-siding building, 30' wide x 100' long x 40' high was demolished.

This project was performed in compliance with all applicable regulations of the USEPA and NJDEPE, and in addition, required permits for soil erosion control, water discharge, soil disposal, and water treatment.

Project Summary

Project Title: Muratti Drum Dump Superfund Site; Penuelas, PR

Contract No.: 68-01-7445

Client: USEPA Region II

Total Funding: \$438,000

Level of Subcontracting: 53 %

Period of Performance: October 1990 - Spring 1991

Protection Level: B

Client Reference: Angel Rodrigues (201) 321-6664

Abstract/Responsibilities: OHM performed a drum project involving the overpacking and disposing of drums containing oils and associated organics. Working on one of the Caribbean islands required careful preplanning and organization prior to mobilization. OHM crews were faced with excessive heat and humidity, a foreign culture with associated language barriers, and the unavailability of vendors or subcontractors for sourcing materials and equipment.

Health and safety of all crew members was a critical factor in the operations. Careful monitoring of personnel for heat-induced illness and stress, in addition to the monitoring of water intake, posed a special challenge for the response manager and crew. The subcontractor provided assistance in meeting this challenge as well as providing assistance to expedite the procurement of materials on the island. Relatively little environmental cleanup had proceeded on the island, creating a dearth of qualified subcontractors and little availability of specialized materials. Coordination with Caribe Hydroblasting Environmental Division by program management made for a successful effort in meeting the challenges faced in this project.

Initial site preparation required clearing and grubbing of the site, dozing of the major staging areas, and repair of the fence around the site. The thick undergrowth proved resistant to normal grubbing techniques, and constant attention was paid throughout the project to keep growth in check. The assistance of local subcontracted personnel and equipment minimized the effect of the high temperatures and humidity, particularly the impact in working in Level B protection.

The environmental task was to search the site for all drums, sample jars, and tanks, both empty and containing product, to be overpacked and staged for future disposal. One hundred sixty-two overpack drums were staged on site and sampled for disposal analysis. A magnetometer sweep was performed to determine if the site contained any buried drums, tanks, or metal. No buried product was found, and the drums were secured from the elements until disposal.

Benefit to the Government: Subcontractors with local workers were used extensively on this job, assisting with the language barrier. Extreme heat and humidity required careful monitoring of workers.

PROJECT SUMMARY

<u>PROJECT TITLE</u>	Jersey City Tire Fire, New Jersey Dump No. 5 Site
<u>LOCATION</u>	Jersey City, New Jersey
<u>CLIENT</u>	USEPA Region II
<u>PERFORMANCE PERIOD</u>	April 1991/Present
<u>PROJECT AMOUNT</u>	\$850,000.00

OHM responded to a fire that started at the New Jersey Turnpike Dump No. 5 site on Wednesday, April 10, 1991. The site, located in Jersey City, Hudson County, New Jersey in the vicinity of Exit 14C of the Turnpike, extends approximately 15.8 acres and is comprised of three lots owned by the city of Jersey City. The fire consumed partially buried drums, tires, and other solid waste/debris. After initial site investigations and air monitoring by USEPA and TAT, as well as conversations with state and local officials from the fire and health departments, it was determined that an emergency removal action was warranted.

Initial/emergency response activities at the site took place from April 10, 1991 through April 23, 1991. ERCS mobilized the required personnel and equipment to the site; performed initial site entry and site assessment; constructed a fire break; performed site set up activities (e.g. light plant, generator, security and office trailers, decontamination trailer, drum staging, site access road, and hazardous waste and trash area); initiated drum retrieval, marking, and staging; conducted sampling and performed excavation/site clearance for the contamination reduction zone (CRZ) and decontamination lines.

Following initial/emergency response activities, a fence was constructed for security purposes. Fence construction began on April 24, 1991 and was completed June 6, 1991 except for some minor adjustments. Fencing consists of approximately 2,750 linear feet of 9 gauge, 6-foot high fence. There are four, 12-foot drive through gates and two 4-foot walk through gates. OHM remains on site involved in clean up activities.

PROJECT SUMMARY

PROJECT TITLE

Underground Storage Tank Removal

LOCATION

Jamesburg, New Jersey

CLIENT

BASF Corporation

PERFORMANCE PERIOD

December 1990/March 1991

OHM removed two 28,000-gallon underground storage tanks (USTs) as per BASF's internal UST abatement policy, and performed the associated NJDEP sampling, analytical, and reporting. The tanks were removed during ongoing plant operations in very limited work and staging areas. Steel sheeting had to be installed adjacent to an aboveground nitrogen tank that was within 5 feet of the foundation of the USTs. The sheeting was left in place at the completion of the project. A temporary support was erected for the existing overhead pipe rack. The tank area was excavated inside the sheeting, and the dirt loaded out to the staging area via articulated, off road dump trucks. The tanks were removed with a crane and moved to the staging area where they were cleaned. The tank ends were removed with pneumatic "travel cutters" as a safety precaution. The interior was inspected and the tanks were cut with hydraulic shears into pieces suitable for disposal. The excavation and the excavated material were sampled to verify compliance with NJDEP regulations; OHM backfilled the excavation with suitable excavated material, supplemented with off site clean fill.

While on-site, all personnel strictly adhered to OHM/BASF site-specific health and safety procedures.

PROJECT SUMMARY

PROJECT TITLE

Underground Storage Tank Removal

LOCATION

Philadelphia, Pennsylvania

CLIENT

Valspar Corporation

PERFORMANCE PERIOD

December 1990/December 1991

OHM removed 15 underground storage tanks (USTs) as part of the owner's internal UST abatement policy. OHM performed the associated sampling, analytical, and reporting. Safety is a major priority at OHM. Specialized procedures and equipment such as our hydraulic shears were used to minimize worker exposure to and client liability for environmental hazards. The tanks were removed and cleaned without requiring personnel entry. Another priority was meeting the city of Philadelphia's deadline for the immediate removal of the one tank which had failed the tightness test. Within 5 days of award, OHM was able to secure the necessary permits and mobilize sufficient personnel and equipment to meet the client's and the city's requirement for decommissioning the first tank.

A second mobilization was required to remove the remaining 14 tanks. The job took place during ongoing plant operations. OHM had to coordinate its operation with the plant, and took part in the plant safety program including alarm testing and evacuation procedures.

OHM adopted a "phased" approach with overlapping task assignments to expedite, protect, and minimize personnel/equipment time required for completion. One crew was used for cleaning, one for collecting rinsate, another for excavating, and another for demolishing steel. Preconstruction sampling was done to expedite the transportation and disposal. The tanks were cleaned in place with a specially designed hydro blasting spray head using a 8000-psi water laser and detergent to rinse the tanks. Preapproval allowed a vac truck to collect solids (resin sludge) and perform transportation and disposal in the same day which eliminated on-site storage. Sampling and reporting were performed for the Pennsylvania Department of Environmental Resources.

APPENDIX B
OHM FIELD SAMPLING MANUAL

FIELD SAMPLING MANUAL

Prepared by:

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March, 1989

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FIELD SAMPLING MANUAL

1.0 INTRODUCTION

Many jobs performed by O.H. Materials Corp. (OHM) result in some sort of litigation. It is important therefore, that all phases of OHM jobs be properly performed and carefully documented.

In the chain of events that generally unfolds during the course of OHM jobs (job planning, preparation, sampling, analysis, cleanup, and disposal), sampling must be given careful attention from the proposal stage to performance.

1.1 SAMPLING SITUATIONS

There are nine distinct contexts in which OHM conducts sampling operations. These are described below.

1.1.1 Hazardous-Waste-Site Investigations

Hazardous-waste-site investigations are often performed at abandoned waste sites or abandoned manufacturing facilities, such as abandoned metal plating works, drums left out in a field, or oil- and solvent-reclamation facilities. Sampling is undertaken to gather data for litigation, risk assessment (e.g., migration of contaminants off site), and/or preparation of plans for cleanup or requests for proposals for cleanup.

The client is typically the United States Environmental Protection Agency (USEPA), a state or municipal environmental agency, or a private client working to meet the requirements of a consent order from a governmental agency.

The goal of the cleanup may be simply to mitigate a present danger to public health and safety or to restore a site to suitable condition for some future use.

1.1.2 Spill Investigation

A spill investigation is similar to a hazardous-waste-site investigation but is typically performed in haste and with an eye toward directing the cleanup operation, which will be in progress. Success in this type of sampling requires experience, knowledge of the environmental impact of the pollutant, and the ability to make quick and accurate decisions.

1.1.3 Cleanup in Progress

Pre-decontamination, progress, and post-decontamination sampling is performed in connection with various cleanups (e.g., soil excavation or building decontamination) to direct the resources of the cleanup effort.

1.1.4 Disposal

Most jobs involve disposal. Wastestreams generally must be sampled for disposal. The disposal option under consideration for a given wastestream determines the testing required. Careful representative sampling is important, since the testing results may affect disposal costs. In addition, if poor sampling results in hazardous materials being treated as nonhazardous, OHM's and the client's liabilities are increased.

1.1.5 Litigation

Any sampling and analytical effort can become involved in litigation; however, occasionally, sampling is commissioned to support a lawsuit or a legal defense.

Sample results are often used in Emergency Response Cleanup Services (ERCS) jobs to support negotiations with the waste generators or litigation against them to recover the cost of a cleanup.

1.1.6 Occupational Safety and Health Act (OSHA) Compliance

Sampling and air monitoring at OHM job sites is often performed to verify that personnel are adequately protected. It is necessary to show that in the support or "clean" zone there is no exposure exceeding OSHA limits.

1.1.7 NPDES Compliance

Industries and municipalities which discharge treated or untreated wastewater into public waterways are regulated under a permit system known as the National Pollutant Discharge Elimination System (NPDES). These permits limit the concentrations and total quantities of various pollutants that the permit holder is allowed to discharge.

Periodic sampling and analysis of the water discharge stream is required for the preparation of compliance reports. The particular sampling and reporting schedule is determined by the responsible state agency (e.g., the Ohio EPA).

Corporations often hire outside firms to perform the sampling and analysis. Expertise is required, since poor sampling could cause the permittee to appear to be out of compliance (and thus subject to fines) when, in fact, the permittee is not. NPDES is a federally mandated program administered by the states.

1.1.8 Engineering and Biodegradation Feasibility

Samples are generally required for engineering and biodegradation studies which will provide guidance for remedial-action plans. Examples of engineering studies in this context are carbon-absorption isotherms, wastewater-treatability studies, flocculation studies, and sludge-dewatering studies. Examples of biodegradation studies are plate counts and electrolytic-respirometer studies.

1.1.9 Treatment-System Monitoring

All treatment systems require monitoring to be kept under control. Part of the required monitoring is sampling and analysis for parameters which are indicators of system performance, such as pH, free chlorine, or polychlorinated biphenyls (PCBs). Sampling the effluent of a wastewater system is a minimum requirement to ensure that the water discharged is of acceptable quality.

1.2 GOALS OF SAMPLING

Sampling may be viewed in terms of what it is designed to show about the chemical parameter of interest. From this perspective, four distinct goals may be defined:

- o Sampling to discover whether an area is contaminated, in terms of finding localized "hot spots". This type of sampling is exploratory, and if the contaminant is found at levels that exceed the regulatory threshold (RT), further sampling is required.
- o Sampling to determine a value or confidence interval (CI) for the mean value of some parameter, or to determine whether the upper limit of this CI is less than some RT. An example would be determining that the mean PCB concentration in a solids pile is less than 50 parts per million (ppm) and finding a CI for its fuel value (Btu/lb).

- o Sampling to define levels of contamination. This is the most involved type of sampling. It varies in its complexity from determining rough "hot/clean" boundaries to producing detailed concentration contour maps for the contaminant(s) of interest.
- o Demonstrating an area to be "clean". This type of sampling is usually performed after a cleanup and generally involves demonstrating either that the mean value of some chemical parameter is below the RT or that in no part of the sample medium will a sample be found in which the parameter of interest is greater than or equal to the RT.

Each of these goals requires a different approach in terms of the number of samples required, the care that must be taken, the statistical treatment of the data produced, and the data's presentation and interpretation.

1.3 OBJECTIVE AND PURPOSE OF SAMPLING

The basic objective of any sampling campaign is to collect samples which are representative of the media under investigation. More specifically, the purpose of sampling at hazardous-waste sites is to acquire information that will aid investigators in determining the presence and identity of contaminants on site and the extent to which these compounds have become integrated into the surrounding environment. This information can then be used as support for risk assessments, cleanup progress, or cleanup verification.

The term "sample" may be defined as: a representative part of the medium under investigation. Representativeness, however, is a relative term and must be considered along with other criteria prior to sample acquisition. Following is a list of those criteria:

- o Representativeness - The sample should possess the same qualities or properties (which are relevant to the investigation) as the material under consideration.
- o Sample Size - This should be chosen carefully in respect to physical properties of the media and the requirements and limitations of the sampling techniques. In all cases, however, a sample larger than needed to perform all required analyses must be taken.

- o Number of Samples - Decisions on the number of samples required are based on the type and quality of statistical information desired and the nature of the material collected.
- o Maintenance of Sample Integrity - The sample must retain the properties of the original medium (at the time of sampling) through collection, transportation, and delivery to the analyst.

1.3.1 Cross Contamination

Cross contamination is the introduction of contaminants into the sample through the sampling and/or sample-handling procedures. It can cause an otherwise representative sample to become nonrepresentative. What constitutes cross contamination is dependent on the analysis and the detection limit. Handling procedures that would cross contaminate a water sample being taken for PCB analysis might be acceptable for a drum sample taken for compatibility analysis. The most important means of minimizing cross contamination are as follows:

- o Changing Sampling Expendables - Sample gloves, pipettes, sample string, dip jars, etc., must not be reused. Dip jars and pipettes should be disposed in a drum designated for contaminated glass. Other expendables may be bagged. They should be labeled so they are not confused with noncontaminated trash.
- o Decontamination of Sampling Tools - Any tools used in sampling must be carefully decontaminated prior to first use and after each sample is taken using a decontamination method that is appropriate to the contaminant, the sample matrix, and the material with which the sampling tool is constructed. Some of the tools used in sampling are: shovels, picks, triers, trowels, split spoons, pyrex dishes, screwdrivers, bacon bombs, Coliwasas, bailers, and Isco pumps. Recommended decontamination procedures are listed in Section 2.7.
- o Minimizing Contact with Sample Medium - Workers' protective clothing may very easily be a source of cross contamination. On reflection, a sampler would not walk across a contaminated area and then take a surface soil sample where he has just stepped.

But when a sampler is under pressure to produce, it is easy not to reflect. This error of spreading contamination to the sample area is one that is only diminished by vigilance. Since the sampler cannot know what others have done, exactly where the contamination is, or perhaps, even remember where he has walked, it cannot be avoided entirely.

1.4 TYPES OF SAMPLES

Before defining the general sample types, the nature of media must be discussed. Materials can be divided into three basic groups: homogeneous, discrete heterogeneous, and continuous heterogeneous. Examples of homogeneous materials are well-mixed liquids and gases, as well as pure metals. Examples of heterogeneous materials with discrete changes throughout the material are pellets, tablets, crystallized rocks, suspensions, or layered liquids. Examples of continuous quality change throughout a heterogeneous material are fluids or soils with gradients.

Of least concern to the sampler are homogeneous materials, since these are defined as having uniform composition throughout. In this case, any sample increment can be considered representative of the entire material. Heterogeneous matrices, on the other hand, present problems to the sampler because of changes in the quality of material over distance or time.

In general, two basic types of sampling techniques are recognized, both of which can be used for either environmental samples (ambient air, soils, streams, etc.) or concentrated waste samples (drums, tanks, pits, lagoons, waste piles, fresh spills, etc.).

1.4.1 Grab Samples

A grab sample is defined as a single sample representative of a specific location at a given point in time. The sample is collected all at once from one particular point in the sample medium. The representativeness of such samples is defined by the nature of the materials being sampled.

1.4.2 Composite Samples

Composite samples are combinations of more than one sample collected at various sampling locations and/or different points in time.

Analysis of composite samples yields an average value and can, in certain instances, be used as an alternative to analyzing a number of individual grab samples and calculating an average value. It should be noted, however, that compositing can mask problems in two ways. It can dilute isolated concentrations of some hazardous compounds below detection limits, or can mask the variability in the material, making inferences drawn from the data seem more reliable than they are. Composites are put together according to various rules or bases of composition:

- o Time-Based Composites - Time-based composites are typically taken from an influent or effluent flow of some continuous process to obtain a representative sample of that flow over a specified time period. Some of the assumptions underlying the validity of this method are as follows:
 - The flow rate is fairly constant over the time period covered by the composite.
 - The parameter(s) being measured do not change in the sample during the time between collection of the first aliquot and analysis (i.e., preservatives have been used, if necessary).
 - The aliquots are of equal size.
 - With respect to time, the aliquots are distributed either randomly or evenly. (Of course, it is easier to spread the sampling times out evenly.) The application of time-based compositing to wastewater treatment is obvious. When composite sampling is used in wastewater treatment, time-based compositing is the simplest and most commonly used method. Air sampling with a pump and a collection medium is an example of a time-based composite which does not necessarily sample from some flow. The sampler operates under a completely different set of assumptions in that case.
- o Flow-Based Composites - Flow-based composites involve taking sample aliquots based on flow of sample medium. There are several variations on this which might be used, such as taking an aliquot of specified size every time a certain volume has passed the sampling point (e.g., 100 ml per 1,000 gal.) or sampling at specific time intervals and using an amount of each aliquot proportional to flow for that period.

The flow for a sampling period may be approximated by using either the flow rate at the time the aliquot was taken or the volume of flow between the time an aliquot was taken and the time the previous one was taken.

- Some of the assumptions underlying the validity of this sampling method are as follows:
 1. The flow can be measured accurately.
 2. The parameter(s) being measured do not change in the sample during the time between collection of the first aliquot and analysis.
 3. If flow is episodic, the parameter(s) being sampled for are not functions of the elapsed time into the flow episode.
- The application of this sampling technique to water treatment and sludge processing is obvious. A less obvious application is to the movement of earth from an excavation to a pile. Sampling the material in each bucket eliminates the need for pile sampling, which can be very difficult where there are many rocks, pieces of metal on wood, or bricks in the pile.
- o Area-Based Composites - An area-based composite is collected to obtain a representative sample of some parameter(s) when it is believed that a useful representation can be obtained by sampling near the surface of the sample medium.
 - The validity of an area-based composite results in part on the following assumptions:
 1. The sampling points are chosen randomly.
 2. The pattern or rationale used to select sampling points has no relationship to the distribution of the values of the parameter(s) of interest, unless stratified random sampling is used.

- There are obvious applications to surface soils and to standing water. A less obvious application is to wipe sampling when it is desired to demonstrate that a surface is "clean" (i.e., the parameter of interest does not exceed a certain value within that area).
- o Depth-Based Composites - A depth-based composite involves taking a non-horizontal column (a core of aliquots at various depths) between two specified depths. Depth-based composites are used either To obtain a depth profile of some material in bulk to check for layering; or to obtain a volume-based composite of bulk material.
 - The user of this method assumes:
 1. If a column of material is taken, it includes all depths of interest.
 2. If there is layering, representative amounts of each layer move into the sampler (or it is possible at least to measure the layering in some other way).
 3. The various layers will not react with each other in such a way as to affect the measurement of the parameter(s) of interest.
 4. If the entire column or core of material taken is not used, the final sample is taken from it representatively.
 - Volume-based composites are often applied when sampling soil, solids piles, lagoons, ponds, and tanks, (i.e., bulk solids, liquids, and sludges).
 - There are obvious applications to soil sampling and to any situation in which a layered liquid might be sampled.

1.5 CRITERIA FOR SELECTING A SAMPLING METHOD

- o Practicality - Selected methods must be simple, proven procedures that are capable of being adapted easily to a variety of situations.

- o Representativeness - The essence of any sampling campaign is to collect samples that are representative of the material or medium under consideration and of the situation under investigation.
- o Economics - The costs of equipment, manpower, and maintenance need to be considered in relationship to their overall benefit. Instrument durability, cost of decontamination, and degree of precision required can all have economic impact which must be considered.
- o Simplicity/Ease of Operation - Sampling equipment should be simple to operate, and procedures selected should be easy to follow. Equipment should be portable, lightweight, and direct-reading if possible. Most OHM field equipment meets these criteria.
- o Compatibility with Analytical Consideration - The uncertainty of sample integrity as it relates to the analytical techniques should be reduced as much as possible. Errors induced by poor sampling techniques can be the weakest link in the quality of generated data. Special consideration must therefore be given to the selection of sampling methods in relationship to any adverse effects that might surface during analysis.
- o Safety - The risk to sampling personnel must be evaluated to determine the safety equipment required and to select the proper sampling procedure.

1.6 SOURCES OF SAMPLING METHODS

Numerous published sampling methods covering chemical parameters in most matrices are available; many of these are readily available at OHM. The sources of these methods include the following:

1. Test Methods for Evaluating Solid Waste (EPA SW-846, July 1982) and 1984 updates.
2. Methods for Chemical Analysis of Water and Waste (EPA 600/4-79-020, March 1983); contains information on containers and preservation.

3. Characterization of Hazardous Waste Sites: A Methods Manual - Volume II, Available Sampling Methods, Second Edition (EPA 600/4-841-076, December 1984).
4. The ASTM books of standards, particularly Volumes 05.01-05.05 on "Petroleum Products, Lubricants and Fossil Fuels," Volumes 11.00-11.04 on "Water and Environmental Technology," Volume 14.02 (contains a section on statistical methods), and Volume 15.05 "Engine Coolants; Halogenated Organic Solvents; Industrial Chemicals".
5. RCRA Groundwater Monitoring Technical Enforcement Guidance Document (EPA, August 1985).
6. Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases (USGS).
7. NIOSH Manual of Analytical Methods: Volumes 1-7 (United States Department of Health and Human Services).
8. Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA-600/4-82-029, September 1982).
9. Standard Methods for the Examination of Water and Wastewater.

Occasions will arise, however, when improvisation will be necessary to meet the requirements of unusual sampling situations. This should be done carefully, and some attempt should be made to validate the sampling method.

2.0 SAMPLING PLAN PREPARATION

Before any sampling activities begin, it is important to develop a sampling plan. This plan defines the purpose and goals of a sampling program and identifies the equipment, method, and logistics to be used during the actual sampling. This plan should be concise and comprehensible, and should address the following items:

- o Review of existing work and site historical data
- o Definition of goals and scope of work
- o Statistical strategy
- o Quality assurance/quality control
- o Document control/chain-of-custody procedures
- o Documentation requirements
- o Decontamination procedures
- o Safety considerations

2.1 BACKGROUND DATA

A site operational history and a review of previous study data, conclusions, and recommendations are necessary to familiarize field team members with the investigation going on at a particular site. Preliminary data on concentrations of contaminants are needed to develop a statistically sound sampling plan. In addition, detailed maps and photographs of the site should be obtained. Of particular importance is information pertaining to:

- o Composition and characteristics of wastes on the site
- o Security and stability of wastes on the site
- o Routes through which the wastes could migrate off site
- o Effects that would occur (or might have occurred) through waste discharge

2.2 GOALS AND SCOPE OF WORK

The sampling plan should include both a clear definition of goals and a detailed explanation of the tasks designed to obtain those goals.

2.3 STATISTICAL STRATEGY

The sampling schemes discussed below are among the different types that could be chosen and some of their associated advantages and potential problems.

2.3.1 Random Sampling

Random sampling uses probability theory to choose representative sample locations. It is generally employed when little information exists concerning the material, location, etc. It is most effective when the population of available sampling locations is large enough to lend statistical validity to the random selection process. Since one of the main difficulties is achieving a truly random sample, it is advisable to use a table of random numbers with a grid system, in order to reduce or eliminate bias.

2.3.2 Systematic Sampling

Systematic sampling involves the collection of samples at predetermined, regular intervals. It is the most frequently used scheme for sampling; however, care must be taken to avoid bias in choosing sampling locations. If, for example, there are periodic variations in the material to be sampled such that the systematic plan becomes partially phased with these variations, bias will result.

A systematic sampling plan can be the end result of an approach that was begun as random because of the tendency of investigators to subdivide large sample areas into smaller increments before randomizing. The hexagonal grid sampling plan is standard for cleanup verification.

2.3.3 Stratified Random Sampling

Data and background information made available from the preliminary site survey, prior investigations conducted on site, and/or experience with similar situations can be useful in reducing the number of samples needed to obtain a specified precision. Stratified sampling involves division of the sample area and number into groups based on knowledge of sample characteristics at these divisions.

The purpose of this approach is to increase the precision of the estimates made by sampling. This objective should be met if the divisions are selected in a way such that the units within each division are more homogeneous than the total population. The procedure basically involves handling each stratum in a simple random approach.

2.3.4 Judgment Sampling

A certain amount of judgment enters into any sampling approach. In fact, a biased approach is often the one most employed when the intent of the client is to discover or document the presence of contamination. Since judgment approaches tend to allow investigator bias to influence decisions, care must be exercised. Poor judgment can lead to poor-quality data and improper conclusions. If judgment sampling is employed, it is generally advisable that enough samples be collected to lend credibility to any conclusions drawn about the area under investigation.

Measuring sample accuracy is very difficult when using this type of sampling. This is especially true for enforcement samples when the analytical results indicate no apparent contamination. In such cases, the inability to measure sample accuracy makes it very difficult to rule out the possibility that contaminants are present at the site, even if not found in the samples.

2.3.5 Hybrid Sampling Schemes

In reality, most sampling schemes consist of a combination or hybrid of the types previously mentioned. Hybrid schemes are usually chosen because they can allow for greater diversity without compromising the objectives of the program.

2.4 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Adherence to a proper QA/QC plan is essential for a successful sampling effort. The two major concerns of a QA/QC plan are QA samples and document control/chain-of-custody.

QA samples should be collected in all sampling surveys to verify the quality of data collected. The following is a list of the types of QA samples required:

- o Trip (travel) blanks are distilled or deionized water put into sample containers to verify their cleanliness. One trip blank should be used for each analyte for each group of samples sent out, or daily if a field analytical unit (FAU) is used.
- o Equipment (field) blanks verify the cleanliness of the sampling equipment. The piece of equipment in question is used to take a sample of distilled or deionized water. One per analyte per piece of equipment per day is recommended.

- o Duplicates are essentially identical samples collected at the same time, in the same way, and contained, preserved, and transported in the same manner. They are used to verify the reproducibility of the sampling procedure. They are also necessary to cover breakage and accidents in the lab and for lab matrix spikes. Normally, 10 percent of samples should be duplicates.
- o Split samples are samples that are split with the client or a regulatory agency for independent analysis by another laboratory. Care must be taken to ensure accurate splitting. Because the integrity of samples for volatiles may be compromised by the handling involved in physically splitting them, duplicates should be used instead of splitting these samples.
- o Field spikes are duplicate samples or blank samples that have been spiked in the field with a known amount of analyte. A field spike indicates the amount of analyte lost or gained due to handling procedures. Field spiking must be performed by competent personnel and carefully documented.

2.5 DOCUMENT CONTROL/CHAIN-OF-CUSTODY

Strict adherence to document- and data-control procedures is essential for good QA/QC. Data, calibration and maintenance records, samples, and documents must be accounted for and retrievable at any time during an investigation. Types of documents which are considered essential and must be accounted for are notes, maps, drawings, photographs, safety plans, QA plans, log books, data sheets, reports, etc.

Chain-of-custody records are necessary to document the sample identity, handling, and shipping procedures.

2.6 ALLOWING TIME FOR DOCUMENTATION

Documentation that is hurried because of time and/or manpower constraints on the job can lead to expensive problems. In both the proposal and operational stages of any job, sufficient time must be allowed for proper technical documentation.

2.7 DECONTAMINATION PROCEDURES

Decontamination procedures are designed to provide two primary safeguards.

They reduce the chances of cross contaminating samples and help prevent the introduction of contaminated materials into noncontaminated areas. Proper decontamination is not only a health and safety concern but also an analytical and sampling consideration.

The first consideration in decontamination is the implementation of a proper site-control plan to reduce the spread of contaminants.

Beyond this, sampling devices require special cleaning protocols. General guidelines are given below, but in each case the project chemist or senior personnel in Field Analytical Services in Findlay should be consulted.

Common to all of these protocols is a preliminary detergent and water wash with tap water and distilled- or deionized-water rinse. Rust, paint, and visible dirt must be removed by whatever method is necessary. Following this are the procedures listed below:

<u>Analyte</u>	<u>Decontamination Technique</u>
Volatile organic	Flame drying
Non- and semi-volatile organics (eg., PCB, pesticides)	Acetone, then hexane rinse
Metals	10% HNO ₃ , tap water, then deionized-water rinse
Bacteria	Methanol rinse with flame drying
Phenols	Methanol, then distilled-water rinse

2.8 SAFETY

Any important safety considerations involving obtaining, transporting, and analyzing samples should be addressed in the sampling plan as well as the site-safety plan. It is important to provide a reminder of the need for taking proper, well-developed precautions when dealing with hazardous materials.

TABLE 12-1
PROJECT CENTRAL FILE CATEGORIES

<u>CATEGORY</u>	<u>DESIGNATION</u>	<u>LETTER</u> <u>CONTENTS EXAMPLE</u>
Job Set-Up Forms	A	Copy of job set-up form
Correspondence	B	Incoming and outgoing letters, memos, telecopies, telephone conversation records, etc. Subcategories for this section will be created based on the extent of information in this file. Such subcategories are: "B1" - General in-house memos "B2" - Outgoing correspondence "B3" - Incoming correspondence "B4" - Telecopies "B5" - Conversation records, etc.
Notes	C	This section is set up for all notes, handwritten or typed, by the project managers or other in-house people.
Request for Proposal (RFP)	D	Copy of the RFP and all related paperwork.
Estimates	E	This category will contain all written estimates.
Originals	F	Typed originals for reports, regulatory submittals, applications, specifications, proposals, etc. Oversized tables should be folded and placed in the same folder as the report. Original camera reduced copies of oversized tables should be included in the body of the original report. Also, originals for the proposals/reports will be found in this category.

Proposal	G	This category contains a bound copy of each proposal.
Bids, Specifications and Purchase Orders	H	Copies of bids, specifications and purchase orders for services, purchase orders for services, whether they are submitted by OHM Corporation to a client or subcontractor or vice versa will be filed here.
Field Data Daily Logs/Reports, and Health and Safety	I	Analytical results, test data, forms, calibration records, daily field logs, subsurface logs, waste handling data/manifests, inspection reports, subcontractor data, etc. This category includes information generated by the field personnel at the site, including all health and safety records.
Calculations, Checkprints, Drawings	J	Each set of calculations, checkprints and drawings (figures) should be placed in the same folder.
Reports from Others	K	Reports received from clients or reports by other organizations/subcontractors are listed here.
OHM Corporation Reports	L	Copies of OHM Corporation prepared reports containing the results of project activities and prepared by OHM Corporation are located in this category.
Photographs	M	All photographs are to be identified by project number, date, and description. Negatives should accompany photographs.
Miscellaneous	N	This category will be created only for those extreme instances when an item cannot be placed in any other category.

3.0 DOCUMENTATION

A sample is physical evidence collected from a facility or from the Environment. An essential part of a sampling effort is the control of the evidence gathered. To accomplish this a series of sample identification and chain-of-custody procedures have been established. It is this "paper trail" which establishes the sample identity, sampling procedures, and the purpose of the sample. This becomes critical when recreating the project for report or legal purposes. It is the purpose of document control to organize all the parts of the documentation into a useful whole at project's end.

The following sections provide instructions on how to fill out various logs and forms. An important point to remember is that essential information may be forgotten very quickly during field work. It is essential that information is set down in a timely fashion. It is equally important that the documentation provide complete information without assuming the reader has prior knowledge of the site.

The basic documentation for a project is:

<u>Item</u>	<u>Purpose</u>	<u>Responsibility</u>
Sample Label	Links sample to a particular project, time, place and sampler.	Sampler/Sampling Crew
Sample Notes	Describes procedure, changes to procedures, meetings, and other day by day activities of sampling crew.	Sampler/Senior Sampler
Sample Log	Places the sample by sequential sample number and identifies its history in detail.	Sampler/Senior Sampler
Chain of Custody	Extremely important connecting document which verifies the transfer of samples.	Sampler/Senior Sampler
Custody Seal	Seal on sample jar or shipping container which insures no tampering has occurred during transfer to laboratory or during storage.	Sampler/Senior Sampler

3.1 SAMPLE NUMBER

Each sample's identification number includes a four-digit project code (the project number), a two-digit station or sample type number assigned by the response manager/senior sampling technologist and listed in the project plan, and a two-digit (or more as required) sequence number assigned by the sampler(s) at the time of collection.

At each station, the sequence number begins at 01 for each sample type and is increased by one each time a sample is collected or composited for the particular sample type, regardless of date or time. For example, if the 10th "metals" sample was collected at the same time as the 17th "nutrients" sample at the same station, the sequence numbers would be 10 and 17, respectively.

The information listed above is also recorded in the appropriate logbook or FDR, along with any pertinent in situ measurement data and field observations. Thus, while provisions will be made where circumstances require a slight modification to the number sequence for a specific survey, a typical sample number will be:

	Station/Sample		
Project Code	Sample Type Code	Sequence No.	
202	03	07	or, 202-03-07

This station/sample type code can be used to identify tank, drum or monitoring well samples or a designated abbreviation could be used. For example, 7000-D260 or 7000-TK300, where "D" refers to drums and "TK" refers to tanks. This code can also refer to a designated sample point where samples are taken routinely such as a monitoring well or air sample station.

After collection and identification, the sample is preserved and maintained using the chain-of-custody procedures. Sample labels with identical information are attached to each of the samples with the tag on the split being marked as a split. The same procedure is followed when splitting samples with other USEPA regional offices, federal agencies, or state agencies. The appropriate agency is marked on the split tag.

3.2 DOCUMENT CONTROL

The goal of the Document Control Program is to assure that all documents created during a specific project will be accountable when the project is completed. For the EPA Emergency Response Contract (ERC's), this program includes a serialized document number system, a document inventory procedure, and a central filing system, all under the supervision of the PCT or on smaller projects, the Response Manager.

Regulatory Submittals O
Licensing and Per-
mitting Applications

Contained here are copies of documents, including responses to questions, issued by OHM Corporation to regulatory agencies either on behalf of a client or OHM Corporation. Also included would be submittals made by a client using information provided by OHM Corporation.

Insurance P

All insurance forms, whether OHM generated or subcontractor, will be filed here.

"Blank" Q

This category has been created for a project-specific need.

Contracts

This file is not designated by a letter. Instead, it is set up using a RED colored folder. The reason for this was determined for accounting purposes.

Financial File
(includes copies of
statements, invoices
etc.)

This file is also not designated by a letter. It is set up using a YELLOW colored folder. This is also done for Accounting purposes.

Document Control Number Guidelines:

The document control number is a combination of OHM and EPA information. The purpose of the number is to track each document produced, creating proof that it was produced. If portions of the job file are lost or borrowed, the book of document control numbers will show that the work was performed. If a portion of a job file shows up, the document control number on it will identify where the document came from.

The number consists of the document control number on the delivery order in box number six labeled document control number at the beginning, a number you generate in the middle, and the job number at the end.

(a) (b) (c)

Example: GX1739-A001-6295E

Interpretation:

- (a) Represents the EPA document control number, this will remain the same for all documents labeled on this job site.
- (b) Represents your number. You can use any system you like to produce this number. The recommended way is to begin the label with a letter:

Example: "A" would signify daily notes
 "B" would signify sample books
 "C" would signify safety meeting log
 "D" would signify analytical data/notes
 "E" would signify breathing air logs

The rest of the (b) portion of the document control number represents the document number. As each additional document is assigned to a "letter" category it takes the next sequential number.

- (c) This represents the OHM job number.

So, GX1739-D007-6295E means it is EPA site GX1739 and it is the 7th analytical data/note document logged in on OHM job site number 6295E.

For an OHM private sector project, this numbering system is changed. The (a) number will be replaced by (c), the OHM project number. All projects are assigned an OHM project number. The (b) number will remain the same, OHM uses a sequential number which indicates whether it is the first, second, third, etc. logbook respectively.

So document number 6295-B002 will describe the second sample logbook created on project 6295.

[illegible]

To use this system, buy a hard bound logbook, put a description at the beginning and record the numbers with descriptions in following sections. leave plenty of blank pages to allow for the site information to grow as time goes on. The following example form is a good example of the possible document log organization.

Accountable technical documents include items such as logbooks, field data records forms, correspondence, sample labels, graphs, chain-of-custody records, maps, raw analytical data and photos. Each document bears a serialized number and is listed, with the number, in a project document inventory assembled by the Project Control Technician.

It is important that if no document control logbook is created on site, that an inventory of forms and logs used is clearly provided in the front of the sample notebook. This information should also be provided in the project summary of small projects.

NOTE: It is not necessary to provide an individualized serial number on a series of forms providing the same service. For example, all drum log inventory sheets may bear the same number which can be placed on the blank original from which all copies used at the site are xeroxed.

****SEE ATTACHED SAMPLE NOTEBOOK EXAMPLE****

3.3 SAMPLE NOTEBOOK

Because of legalities involved in cleanup activities, it is necessary for the sampling crew to maintain daily field notes. Items that must be included are sampling protocol, any changes to the procedure, meetings, instructions, safety precautions, and personnel protection. Descriptions of special projects such as soil borings, test well installation, and air monitoring must be very detailed. The person taking notes must be knowledgeable enough about these activities to know which details are important.

Repetition of information recorded in other permanent logs should be avoided, but enough should be recorded to present a clear and accurate picture of technical activities. At a later date, should a question arise concerning a specific event or a procedure used, it will be answered from these notes. Some items that would be considered noteworthy are as follows:

- o Termination of a sample point, reasons
- o Unusual appearance of a sample
- o Measurements, volume of flow/given time of a leachate sample.

5436

Newark, OH

11/3/87

Van # 1871

Personnel: Stan Carson, Tom Rinebolt, Quentin Clady

Depart Shop at 0930
Arrive 1115

1120 Personnel are given tour of plant.
S.C., T.R., & Q.C. discuss assignments
S.C. will handle tank & well samples, T.R.
will sample drums, & Q.C. will assist
S.C. & T.R.

Five drums were sampled using pipette for liquids and a scoop for the solids.
Drum ID. numbers are on drum logs. At least 90 grams was collected from each drum
Tanks 5 & 6 were also sampled. Tank 5 was sampled from a valve, while Tank 6 was sampled with a sludge judge.
Tank 5 contained a thick sludge; more than 90 grams was collected. Tank 6 had two layers with about 1 foot of ink floating on what seemed to be water. EP TOX Metals and Flash Point will be run for drum & tank samples

Stan Carson

1874

lady

	Depth to Water	Depth to bottom	Vol. purged
MW-3	~~18.55~~ 18.30	23.25	2 gal
MW-2	17.50	22.80	2.5 gal
MW-1	17.00	22.75	2.5 gal

MW-1, 2, 3 were sampled after first being bailed of 3 well volumes. Samples were collected for priority pollutants, 2 qt jars and Volatiles, 2-40 ml vials. A Teflon bailer was used for both purging & sampling. Depth to water and depth to well bottom were measured with a sinco water level indicator. Depth to bottom subtract Depth to water gives feet of water column. Multiply ft. column by .16 gal/ft (2 in dia.) to get Vol. in Well. From this we get the amount for 3 well volume which is the purge.

1430- depart site

1700- arrive OTHM site shop, SC. checks in samples, T.R. goes home, Q.C. refuels van and inventories supplies.

1730 SC & QC leave shop

Stan Carson

- o Additional samples and reasons for obtaining them
- o Weather
- o Levels of protection used (with justification)
- o Meetings and telephone conversations held with clients, regulatory agencies, citizens, OSC, response manager or supervisor.
- o Details concerning any samples split with another party.

It is important that the notes not only describe what is done, but why and by whose instructions!

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

The person in charge of the sampling program must review these notes daily and initial them at the bottom of each page. This person is also responsible for sending a copy of these notes to the appropriate supervisory personnel on a weekly basis. These notes will be reviewed for troubleshooting, quality control, and putting together information for progress reports.

It is important that the initial pages be organized and used to provide the initial purpose of the work. In addition, these initial pages should provide enough room for initials, full name and the position of personnel used in sampling. Even personnel from other companies should be included as necessary. If no documentation control log is used, the different documentation logs and forms used should be noted. NOTE: Not each individual COC or drum form, but the fact that this documentation was used.

3.4 SAMPLE LOGBOOKS

The sample logbooks are set up for each type of sample taken (i.e. drums, tanks, soil, etc. Several different logbooks may be required according to project requirements. All samples are logged in logbooks (including soil, air, water, sludge, etc.). The following columns are standard for all projects:

1. DATE - Date sample was obtained

2. SAMPLE NUMBER - Consecutive series of numbers in which every sample is assigned (transferred to sample jar before analysis)
3. LOCATION - Description of area sampled (abbreviated form is sampled twice or more--log explaining locations and abbreviations should be attached to or written in front of the logbook)

Eg: SS 6"-12" at Point 25A

SAMPLE LOCATION ABBREVIATIONS:

INF - Influent
EFF - Effluent
DUP - Duplicate (e.g., 2999 - 010DUP)
FSP - Field Spike (e.g., 3000 - 101FSP)
TW - Test Well
RP - Recovery Point
CF - Carbon Filter
SF - Sand Filter
CL - Clarifier
SS - Split Spoon Soil Sample
FF - Free Flow Sample
P - Pool
TK - Tank
D - Drum
4. TIME - Military time sampled
5. SAMPLERS - Initials of persons obtaining sample (usually two, at least witnessing if not involved in actual sampling task)
6. DESCRIPTION OF SAMPLE - Physical description of sample (e.g., clear red, organic/cloudy, aqueous/brown sludge, or light sandy soil)
7. WEIGHT OR VOLUME - Size of sample (20 ml, 200 grams, 1 oz., etc.)
8. DATE RESULTS ARE DUE - Date analytical results should be reviewed
9. LABORATORY ANALYSIS BY - Laboratory who performed analytical work
10. RESULTS - Will vary according to project requirements; should be stated in consistent units (ppm, ppb, etc.,) when possible
11. CHAIN-OF-CUSTODY NO. - For samples sent off site

SAMPLE #	DATE	LOCATION NEAR FENCE	NAME	SOCIAL SECURITY NUMBERS	ON	WTS	TASC	PER	POS	TOT MEN	LEADERS	REMARKS	COUNT	ASD
6488-A-001	11-7-88	MGT AREA A CASHING IN FENCE AT SUB STATION			1128	2587		15	15	780m	1152L	<.005	43470	ASD 41
6488-A-002	11-7-88	GRINDING TANK MID CHIM DECONTAINER			1128	2582		15	15	720m	1152L	<.005	43470	ASD 41
6488-A-003	11-7-88	MGT AREA J DOWNWIND CHIM WATER TREATMENT			1113	2313		15	15	720m	1152L	<.005	43470	ASD 44
6488-A-004	11-7-88	OLDG ALONG RIVER NADIC IN THE MIDDLE OF MGT			1117	2317		15	15	620m	992L	<.005	43470	ASD 46
6488-A-005	11-7-88	AREA'S C-O BY OVENS			1131	2331		15	15	780m	1152L	<.005	43470	ASD 37
6488-A-006	11-7-88	Blank												
6488-A-007	11-7-88	Blank												
6488-A-008	11-11-88	MGT AREA A	TERRY LOWE	268-60-2871	1746	1554	PIR	15	15	68m	1088L	<.028	43470	ASD 46
6488-A-009	11-11-88	Blank												
6488-A-010	11-14-88	MGT AREA A OF OISM DECON	MARK SACKMAN	291-60-2866	1013	1706		15	15	418m	5734L	<.005	43470	ASD 41
6488-A-011	11-14-88	MGT AREA A UPWIND ARMCO SCALE HOUSE			1004	1713		15	15	429m	72785L	<.005	43470	ASD 52
6488-A-012	11-14-88	MGT AREA A CLEAN ROOM			1008	1659		15	15	413m	5369L	<.005	43470	ASD 39
6488-A-013	11-14-88	CHIM ASBESTOS TRAILER			1107	1710		15	15	446m	5798L	<.005	43470	ASD 37
6488-A-014	11-14-88	MGT AREA A	KILLIEBARRIENTOS	295-74-4237										
6488-A-015	11-14-88	Blank												
6488-A-016	11-14-88	Blank												
6488-A-017	11-15-88	MGT AREA A	BREAN HOLCOMB	292-62-0410	1004	1645	PIR	15	13	777m	620L	<.02	43470	ASD 37
6488-A-018	11-15-88	MGT AREA A	BILLY SMITH	429-04-6064	1006	1646	PIR	15	13	475m	6175L	<.02	43470	ASD 37
6488-A-019	11-15-88	MGT AREA A	KELLY BALM	283-68-8555	1009	1645	PIR	15	13	462m	6006L	<.02	43470	ASD 37
6488-A-020	11-15-88	MGT AREA A	DOUG CASH	387-78-9960	1015	1213	PIR	15	13	240m	3120L	<.04	43470	ASD 46
6488-A-021	11-15-88	CHIM DECON TRAILER AND SUPPORT CONE UPWIND FROM THE	BY FENCE		1016	1717		15	165	576m	9504L	<.005	43470	ASD 55
6488-A-022	11-15-88	ASBESTOS TRAILER MGT	AREA A DU RDE		1017	1700		15	13	540m	7080L	<.005	43470	ASD 41
6488-A-023	11-15-88	CHIM CULCH ROOM			1016	1700		15	165	600m	9900L	<.005	43470	ASD 52
6488-A-024	11-15-88	Blank												
6488-A-025	11-15-88	Blank												
6488-A-026	11-16-88	MGT AREA A CHIM DECON TRAILER	MARK SACKMAN	291-60-2866	1030	1700	PIR	15	15	270m	3120L	<.005	43470	ASD 51
6488-A-027	11-16-88	MGT AREA A IN FENCE WEST OF CHIM	BOB BEAMER	287-72-1364	1030	1700	PIR	15	15	240m	3120L	<.02	43470	ASD 51
6488-A-028	11-16-88	ASBESTOS TRAILER MID OF CHIM DECON			1037	1713		15	15	520m	6260L	<.005	43470	ASD 41
6488-A-029	11-16-88	BY METAL TRAILER			1041	1717		15	15	524m	6812L	<.005	43470	ASD 41

Sample #	Core #	Date	Matrix	Description of matrix	Item #	Core #	Sample #
6488-D-001	113	12-13-88	Liquid	Thick blue bottom layer, cloud, layer with white cloud		62624	6488-D-001
6488-D-002	114	12-13-88	Liquid	Yellow bottom layer, off white middle layer, white		62624	6488-D-002
6488-D-003	115	12-13-88	Liquid	Cloudy white (off colored) gel on bottom sides of jar		62624	6488-D-003
6488-D-004	116	12-13-88	Liquid	Thick orange liquid		62624	6488-D-004
6488-D-005	117	12-13-88	Liquid	Cloudy with sediment on bottom		62624	6488-D-005
6488-D-006	118	12-13-88	Liquid	Black, non-transparent		62624	6488-D-006
6488-D-007	119	12-13-88	Liquid	White with first colored sediment on bottom, black on top		62624	6488-D-007
6488-D-008	120	12-13-88	Liquid	Red-brown		62624	6488-D-008
6488-D-009	121	12-13-88	Liquid	White on bottom, sediment in middle, clear on top		62624	6488-D-009
6488-D-010	122	12-13-88	Gel	Cloudy, white		62624	6488-D-010
6488-D-011	123	12-13-88	Liquid	White with black and orange sediment on bottom		62624	6488-D-011
6488-D-012	124	12-13-88	Liquid	ORANGE		62625	6488-D-012
6488-D-013	125	12-13-88	Liquid	MT		62625	6488-D-013
6488-D-014	126	12-13-88	Liquid	Thick blue bottom layer, white top layer		62625	6488-D-014
6488-D-015	127	12-13-88	Liquid	White		62625	6488-D-015
6488-D-016	128	12-13-88	Liquid	Black, non-transparent		62625	6488-D-016
6488-D-017	129	12-13-88	Liquid	MT		62625	6488-D-017
6488-D-018	130	12-13-88	Liquid	MT		62625	6488-D-018
6488-D-019	131	12-13-88	Liquid	Yellow bottom layer, off white middle layer, white		62625	6488-D-019
6488-D-020	132	12-13-88	Liquid	Clear bottom layer, Brown top layer		62625	6488-D-020
6488-D-021	133	12-13-88	GEL	Cloudy white		62625	6488-D-021
6488-D-022	134	12-13-88	Liquid	Clear bottom layer, Brown top layer		62625	6488-D-022
6488-D-023	135	12-13-88	Liquid	ORANGE		62625	6488-D-023
6488-D-024	136	12-13-88	Liquid	Cloudy with Tan gel on sides of jar		62625	6488-D-024
6488-D-025	137	12-14-88	Liquid	Dark brown		62625	6488-D-025
6488-D-026	138	12-14-88	Liquid	Clear with orange sediment on bottom		62625	6488-D-026
6488-D-027	140	12-14-88	Liquid	Black bottom layer, Brown top layer		62625	6488-D-027
6488-D-028	141	12-14-88	Liquid	Clear bottom layer, Brown top layer		62625	6488-D-028
6488-D-029	142	12-14-88	Liquid	Yellow		62625	6488-D-029

12. ADDITIONAL COMMENTS - Space reserved for any other information concerning particular sample or special procedure or analysis
13. Other Information of Note:
 - PRESERVATIVES - Note if used
 - SPLIT SAMPLE - If a regulatory agency received a portion of the sample for analysis by another lab
 - COMPOSITE NUMBER - For PCB or bulking composites

Columns must be added for different types of analysis. An additional book for sample logging may be needed if different types of samples are being taken which have very different requirements for logging.

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

3.5 FIELD DATA RECORDS

Where appropriate, serialized FDRs (in the form of individual sheets or bound logbooks) are maintained for each survey sampling station or situation. Each FDR should be numbered with the appropriate document control number. All in situ measurements and field observations are recorded in the FDRs with all pertinent information necessary to explain and reconstruct sampling operations. Each page of a Field Data Record is dated and signed by all individuals making entries on that page. These sheets must be filed and stored safely to avoid possible tampering. Binding them or organizing them into a 3-ring binder is strongly suggested.

Type of Form:

Use:

Drum Inventory Log

Sample and drum description. Its 2-part form provides room for laboratory work for easy review.

Tank Log

Inventory and sample information.

Soil and Coring Forms

Various forms are available.

Well Monitoring

Various forms are available.

Air Monitoring

Various forms are available.

3.6 LABELING

The method of sample identification depends on the type of measurement performed. An in situ measurement is one in which the sample is collected and/or the measurement performed and the data are recorded directly in logbooks or field data forms with identifying information while in the possession of the sampling team. Examples of in situ measurements are pH, temperature, conductivity, flow measurements, and continuous air monitoring.

Samples other than in situ measurements are identified by a sample label attached to the sample. Included on the label are the sample identification number, date, time, and location of sample collection, designation of the sample as a grab or composite, type of sample and preservation, remarks, and sampler's signature.

The following information is recorded on the label:

- o JOB NUMBER
- o DATE - Month, day, year
- o TIME - Military time (100, 1400, 2320)
- o SAMPLE - Description of sample. The sample number assigned from the sample log is a part of this description.
- o ANALYTE - Analysis which will be performed, if more than one analysis is being done on samples from that job.
- o PRESERVATIVE - If used
- o TAKEN BY - Initials of person taking sample
- o WITNESS - Initials of person witnessing or assisting in taking sample
- o NUMBER OF JARS - e.g., 1 or 2. Used with duplicate samples or when one jar cannot hold all the sample

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

After the sample is taken and the label is securely attached, the sample is logged into the sample log book and the sample number is written on the sample label as part of the sample description.

Job # _____ Sample # _____
Date _____ Time _____
Sample _____

Taken by _____
Witness _____

3.7 CUSTODY SEALS

Custody seals are narrow strips of adhesive tape of glass fiber used to demonstrate that no tampering has occurred. They may be used on sampling equipment, sample transport containers, or individual sample jars. They should be signed and dated by the sampler.

3.8 CHAIN-OF-CUSTODY PROCEDURES

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

3.8.1 Sample Custody

A sample is under your custody if:

1. It is in your actual possession, or
2. It is in your view, after being in your physical possession, or
3. It was in your physical possession and then you locked it up to prevent tampering, or
4. It is in a designated secure area.

3.8.2 Field Custody Procedures

- o In collecting samples for evidence, collect only that number which provides a fair representation of the media being sampled. To the extent possible, the quantities and types of samples and sample locations are determined prior to the actual field work. As few people as possible should handle samples.
- o The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or properly dispatched.

- o Sample labels shall be completed for each sample using waterproof ink unless prohibited by weather conditions.
- o Throughout the course and at the end of the field work, the senior sample technologist determines whether these procedures have been followed and whether additional samples are required.

3.8.3 Transfer of Custody and Shipment

- o Samples are accompanied by a chain-of-custody record. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. The person receiving the samples, should always inspect for correct sample description and sample count. This record documents transfer of custody of samples from the sampler to another person, a mobile laboratory, or an analytical laboratory specified by the USEPA OSC.
- o Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate record prepared for each laboratory.
- o Whenever samples are split with a facility or government agency, a separate chain-of-custody record is prepared for those samples and marked to indicate with whom the samples are being split.

3.8.4 Chain-of-Custody Records

- o All packages will be accompanied by the chain-of-custody record showing identification of the contents. The original record will accompany the shipment, and a copy will be retained by the project files.
- o If sent by mail, the package will be registered with return receipt requested. Receipts from post offices and bills-of-lading will be retained as part of the permanent documentation. The person relinquishing the sample shall sign off his custody and sign the courier company's name and the bill-of-lading number.
- o When samples are split with the facility or another government agency, the separate custody record that is prepared is labeled to indicate this. In addition, the sample numbers from all the labels are recorded on the custody record. 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 (i.e., the representative is unavailable), the custody record

INSTRUCTIONS FOR FILLING OUT CHAIN-OF-CUSTODY RECORD

1. Project Name

Name assigned by OHM (generally the clients company's name or the facility at which the work is being performed).

2. Project Location

City and state in which the project is located. Use street address if possible.

3. Project Number

Number assigned by OHM.

4. Project Contact

Usually an OHM employee who is responsible for overseeing the sampling operation. This person should be the individual to whom questions are to be directed or verbal results given (i.e., senior sampling technician or project chemist).

5. Project Telephone Number

Telephone number of OHM on-site office trailer or number where person responsible for samples (project contact) can be contacted. On a short term project, write none or put in the project manager's number.

6. Client Representative

The individual employed by our client to oversee and coordinate work performed by OHM on-site (i.e., contract coordinator, OSC).

7. Project Manager/Supervisor

The name of the OHM designated project manager should be entered here. If the project does not have a project manager, such as an ERCS job, then the name of the site supervisor or response manager should be entered.

8. Sample Number

Number assigned (project number-sequential number) in the field during collection of samples. Continue numbering in sequence from last sample obtained; refer to project field sample log.

9. Date

Date on which sample is collected.

10. Time

Time at which sample is collected (24-hour time).

11. Composite/Grab

Checkmark (✓) in the appropriate column to indicate whether sample is composite or grab.

12. Sample Description (Include Matrix and Point of Sample)

Indicate whether it is soil, liquid, air, oil, etc., along with any useful description, such as appearance (color, density, odor, etc.) Includes the location, designation, such as monitoring well number, soil sample coordinates, or EPA description number. This information must be the same as the sample label information.

13. Number of Containers

Number, size (capacity), and types of containers that are sealed and labeled for transfer to another location.

14. Analysis Desired (Indicate Separate Containers)

The name of the test (i.e., PCBs) or series of tests (VOAs) is to be entered on the diagonal lines. For each sample container designated in the number of containers, a checkmark (✓) should appear in the column for the desired analysis.

15. Remarks

Enter sample specific instructions, cautions, or priorities (i.e., do cyanide test first on this sample or caution may contain hydrofluoric acid; also indicate preservation of sample (i.e., sulfuric acid added). Enter a sample specific comment (i.e., sample lost in shipping).

16. Item Number

Each sample number is considered a separate item. Use sequential number (1,2,3...). Item numbers begin with No. 1 on each form. Do not carry item numbers from one form to another. List items 1,2,3... that you accepted.

17. Transfers Relinquished By

Name of person and affiliation transferring or surrendering the sample to another person, (do not use only the name of the organization).

18. Transfers/Accepted By

Person signing this part is responsible for the sample(s). In addition to the person's name, he should include his company name or agency(s) initial. Person accepting sample(s) is also responsible for making sure that all samples are accounted for when he signs an acceptance. If a common carrier is used, include the carrier name and bill-of-lading number.

19. Date

Date on which sample is released to next person.

20. Time

Time at which sample is released to next person.

21. Remarks

Enter general instruction or requests, such as, send additional report to: _____

22. Sampler's Signature

The signature of the individual performing, or having immediate oversight of the sampling should appear in this section.



OHM

CHAIN-OF-CUSTODY RECORD

Form 001
Field Technical Service
Rev. 00/96

No. 43501

O.H. MATERIALS CORP. • P.O. BOX 551 • FINDLAY, OH 45838-0551 • 419-423-3526

PROJECT NAME		1		PROJECT LOCATION		2	
PROJECT NO	3	PROJECT CONTACT	4	PROJECT TELEPHONE NO		5	
CLIENT'S REPRESENTATIVE				PROJECT MANAGER/SUPERVISOR			
6				7			
SAMPLE NUMBER	DATE	TIME	COMP	GRAB	SAMPLE DESCRIPTION (INCLUDE MATRIX AND POINT OF SAMPLE)		
8	9	10	11	11	12		
					13		
					14		
					15		
					16		
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OHM

CHAIN-OF-CUSTODY RECORD

Form 0018
Field Technical Services
Rev. 03/86

No. 43501

OHM MATERIALS CORP.

P.O. BOX 551

FINDLAY, OH 45839-0551

419-423-3528

PROJECT NAME		PROJECT LOCATION		PROJECT CONTACT		PROJECT TELEPHONE NO.			
J & D Plating		West Branch, IN		Jeff Doe		413-555-2000			
CLIENT REPRESENTATIVE		PROJECT MANAGER/DEVELOPER							
CHARLES SMITH (OSC)		Bob BOARNE							
SAMPLE NUMBER	DATE	TIME	COMP	GRAB	SAMPLE DESCRIPTION (INCLUDE MATRIX AND POINT OF SAMPLE)	NUMBER OF CONTAINERS	ANALYSIS DESIRED (INDICATE SEPARATE CONTAINERS)	REMARKS	
4111 - 01	5/3/88	14:15		✓	WATER SAMPLE FROM DISCHARGE POOL #2	2 - 40ml 1 - 4T	✓	TOP PRIORITY	
4111 - 02	5/3/88	15:30	✓		Composite Soil Sample From Northwest Corner of Building	2 CATS	✓	DO CYANIDE TEST FIRST	
4111 - 03	5/3/88	15:45	✓		SAMPLE OF Green Liquid From NICKEL DRUM	1 - 802	✓	CAUTION DRUM IS LABELED CHLOROSULFONIC ACID	
4111 - 04	5/3/88	16:10	✓		Sludge Sample From TANK T-10	1 - 5 Gallon Pail	✓	Ferric Iron Determination Study	
4111 - 05	5/3/88	16:25	✓		Sample of Clear Liquid From VAT No. 1	2 - 40ml 1 - 802	✓		
4111 - 06	5/3/88	16:35	✓		Sample of Yellow Liquid and White Solids From VAT No. 2	2 - 802	✓		
4111 - 07	5/3/88	16:44	✓		WATER SAMPLE From NICKEL WELLS NO. 817-2	2 - 40ml 2 - 40ml 2 - 40ml	✓	SECOND PRIORITY	
4111 - 08	5/3/88	16:51	✓		WATER SAMPLE From CLEM'S Creek 100 ft South of Discharge Pipe	2 - 40ml 2 - 40ml	✓	THIRD PRIORITY	
4111 - 09	5/3/88	16:59	✓		WATER SAMPLE From TRANSFORMER VENT 15 feet From Well 3' from well	2 - 40ml 2 - 40ml	✓		
4111 - 10	5/3/88	17:05	✓		Cellulose Acetate Filtered vol. 94mls	1	✓		
ITEM NUMBER	TRANSFERS RELINQUISHED BY			TRANSFERS ACCEPTED BY			DATE	TIME	REMARKS
1-10	Jeff Doe			W. WOOD			5/7/88	9:30	I need 3 DAY Turn Around on sample 5 11, 07 & 08. Please issue a separate report for these samples. Fax Report ASAP. Fax No. 413-555-2001
4	W. WOOD			S. Jones			5/9/88	15:30	
SAMPLES SIGNATURE Jeff Doe									

should contain a statement that the samples were delivered to the designation location at the designated time. The copy of the custody record may be given to the facility or agency upon request.

3.8.5 Laboratory Custody Procedures

- o A sample custodian or a designated alternate will receive the samples for the laboratory and verify that the information on the sample labels matches that on the chain-of-custody record included with the shipment. The custodian will sign the custody record in the appropriate space.
- o When samples are delivered to an OHM laboratory and no one is present to accept them, the samples are placed in the refrigerated storage cooler. The COC will show the samples placed in the cooler and will be initialed by the guard. The COC will be placed in the slot by the cooler door.
- o The custodian will distribute samples to the appropriate analysts. The names of individuals who receive samples will be recorded on internal laboratory records. Laboratory personnel will be responsible for the care and custody of samples from the time they receive them until they return them to the custodian. Samples received after normal working hours may be analyzed immediately or stored as appropriate.
- o All data sheets, chain-of-custodies, and laboratory records shall be retained as part of the permanent documentation. Samples forwarded to the laboratories for analysis will be retained after analysis are completed. These samples may be disposed only upon the orders of the OSC or the required holding period has passed (90 days for ERCs).

3.9 SAMPLE SHIPPING

This policy is designed to limit corporate and individual liabilities through strict compliance with Department of Transportation (DOT) and Federal Aviation Administration (FAA) Regulations. The packaging, marking, labeling, and shipping paper guidelines published here are excerpted from Title 49 of The Code of Federal Regulations, Parts 100 through 179 and The International Air Transport Association (IATA) Dangerous Goods Regulations for Domestic Air Transport. Failure to comply with these regulations may result in the frustration of shipments, civil penalties, and potential criminal violations. Therefore, all ETTC personnel are expected to follow these guidelines when shipping samples.

These guidelines are based on three fundamental types of sample materials:

- 1) Environmental samples (water and soils)
- 2) Known dangerous goods (cyanide plating bath solutions)
- 3) All other unknown sample materials (drums, tanks, lagoons, etc.)

Definitions:

I. Environmental Samples

Materials that are collected from off-site areas and/or are not expected to be grossly contaminated with high levels of hazardous materials. This determination is made according to the judgment and knowledge of the sampler. If there is insufficient information on which to base this determination, treat the sample as a category III (unknown).

II. Known Dangerous Goods

Materials which are reasonably identified as a Dangerous Good (see IATA 2.1 for the definition of dangerous goods) must be packaged, marked, labeled, and shipped in accordance with the guidelines established in the alphabetical list of dangerous goods (IATA 4.2).

*Examples of category II materials: drums, tanks, lagoons, etc.

III. Unknowns and all Other Sample Materials not Identified Above

All unknown samples being shipped to a laboratory for testing to determine hazard class or samples of hazardous wastes, will be shipped according to guidelines set out in the "Standard" UN/ICAO General Packing Requirements of IATA (5.0.8-5.0.23)

*Examples of category III materials: drums, tanks, lagoons, etc.

A. Category I - Environmental Samples

1. Packaging

Environmental samples may be packaged according to the procedures outlined later in subsection D. Requirements for marking, labeling, and shipping papers do not apply.

Environmental samples may also be packaged without being placed inside metal cans.

- Place sample container, properly identified and with a sealed lid, in a polyethylene bag, and seal bag.
- Place sample in a fiberboard container or metal picnic cooler which has been lined with a large polyethylene bag.
- Place with non-combustible, absorbent, cushioning material to minimize the possibility of the container breaking.
- Seal large bag.
- Seal or close outside container.

2. Marking/Labeling

Sample containers must have a completed sample identification label tab and the outside container must be marked "Environmental Sample". The appropriate side of the container must be marked "This End Up" and arrows placed accordingly. No marking or labeling is required.

3. Shipping Papers

No shipping papers are required.

4. Transportation

There are no restrictions on mode of transportation.

B. Category II - Hazardous Materials Samples

If the substance in the sample is known or can be identified; package, mark, label, and ship according to the specific instructions for the materials (if it is listed) in IATA's Alphabetical List of Dangerous Goods, 4.2.

C. Category III - Unknown Materials

For samples of hazardous materials of unknown content, the IATA shipping name, Other Regulated Substances will be used.

D. Packaging: Samples Classified Other Regulated Substances

1. Packaging - one pint maximum

- a) Collect sample in a glass container (16 oz. or less) with nonmetallic, teflon-lined screw cap. To prevent leakage, fill container no more than 90% full at 130° F. If an air space in the sample container would affect sample integrity, place that container within a second container to meet 90% requirement.
- b) Complete sample identification label/tag and attach securely to sample container.
- c) Seal container and place in 2-mil thick (or thicker) polyethylene bag, one sample per bag. Position identification tag so it can be read through bag. Seal bag.
- d) Place sealed bag inside metal can and cushion it with enough non-combustible, absorbent material (for example, vermiculite or diatomaceous earth) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to hold can lid securely, tightly, and permanently.
- e) Place one or more metal cans into a strong outside container, such as a metal picnic cooler or a DOT approved fiberboard box. Surround cans with non-combustible, absorbent, cushioning material for stability during transportation.
- f) Place no more than one pint or one pound inner containers per strong outside container.
- g) Note that this packaging is essentially identical to DOT limited quantity packaging for flammable liquids or oxidizers.

2. Packaging

- a) One quart maximum size samples can be individually shipped in the All-Pak, Inc. DOT-E-9168 packaging.
- b) Instructions for using this package are found inside the box.

3. Marking/Labeling

- a) Use abbreviations only where specified.
- b) Place following information, either hand printed or in label form, on the metal can:
 - Laboratory name and address
 - Other Regulated Substances, ID 8027
- c) Place all information on the outside shipping container as on a can (or bottle), specifically,
 - Other Regulated Substances
 - ID 8027
 - Addressee and addresser

4. Shipping Papers (see Appendix A for example)

- a) Use abbreviations only where specified.
- b) Complete bill of lading and present to client for signature on certification statement (if carrier does not provide, use standard industry form). Provide the following information in the order listed (One form may be used for more than one exterior container. In completing the Federal Express form for example (Appendix A):
 - Under proper shipping name write: Other Regulated Substances.
 - Under class or division write: 9
 - Under UN or ID No. write: ID 8027Further descriptions such as "Laboratory Samples" or "Cargo Aircraft Only" (if applicable) are allowed if they do not contradict required information.
- c) Include chain-of-custody record, properly executed, in the outside container if legal use of samples is required or anticipated.

5. Transportation

- a) Transport unknown dangerous goods samples classified as Other Regulated Substances by rented or common carrier truck, railroad, or express overnight package services.

6. Other Considerations

- a) Check with analytical laboratory for size of sample to be collected and if sample should be preserved or packed in ice.
- b) For overnight package services, determine weight restrictions - at least one service limits weight to 70 pounds per package.
- c) Hazardous materials or hazardous waste samples prior to shipment should be staged only in those areas of each ETTC facility designated specifically for such purpose. Health and safety considerations mandate that hazardous materials should not be stored, shipped from, or received in office areas.

3.10 MAPS

All sites require some type of map describing the location of the project and what changes take place. A project which involves sampling or air-monitoring activities must have maps drawn up describing locations of sample points, landmarks, treatment equipment, etc. One master map will contain the following information:

- o Survey points and/or survey line
- o Local landmarks
- o Locations of OHM trailers, buildings and equipment
- o Original data obtained from other maps

An easy way to assemble a site map is to set up a survey line along a border of the site (a street or railroad can usually serve this purpose). Take measurements of all items from this line and then transfer to a map.

Maps are useful for communications with the client and project management to describe the site and show progress. This same map will be used to plot chemical contours, equipment locations, soil borings, and piezometric levels.

The site map should be revised whenever changes are made on the job. A copy of all maps and revisions will be sent to Findlay and added to the job file.

Most maps can be drawn up on 11/17 gridded sketch pads. This and assorted drafting equipment may be carried in spill bags. The title block should be set up as shown in Figure 3.2:

59 57 55 53
58 56 54 52

51 49 47 45
50 48 46 44

Conveyor/Stairs

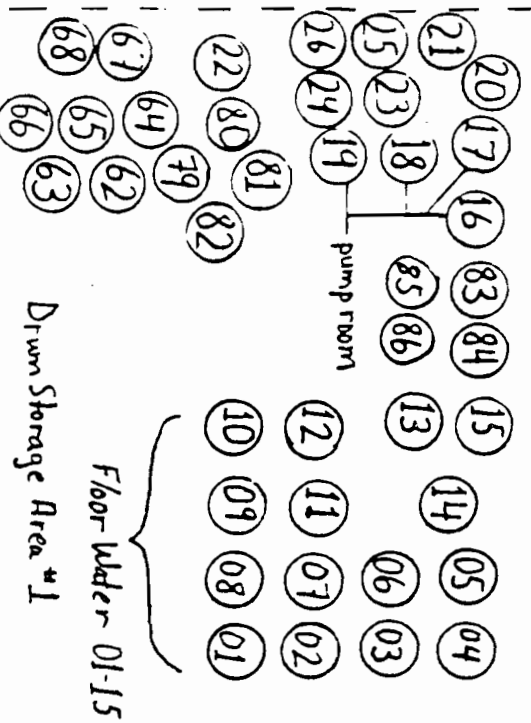
42 41 39 37 35 33 31 60 27 77 75 73 71 67 70
43 40 38 36 34 32 30 61 29 28 78 76 74 72

Transition Zone

Not to scale

Each drum was sampled individually then grouped based on Visual inspection in the field. Samples will be composited in the lab.

Composite #1, drums 01-08
Composite #2, drums 09-15
Composite #3, drums 16-19
Composite #4, drums 20-22
Composite #5, drums 23-26
Composite #6, drums 27-34
Composite #7, drums 35-43
Composite #8, drums 44-51
Composite #9, drums 52-55
Composite #10, drums 56-59
Composite #11, drums 60-61
Composite #12, drums 62, 63, 69, 83, 84, 85, 86
Composite #13, drums 64-68
Composite #14, drums 70-78
Composite #15, drums 79-82



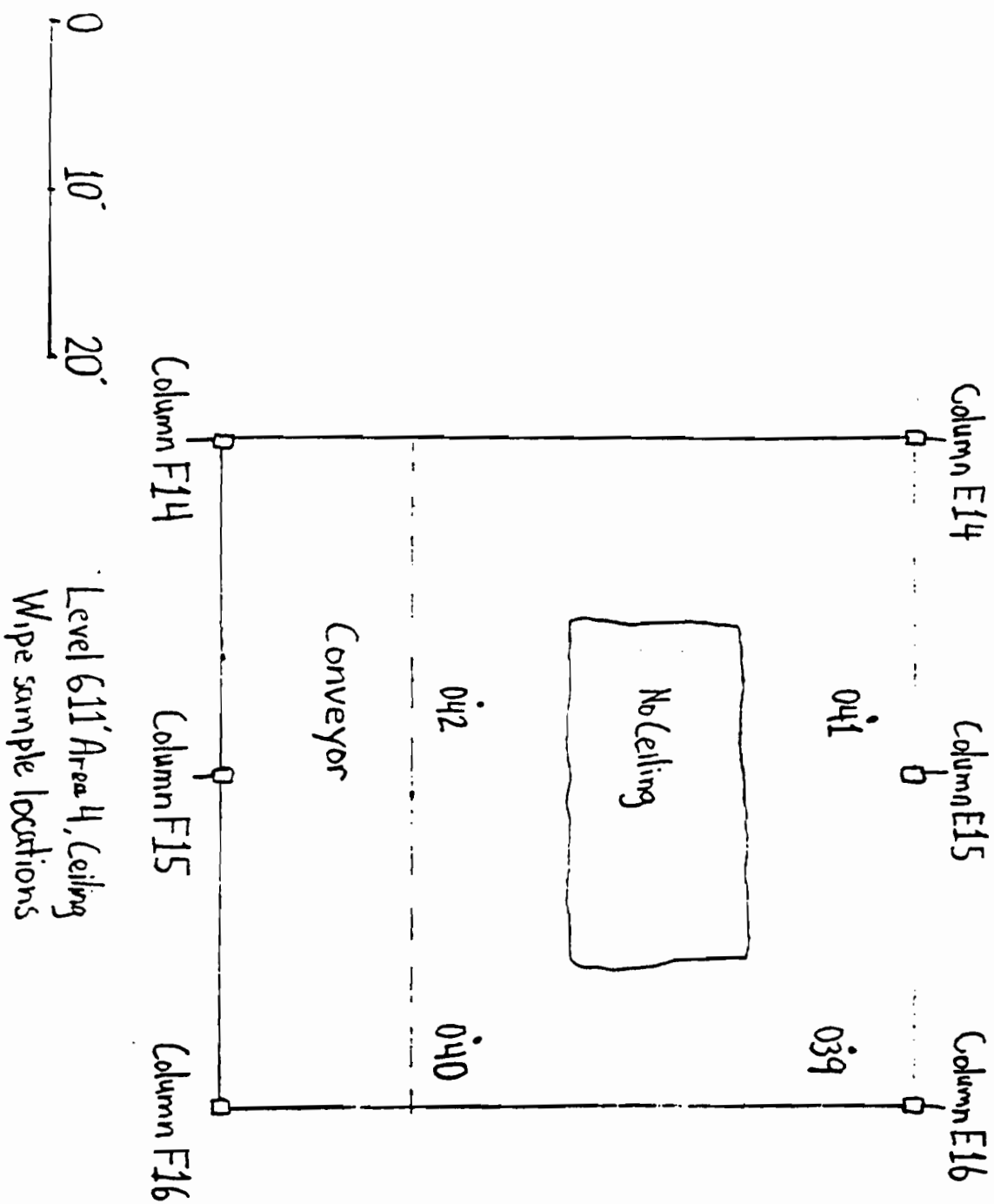
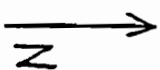


FIGURE 3.2

SAMPLE TITLE BLOCK

		ENVIRONMENTAL TREATMENT AND TECHNOLOGIES CORP.	
		P.O. BOX 881 4191 423-3626	FINDLAY, OHIO 43021 537-8848
30" AIR STRIPPER UNIT COLUMN ASSEMBLY SECTIONS			
DRAWN BY R.J.D.		APPROVED	DATE 1/27/88
CHECKED		APPROVED	SCALE NONE
B	DWG. NO. SHEET 2	PROJ. NO.	REV.

Smaller jobs should at least have a site sketch prepared. If this sketch is not to scale, the abbreviation "NTS" should appear on it.

3.11 PHOTOGRAPHS

When movies, slides, or photographs are taken which visually show the effluent or emission source and/or any monitoring locations, they are numbered to correspond to logbook entries. The name of the photographer, date, time, site location, and site description are entered sequentially in the logbook as photos are taken. Once developed, the slides or photographs should be serially numbered corresponding to the logbook descriptions.

3.12 CORRECTIONS TO DOCUMENTATION

As previously noted, unless prohibited by weather conditions, all logbooks, FDRs, sample labels, chain-of-custody records, and other data sheets are filled out with waterproof ink. None of the accountable serialized documents listed above are to be destroyed or thrown away, even if they are illegible or contain inaccuracies which require a replacement document.

If an error is made in a project logbook, corrections may be made by crossing a line through the error and entering the

correct information. Changes made subsequently are dated and initialed. If an error is discovered on a sample label, custody record, or FDR, when possible the person whom made the error should correct it. Corrections or insertions are made by inserting the word or abbreviation for "corrected", the date, and the correcting person's initials beside the correction. The procedure applies to words or figures inserted or added to a prior recorded statement.

If a sample label is lost in shipment, a label was never prepared for a sample(s), or a properly tagged sample was not transferred with a formal chain-of-custody record, the following procedure applies. A written statement is prepared detailing how the sample was collected, air-dispatched, or hand-transferred to the field or laboratory. The statement should include all pertinent information such as entries in field logbooks regarding the sample, whether the sample was in the sample collector's physical possession or in a locked compartment until hand-transferred to the laboratory, etc. Copies of the statement are distributed to the appropriated project files and laboratory involved.

3.13 ARCHIVING FILES

After OHM has completed its work for a particular cleanup, all documents generated from the project should be assembled in the project file. Individuals may retain clean (no handwritten comments) copies of documents for their personal files but only after personally verifying that the original or similar copy is in the ERC's file. The RM/supervisor of each removal is responsible for assuring the collection, assembly, and inventory of all documents relative to a particular project at the time the project objectives are completed. The file then becomes accountable. Any records leaving the file must be signed out.

When the contractor has completed the project objectives, all file documents are reviewed and submitted to the general file. By this time, if it is an ERCs project, each document will have been labeled with a unique serialized number as specified above. The project file contains the following document classes:

- A. Project logbooks
- B. FDRs/Forms
- C. Sample identification documents
- D. Chain-of-custody records
- E. Analytical logbooks, lab data, calculations, bench cards, graphs, etc.
- F. Correspondence
 - 1. Intra-office
 - 2. EPA
 - 3. Industry
 - 4. Record of confidential material
- G. Report notes, calculations, drafts

- H. References, literature
- I. Sample (on-hand) inventory
- J. Check-out logs
- K. Litigation documents
- L. Miscellaneous - photos, maps, drawings, etc.

Once deposited in the file, documents must be checked out.

3.14 PROJECT SUMMARIES

It is strongly suggested that a project summary be written by the senior sampling technologist for the review by his immediate supervisor review, the project manager, and archives. For ERCs projects a copy should be sent to the ERCs project management. This is especially true following short projects where a proper file may not be prepared. The object is to provide information concerning the work accomplished and documentation created into several sets of concerned hands.

The following page is a good example. However, in order to provide maximum usefulness, the sampler's project summary should provide the sample documents created and who retained their control at the project's end.

JOB SUMMARY

Client: GM-Inland, Job #3492
Temporary Water Treatment For Zinc Removal

Project Manager: John Hitchings

Site Supervisor: Chris Witter

Engineer: Greg McCartney

Problem: The GM-Inland plant in Vandalia, Ohio was unable to meet the corporate deadline for the pre-treatment of Zinc. The plant has been discharging above the allowable criteria of 1.4 ppm for several years. The Zinc originates in the metal finishing area and also in an electroplating line. The expected treatment flow rate is 20-25 gpm, with an initial pH=12.

Goal: Produce a clear effluent with a pH=9. Zinc solubility is lowest at a pH of 9...

Solution: Benchscale studies began as soon as the crew arrived on site. Alum was identified as a good readily available coagulant and Dearborn 304 polymer was identified as a good flocculant. Since Alum should be added to waste stream with a pH below 7 sulfuric acid was used to lower the initial pH. NaOH was used to increase the pH back to 9.0 after Alum addition. The system had the following operations:

- o pH adjustment using sulfuric acid pH=4
- o Alum addition (600 ppm Alum/C-309)
- o oil water separation
- o pH adjustment using Sodium Hydroxide pH=9
- o flocculation with anionic polymer (10 ppm A-220)
- o settling in 10,000 gallon clarifier
- o sand filtration and discharge

Additional bench studies were performed during operation. An Alum substitute was found that decreased the Alum requirement by 30%. The polymer was Allied's C-309 which was directly mixed with the Alum at 5%. An Allied emulsion polymer A-220 was found as a replacement for the Dearborn powder polymer 304, due to the ease of preparing an emulsion feed solution. The system had the following characteristics:

- o ~20 gpm
- o influent Zinc concentration ~10 ppm
- o effluent Zinc concentration BDL (0.2 ppm)
- o effluent pH of 9

JOB SUMMARY
Water Treatment

Client: Ciba-Geigy
Project Manager: Jeff Gillus
Supervisor: Dave Leadenham
Engineer: Greg McCartney

Problem:

Ciba-Geigy has contracted OHM to clean and dismantle its Cranston, RI chemical plant. In the process of cleaning the plant penetone containing rinse water will be generated, which must be pretreated by OHM. Along with rinse water, decon water and stagnant water from Ciba-Geigy's initial cleaning. Rinse water is expected to contain zinc in quantities greater than the daily discharge criteria of 6.5 #/day.

Goal:

Produce a waste stream with less than 1 ppm Zinc.

Approach:

The decontamination of equipment produces a very inconsistent flow rate and waste stream quality. Therefore, an approach that works under the widest conditions must be undertaken. The treatment of penetone containing waste has notoriously required a radical pH shift in order to break the micelle structure. Sulfuric acid will be used to lower the pH to 4.0. Alum is added to the pool at this point, Alum was chosen because of its availability and self flocculating nature. The pH is then increased to 9 to induce precipitation and flocculation of suspended solids. Caustic is metered directly into a 32 gallon plastic container in the raw pool which contains the clarifier feed pump. An anionic polymer flocculant is added directly in line before a static mixer to aid in floc formation.

After clarification suspended solids will be removed in a sand filter then organics will be remove in a Dual carbon cell containing 7,260 #'s of carbon.

4.0 PREPARATION FOR SAMPLING

Detailed guidelines for sample preservation, shipment, and handling; quality-control considerations for sampling; and sampling materials are described in this section. These guidelines are taken from "Characterization of Hazardous Waste Sites, a Methods Manual, Volume two; Available Sampling Methods (2nd Edition)", EPA-600/4-84-076, December 1984.

4.1 SAMPLE CONTAINERS

Polyethylene, polypropylene, Teflon, and glass with Teflon-lined lids are acceptable sample containers. The particular container used depends on the type of analysis to be conducted.

Unless the sample containers arrive at the site precleaned (such as the 40-ml I-Chem vials), they must be cleaned before use. The requirements for cleaning are generally specified in the analytical method and will be similar to the procedure for cleaning glassware used in the analysis. A similar procedure will be used to clean the sampling equipment. If containers are to be cleaned at the project site, the proper cleaning agents must be taken to the site and provisions made for disposal of any acid or solvents used.

4.2 SAMPLE VOLUME

Section 4.5 specifies minimum volumes for each type of sample. If feasible, one should plan on taking four times the minimum required volume.

4.3 PRESERVATION

Preservation requirements for water and wastewater samples are also provided in Section 4.5. More detail concerning these requirements may be found in the specific analytical procedures. Preservation for oils and solid samples, if required, is usually cooling to 4 degrees Centigrade (40 degrees Fahrenheit). Consultation with a project chemist or Findlay analytical personnel is advisable.

4.4 HOLDING TIME

Maximum holding times are specified in Section 4.5 for each type of sample. If these are exceeded, the validity of the sample is diminished. It is important that the site supervisor arrange to have all samples processed within the specified maximum holding time.

4.5 DETAILED GUIDELINES BY ANALYTE

Acidity and Alkalinity

Apparatus and Materials:

- o Polyethylene or borosilicate glass (Pyrex or equivalent) bottles

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o Fill sample bottles completely and cap tightly
- o Store samples at 4 degrees Celsius.
- o Analyze all samples within 14 days of collection

Quality Control:

- o Dissolved gases contributing to acidity or alkalinity, such as carbon dioxide, hydrogen sulfide, or ammonia, may be lost or gained during sampling or storage. Sample bottles must be capped and sealed tightly, avoiding sample agitation or prolonged exposure to air.

Asbestos

Apparatus and Materials:

- o One-liter polyethylene bottles

Minimum Volume:

- o 1 liter

Sample Collection, Preservation, and Handling:

- o Leave air space at the top of the sample container to allow for shaking the sample
- o Avoid contacting the sample with acid
- o If the sample cannot be filtered within 48 hours of collection, add 1 ml of a 2.71-percent solution of mercuric chloride per liter of sample to prevent bacterial growth.
- o Store at 4 degrees Celsius

Quality Control:

- o Rinse the sample bottle at least twice with the water that is being sampled

Bacteria

Apparatus and Materials:

- o Polypropylene or glass bottles
 - Samples for bacteriological examination must be collected in bottles that have been cleansed and rinsed with great care, given a final rinse with distilled water, and sterilized.
 - Bottles of glass capable of being sterilized and of any suitable size and shape may be used for samples intended for bacteriologic examination.
 - Bottles shall hold a volume of sample that is sufficient for all the required tests, permit proper washing, and keep the samples uncontaminated until the examinations are completed.
 - Ground-glass-stoppered bottles, preferably wide-mouth and of break-resistant glass, are recommended. Polypropylene bottles of suitable size which are wide-mouthed and capable of being sterilized are also satisfactory.
 - Metal or plastic screw-cap closures may be used on sample bottles, provided that no volatile compounds are produced on sterilization and that they are equipped with liners that do not produce toxic or bacteriostatic compounds up on sterilization.
 - Before sterilization, cover the tops and necks of sample bottles having glass closures with metal foil, rubberized cloth, heavy impermeable paper, or milk bottle cover caps.
 - Sterilize glassware for no less than 60 minutes at 170 degrees Celsius.

- For plastic bottles that distort on autoclaving, low-temperature ethylene oxide gas sterilization should be used.
- o Sodium thiosulfate (ACS), 10 percent solution
 - When sampling water containing residual chlorine, sodium thiosulfate should be added to the clean sample bottle before sterilization in an amount sufficient to provide an approximate concentration of 100 mg/L in the sample. This can be accomplished by adding 0.4-ml of a 10 percent solution of sodium thiosulfate to a 500-ml bottle. (This will neutralize a sample containing about 15 mg/L of residual chlorine.) The bottle is then stoppered, capped, and sterilized.
- o Water samples high in copper or zinc and wastewater samples high in heavy metals should be collected in sample bottles containing a chelating agent that will reduce metal toxicity. This is particularly significant when such samples are in transit for 24 hours or more. Ethylenediaminetetraacetic acid (EDTA) is a satisfactory chelating agent. A concentration of 372 mg/l should be added separately to the sample bottle before sterilization (0.3 ml of a 15 percent solution in a 500 ml bottle) or it may be combined with the sodium thiosulfate solution before addition.

Minimum Volume:

- o 200 mL

Sample Collection, Preservation, and Handling:

- o When the sample is collected, leave ample air space in the bottle (at least 2.5 cm or 1 inch) to facilitate mixing of the sample by shaking, preparatory to examination. Care must be exercised to take samples that will be representative of the water being tested and to avoid contamination of the sample at the time of collection or in the period before examination.
- o The sampling bottle shall be kept unopened until the moment it is to be filled. Remove the stopper and hood or cap as a unit, taking care to avoid soiling.

During sampling, do not handle the stopper or cap and neck of the bottle and protect them from contamination. Hold the bottle near the base, fill it without rinsing, replace the stopper or cap immediately, and secure the hood around the neck of the bottle.

- o Store samples at 4 degrees Celsius
- o Analyze all samples within 6 hours of collection

Quality Control:

- o Begin the bacteriological examination of a water sample promptly after collection to avoid unpredictable changes. The time and temperature of storage of all samples should be recorded and should be considered when interpreting the data.

Bicarbonate/Carbonate

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o Bicarbonate/carbonate analysis should be performed on site. If on-site determination is not possible, completely fill the sample bottle, leaving no headspace, and return it to the laboratory as quickly as possible for analysis.
- o Store samples at 4 degrees Celsius until analyzed.

Quality Control:

- o Carbon dioxide may be lost or gained during sampling and storage. Sample bottles must be capped and sealed tightly, avoiding sample agitation or prolonged exposure to air.

Biochemical Oxygen Demand (BOD)

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 1 liter

Sample Collection, Preservation, and Handling:

- o If possible, avoid samples containing residual chlorine by sampling before chlorination. Notify laboratory if sample is from a chlorinated effluent.
- o Store sample at 4 degrees until analyzed.
- o Analyze all samples within 48 hours of collection.

Quality Control:

- o Samples for BOD analysis may undergo significant degradation during storage, resulting in a low BOD value. Minimize reduction of BOD by promptly analyzing the sample.

Bromide

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o There are no required preservation techniques, although storage at 4 degrees Celsius is recommended.
- o Analyze all samples within 28 days of collection

Quality Control:

- o No special precautions

Chloride

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 50 mL

Sample Collection, Preservation, and Handling:

- o No preservative necessary
- o Analyze all samples within 28 days of collection

Quality Control:

- o No special precautions

Chlorine Demand

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Testing apparatus and reagents, if analysis is to be performed on site

Minimum Volume:

- o 200 mL

Sample Collection, Preservation, and Handling:

- o Chlorine in aqueous solution is unstable and the chlorine content of samples or solutions, particularly weak solutions, will decrease rapidly. Exposure to sunlight or other strong light or agitation will accelerate the reduction of chlorine. Therefore, sample must be analyzed on site or brought immediately to the laboratory. The maximum holding time is 2 hours.

Quality Control:

- o Chlorine determinations must begin immediately after sampling. Avoid excessive light and agitation.

Chromium VI

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o Store samples at 4 degrees Celsius
- o Analyze all samples within 24 hours of collection
- o Do not contact sample with acid

Quality Control:

- o No special precautions

Chemical Oxygen Demand (COD)

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Concentrated sulfuric acid, H_2SO_4 (ACS)

Minimum Volume:

- o 50 mL

Sample Collection, Preservation, and Handling:

- o Preserve the sample by acidification with concentrated sulfuric acid to a pH less than 2
- o Store samples at 4 degrees Celsius

- o Analyze all samples within 28 days of collection

Quality Control:

- o Test unstable samples without delay

Color

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 50 mL

Sample Collection, Preservation, and Handling:

- o Store samples at 4 degrees Celsius
- o Analyze all samples within 48 hours of collection

Quality Control:

- o No special precautions

Compatability

Apparatus and Materials:

- o Eight ounce glass jars

Minimum Volume:

- o Four ounces

Sample Collection, Preservation, and Handling:

- o Clean outsides of jars off to reduce hazards.
- o Some materials, such as fuming liquids or materials which are particularly odoriferous, require larger samples (approximately one liter) so that they may be characterized more fully. This is necessitated by problems which may be encountered in handling or disposal.

- o Large volumes of materials will require samples for disposal analysis.

Quality Control:

- o No special requirements

Conductance

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o Store samples at 4 degrees Celsius
- o Analyze all samples within 28 days

Quality Control:

- o No special precautions

Cyanide, Total and Amenable to Chlorination

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Sodium hydroxide solution (ACS)
- o Ascorbic acid

Sample Collection, Preservation, and Handling:

- o Because most cyanides are highly reactive and unstable, analyze samples as soon as possible. Preserve the sample by adding 2 ml of 10 N NaOH to raise the pH of the sample to 12 or above and store in a closed, dark bottle at 4 degrees Celsius.
- o If residual chlorine is present in the sample, add 0.6 g ascorbic acid.

- o Analyze all samples within 14 days of collection.

Quality Control:

- o Maximum holding time is 24 hours when sulfide is present. As an option, all samples may be tested with lead acetate paper before the pH adjustment to determine whether sulfide is present. If sulfide is present, it can be removed by adding cadmium nitrate powder until a negative spot test is obtained. Filter the sample and then add NaOH to a pH of 12.

Disposal

Apparatus and Materials:

- o One liter glass jars

Minimum Volume:

- o One liter
- o Typically one liter is required for preliminary analysis. After the disposal method has been determined, three 1-liter samples that are certified to be representative must be sent to three disposal firms for their analysis for acceptance of the material.

Sample Collection, Preservation, and Handling:

- o Must be shipped in approved containers.
- o Must be as representative as possible.

Quality Control:

- o Normal precautions should be employed.

Fluoride

Apparatus and Materials:

- o Polyethylene bottles

Minimum Volume:

- o 300 mL

Sample Collection, Preservation, and Handling:

- o Polyethylene bottles are required for collecting and storing samples for fluoride analysis. Always rinse the bottle with a portion of the sample.
- o Analyze all samples within 28 days of collection

Quality Control:

- o No special precautions

Hardness

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o Acidify with HNO_3 to pH 2; store samples at 4 degrees Celsius
- o Analyze samples within 6 months of collection

Quality Control:

- o Serious errors may be introduced during sampling and storage by failure to remove residues of previous samples from the sample container; therefore, clean all containers and sampling equipment thoroughly before use.

Hydrazine

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o If the sample cannot be analyzed immediately, collect it under acid. Add 90 ml of sample to 100 ml of (1 + 9) hydrochloric acid: one volume concentrated hydrochloric acid mixed with nine volumes water.

Quality Control:

- o Avoid contacting the sample with oxidizing agents which may diminish the hydrazine content.

Iodide

Apparatus and Materials:

- o Polyethylene or glass containers

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o Store samples at 4 degrees Celsius; analyze within 24 hours of collection

Quality Control:

- o No special precautions

Iodine

Apparatus and Materials:

- o Polyethylene or glass containers

Minimum Volume:

- o 500 mL

Sample Collection, Preservation, and Handling:

- o The samples must be analyzed on site or brought immediately to the laboratory. The maximum holding time is 2 hours.

Quality Control:

- o Iodine determinations must begin immediately after sampling.

Metals (except Chromium VI)

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Nitric acid (1 + 1): Mix equal volumes of concentrated nitric acid, HNO_3 (ACS) with deionized water.
- o Deionized water

Minimum Volume:

- o 200 mL

Sample Collection, Preservation, and Handling:

- o Wash and rinse sample container thoroughly with 1 + 1 nitric acid, then with deionized water before use.
- o For total metals, acidify the sample with 1 + 1 nitric acid to a pH of 2 or less. Normally, 3 ml of 1 + 1 nitric acid per liter should be sufficient to preserve the samples. This will keep the metals in solution and minimize their absorption on the container wall.
- o For dissolved metals, filter samples on site (0.45 μm) before acidification.
- o For suspended metals, filter the sample (0.45 μm) and then collect the filter.
- o Analyze all samples within 6 months of collection. An exception is mercury analysis, which must be completed within 28 days.

Quality Control:

- o Serious errors may be introduced during sampling and storage by failure to remove residues of previous samples from the sample container; therefore, follow the described rinsing procedures for all containers and sampling equipment.

Ammonia Nitrogen

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Concentrated sulfuric acid, H_2SO_4 (ACS)

Minimum Volume:

- o 400 mL

Sample Collection, Preservation, and Handling:

- o In the event that a prompt analysis is impossible, add concentrated sulfuric acid to lower sample pH to less than 2.
- o Analyze all samples within 28 days of collection
- o Store samples at 4 degrees Celsius

Quality Control:

- o The most reliable results are obtained from fresh samples.

Kjeldahl Nitrogen

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Concentrated sulfuric acid, H_2SO_4 (ACS)

Minimum Volume:

- o 500 mL

Sample Collection, Preservation, and Handling:

- o Acidify samples with concentrated sulfuric acid to a pH of 2 or less
- o Store samples at 4 degrees Celsius
- o Analyze all samples within 28 days of collection

Quality Control:

- o The most reliable results are obtained from fresh samples. If prompt analysis is impossible, retard biological activity with the above preservation method.

Nitrate and Nitrite

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Concentrated sulfuric acid, H_2SO_4 (ACS)

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o Store samples at 4 degrees Celsius
- o Analyze all samples within 48 hours of collection
- o If nitrate or nitrate plus nitrite are to be determined, preserve the sample by addition of sulfuric acid to a pH of 2 or less.
- o Do not add sulfuric acid to samples requiring analysis for nitrite only.

Quality Control:

- o Make nitrate and nitrite determinations promptly after sampling.

Oil and Grease

Apparatus and Materials:

- o Glass bottles
- o Concentrated sulfuric acid, H_2SO_4 (ACS)

Minimum Volume:

- o One liter

Sample Collection, Preservation, and Handling:

- o Collect a representative sample in a wide-mouth glass bottle and acidify in the sample bottle with concentrated sulfuric acid to a pH of 2 or less. If other parameters are to be analyzed for, collect a separate sample for the oil and grease determination to avoid subdividing the sample in the laboratory.
- o Store samples at 4 degrees Celsius
- o Analyze all samples within 28 days of collection

Quality Control:

- o Because grease will be lost on sampling equipment, the collection of a composite sample is impractical. Analyze individual portions collected at prescribed intervals separately to obtain the average concentration over an extended period of time.

Method 624: Purgeables

Apparatus and Materials:

- o The water sample is to be collected in two 40-ml vials with Teflon-faced silicone septa and screw caps and maintained at 4 degrees Celsius until the sampler's responsibility has been relieved at the Sample Bank.

o Container Preparation

1. Wash 40-ml vials with screw caps (Pierce No. 13075 or equivalent) and Teflon-faced silicone septa (Pierce No. 12722 or equivalent) separately, using a solution of Alconox detergent or equivalent and hot tap water.
2. Rinse thoroughly with deionized water
3. Place vials, caps, and septa on precleaned aluminum foil (as described above) and bake in an oven for 1 hour at 105 degrees Celsius.
4. Allow the vials to cool with the septa properly inserted and the caps screwed on loosely. Tighten down caps when cool.
5. Store vials in an area not subject to contamination by air or other sources.

Minimum Volume:

- o 40 mL

Sample Collection, Preservation, and Handling:

- o If the sample contains residual chlorine, add sodium thiosulfate as a preservative (10 mg/40 ml is sufficient for up to 5 ppm Cl_2) to the empty sample bottles just prior to shipping to the sampling site.
- o If aromatic compounds such as benzene, toluene, and ethylbenzene are to be determined, one of the following procedures should be used to minimize degradation of these compounds by microbial action.
 - Collect about 500 ml of sample in a clean container. Adjust the pH of the sample to about 2 by addition of 1 + 1 HCl. Cap the container and invert once to mix; check the pH with narrow-range (1.4 to 2.8) pH paper. Transfer the sample to a 40-ml vial as described below. If residual chlorine is present, add sodium thiosulfate to another sample container and fill as described below.

- Alternatively, the addition of the HgCl_2 to the sampling vial (approximately 12 mg per 40 ml vial) has been found to be effective for inhibiting microbial action.
- o The following procedures apply to sampling directly with the sample vial.
 1. Collect a single undisturbed sample of water for the analysis of volatile organics. Submerge the sample vial just below the surface upside down and slowly invert. Try to create as little disturbance as possible while doing this.
 2. Allow the vial to fill and reach equilibrium with its surrounding reservoir for several seconds.
 3. Place the cap over the mouth of the vial so that the septum is properly oriented, and firmly screw down the cap.
 4. Invert the vial to discover any entrapped air bubbles. If such is the case, the sample will be discarded and another 40-ml vial selected and filled.
 5. Collect a replicate sample in accordance with the above instructions.
 - Label the sample vials with the appropriate designated sample tag.
 - Place the properly labeled sample vials in an appropriate carrying container maintained at 4 degrees Celsius throughout the sampling and transportation period.
- o Analyze samples within 14 days

Quality Control:

- o Use standard QA practices with this method. Collect field replicates to validate the precision of the sampling techniques.

- o Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride) through the septum seal into the sample during shipment and storage. A field blank* prepared from organic-free water and carried through the sampling and handling protocol can serve as a check on such contamination.

Method 625: Extractables
(Base/Neutrals, Acids, and Pesticides)

Apparatus and Materials:

- o Sampling equipment for discrete or composite sampling
 - Grab sample bottle - Amber glass, 1- liter to 1-gallon volume. French or Boston Round design is recommended. The container must be washed and solvent- rinsed before use to minimize inter- ferences.
 - Bottle caps - Threaded to fit sample bottles. Caps must be lined with Teflon. Aluminum foil may be substituted if sample is not corrosive.
 - Compositing equipment - Automatic or manual compositing system. Must incorporate glass sample containers for the collection of a minimum of 1000 ml. Sample containers must be kept refrigerated during sampling. No plastic or rubber tubing other than Teflon may be used in the system.

Minimum Volume:

- o One liter

*A field blank is defined as an appropriate volume of "organic-free" water which has been sent to the sampling site and back to the analytical laboratory in a container and bottle identical to the type used to collect the samples. Field blanks and samples must be shipped in separate containers. When received in the lab, the field blank is analyzed as if it were an actual sample.

Sample Collection, Preservation, and Handling:

- o Grab samples must be collected in glass containers. Conventional sampling practices should be followed, except that the bottle must not be prerinsed with sample before collection. Composite samples should be collected in refrigerated glass containers. Automatic sampling equipment must be free of Tygon and other potential sources of contamination.
- o The sample must be iced or refrigerated from the time of collection until extraction.
- o All samples must be extracted within 7 days and completely analyzed within 30 days of collection.

Quality Control:

- o Use standard QA practices with this method.
- o Glassware must be scrupulously clean
 - Clean all glassware as soon as possible after use by rinsing with the last solvent used. This should be followed by detergent washing in hot water. Rinse with tap water, distilled water, acetone, and finally pesticide-quality hexane. Heavily contaminated glassware may require treatment in a muffle furnace at 400 degrees Celsius for 15 to 30 minutes.
 - Some high boiling materials, such as PCBs, may not be eliminated by this treatment.
 - Glassware should be sealed/stored in a clean environment immediately after drying or cooling to prevent any accumulation of dust or other contaminants.
 - Store inverted or capped with aluminum foil.

Method 608: Organochlorine Pesticides and PCBs

Apparatus and Materials:

- o Sampling equipment for discrete or composite sampling:
 - Grab sample bottle - Amber glass, 1-liter or 1-quart volume. French or Boston Round design is recommended. The container must be washed and solvent-rinsed before use to minimize interferences.
 - Bottle caps - Threaded to screw on to the sample bottles. Caps must be lined with Teflon. Foil may be substituted if sample is not corrosive.
 - Compositing equipment - Automatic or manual compositing system. Must incorporate glass sample containers for the collection of a minimum of 250 ml. Sample containers must be kept refrigerated during sampling. No Tygon or rubber tubing may be used in the system.

Minimum Volume:

- o One liter

Sample Collection, Preservation, and Handling:

- o Grab samples must be collected in glass containers. Conventional sampling practices should be followed, except that the bottle must not be prewashed with sample before collection. Composite samples should be collected in refrigerated glass containers. Automatic sampling equipment must be free of Tygon and other potential sources of contamination.
- o The samples must be iced or refrigerated from the time of collection until extraction.
- o Extract all samples within 7 days and completely analyze them within 30 days of collection.

Quality Control:

- o Use standard QA practices with this method.

Hydrogen Ion (pH)

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Electronic pH meter with temperature-compensation adjustment. Glass electrode: Glass electrodes are available for measurement over the entire pH range. Use minimum-sodium-ion-error type electrodes for high-pH, high-sodium samples. Reference electrode: Use calomel, silver-silver chloride, or other constant-potential electrode.
- o Standard buffer solutions of known pH

Sample Collection, Preservation, and Handling:

- o The electrometric measurement of pH is the only method approved by USEPA. The determination should be made on site. The maximum holding time for any sample is 2 hours.
- o Because of the difference between the many makes and models of commercially available pH meters, it is impossible to provide detailed instructions for the proper operation of every instrument.
 - In each case, follow the manufacturer's instructions.
 - 1. Thoroughly wet the glass and reference electrodes by immersing the tips in water overnight or in accordance with instructions. Thereafter, when the meter is not in use for pH measurement, keep the tips of the electrodes immersed in water.
 - 2. Before use, remove the electrodes from the water and rinse with distilled or demineralized water. Dry the electrodes by gently blotting with a soft tissue.

3. Standardize the instrument with the electrodes immersed in a buffer solution with a pH approaching that of the sample and note the temperature of the buffer and the pH at the measured temperature. Remove the electrodes from the buffer, rinse thoroughly, and blot dry.
 4. Immerse in a second buffer approximately 3 pH units different from the first and note the temperature of the buffer and the pH at the measured temperature; the reading should be within 0.1 unit of the pH for the second buffer.
 5. Rinse electrodes thoroughly, blot dry, and immerse in the sample. Agitate the sample sufficiently to provide homogeneity and keep solids in suspension.
 6. If the sample temperature is different from that of the buffers, let the electrodes equilibrate with the sample. Measure the sample temperature and set the temperature-compensator on the pH meter to the measured temperature.
 7. Note and record the pH and temperature.
 8. Rinse electrodes and immerse in water until the next measurement.
- When only occasional pH measurements are made, standardize the instrument before each measurement. Where frequent measurements are made, less frequent standardization (every 1 or 2 hours) is satisfactory.
- However, if sample pH values vary widely, standardize more frequently with a buffer having a pH within 1 to 2 pH units of that sample. Measure with two or more buffers of different pH at least once daily and more frequently if samples contain abrasive solids or dissolved fluorides to check the linearity of response.

When electrode response to two buffers 3 pH units apart show differences greater than 0.1 pH unit, replace the glass electrode.

- Measurements of pH in high-purity waters, such as condensate or demineralizer effluents, are subject to atmospheric contamination and require special procedures for accurate pH measurement.

Quality Control:

- o The glass electrode is relatively free from interference from color, turbidity, colloidal matter, oxidants, reductants, or high salinity except for a sodium error at high pH. This error at a pH above 10 may be reduced by using "low sodium error" electrodes. When using ordinary glass electrodes, make approximate corrections for the sodium error in accordance with information supplied by the manufacturer. Temperature exerts two significant effects on pH measurement.
- o The pH potential, i.e., the change in potential per pH unit, varies with temperature, and ionization in the sample also varies. The first effect can be overcome by a temperature-compensation adjustment provided on the better commercial instruments. The second effect is inherent in the sample and is taken into consideration by recording both the temperature and pH of each sample.

Phenols

Apparatus and Materials:

- o Glass bottles
- o Concentrated sulfuric acid, H_2SO_4 (ACS)

Minimum Volume:

- o 500 mL

Sample Collection, Preservation, and Handling:

- o Acidify sample with concentrated sulfuric acid to a pH of 2 or less.
- o Remove oxidizing agents such as chlorine immediately after sampling by adding an excess of ferrous ammonium sulfate.
- o Store samples at 4 degrees Celsius
- o Analyze all samples within 28 days of collection

Quality Control:

- o Phenols in the concentrations usually encountered in wastewaters are subject to biological and chemical oxidation. It is recommended that preserved and stored samples be analyzed as soon as possible.

Orthophosphate

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 50 mL

Sample Collection, Preservation, and Handling:

- o Filter on site
- o Store samples at 4 degrees Celsius
- o Analyze all samples within 48 hours of collection

Quality Control:

- o Do not store samples containing low concentrations of phosphorus in plastic bottles, because phosphate may be adsorbed onto the walls of the bottles. Rinse all glass containers with hot dilute HCl, then rinse several times in distilled water. Never use commercial detergents containing phosphate for cleansing glassware used in phosphate analyses.

Phosphorus, Total

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Concentrated sulfuric acid, H_2SO_4 (ACS)

Minimum Volume:

- o 50 mL

Sample Collection, Preservation, and Handling:

- o Acidify sample with concentrated sulfuric acid to a pH of 2 or less
- o Store samples at 4 degrees Celsius
- o Analyze all samples within 28 days of collection

Quality Control:

- o Do not store samples containing low concentrations of phosphorus in plastic bottles, because phosphate may be adsorbed onto the walls of the bottles. Rinse all glass containers with hot dilute HCl, then rinse several times in distilled water. Never use commercial detergents containing phosphate for cleansing glassware used in phosphate analyses.

Radioactivity

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Concentrated nitric acid, HNO_3 (ACS)

Minimum Volume:

- o One gallon

Sample Collection, Preservation, and Handling:

- o Acidify samples with concentrated nitric acid to a pH of 2 or less.
- o Analyze all samples within 6 months of collection

Quality Control:

- o The principles of representative water and wastewater sampling apply to sampling for radioactivity examinations. When radioactive industrial wastes or comparable materials are sampled, consideration should be given to the deposition of radioactivity on the walls and surfaces of glassware, plastic containers, and equipment.

Because a radioactive element is often present in submicrogram quantities, a significant fraction of it may be readily lost by adsorption on the surface of containers or glassware used in the examination. This may cause a loss of radioactivity and possible contamination of subsequent samples due to reuse of inadequately cleansed containers.

Silica

Apparatus and Materials:

- o Polyethylene bottles

Minimum Volume:

- o 50 mL

Sample Collection, Preservation, and Handling:

- o Collect samples in bottles of polyethylene plastic only; do not use glassware for any sample handling.
- o Store samples at 4 degrees Celsius
- o Analyze all samples within 28 days of collection

Quality Control:

- o If samples are stored in glass, silica may leach into the sample and raise concentrations. Therefore, glassware cannot be used.

Solids

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o Store samples at 4 degrees Celsius
- o Analyze samples within the following times according to the analysis to be performed:

Dissolved	7 days
Volatile Dissolved	7 days
Suspended	7 days
Volatile Suspended	7 days
Total	7 days
Volatile Total	7 days
Settleable	48 hours

Quality Control:

- o Sample should be analyzed as soon as possible after collection for best results.
- o Exclude unrepresentative particles such as leaves, sticks or large solids.
- o Glass bottles are preferred. Plastic bottles are satisfactory provided that the material in suspension in the sample does not adhere to the walls of the container. Store samples that are likely to contain iron or manganese so that oxygen will not come into contact with the water. Analyze these samples promptly to minimize the possibility of chemical or physical change during storage.

Sulfate

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 50 mL

Sample Collection, Preservation, and Handling:

- o In the presence of organic matter, certain bacteria may reduce sulfate to sulfide. To avoid this, store samples at 4 degrees Celsius.
- o Analyze all samples within 28 days of collection

Quality Control:

- o No special precautions

Sulfide

Apparatus and Materials:

- o Polyethylene or glass bottles
- o Zinc Acetate [$\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2$], 2 N
- o Sodium hydroxide (NaOH), 6 N

Minimum Volume:

- o 500 mL

Sample Collection, Preservation, and Handling:

- o Take sample with a minimum of aeration. Preserve sample by addition of 2 ml of 2N zinc acetate; raise pH to 9 using NaOH. Fill sample bottle completely allowing no headspace.
- o Store sample at 4 degrees Celsius
- o Analyze all samples within 7 days of collection

Quality Control:

- o It is important that all sample bottles be airtight with no entrapped air.

Sulfite

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 50 mL

Sample Collection, Preservation, and Handling:

- o Collect a fresh water sample and allow as little contact with air as possible, as air will oxidize the sulfite to sulfate.
- o Analyze all samples on site

Quality Control:

- o It is important that all sample bottles be airtight with no entrapped air.

Surfactants

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 250 mL

Sample Collection, Preservation, and Handling:

- o Store samples at 4 degrees Celsius
- o Analyze all samples within 48 hours of collection

Quality Control:

- o No special precautions

Total Organic Carbon (TOC)

Apparatus and Materials:

- o Glass bottles with Teflon-lined caps
- o Concentrated hydrochloric acid, HCl (ACS)

Minimum Volume:

- o 40 mL

Sample Collection, Preservation, and Handling:

- o Acidify samples with concentrated hydrochloric acid to a pH of 2 or less.
- o Store samples at 4 degrees Celsius
- o Analyze all samples within 28 days of collection

Quality Control:

- o Avoid exposure of the sample to light and atmosphere; minimize storage time.

Total Organic Halide (TOX)

Apparatus and Materials:

- o Glass bottles, amber, with Teflon-lined caps
- o Sodium sulfite, Na_2SO_3 , 0.1 M

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o If amber glass bottles are not available, samples should be protected from light.
- o Samples should be stored at 4 degrees Celsius without headspace.
- o Reduce residual chlorine by the addition of 1 mL of 0.1 M sodium sulfite per liter of sample.

- o TOX may increase with storage; therefore, samples should be analyzed as soon as possible after collection. Maximum holding time should not exceed 7 days.

Quality Control:

- o Glassware used in TOX sampling and analysis must be thoroughly cleaned. All glassware should be washed using detergent and hot water, rinsed with tap water, and as a final rinse, deionized water. Drain dry and heat at 105 degrees Celsius for 1 hour. Glassware should be sealed and stored in a clean area after drying and cooling.

Turbidity

Apparatus and Materials:

- o Polyethylene or glass bottles

Minimum Volume:

- o 100 mL

Sample Collection, Preservation, and Handling:

- o Store samples at 4 degrees Celsius
- o Analyze all samples within 48 hours of collection

Quality Control:

- o Turbidity analysis should be performed on the day the sample is taken. If longer storage is unavoidable, store samples in the dark for up to 48 hours. Prolonged storage before measurement is not recommended because irreversible changes in turbidity may occur.

5.0 SPECIFIC SAMPLING METHODS

This section outlines some specific methods for taking samples and guidelines for their use. For more information, consult the Technical Training Manuals or personnel in Field Technical Services.

5.1 LIQUID SAMPLES

The following discussion of liquid sampling deal with ground-water, surface-water, waste-pond, and lagoon sampling. Sampling of containerized liquids is addressed in Sections 6.0, Drum Sampling, and 7.0, Tank Sampling.

5.1.1 Ground-Water Sampling

Ground-water samples may either be samples of leachate, such as water from a spring or excavation, or samples from a monitoring well. Both are discussed below.

5.1.1.1 Leachate Sampling

A leachate sample is one obtained from liquid leaching from a river bank, hillside, or excavation. The size and type of container to be used depends on the type of analysis to be performed. Wearing clean sample gloves, obtain sample as close to leachate source as possible. Exercise caution to minimize the amount of soil or foreign matter in the sample. Seal the sample container with a clean Teflon liner and cap. Label the container immediately, identifying the sample location, time, date, and persons performing sample operation. Record the sample in the sample log, and assign it a sample number. Enter the following pertinent information concerning the sample in the sample notes:

1. Accurate description of sample location
2. Color and viscosity of leaching material
3. Estimate of rate of leaching
4. Unusual odor
5. Immiscible organics in leachate, etc.

NOTE: Upon observation of liquid leaching from an embankment, immediately inform supervisor and technical foreman of the situation before obtaining a sample.

5.1.1.2 Monitoring-Well Sampling

The following general sequence of events should be followed whenever a monitoring well is being sampled. Once the locking cap has been removed, the air above the well head should be sampled to determine the potential for fire, explosion, and/or toxic effects on workers.

This test also serves as a first indication of the presence of immiscible organics. An electronic or acoustical sounder may provide an accurate reading of the depth to the surface of the liquid in the well, but neither are capable of defining immiscible organic layers. The interface probe, however, is able to detect and measure layers of light immiscible organics, floaters and dense immiscible organics, or sinkers. The depth to water and thickness of any immiscible layers are measured as accurately as possible.

Sampling of immiscible fractions should precede well-evacuation procedures. A bottom-filling bailer should be lowered to the levels at which the light and dense phase immiscibles are found and a sample taken. Care should be taken to lower the bailer gently to avoid disturbing the interface between the organic liquid and water as much as possible.

The standing water in the well is generally not representative of the in situ ground-water quality. Therefore, the standing water should be removed so fresh formation water can replace it.

The procedure for well evacuation depends on the yield of the well. If prior data on the yield of a particular well is not available, then one will need to determine the yield of the well in the course of evacuation. When evacuating a low-yield well, the well should be evacuated to dryness once. As soon as the well recovers, the first samples taken should be the ones to be tested for volatilization-sensitive parameters (eg., total organic halogens). The remaining samples should be drawn in order of their volatility.

For high- and medium-yield wells, three casing volumes should be evacuated prior to sampling at a rate which does not cause excessive agitation of the recharge water.

Once sufficient time has been allowed for the well to stabilize, sample collection can begin.

The technique used to withdraw a ground-water sample from a well should be selected based on a consideration of the parameters which will be analyzed in the sample. To ensure the ground-water sample is representative of the formation, it is important to avoid physically altering or chemically contaminating the sample during the withdrawal process. To minimize the possibility of sample contamination, Teflon or stainless-steel (316) sampling devices should be used.

Sampling equipment with neoprene fittings, PVC bailers, tygon tubing, silicon rubber bladders, neoprene impellers, polyethylene, and viton are not acceptable. Samplers should be dedicated to the wells whenever possible. If dedicated sampling equipment is not used, the equipment must be fully disassembled and decontaminated.

Once the sample has been drawn from the well, the sample should be directly transferred into the sample container that has been specifically prepared for that given parameter or set of compatible parameters. Many of the parameters that are included in ground-water-monitoring programs are not stable and therefore require sample preservation.

After sampling is complete, measurements are typically made of several ground-water parameters such as pH, temperature, dissolved oxygen, conductivity, and redox potential.

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

- o Sample identification number
- o Name of collector
- o Date and time of collection
- o Place of collection
- o Parameter(s) requested (if space permits)
- o Preservatives

In cases where samples leave the sampler's immediate control (e.g., shipment to a laboratory by a common carrier like an air freight service), a seal should be provided on the shipping container or individual sample bottles to ensure the samples have not been disturbed during transportation.

To establish the documentation necessary to trace sample possession from time of collection, a chain-of-custody record should be filled out and accompany every sample. The record should contain the following information:

- o Sample number
- o Signature of collector
- o Date and time of collection
- o Sample type (e.g., ground water, immiscible layer)
- o Well identification number
- o Preservation
- o Number of containers and type

5.1.1.3 Well Headspace/Organic Vapor Scan

It is not uncommon around tank farms and hazardous-waste sites for there to be organic vapors, even at explosive concentrations, in the soil and in the headspace of wells placed in the area.

For this reason, the headspace of each well on site should be monitored for organic vapors and explosivity. This should be done, as a minimum, at the beginning of the job. If the initial results are negative and there is no reason to suspect that there will be an increase in organics in the soil or ground water, monitoring may be discontinued. All results should be reported in the field log. High organic-vapor readings in the well head may necessitate an increase in the level of protection required for the sampling team.

The sampler designated to perform ground water sampling should keep an up-to-date field logbook which documents the following:

- o Identification of well
- o Well depth
- o Static-water-level depth and measurement technique
- o Presence of immiscible layers and detection method
- o Well yield - high or low
- o Collection method for immiscible layers and sample identification numbers
- o Well-evacuation procedure/equipment
- o Sample-withdrawal procedure/equipment
- o Date and time of collection
- o Well sampling sequence
- o Types of sample containers used and sample identification numbers
- o Preservative(s) used
- o Parameters requested for analysis
- o Field analysis data and method(s)
- o Sample distribution and transporter
- o Field observations on sampling event
- o Name of collector
- o Number of containers
- o Signature of person(s) involved in the chain of possession
- o Inclusive dates of possession

Blanks should be used to verify that the sample collection and handling process has not affected the quality of the field samples. One trip blank and one equipment blank should be analyzed per parameter.

Trip blanks are used to determine if contamination is introduced from the sample containers. Equipment blanks are used to determine if contamination is introduced by the sample-collection equipment.

The field instruments which will likely be available for use include the HNU PID, OVA, and MSA Model 2a Explosimeter.

Since the HNU 101 PID is not intrinsically safe, the air in the well head should first be tested with an explosimeter.

5.1.1.4 Static-Liquid-Level Determination

The depth to water in the well must be measured to calculate the well casing volume for purging and is also important to any hydrological interpretations of the analytical results. (Note: All water-level measurements used to construct a single piezometric surface should have been made within a 24-hour period.) Depths to water are measured with respect to the top of casing, as in well-depth determinations.

Several methods are available including: the electric sounder and the popper (sounder). The electric sounder, although not the most accurate, is recommended for initial site work because of the minimal potential for equipment contamination and simplicity of use. Electric sounders usually consist of a conductivity cell at the end of a graduated wire and a battery powered buzzer. When the cell contacts the water, the increased conductivity completes the circuit and allows current to flow to the alarm buzzer. The depth to water can then be read from the graduations on the wire or the wire can be measured directly. This device may not be suitable for use if a potentially flammable or explosive layer is present in the well, unless it is an intrinsically safe version.

Sinco Water-Level Indicators

Additional Equipment Needed:

- o Sample gloves - to avoid coming in direct contact with contaminant
- o Measuring Tape - preferable in hundreths of a foot. A 5-foot section will be sufficient since the water-level indicator cord is marked every 5 feet by a metal ring.

- o Cleaner - for removing contaminant from line (type differs on each project)
- o Roll of Paper Towels - used to wipe off the probe and cord after each water level is taken to reduce the possibility of cross contamination
- o Visqueen - used to place equipment on a clean surface; the water level indicator should never be placed on the ground

Steps for checking water levels in monitoring wells:

1. Turn indicator on and press test button to check if battery is functional (buzzer will sound when functional).
2. Remove the cap on well casing.
3. Put sample gloves on.
4. Slowly lower the probe down the well casing.
5. The buzzer will sound as the probe hits the water. When the buzzer sounds, slowly pull the cord up until the buzzer fades completely out.
6. When the buzzer fades completely out, "pinch" the cord where it meets the top of the casing. (Note: Measurements are to be taken from the same position on top of the casing every time a measurement is taken.) The measurements should be accurate at least to the nearest 0.1 foot. Each well should have a reference point from which its water-level measurement is taken. This reference point should be established by a licensed surveyor and is typically located at the top of the well casing with locking cap off. This position will be marked, by the rodman, when the elevation for the top of the casing is "shot" and will be marked using a permanent marker. If it is not marked, mark it the first time you take a water level. This process will prevent any deviations in measurements.
7. Measure from where you are pinching the cord to the closest metal ring toward the probe. Add this measurement to the number shown on the ring.

The total is the number of feet from the top of the casing to the water surface. (This figure will later be subtracted from the top-of-casing elevation, and the end result will be the elevation of the water.)

8. After the measurement is taken, reel the cord in, wiping it off with paper towels and cleaner. (You should have a container of some sort to discard used sample gloves and paper towels.)
9. Place cap back on casing.
10. Record the results on field sheet.
11. Proceed to the next sample point.

Poppers

The metal tape and popper is another simple and reliable method for measuring depth to water in wells more than 3.8 cm (1.5 in.) in diameter. The popper is a metal cylinder with a concave undersurface fastened to the end of the metal tape. The procedure for using a popper is as follows:

1. Lower the popper until it hits the water surface, making a distinct "popping" sound.
2. Adjust the tape length so that the popper just hits the water surface.
3. Read the depth to water from the tape measure.
4. After the measurement is taken, reel the tape in, wiping it off with paper towels and cleaner. Decontaminate the popper before proceeding to the next point.
5. Place cap on casing.
6. Record the results on field sheet.

"Water finder" paste, a colorimetric water indicator, is not to be used at all in a monitoring well.

5.1.1.5 Immiscible Layer Determination and Sampling

The first indicators of the possibility of measurable layers of immiscible organics, "floaters" or "sinkers", in the ground water are site history and site surroundings.

Spills and leaking underground tanks or pipes, as well as deliberate dumping, or the suspicion of any of these should cause one to suspect an immiscible layer.

Another indication is a reading with a photoionization detector or OVA that indicates organic contaminants in the well headspace at greater than background concentrations.

The presence of immiscible organics may be confirmed by the use of an interface probe or by sampling the very top and very bottom of the liquid column in the well with a bailer.

Once an immiscible layer is discovered, it must be measured and sampled before the well may be purged for ground-water sampling. Measurement with the interface probe is straightforward. The layer may also be captured in a bailer and measured.

A Teflon bailer should be dedicated to sampling immiscible layers. It should not be used for sampling ground water. The bailer should be lowered gently so it will not cause unnecessary mixing between the layers.

5.1.1.6 Well Evacuation

To obtain a representative sample of the ground water, it must be understood that the composition of the water within the well casing and in close proximity to the well is probably not representative of the overall ground-water quality at that sampling site. This is because of the possible presence of drilling contaminants near the well and because important environmental conditions such as the oxidation-reduction potential may differ drastically near the well from the conditions in the surrounding water-bearing materials.

While water within the screened portions of a non-pumping well may experience a continued exchange with formation water because of natural flow within an aquifer, limited vertical mixing of water occurs in the casing above the screens. Thus, water standing within a non-pumping well will tend to stratify and stagnate with time.

Stagnant water in a monitoring well can develop substantially different chemical characteristics than ground water in the formation surrounding the well. Changes in the concentration of dissolved gases in the water within the well can occur. This is caused by exchange of gases across the interface between water and the atmosphere within the well.

The result can be change in a redox condition and the pH in the well. This change can be accompanied by changes in the chemical species present, precipitation or dissolution of metals, and the removal or addition of constituents due to subsequent sorption reactions.

The chemical quality of water standing in contact with well materials such as the casing, screen, or grouting for long periods of time may also be altered by leaching or adsorption of constituents from those materials. Biological activity within the well may affect certain chemical parameters as well. A common example would be sulfate reducing or iron bacteria that can be responsible for the formation of iron sulfide and iron hydroxide in the well. These compounds may then absorb selected constituents. Biological activity may also be responsible for the degradation of certain constituents.

The first step in purging a well is the calculation of the volume of stagnant water stored in the well casing. The required data are well-casing radius, depth to well bottom (DTB), and depth to water (DTW). One must be careful that the screen radius is the same as the casing radius. This may very well not be the case for a production well (which would only need purging if it had not been pumping for half a day or so). When this is the case, the depth of the transition to a larger-diameter screen must be obtained from the drilling log. The casing volumes must then be calculated for the two sections and added together. The height (h) of the water column is $DTB - DTW$. The casing volume is then $V = r^2 h$.

The next step is to purge the well by pumping or bailing. Any equipment used to evacuate a well must be thoroughly decontaminated prior to use.

The most efficient way to purge a well is by pumping from near the top of the water column. This causes the stagnant water in the casing above the screens to be removed first. When the water level in the well has stabilized, virtually all the water being removed from the well is coming from the aquifer rather than from storage in the well. Using a bailer for well purging also removes the water from the top of the column.

A further point is that the amount of water purged and the rate of purge, if feasible, should be tracked during purging operations. If a bailer is used, one may count the number of full bailers withdrawn. The capacities of the Teflon bailers used by OHM are 350, 710, and 1075 ml. The bailer may also be emptied into a graduated bucket.

When using a pump without a known flow rate, pump into a container that is graduated or has a known volume. When using a pump with a known flow rate, keep track of the volume purged by tracking the time.

Next, it is important to note whether the water level in the well drops significantly during purging. If it does not, record in the notes "high yield - recovers immediately at ___gpm purge rate". Then proceed to pump out three well casing volumes.

If there is a significant drop in the water level, one should look for it to stabilize. If the water level stabilizes at the well screen, however, care must be taken to ensure that water does not cascade down the screen and cause loss of volatiles or absorption or desorption of gases (which could affect pH and pH-sensitive parameters). If this happens, reduce the pumping rate.

When the water level has stabilized, measure the new DTW and record it, along with the purging rate in the field logbook. Then proceed to purge a total of three casing volumes from the well.

The best situation to encounter is when one can pump the well dry without pumping at a rate which would cause loss of volatiles in the water coming into the well. This ensures complete removal of stagnant water.

After the well has been completely or nearly completely evacuated, the new DTW is measured and recorded. The elapsed time and new DTW should be recorded again when the water level has risen about 1 foot. If the well recovers to half of its static volume within a reasonable period of time, it should be evacuated again. When recovery allows, volatilization sensitive parameters should be sampled for. When full recovery time exceeds 3 hours, the remaining samples should be taken as soon as there is sufficient volume.

5.1.1.7 Well Purging and Sampling Equipment

EPA recommends the use of positive gas displacement Teflon bladder pumps, Teflon bailers, and stainless-steel bailers for purging and sampling wells. When these are not available or are impractical, peristaltic, gas lift or centrifugal pumps may be used for purging. However, a period of time must be allowed before sampling to let the water stabilize. Peristaltic, gas lift, and centrifugal pumps should not in most instances be used at all for sampling. Purging equipment must be decontaminated between wells or must use dedicated tubing.

Bailer

The bailer is one of the oldest and simplest methods available. It consists of a container attached to a cable which is lowered into the well to retrieve a sample. Bailers can be of various designs. The simplest is a weighted bottle or basally-capped length of pipe which fills from the top as it is lowered into the well. Top-filling bailers are acceptable for well purging but not for sampling. More sophisticated bailers (see Figure 5.1) have a check valve located at the base which allows water to enter from the bottom as it is lowered into the well. When the bailer is lifted, the check valve closes, allowing water in the bailer to be brought to the surface.

More sophisticated bailers are available that remain open at both ends while lowered into the well, but can be sealed at both top and bottom by activating a triggering mechanism from the surface. This allows more reliable sampling at discrete depths within a well. Perhaps the best known bailer of this design is the Kemmerer sampler.

Bailers generally provide an excellent means for collecting samples from monitoring wells. They can be constructed from a wide variety of materials compatible with the parameter of interest. Only Teflon and stainless-steel bailers are acceptable for all parameters. Since they are relatively inexpensive, bailers can be easily dedicated to an individual well to minimize cross contamination during sampling. If not dedicated to a well, they can be easily cleaned to prevent cross contamination. Nylon sample string is commonly used to raise and lower bailers. Monofilament line (fishing line), however, is more acceptable.

Suction Pumps

As the name implies, suction pumps operate by creating a partial vacuum in a sampling tube. This allows the pressure exerted by the atmosphere on the water in the well to force water up the tube to the surface. Accordingly, these pumps are located at the surface and require only that a transmission tube be lowered into the well. Unfortunately, their use is limited by their reliance on suction to depths of 20 to 25 feet, depending on the pump. In addition, their use may result in out-gassing of dissolved gases or volatile organics and is therefore limited in many sampling applications. In spite of this, suction methods may provide a suitable means for well evacuation, since the water remaining in the well is left reasonably undisturbed.

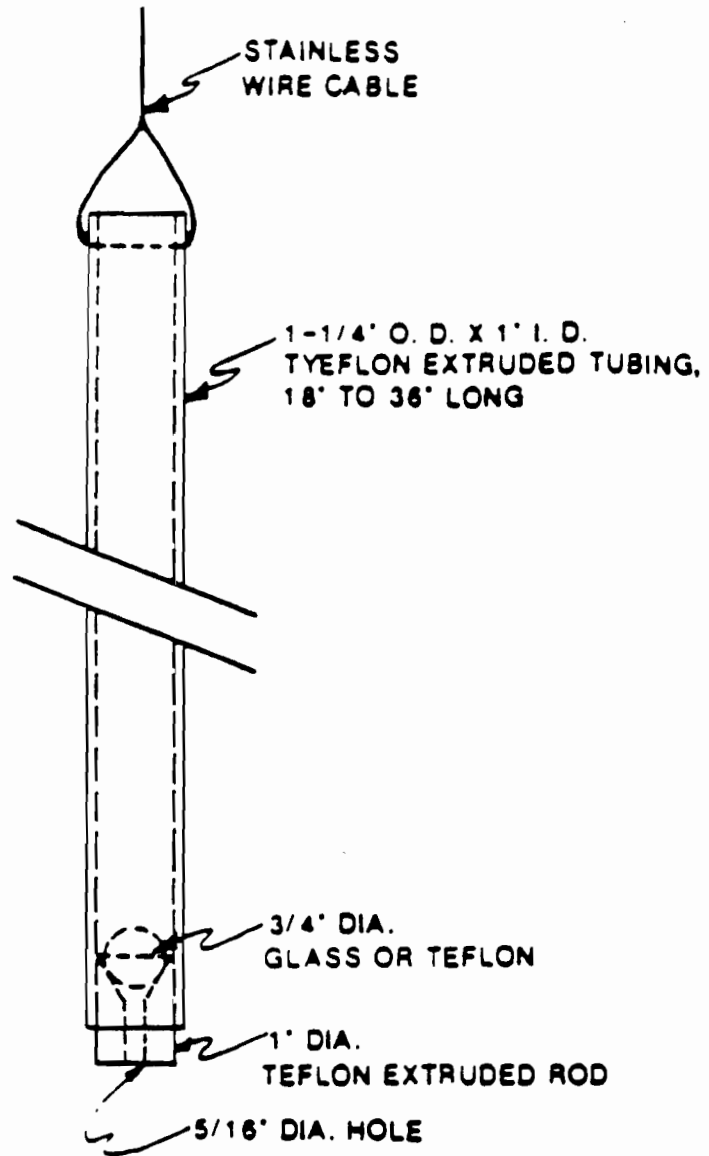


FIGURE 5.1

TEFLON BAILER

A variety of pumps are available that operate on this principle, but the most commonly suggested ones for monitoring purposes are the centrifugal and peristaltic pumps.

In the centrifugal pump, the fluid is displaced by the action of an impeller rotating inside the pump chamber. This discharges water by centrifugal force. The resulting pressure drop in the chamber creates a suction and causes water to enter the intake pipe in the well. These pumps can provide substantial yields and are readily available and inexpensive. The disadvantages are that they require an external power source and may be difficult to clean between sampling events. In addition, the materials with which these pumps are constructed may frequently be incompatible with sampling certain constituents. However, their substantial pumping rates make them suitable for well evacuation.

Peristaltic pumps operate in a similar manner to centrifugal pumps but displace the fluid by mechanical peristalsis. A flexible transmission line is mounted around the perimeter of the pump chamber, and rotating rollers compress the tubing, forcing fluid movement ahead (the peristaltic effect) and inducing suction behind each roller. This design isolates the sample from the moving part of the pump and allows for easy cleaning by removal and replacement of the flexible tubing. Unfortunately, peristaltic pumps are generally capable of providing only relatively low yields. They are, therefore, not well suited for well evacuation.

5.1.1.8 Positive Displacement Pumps

A variety of positive-displacement pumps are available for use in withdrawing water from wells. These methods use some pumping mechanism placed in the well that forces water from the bottom of the well to surface by some means of positive displacement. This minimizes the potential for aerating or stripping volatile organics from the sample during removal from the well.

The submersible centrifugal pump is one common example of a positive-displacement pump. It works in a similar manner to the centrifugal suction lift pump previously described except the pump and electric motor are lowered into the well. As the impeller rotates and fluid is brought into the pump, fluid is displaced up the transmission line and out of the well.

These pumps are capable of providing a high yield. They require an external source of power, however, and are frequently constructed with materials and contain lubricants incompatible with sampling certain constituents, particularly organics.

They require considerable equipment and effort to move from well to well. Cleaning between sampling events is also difficult, and until recently, they have not been available for well diameters less than 3 inches.

Several manufacturers are marketing submersible pumps specifically designed for ground-water monitoring. They are generally capable of fitting down 2-inch ID wells. Most of these pumps have effective depth limitations of less than 150 feet. Although some can operate to depths greater than 300 feet, they usually have substantially reduced discharge flows and significant power consumption. All electrically powered equipment should be checked for electrical safety certification (UL, FM, NFPA, NEC).

Piston-driven or reciprocating-piston pumps are another example of common positive-displacement pumps. These pumps consist of a piston in a submerged cylinder operated by a rod connected to the drive mechanism at the surface. A flap valve or ball-check valve is located immediately above or below the piston cylinder. As the piston is lowered into the cylinder, the check valve opens and water fills the chamber. On the upstroke, the check valve closes and water is forced out of the cylinder up into the transmission line and to the surface. The transmission line or piston contains a second check valve that closes on the down stroke, preventing water from reentering the cylinder. These pumps are capable of providing high yields. However, moving these pumps from well to well is difficult, and their use in monitoring programs may require that a pump be dedicated to each well. Many of these pumps may not be constructed with materials compatible with monitoring certain constituents.

A special adaptation of this pump has recently become available for use in ground-water monitoring. These piston-pumps use compressed gas rather than a rod connected to a driving mechanism at the surface to drive the pistons. This provides a much more convenient and portable means for collecting samples from monitoring wells. They provide good yields and can be constructed with materials compatible to many sampling programs.

Another positive-displacement pump applicable for monitoring purposes is the gas-operated squeeze pump or bladder pump. This pump was originally developed by R. F. Middleburg of the United States Geological Survey (USGS) and consequently is referred to as the Middleburg pump. It consists principally of a collapsible membrane inside a long, rigid housing, compressed gas supply, and appropriate control valves. When the pump is submerged, water enters the collapsible membrane through the bottom check valve.

After the membrane has filled, gas pressure is applied to the annular space between the rigid housing and membrane, forcing the water upward through a sampling tube. When the pressure is released, the top check valve prevents the sample from flowing back down the discharge line, and water from the well again enters the pump through the bottom check valve.

Gas-operated squeeze pumps offer a number of advantages for use in ground-water-monitoring programs. They can be constructed in diameters as small as 1 inch and from a wide variety of materials. They are also relatively portable and are capable of providing a fair range of pumping rates. Most importantly, the driving gas does not contact the water sample, thus eliminating possible contamination or gas stripping. However, they do require a gas source, and withdrawal of water from substantial depths may require large gas volumes and long pumping cycles.

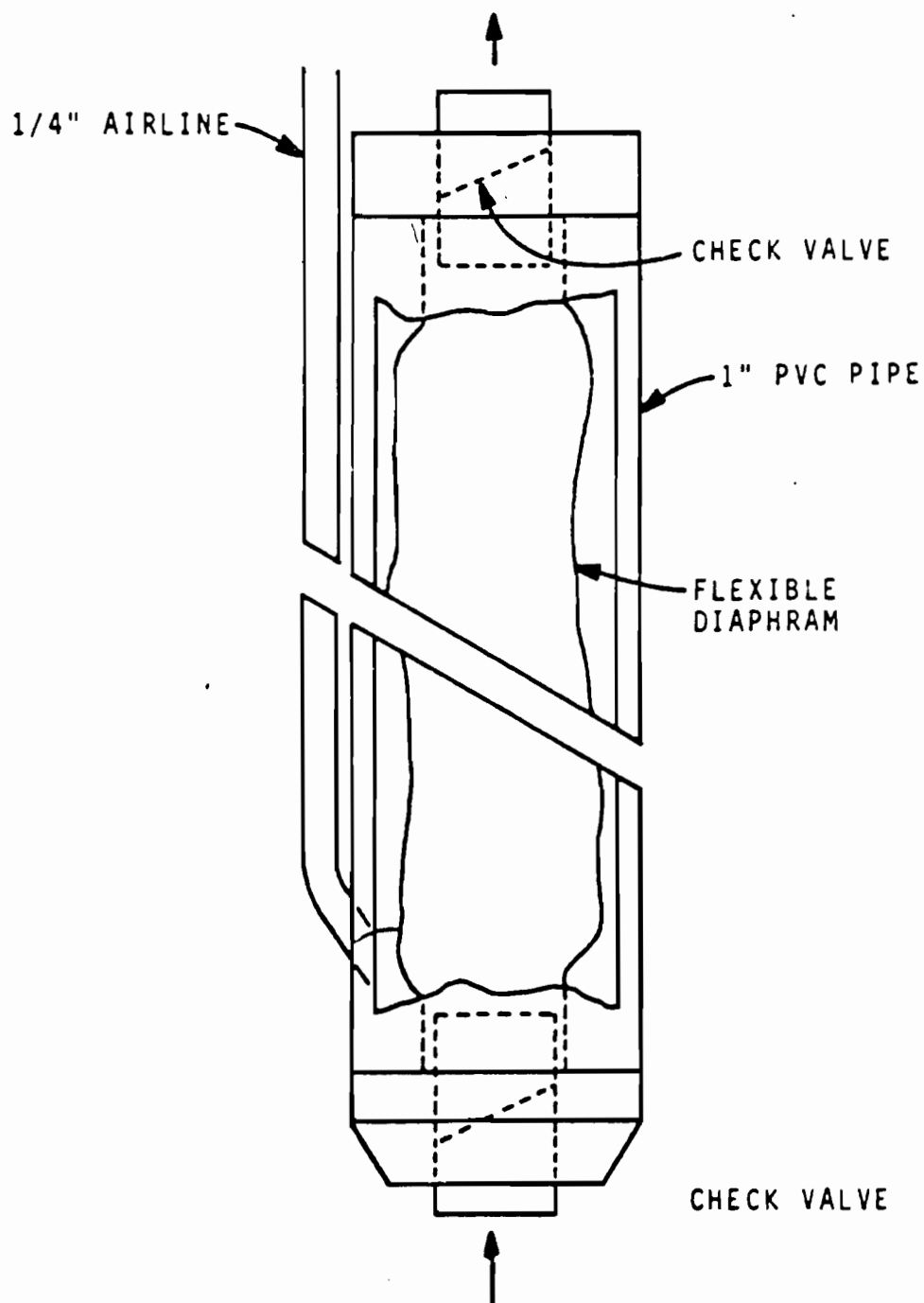
5.1.1.9 Sampling and Purging Equipment Decontamination

When dedicated equipment is not used for sampling (or well evacuation), the sampling plan should include procedures for disassembly and cleaning of equipment before each use. If the constituents of interest are inorganic, the first rinse should be with dilute (0.1 N) hydrochloric acid or nitric acid, the second rinse should be with tap water, and the third with distilled water or deionized water. Dilute hydrochloric acid is generally preferred to nitric acid when cleaning stainless steel because nitric acid may oxidize stainless steel. When organics are the constituents of concern, the sampler should wash equipment with a nonphosphate detergent and rinse with tap water, distilled water, acetone, and finally pesticide-quality hexane, in that order. The sampling equipment should be thoroughly dried before use to ensure that the residual cleaning agents (e.g., acetone, hexane) are not carried over to the sample.

- o Clean sampling equipment should not be placed directly on the ground or other contaminated surfaces prior to insertion into the well.
- o Sampling equipment may be wrapped in tinfoil (unless aluminum is an analyte or an interference) or placed in a clean plastic bag (unless phthalate esters or the plastic monomer are analytes or interferences) after decontamination.

5.1.1.10 In Situ or Field Analyses

Several parameters are physically or chemically unstable and must be tested either in the borehole using a probe (in situ) or immediately after sample collection using a field test kit.



Gas-Operated Squeeze Pump

SITE: _____

[illegible]

Examples of unstable parameters include pH, redox potential, chlorine, dissolved oxygen, and temperature. Although specific conductivity (analogous to electrical resistance) is relatively stable, it is recommended that this characteristic be determined in the field. Most conductivity instruments require temperature compensation, therefore, temperatures of the sample should be measured at the time conductivity is determined.

If the sampler uses downhole probes (pH electrode, specific ion electrode, thermistor) to measure any of the above parameters, it is important that this is done after well evacuation and after any samples for chemical analysis have been collected so that the probe(s) do not contaminate the sample designated for laboratory analysis.

Similarly, if the unstable parameters are to be determined in a sample withdrawn from a well, the sampler should take a separate sample for field testing. Monitoring probes should not be placed in containers containing ground water for laboratory analysis.

5.1.1.11 Field QA/QC Program

The fundamental purpose of the Field QA/QC Program is the continuing assurance of reliability and validity of data and samples gathered as part of the overall ground-water-monitoring program. The most important aspect of field QA/QC is the development and implementation of the sampling plan. If this is done properly, it should ensure consistent quality results. The sampling plan should address all of the aforementioned issues as well as those which are traditionally thought of as part of QA/QC.

Background Determination

To evaluate ground-water contaminant data, it is necessary to obtain good data on the background levels of the contaminants of interest. This is accomplished by installing at least one monitoring well/well cluster upgradient of the source of contamination and sampling it periodically. If a well cluster is installed for background determination, comparisons between background and downgradient contaminant concentrations should be made within stratigraphic horizons as much as possible.

The use of only one monitoring well/well cluster upgradient for determination of the background characteristics of the groundwater on a site may result in important variations in these characteristics being missed.

Use of more than one upgradient well for background determination is recommended and will indeed be necessary for adequately constructing a piezometric surface.

Additional information on background characteristics of ground water can sometimes be obtained from downgradient wells. In the case where a spill has recently occurred and the site history is free of incidents which would have left the site globally contaminated, it is common OHM practice to install wells downgradient of the spill until a "clean" zone around the spill is defined. These wells are then monitored for intrusion of the contaminant(s) into the clean zone. These "clean zone" wells may, at least initially, provide further data on background ground-water quality.

If a plan for biological treatment of the ground water is to be developed later, it will be important to have good information on background levels of several parameters, including pH, temperature, dissolved oxygen, aerobic heterotroph concentration (plate count), ammonia nitrogen, nitrate nitrogen, and phosphorus as phosphate. Since there might be important spatial variations or variations between stratigraphic horizons in these parameters, it is important that samples from as many "background" wells as possible be taken.

Of course, whatever the exact purpose of background sampling, more data points will make the numbers more reliable.

Order of Sampling

One important aspect of the conduct of a sampling program is the order in which the monitoring wells are sampled. As much as possible, monitoring wells should be sampled starting with the least contaminated and ending with the most contaminated. This should also be the order for static-water-level determination and well purging. This is done to minimize crosscontamination between wells.

While sampling wells in the proper order does reduce cross contamination, it does not eliminate the need to decontaminate purge and sampling equipment.

Other QA Issues

In addition to the above mentioned points, standard QA should be followed, including use of blanks and duplicates.

5.1.2 Stream Sampling

To obtain a sample from a stream, take proper precautions to avoid cross contamination of the sample. If it is necessary to enter the stream, enter from the sample point. However, use of a pond sampler (Section 5.1.5.2) should make entry unnecessary in most cases.

Put on a clean pair of sample gloves just prior to sampling, using caution to ensure that the sample gloves come into contact with only the sample container and water being sampled.

The sample container type and size is dependent on the type of analysis to be run on the sample. Dip the sample container into water upstream from the sampler, and rinse it out downstream of the sampler. Lower the jar in an inverted position to just below the surface of the water and slowly turn it over, allowing it to fill with minimum turbulence. Dry it with paper towels and label it before proceeding to the next sample location. If a series of samples must be taken at increments in the same stream, sampling should begin at the furthest point downstream, and the sampler should work his way upstream until he has sampled all points.

The sampler must take at least one sample upstream of the source of contamination to establish the background level for the contaminant(s) of interest. Also, sufficient downstream samples should be taken to establish the area in which the contaminant concentration drops to an acceptable level. NOTE: At no time should a sample be taken from the assigned sample point if the sampler accidentally walked upstream of the point. The sample should be taken at the closest location upstream for the sample point which has not been entered. This change in sample location should be noted and the sample labeled accordingly.

5.1.3 Surface Run-Off Sampling

Surface run-off sampling procedures are very similar to procedures used for sampling a stream. Acquire a series of surface run-off samples by beginning downstream from the run-off and proceeding upstream.

Because most surface run-off is relatively shallow, use caution to minimize the amount of soil and foreign matter in the sample. Enter an accurate description of sample locations in the sample notes.

5.1.4 Standing Surface-Water Sampling

When taking a standing surface-water sample, it is very important to avoid cross contamination. Use clean sample gloves, containers, and sampling devices. At no time should the sampler or witness enter the body of standing water. Use either a pond sampler (preferred) or a peristaltic pump such as the Isco or Little Giant. Label the sample immediately. Record the exact location of the sample and the method of sampling in the sampling notes.

5.1.5 Pond or Lagoon Sampling

There are two types of samplers for pond or lagoon sampling: the bacon bomb sampler and the pond sampler. Typically composite samples are taken with these samplers.

5.1.5.1 Bacon Bomb Sampler

The bacon bomb sampler (see Figure 5.2) is designed for obtaining liquid depth composites or discrete depth samples from tank trucks, above- and belowground storage tanks, railroad tank cars, test wells, etc. It consists of a stainless-steel or Teflon cylinder with a hole at the bottom and a weighted plunger to plug the hole (Section 5.1). The plunger protrudes through the top of the cylinder. There is a hole at the top of this rod where string can be tied to operate the plunger while sampling.

To use the bacon bomb, attach to the top of the bacon bomb a wire that is long enough to reach the maximum desired depth in the tank. After the wire is connected, tie a piece of string to the rod which operates the plunger. The wire should be marked off in 1-foot increments or depths which will be needed for a representative sample of the container in question. After connecting the premarked wire and the string, lower the bacon bomb by the wire, to the premarked depth. At this time, give the string a smooth, even tug. Repeat at each depth until the bacon bomb is full or you reach the bottom of the tank. Then pull up the bomb and unload into a sample jar by holding it above the jar and holding the plunger open with the string.

It is important that the surface of the liquid be visible to the sampler using the bacon bomb, because when the liquid flows into the device, air is forced out the top.

The absence of air bubbles rising to the surface of the liquid lets the sampler know when the bomb is full. If the bomb is full before the bottom of the tank is reached, note the depth, retrieve the bomb, unload the contents into a sample jar, return the bomb to the noted depth, and continue until the bottom of the tank is reached.

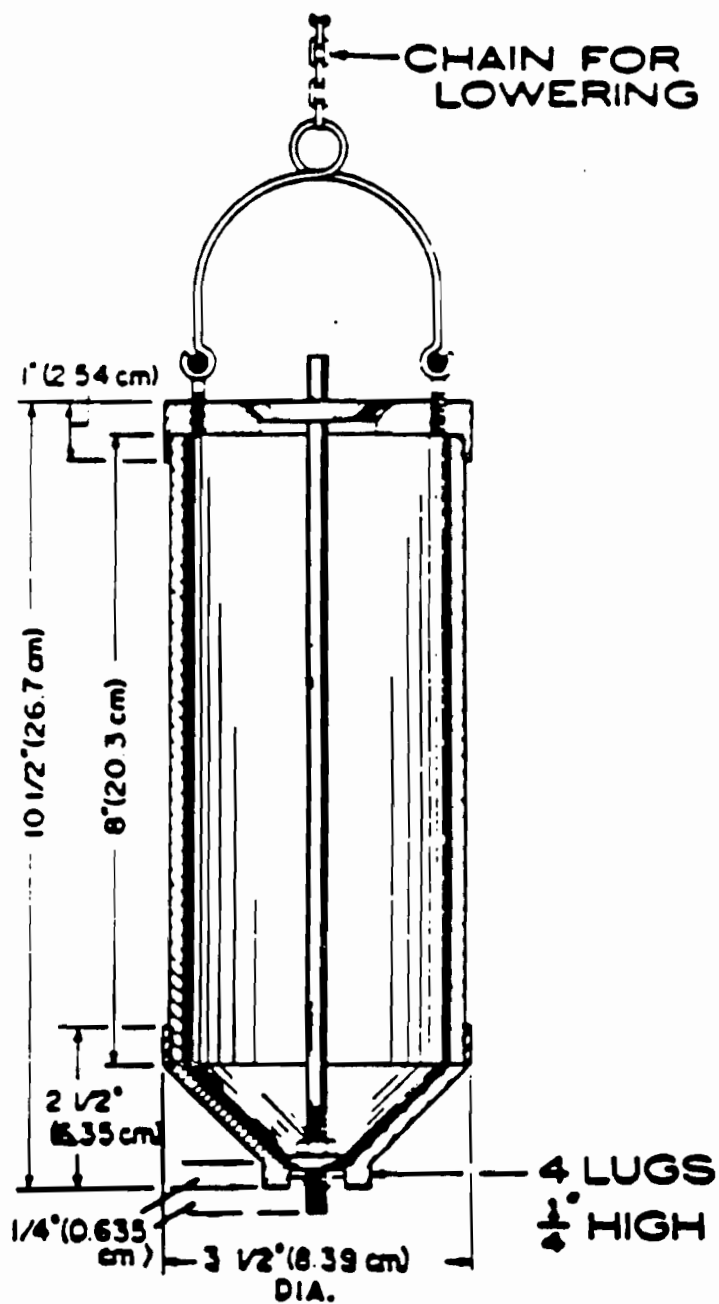


FIGURE 5.2
BACON BOMB SAMPLER

Make every attempt to obtain equal amounts of sample at each depth. The bacon bomb can also be filled at a single depth for a discrete depth sample.

The capacity of the bacon bomb is either 1 liter or 500 ml. It is important to know the size of the bomb that is being used so that the correct size sample jar may be selected. For the 1-liter bacon bomb, it would be safer to use a half-gallon jar rather than a quart jar. If the 1-liter bomb is completely full, a quart will not hold the entire sample. A quart jar is used for the 500-ml bacon bomb.

After each use of the bacon bomb, it should be disassembled and decontaminated appropriately depending on the type of sampling being done.

After each day of sampling or at periodic intervals during the day, it is important to prepare an equipment blank for QA/QC purposes. This is made by taking a sample of distilled or deionized water with the freshly decontaminated bacon bomb. This is to ensure that the decontamination procedure being used is effectively preventing cross contamination.

5.1.5.2 Pond Sampler

The pond sampler consists of an adjustable clamp attached to the end of a two- or three-piece telescoping aluminum tube that serves as the handle. The clamp is used to secure a sampling beaker or sample jar (see Figure 5.3). The sampler is not commercially available, but it is easily and inexpensively fabricated. The tubes can be readily purchased from most hardware or swimming-pool-supply stores.

The pond sampler is used to collect liquid waste samples from disposal ponds, pits, lagoons, and similar reservoirs. Grab samples can be obtained at distances as far as 3.5 meters from the edge of the ponds. The tubular aluminum handle may bow when sampling very viscous liquids if sampling is not done slowly.

Procedures for Use

1. Assemble the pond sampler. Make sure that the sampling beaker and the bolts and nuts that secure the clamp to the pole are tightened properly.
2. With proper protective garment and gear, take grab samples by inverting and submerging the precleaned beaker or jar with minimal surface disturbance. Then slowly turn the jar to fill it with sample.

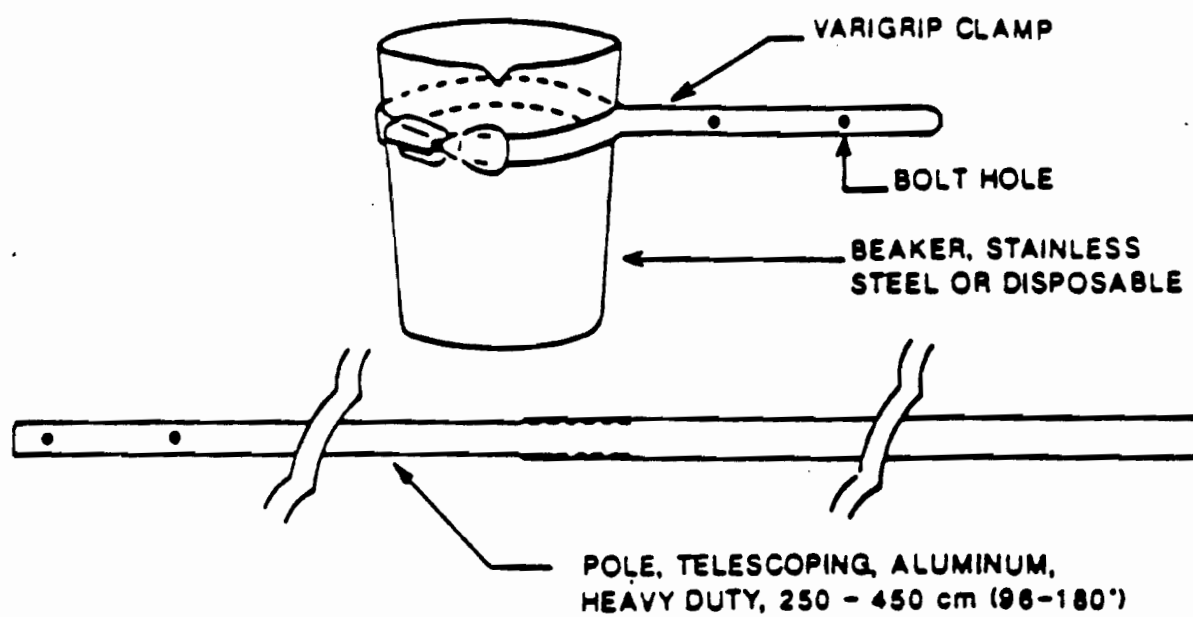


FIGURE 5.3
POND SAMPLER

3. Retrieve the pond sampler from the surface water.
4. Remove the cap from the sample bottle and slightly tilt the mouth of the bottle below the dipper/device edge. If a sample jar is used in the pond sampler, transferring the sample to another container is probably not necessary.
5. Empty the sampler slowly, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence.
6. Continue delivery of the sample until the bottle is almost completely filled.
7. Select appropriate sample bottles and preserve the sample if necessary.
8. Check that a Teflon liner is present in the cap. Secure the cap tightly.
9. Label the sample bottle with an appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories or parameters. Record the information in the field logbook and complete the chain-of-custody documents.
10. Properly clean and decontaminate the equipment prior to reuse or storage, following recommended guidelines.

5.2 SOLIDS SAMPLING

The sampling of solid or semi-solid materials is complicated by the structural properties of the material. For example, the presence of entrapped gases and fluids is often an integral part of the substance and may be of consequence in the analytical techniques for which the sample was collected.

It is necessary in most cases to collect a sample which does not alter this balance. In addition, physical strength and density of the material demand sampling devices of significant rigidity and strength. As a result, a great deal of disturbance will occur at the sample-sampler interface. These effects can be reduced by careful sampling and by collecting aliquots with a high volume-to-surface-area ratio.

A solid does not necessarily have uniform characteristics with respect to distance or depth. In fact, waste piles, sludge lagoons, and contaminated soils are usually extremely variable in their composition. Care must be exercised to prevent aeration of sample or significant changes in moisture content. Samples should be tightly capped and protected from direct light.

Most commercially available solids sampling devices are steel, brass, or plastic. In general, use of stainless steel is the most practical and several manufacturers will fabricate their equipment with all stainless-steel parts on a special-order basis. Another alternative is to have sampler contact surfaces coated with Teflon. This can be accomplished by either sending the device to a commercial coater or by in-house application of spray-on Teflon coatings.

Some devices, especially those for soil sampling, have traditionally been chrome or nickel-plated steel. These should be particularly avoided, or the plating should be removed, because scratches and flaking of the plating material can drastically affect the results of trace-element analysis.

Plated or painted surfaces can be used in many cases if the outside coating is first removed by using abrasives. Such practice can yield a significant cost savings over more expensive materials, as long as the exposed material will not affect the sample.

5.2.1 Soils Sampling

Soil sampling is an important adjunct to ground-water monitoring. Sampling of the soil horizons above the ground-water table can detect contaminants before they have migrated into the water table, and can help establish the amount of contamination sorbed on aquifer solids that have the potential to contribute to the ground-water contamination.

Soil types can vary considerably on a hazardous-waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. It is important, therefore, to maintain a detailed record during sampling operations, particularly noting location, depth, and characteristics such as grain size, color and odor, and/or readings obtained on field monitoring equipment.

Subsurface conditions are often stable on a daily basis and may demonstrate only slight seasonal variation especially with respect to temperature, available oxygen, and light penetration.

Changes in any of these conditions can radically alter the rate of chemical reactions or the activity of associated microbiological community. As a result, samples should be kept at their at-depth temperature or lower, protected from direct light, sealed tightly in glass bottles, and analyzed as soon as possible.

The physical properties of the soil--its grain size, cohesiveness, associated moisture, and such factors as depth to bedrock and water table--will limit the depth from which samples can be collected and the method required to collect them. Often this information on soil properties can be acquired from published soil surveys available from the USGS and other governmental and farm agencies. A comprehensive listing of these offices and currently available soil surveys is included in the "NEIC Manual for Groundwater/Subsurface Investigations at Hazardous Waste Sites."

Most of the methods employed for soil sampling at hazardous- waste sites are adaptations of techniques long employed by foundation engineers and geologists. This section presents those methods which can be employed with a minimum of special training, equipment, or cost. More detailed methods capable of sampling to greater depths in more difficult soil conditions, or that can simultaneously install ground-water-monitoring wells, usually require a hydrogeologists.

For those wanting a more in-depth discussion of soils and soil sampling, refer to Preparation of Soil Sampling Protocol: Techniques and Strategies, (EPA 600/4-83-020) by Dr. Benjamin J. Mason, prepared under contract to the USEPA, Environmental Monitoring Systems Laboratory--Las Vegas, August 1983. This report discusses in detail the factors that influence the selection of a particular sampling scheme or the use of a particular sampling method with a strong emphasis on statistical design and data analysis. Another source, Soil Sampling Quality Assurance User's Guide, (EPA 600/4-84-043) by Dr. Delbert S. Barth and Dr. Benjamin J. Mason, prepared by the Environmental Research Center, University of Nevada, Las Vegas under a cooperative agreement with the USEPA (May 1984), will also be helpful.

5.2.1.1 Grab Surface Soil Sampling

o Materials Required:

- Clean shovel
- Tongue depressors
- Sample bottles with Teflon-lined caps
- Sample labels

- Sample gloves
- Trash bag
- Materials for decontamination of shovel
- Field log

o Procedure:

1. Determine the number and location of desired samples along with the location of duplicate samples.
2. Dig a hole, 3 to 4 inches deep, with the clean shovel at the first sample location.
3. Don clean sample gloves, and scrape the side of the hole with a tongue depressor to expose a fresh surface. This eliminates the possibility of cross contamination from material below.
4. Discard the first tongue depressor, and use a new one to dig material from the top 2 inches of soil and transfer it in the sample jar. If the soil is too hard for this, chip the sample out with a clean screw driver while holding the open sample jar directly below where you are chipping.
5. After obtaining an adequate sample volume, seal the jar and label the sample. Then record the pertinent information in the field log.
6. Place used expendables in a trash bag. Decontaminate any tools used with soap, water, and appropriate solvent rinses.
7. Repeat steps 2 through 6 until all samples have been taken.

o Notes:

- It is important to take one or more background samples in conjunction with any soil sampling program.
- Samples must be relocatable. That is, the sample locations must be described clearly and accurately, so that someone who reads the descriptions could locate the sample points without prior knowledge of the site. Therefore, it is essential that any descriptions of sample location be consistent with an accurate site map.

5.2.1.2 Manual Split Spoon Sampling

The manual split spoon sampler (see Figure 5.4) is used when taking subsurface samples from 0 to 10 feet. The sample compartment of the split spoon may be 12 to 24 inches long.

Prior to sampling, determine sample points and depths and stake out sampling points. A grid pattern may or may not be used, but in any case, describe the location of each point in the field sampling log or notes in terms of measured distances from known fixed reference points. After completing this, the sampling may begin.

Using a clean shovel or hand auger, dig a hole down to the starting depth. Once the desired depth has been reached with the shovel, place a clean split spoon on the area to be sampled (Note: If the soil appears to be loose, place a basket screen in the end of the sampler to prevent the soil from falling out of the sample). Drive the split spoon into the soil with a sledge hammer until the shoe reaches the desired depth. It is often convenient and necessary to mark the starting and ending depths on the drive rod.

When the sampler has been driven to the desired depth, pull it from the sample point, remove the spoon from the shaft, and open the split tube. At this time, put on a clean pair of sample gloves. With a new tongue depressor, remove an appropriate amount of soil from the center of the compartment and place it into the sample container.

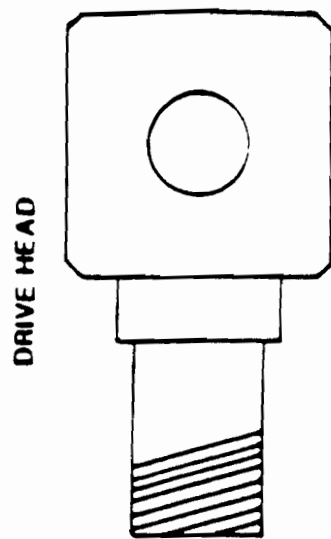
Seal the container is with a Teflon-lined cap, wipe it off, and label the sample immediately. Record a description of the soil in the field log. Since the split spoon has been dismantled, wash its parts are with soap and water, rinse with the appropriate solvents, and dry it. Wash, rinse, and dry the shovel or auger used to prepare the sample point as well. Discard all disposables into a contaminated waste drum.

After cleaning and reassembling the split spoon, mark the sample point. The next sample point then may be sampled.

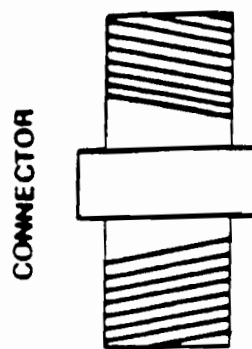
o Materials Required:

- Split spoon kit, containing:

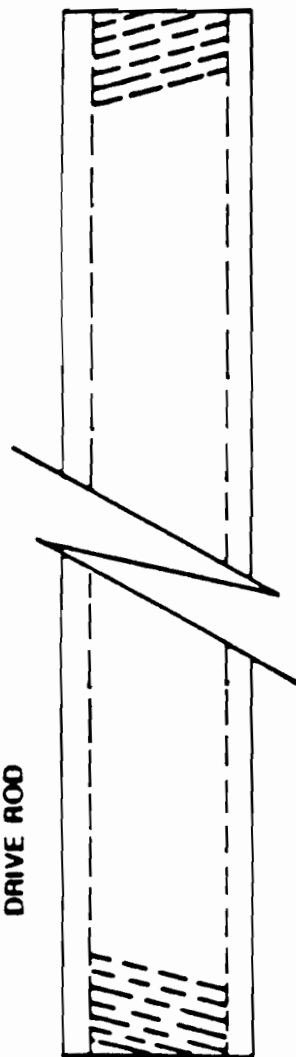
- o Two 12-inch split tubes
- o Two regular shoes
- o One saw-toothed shoe
- o Two head assemblies
- o Three basket screens
- o Two drive-head assemblies



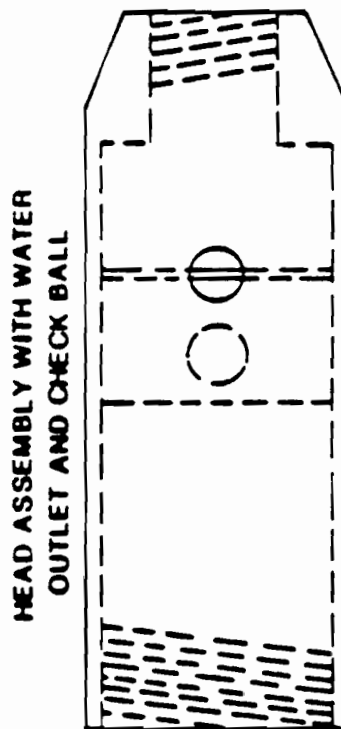
DRIVE HEAD



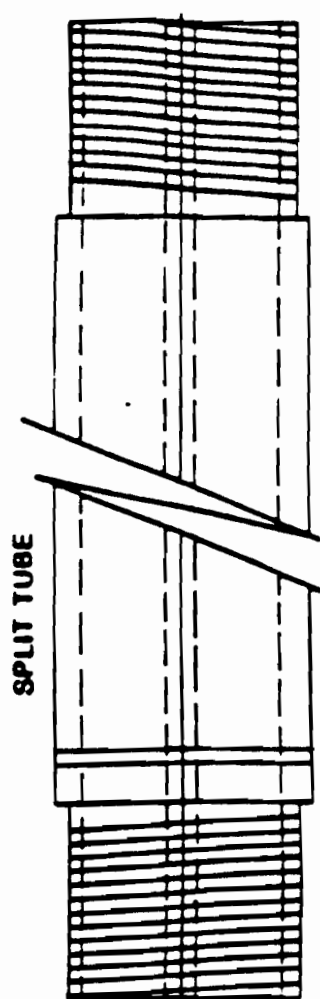
CONNECTOR



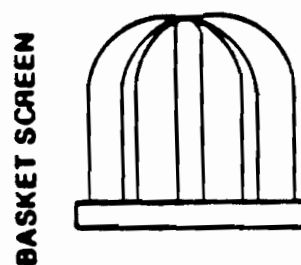
DRIVE ROD



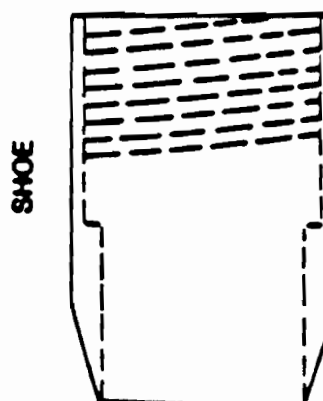
HEAD ASSEMBLY WITH WATER
OUTLET AND CHECK BALL



SPLIT TUBE



BASKET SCREEN



SHOE

- o One bucket auger with rod and handle
 - o Five sections drive rod
 - o Two 18-inch pipe wrenches
 - o Two wire brushes
 - o One sledge hammer
 - o One box of steel wool
 - o One can of WD-40
 - o One stocking list
 - o One written sampling method
 - o One aluminum box
 - o One bucket with soap and water
 - o One scrub brush
 - o Sample jars with Teflon-lined caps
 - o Sample labels
 - o Log book or field sheets
 - o Paper towels
 - o Garbage bags
 - o Sample gloves
 - o Tongue depressors
 - o Appropriate solvents
 - o Squeeze bottles
- o Additional Materials Recommended
 - Pipe vise
 - Pickup truck to haul supplies
- o Guidelines for driving split spoon
 1. One sampling technician uses the sledge-hammer. The other holds the drive rod steady. Personnel must be equipped with hard hats, steel-toed shoes, and any other appropriate safety equipment. Samplers should orient themselves perpendicular to each other.
 2. If the holder feels that the spoon has hit something hard (e.g., a rock), move the spoon to another location. Record the first try as rejected. To continue will only damage the split spoon.
 3. Keep all threaded connections tight. The holder should use the bar inserted into the drive head to maintain clockwise torque on the split spoon as it is being driven in.
 4. In ground that is compacted and/or cemented together, use the sawtoothed shoe. To use this, the holder must rotate the split spoon clockwise between sledgehammer blows.

5. Never use a backhoe is to drive a split spoon down.
- o Guidelines for pulling split spoon out
 1. Use the bar in the drive head. The two samplers, each holding an end of the bar, walk clockwise while lifting up.
 2. If No. 1 above does not work, use a sledge-hammer to rap the underside of the bar handle. Then try the first method again.
 - o Guidelines for disassembling the sampler
 1. Use a pipe vise.
 2. Keep threads kept clean.
 3. If the shoe or head assembly will not loosen up, change the position of the pipe wrench on the split tube.
 - o Guidelines for decontaminating the sampler
 1. Always consult the project chemist or technical foreman about the decontamination procedure.
 2. First, wash the split spoon with soap and water. It is important to remove all soil and visible contamination.
 3. Recommended rinsing regimes
 - a) Metals and cyanide - Ten percent nitric acid, then deionized or distilled water
 - b) Volatile organics - Distilled water with flame drying, acetone rinse, or paper towel drying
 - c) Semi or non-volatile organics - Acetone, then hexane
 - o Guidelines for removing the sample from the spoon
 1. Use clean sample gloves and tongue depressor.
 2. Discard the top and bottom 1/2 inch of sample.

3. A 1-quart or 8-ounce jar with a Teflon liner is usually used. However, use 40-ml Pierce vials with Teflon-lined septa for volatile organics.
4. To split a sample, use a clean knife or sharp, clean spatula to cut the core down its length. Then use a tongue depressor to transfer each half into separate jars.
5. Never drive the spoon in 12 inches to get two 6-inch samples. This may cross contaminate the lower 6-inch sample.
6. If there are still questions about this procedure, call the main laboratory in Findlay.

o Guidelines for Maintenance

1. Keep the split spoon clean and free of rust. A rusty split spoon cannot be properly decontaminated.
2. Oil the split spoon with WD-40 or a similar light oil when it is not in use (i.e., at the end of the day).

5.2.1.3 Shelby Tube Sampling

Thin-walled samplers like the Shelby tube (see Figure 5.5) are used to take undisturbed-type soil cores which adequately represent properties of the soil (porosity, density, permeability) that are of primary interest to hydrogeologists. The split spoon does not do this. Thin-walled samplers are less prone to problems with cross contamination than are split spoons, and sample removal does not require as much disassembly effort. Their main disadvantage is that they are limited to soil that is not rocky or hard.

A small chamber for disturbed soil is provided above the sample tube. This is necessary, as the lower end of the sampler is not closed and:

1. Soil can be scraped off the walls of the boring as the sampler is lowered.
2. Soil cuttings from the bottom of the boring may partially or completely fill the sampler prior to its arrival at the planned sample depth.

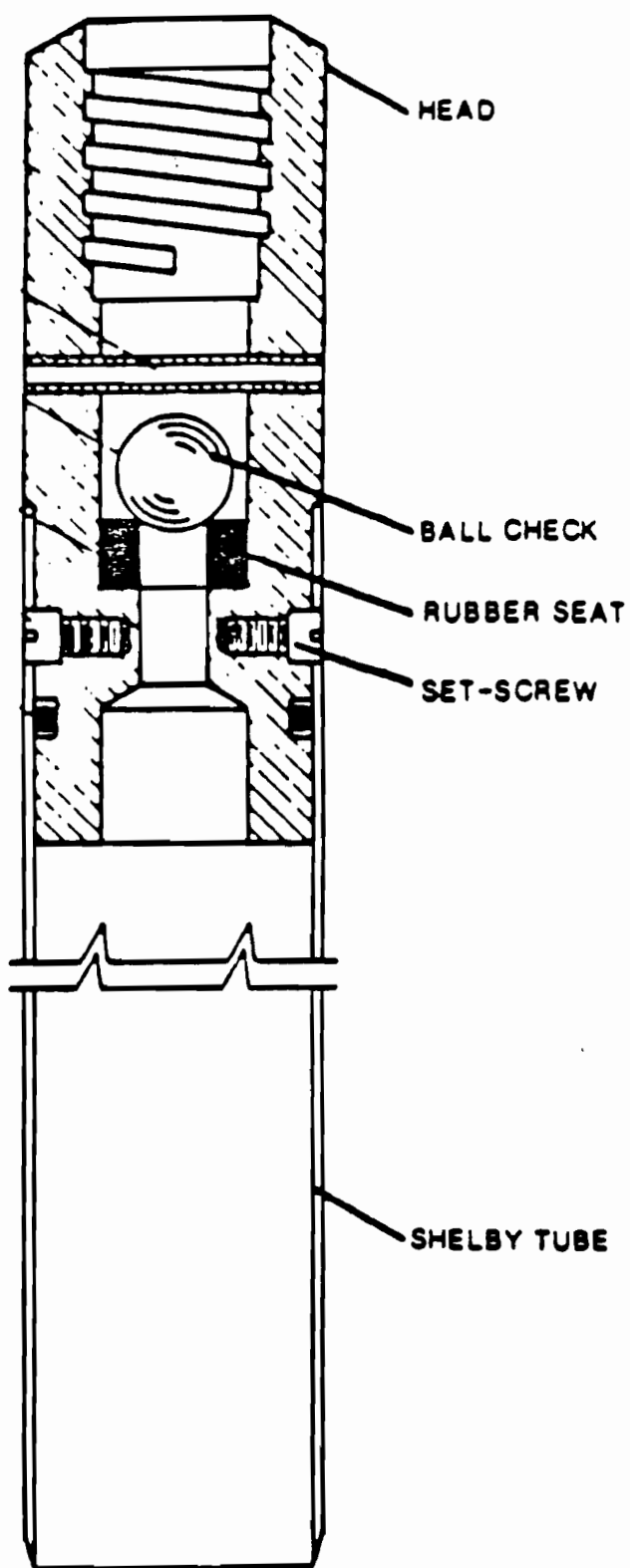


FIGURE 5.5
SHELBY TUBE SAMPLER

Some of the disturbed soil can vent through the ball check into the rods, but then the vacuum may be lost when the sampler is withdrawn. Without vacuum there is a strong likelihood that the sample will be partially or completely lost.

To use the Shelby tube, dig or auger down to the top level of the sample, being careful to leave a clean hole. Then carefully lower the Shelby tube into the hole, being careful not to knock material down from the sides. Exert even pressure to force the sampler into the soil. If the hydraulics on a drill rig are used to force the Shelby tube in, the gauge pressure should be 250 psi for brass tubes and 500 psi for steel tubes. Avoid hammering if possible.

When the sampler has reached the bottom level of the sample horizon, allow it to sit for 2 to 3 minutes to allow the soil to expand in it. Then rotate it clockwise twice to shear the sample from the underlying soil, and remove the sampler. The top 1 to 3 inches of the soil core are discarded as in split spoon sampling.

5.2.1.4 Bucket Auger

The bucket auger is useful for sampling in soil that is not too rocky or too hard. After the auger cuts in to the point where the bucket is full, withdraw it. Then hold the auger horizontally to allow the top 1 to 2 inches of soil to be knocked off. After this, drive the sample jar into the soil in the bucket to grab a sample. After discarding the unused soil, decontamination is relatively quick and easy.

Cross contamination is more of a problem when using the bucket auger than it is with most other soil sampling methods.

See Figure 5.6 for an example of augers and a thin-wall sampler.

5.2.1.5 Trench Side Sampling

When very low levels of soil contamination are a concern, cross contamination becomes a very important issue. Sampling from the side of a trench, if done properly, is less likely to suffer from cross contamination problems than any other method. It is also easier on the samplers and quicker than other methods, provided that a backhoe is used for the excavation.

Use a clean trowel or tongue depressor to scrape a clean surface at the proper depth for the sample, beginning with the lowest depth sampled.

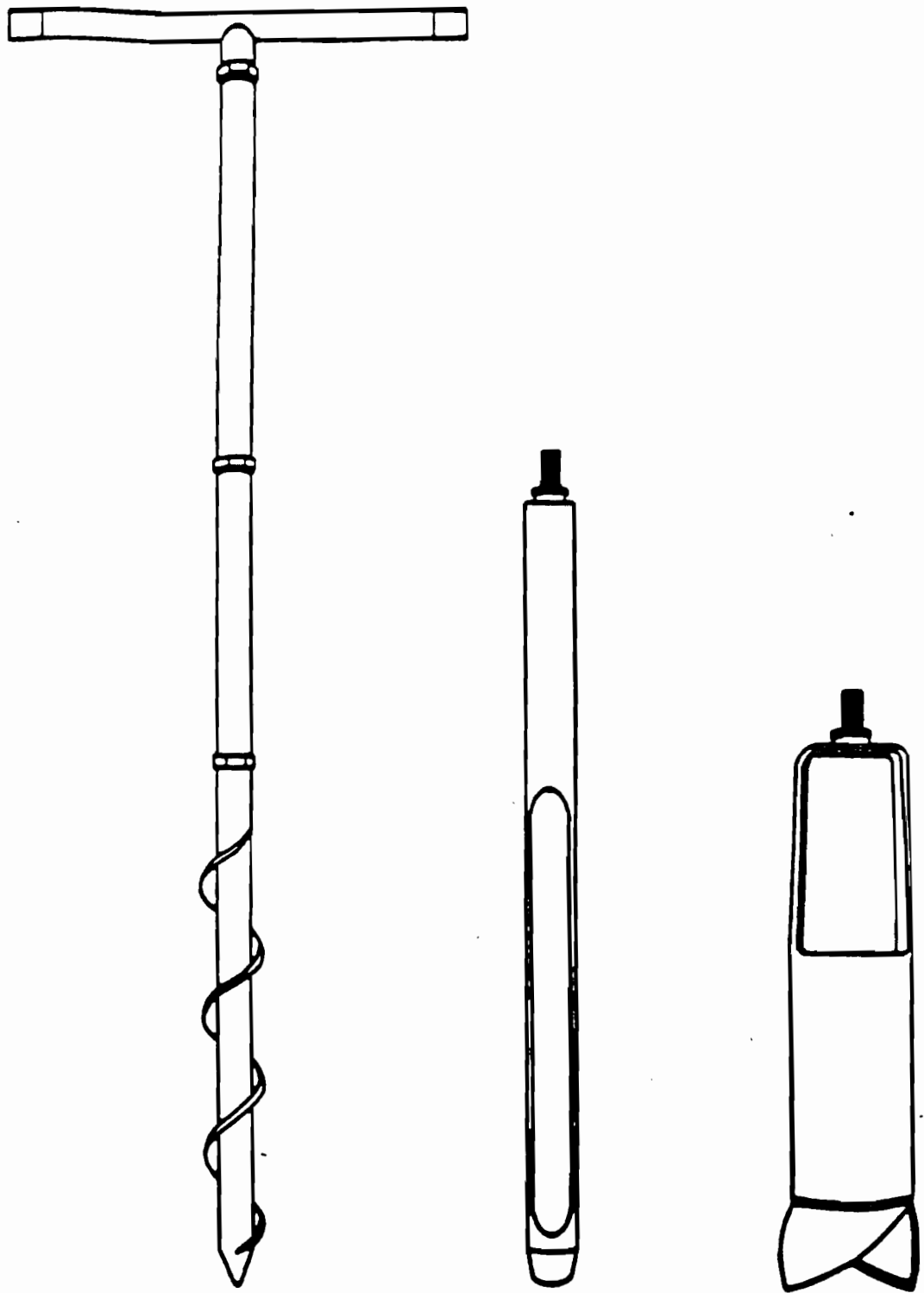


FIGURE 5.6

AUGERS AND THIN-WALL TUBE SAMPLER

Next, use a sharp, clean knife or putty knife to cut a rectangle in the area of the sample, from the top of the bottom of the sample horizon. Then use a clean spoon or spatula to dig out this rectangle to an even depth. Transfer the soil to a sample jar or to a stainless-steel pan for mixing and subsampling.

Be careful that soil particles from the surface and the sides of the trench do not fall into the hole and become incorporated into the sample. Helpers must stay away from the sides of the trench while sampling is in progress.

5.2.1.6 Bulb Planter

The bulb planter is useful for sampling soil that is fairly cohesive and not too hard from 0 to 4 inches deep. To use the bulb planter, clip and remove any grass covering the sample area down to the soil. Force the bulb planter down to the required depth, rotate it 2 to 3 times to shear the sample from the underlying soil, and remove it. If loss of sample occurs, try waiting 2 to 3 minutes before rotating the sampler. Use a tongue depressor to force the soil into the sample jar. Repeat the process as necessary in the sample area until sufficient sample has been collected.

5.2.1.7 Topsoil Trier Sampler

The topsoil trier sampler is appropriate for taking small-volume samples of soil or solids down to about 9 inches. The soil core may be forced out using a tongue depressor through the open slot of the trier. An open 40-ml VOA vial may be inserted into the end of the trier to facilitate filling it with sample with minimum disturbance of the sample.

5.2.2 Bulk Materials

Unlike soils which are heterogeneous associations of earthen and manufactured substances, bulk materials are generally a homogeneous collection of a single, identifiable product. They are usually contained in bags, drums, or hoppers, although occasionally large amounts of the material may be piled directly on the ground, either deliberately or as the result of a spill.

Those surfaces exposed to the atmosphere may undergo some chemical alteration or degradation and should be avoided during sample collection. Since the process producing the bulk material may demonstrate some variation with respect to time, it is advisable to collect a series of samples as one composite to represent the material.

For purposes of sampling, solid piles are often divided into regions of roughly equal volume. One or more core samples is then taken from each region. These samples are then composited to produce either composites of each region or of the whole pile. The number of samples needed for a good composite depends on the size of the sample and the size and homogeneity of the pile.

5.2.2.1 Solids Pile Sampling With The Trier

The trier is used to obtain core samples (which are usually then composited) from sludge and waste piles or from any containers which contain solid or semi-solid material which cannot readily be sampled with liquid or sludge samplers. See Figure 5.7 for an example of a trier sampler.

o Materials Needed

- Trier
- Sledgehammer
- Backhoe and chain (may be needed)
- Spatula
- Pyrex baking pan or metal bucket
- Sample gloves
- Sample jars with Teflon-lined caps
- Sample labels
- Wire brush
- Scrub brush
- Bucket of soap and water
- Appropriate rinse solvents
- Squeeze bottles
- Paper towels
- Trash bags
- Tongue depressors
- Field log

o Procedures for Use

1. Follow an appropriate decontamination procedure to clean the trier prior to use. A thorough soap and water scrub is always the first step. It is important to remove visible contamination.
2. Drive the trier into the material to be sampled with a sledge hammer or a backhoe. If sampling a solids pile, drive the trier in perpendicular to the surface. If however, its angle is too close to the vertical, the core may fall out.

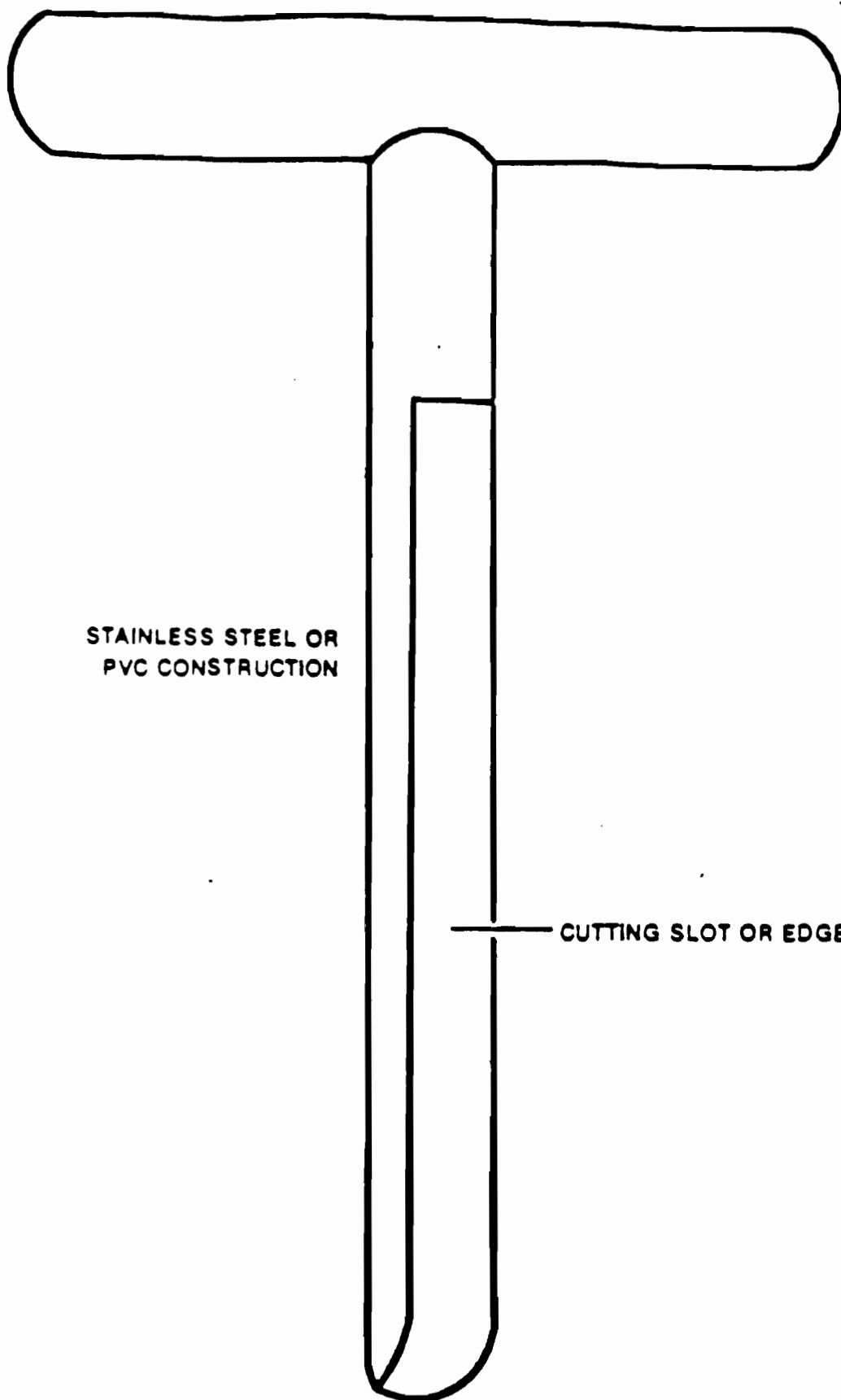


FIGURE 5.7
TRIER SAMPLER

3. Rotate the trier at least 360 degrees to cut out a core.
4. Turn the slot of the trier upward and slowly withdraw it. It may be necessary to pull it out with a backhoe.
5. Using clean sample gloves and a spatula transfer the material in the trier to a clean container (Pyrex baking pan or metal bucket) for mixing.
6. After thoroughly mixing the material with a clean spatula, fill a quart jar is with the material. Label the jar and record the sample location.
7. If the next sample will be composited with the one just taken, decontamination of the trier and spatula is unnecessary. However, they must be thoroughly decontaminated between composites or if the samples are not being composited.
8. Repeat items 1 through 7 until the pile has been sufficiently sampled.

5.2.3 Sludge and Sediment Sampling

For the purpose of this manual, sludges are defined as semi-dry materials ranging from dewatered solids to high-viscosity liquids. Sediments are the deposited material underlying a body of water. Occasionally they are exposed by evaporation, stream rerouting, or other means of water loss. In these instances, they can be readily collected by soil- or sludge-collection methods.

Sludges can often be sampled using of a stainless-steel scoop or trier. Frequently, sludges form as a result of settling of the higher density components of a liquid. In this instance the sludge may still have a liquid layer above it. When the liquid layer is sufficiently shallow, the sludge may be scooped up with a pond sampler or thin-wall sampler. The latter is preferred, as its use results in less sample disturbance, and it will also collect an aliquot of the overlying liquid, thus preventing drying or excessive sample oxidation before analysis.

When the overlying layer is deep, a small gravity corer such as those used in limnological studies will also be useful. Gravity corers, such as Phlegers, are easier to preclean and decontaminate than piston-type corers.

If the sludge layer is shallow, less than 30 centimeters, corer penetration may damage the container liner or bottom. In this instance, a Ponar or Eckman grab may be applicable, as grab samplers are generally capable of only a few centimeters of penetration. Of the two, Ponar grab samplers are more applicable to a wider range of sediments and sludges. They penetrate deeper and seal better than the spring-activated Eckman dredges, especially in granular substrates.

Sediments can be collected in much the same manner as described above for sludges; however, a number of additional factors may be considered. Streams, lakes, and impoundments, for instance, will likely demonstrate significant variations in sediment composition with respect to distance from inflows, discharges, or other disturbances. It is important, therefore, to document exact sampling location by means of triangulation with stable references on the banks of the stream or lake. In addition, the presence of rocks, debris, and organic material may complicate sampling and preclude the use of or require modification to some devices. Sampling of sediments should therefore be conducted to reflect these and other variants.

5.2.3.1 Procedure For Using Sludge Scoop

The sludge scoop is not a commercially available device. It can, however, be easily constructed in the field from supplies readily at hand (see Figure 5.8 for an example).

Thoroughly clean the sampler tube and all parts that come into contact with the sludges before taking each sample.

Lower the sampler into the sludge until the tube is parallel to the surface of the sludge, then move the tube horizontally through the sludge so the tube fills up. When the tube is filled, raise the sampler until the tube is vertical above the surface of the liquid (if any) covering the sludge. Holding the tube vertically above the liquid/sludge allows the excess liquid to drain through the screening on the bottom of the tube.

Raise the tube and have a second person wearing sample gloves empty the tube into a sample container. Repeat the procedure until a sufficient volume has been collected. Properly close, label, seal, log, and store the sampler container. Discard the tube and thoroughly clean the rest of the of the apparatus.

If samples of the overlying liquid are also required, they should be taken before the sludge is sampled, since the scoop will disturb the sludge. Carefully document details of the sampling.

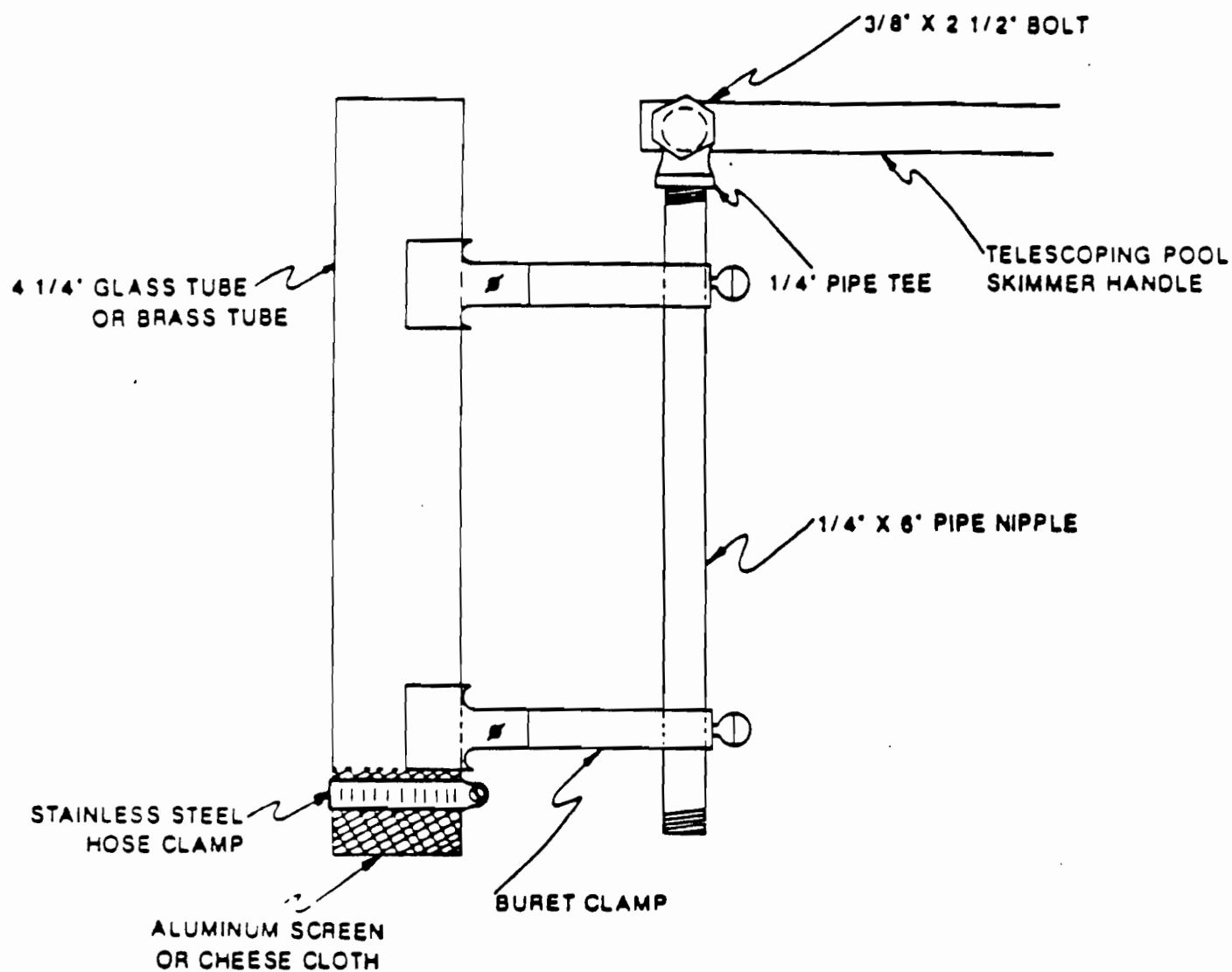


FIGURE 5.8
SLUDGE SCOOP

5.2.3.2 Sampling Ponds and Lagoons with a Syringe-Type Sediment or Sludge Sampler

This sampler is to be used to sample sludges and sediments located under a liquid (i.e. ponds or lagoons). It is to be pushed in by manual pressure only. It was not constructed to withstand any type of mechanical force to push it into the material (see Figures 5.9 and 5.10).

Before entering the pond or lagoon, fully insert the inner pipe should be into the outer sleeve. (This will avoid retrieving liquid with the sample). As the sampler is pushed into the floor of the pond, the material to be sampled will then enter the end of the sampler. The inner tube must be simultaneously pulled out of the outer sleeve at the same rate as the outer sleeve is entering the material to be sampled. NOTE: If the material is not being retained in the sampler, a basket retainer may be placed in the tip of the sampler.

After obtaining the required depth tighten the bolt at the top of the outer sleeve (to avoid allowing the inner pipe to push the sample out of the sampler). Pull the sampler out of the sediment. Remove the tip of the sampler and the basket retainer (if used) and push the sample obtained into the sample jar.

Clean the sampler before returning it to the carrying case. For proper cleaning, it must be completely disassembled. The sampler can be cleaned by wiping with diapers. The inside of the outer tube may be wiped out by tying sample string around a small wad of diaper and pulling it through the tube. Afterwards, the sampler can be washed in detergent and water, rinsed with tap water, acetone and hexane, or other solvents as appropriate. Replace the circular gasket located on the end of the inner sleeve with each sample.

5.2.3.3 Sampling Sludge or Sediments with a Hand Corer

This device is similar to the type of thin-wall corer used for collecting soil samples. It is modified by the addition of a handle to facilitate driving the corer (see Figure 5.11) and a check valve on top to prevent washout during retrieval through an overlying water layer. This device has the advantage of collecting an undisturbed sample which can profile any stratification in the sample as a result of changes in the deposition.

Some hand corers can be fitted with extension handles which will allow the collection of samples underlying a shallow layer of liquid.

- WITH THE INNER PIPE SEATED AT THE BOTTOM
PLACE THE SAMPLER TIP ON THE FLOOR
OF THE POND OR LAGOON

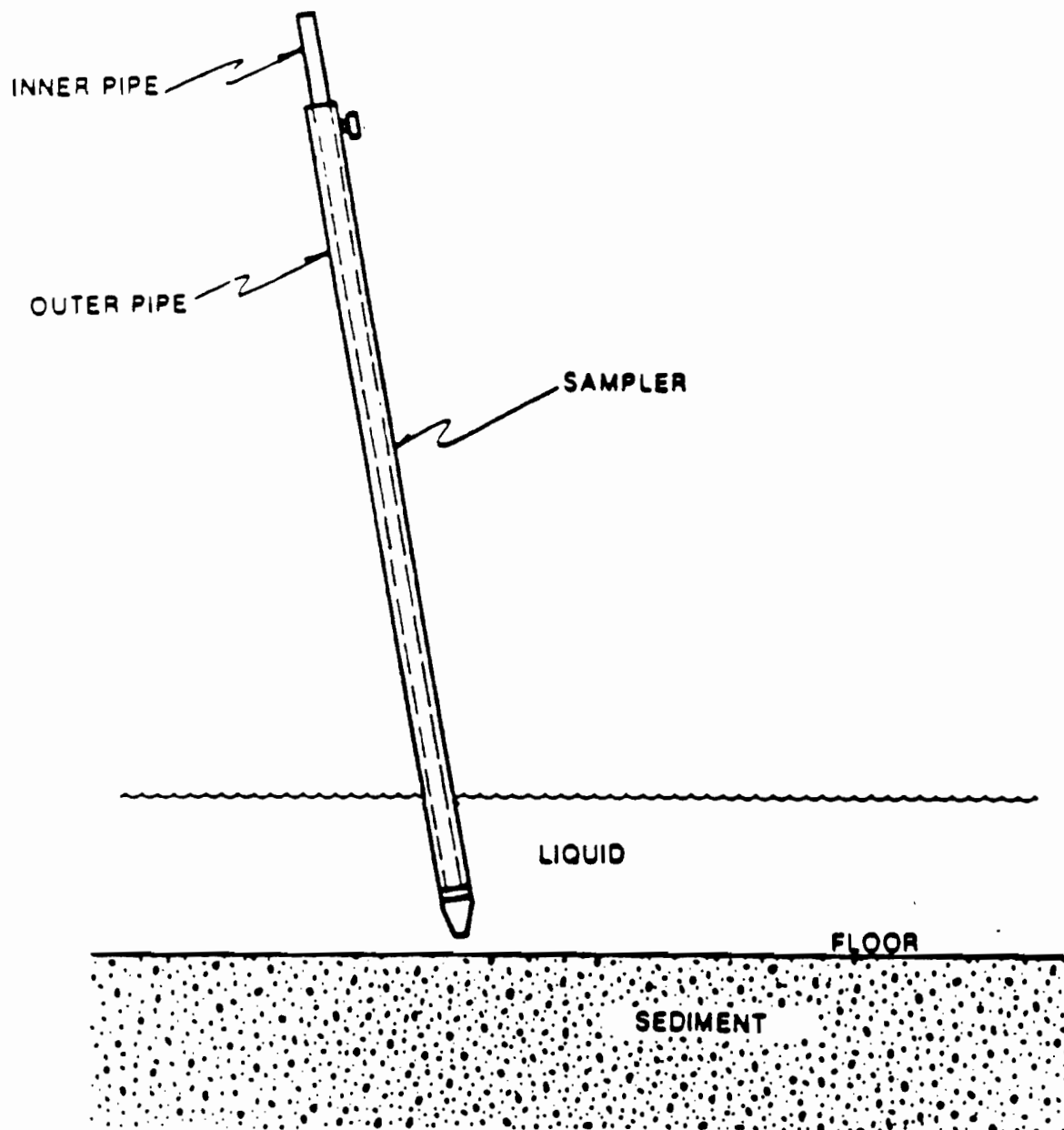


FIGURE 5.9

SLUDGE AND SEDIMENT SAMPLER

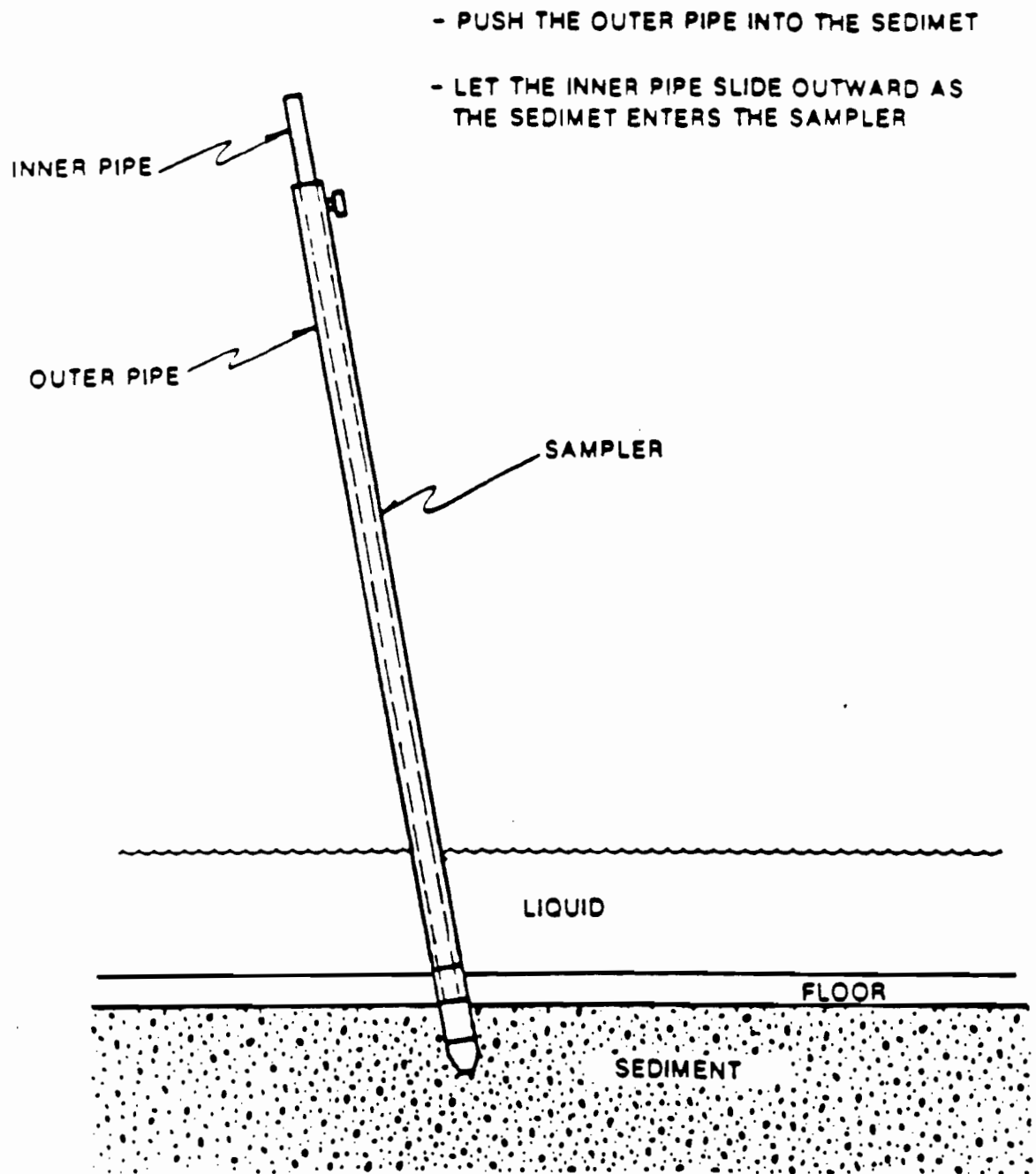


FIGURE 5.10
SLUDGE AND SEDIMENT SAMPLER

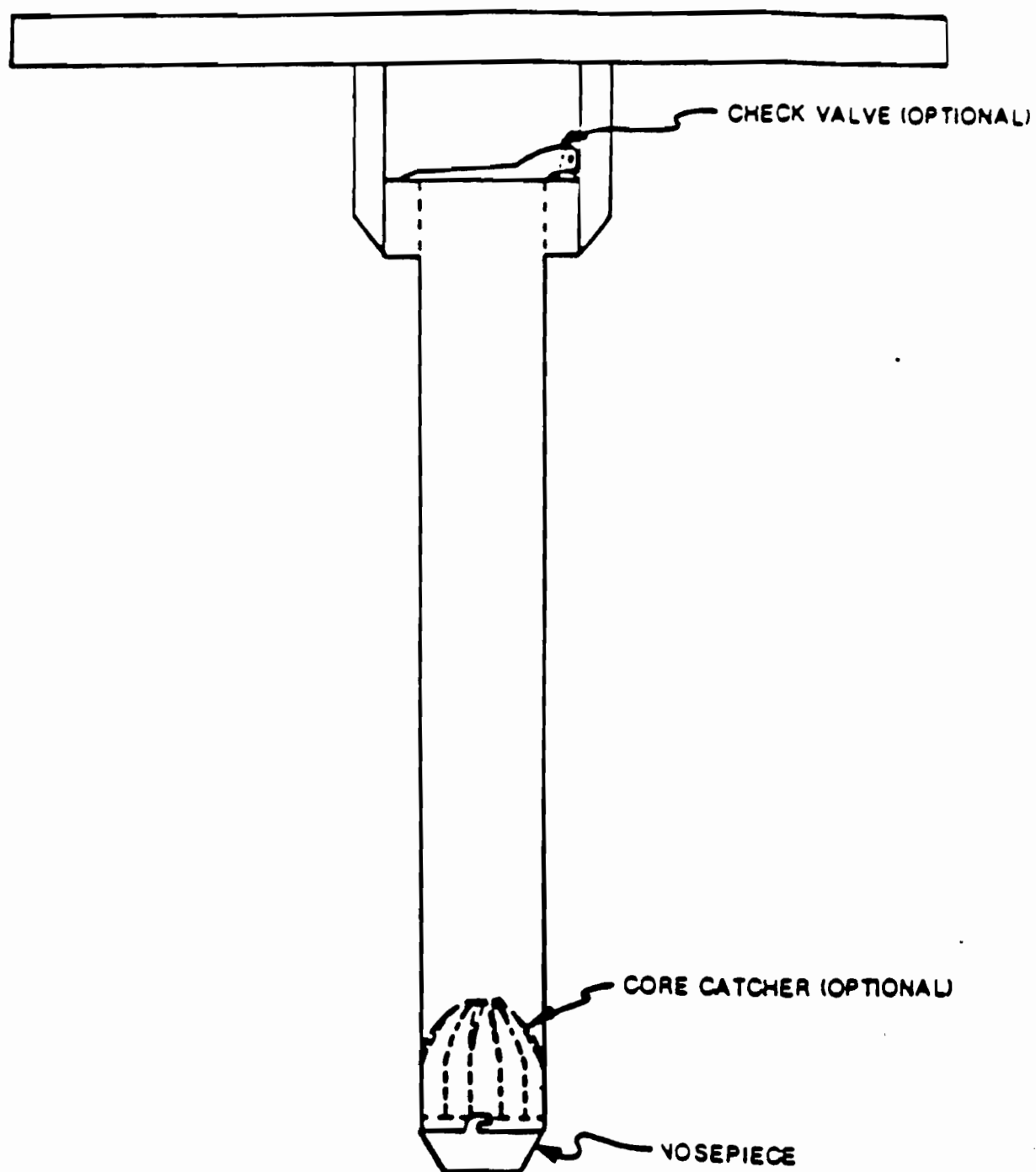


FIGURE 5.11

HAND CORER

Most corers can also be adapted to hold liners generally available in brass, polycarbonate plastic, or Teflon. Care should be taken to choose a material which will not compromise the intended analytical procedures.

Procedure for Use

1. Inspect the corer for proper precleaning, and select sample location.
2. Force corer in with smooth, continuous motion.
3. Twist corer, then withdraw in a single, smooth motion.
4. Remove nosepiece, and withdraw sample into a stainless-steel or Teflon tray.
5. Transfer sample into an appropriate sample bottle with a stainless-steel lab spoon or equivalent.
6. Check that a Teflon liner is present in cap, if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach, supplemented by a minimal holding time.
7. Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly. Complete all chain-of-custody documents and record sample in the field logbook.
8. Decontaminate sampling equipment after use and between samples.

5.2.3.4 Sampling Bottom Sludges or Sediments with a Gravity Corer

A gravity corer is a metal tube with a replaceable tapered nosepiece on the bottom and a ball or other type of check valve on the top (See Figure 5.12). The check valve allows water to pass through the corer on descent but prevents washout during recovery. The tapered nosepiece facilitates cutting and reduces core disturbance during penetration. Most corers are constructed of brass or steel, and many can accept plastic liners and additional weights.

Corers can collect samples of most sludges and sediments. They collect essentially undisturbed samples which represent the profile of strata which may develop in sediments and sludges during variations in the deposition process.

Depending on the density of the substrate and the weight of the corer, penetration to depths of 75 cm (30 inches) can be attained. Care should be exercised when using gravity corers in vessels or lagoons that have liners, because penetration depths could exceed that of the substrate and result in damage to the liner material.

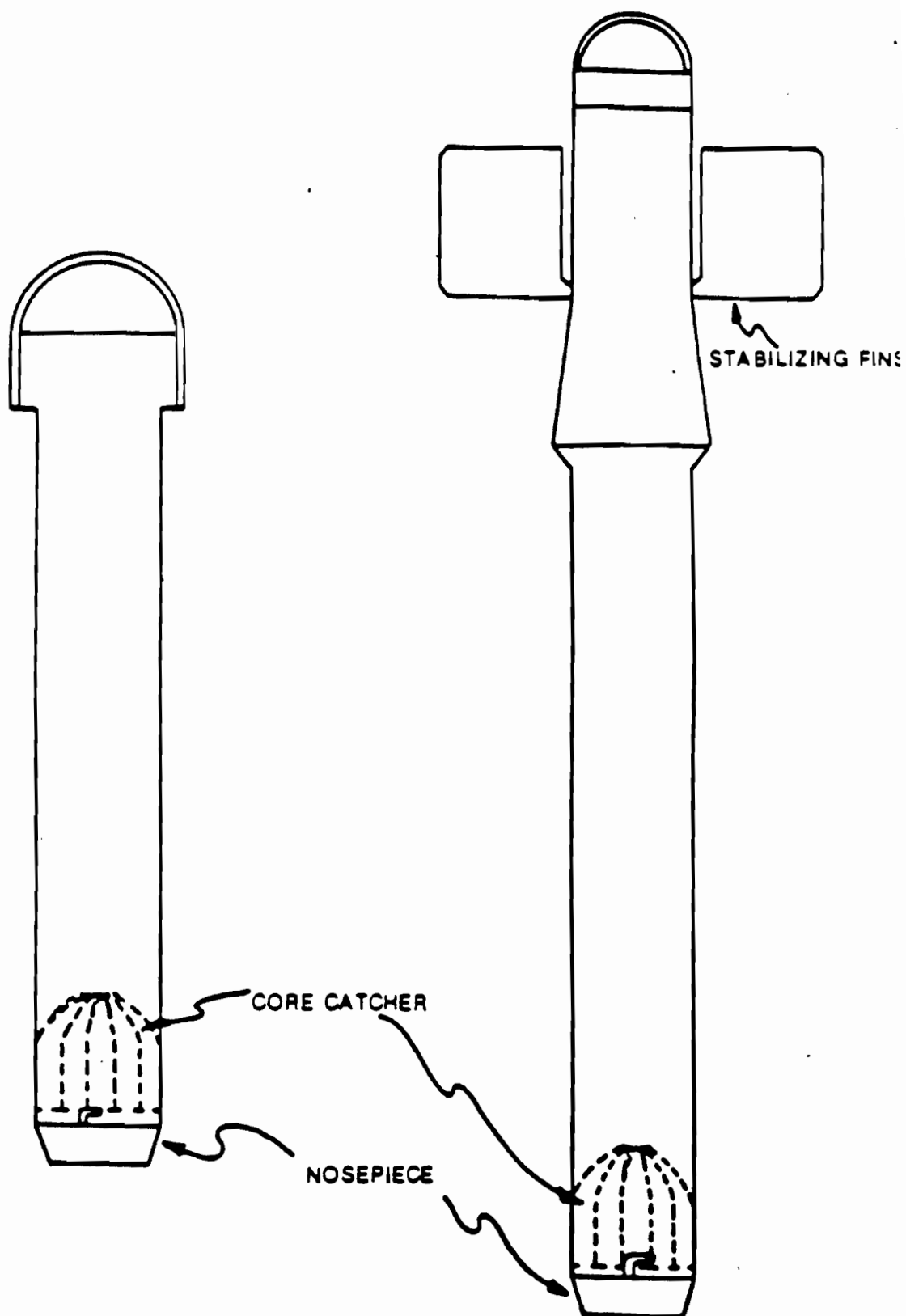


FIGURE 5.12
GRAVITY CORERS

Procedure for Use

1. Attach a precleaned corer to the required length of sample line. Solid braided 5 mm (3/16 inch) nylon line is sufficient; 20 mm (3/4 inch) nylon, however, is easier to grasp during hand hoisting.
2. Secure the free end of the line to a fixed support to prevent accidental loss of the corer.
3. Allow corer to free-fall through liquid to bottom.
4. Retrieve corer with a smooth, continuous lifting motion. Do not bump corer, as this may result in some sample loss.
5. Remove nosepiece from corer, and slide sample out of corer into stainless-steel or Teflon pan.
6. Transfer sample into appropriate sample bottle with a stainless-steel lab spoon or equivalent.
7. Check that a Teflon liner is present in cap if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach, supplemented by a minimal holding time.
8. Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly. Complete all chain-of-custody documents, and record sample in the field logbook.
9. Decontaminate sampling equipment after use and between samples.

5.2.3.5 Sampling Bottom Sludges or Sediments with a Ponar Grab

The ponar grab is a clamshell-type scoop activated by a counter-lever system. The shell is opened and latched in place and slowly lowered to the bottom. When tension is released on the lowering cable the latch releases and the lifting action of the cable on the lever system closes the clamshell (See Figure 5.13).

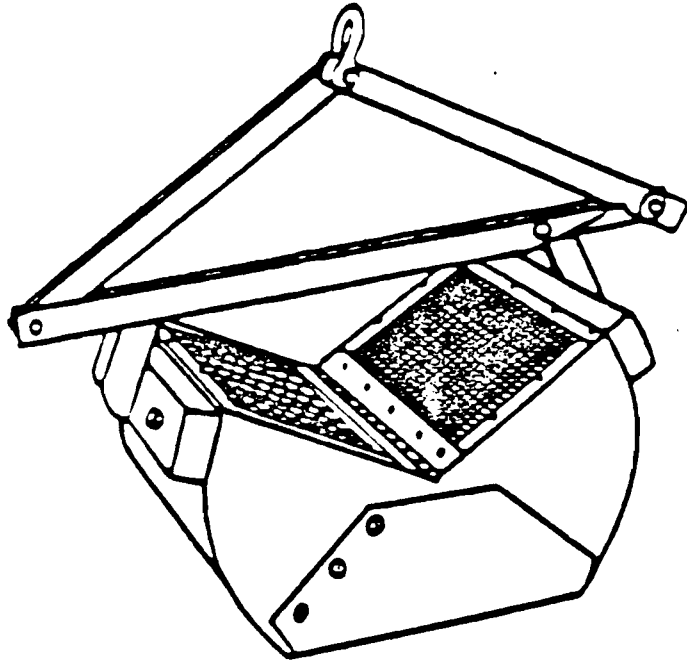


FIGURE 5.13
PONAR GRAB

Ponars can sample most types of sludges and sediments, from silts to granular materials. They are available in a "Petite" version with a 232-square-centimeter sample area that is light enough to be operated without a winch or crane.

Penetration depths will usually not exceed several centimeters. Grab samplers, unlike corers, are not capable of collecting undisturbed samples. As a result, material in the first centimeter of sludge cannot be separated from that at lower depths. The sampling action of these devices causes agitation currents which may temporarily resuspend some settled solids. This disturbance can be minimized by slowly lowering the sampler the last half meter and allowing a very slow contact with the bottom. It is advisable, however, to only collect sludge or sediment samples after all overlying water samples have been obtained.

Procedure for Use

1. Attach a precleaned Ponar to the necessary length of sample line. Solid braided 5 mm (3/16 inch) nylon line is usually of sufficient strength; however, 20 mm (3/4 inch) or larger nylon line allows for easier hand hoisting.
2. Measure and mark the distance to bottom on the sample line. A secondary mark, 1 meter shallower, will indicate proximity so that the lowering rate can be reduced, thus preventing unnecessary bottom disturbance.
3. Open sampler jaws until latched. From this point on, support sampler by its lift line, or the sampler will be tripped and the jaws will close.
4. Tie free end of sample line to fixed support to prevent accidental loss of sampler.
5. Begin lowering the sampler until the proximity mark is reached.
6. Slow rate of descent through last meter until contact is felt.
7. Allow sample line to slack several centimeters. In strong currents, more slack may be necessary to release mechanism.
8. Slowly raise dredge clear of water surface.
9. Place Ponar into a stainless-steel or Teflon tray and open. Lift Ponar clear of the tray.

10. Collect a suitable aliquot with a stainless-steel lab spoon or equivalent and place sample into appropriate sample bottle.
11. Check for a Teflon liner in cap if required and secure cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach, supplemented by a minimal holding time.
12. Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly. Complete all chain-of-custody documents and record sample in the field logbook.

5.3 SAMPLING FOR SURFACE CONTAMINATION

Surface sampling techniques include wipe sampling, chip sampling, dust sampling, and sweeping sampling. They are used to indicate contamination on hard surfaces such as stone, metal, concrete, brick, tile and wood, that are characteristic of manmade structures. These methods sample over a known area (e.g. 100 square centimeters), even if, as in a chip sample, the results could be expressed in mg/kg. Area is important for determining potential exposure.

Surface sampling techniques are not as reproducible as most other sampling techniques. Contaminant recovery varies widely, depending on the technique of the sampler and the texture of the surface. Therefore, concentration values obtained from analysis of these samples should be regarded as rough indicators of contamination and not as hard numbers.

5.3.1 Wipe Sampling Procedure

The following procedure is used for all wipe samples, unless noted otherwise (100 square centimeters area wipe samples).

o Equipment Needed:

- Nonpowdered latex sample gloves
- Teflon-coated forceps
- Eleven-cm-diameter Whatman GF/A filter paper (glass microfibre)
- Eight-ounce glass sample containers with Teflon-lined bakelite caps
- Appropriate solvent (HPLC or pesticide grade if organic)
- Teflon rinse bottle
- Sample labels

o Procedure

1. Don a clean pair of disposable latex sample gloves and remove one GF/A filter.
2. Fold GF/A filter in half three times.
3. Place pre-hexane rinsed forceps onto GF/A filter, holding filter with the forceps approximately 1 cm away from and parallel to the triple-folded edge of the filter.
4. Saturate the filter paper with hexane from Teflon rinse bottle.
5. Wipe the surface (sample surface) 10 times horizontally and 10 times vertically in two swaths each direction (horizontally and vertically). Each swath is 5.5 cm wide, overlapping .5 cm, and approximately 9.5 cm long. (This method of wiping surface areas provides for a consistent wipe sample area (100 sq. cm), and eliminates cross contamination of surface areas resulting from pre measuring and marking areas to be sampled.)
6. After wiping the surface area, dab any torn fragments from the GF/A filter (resulting from rough surfaces) from the sample surface with the filter to prevent loss of recovery from the sample area.
7. Place the filter into an 8-ounce glass sample container. Hold the forceps over the container and rinse with hexane, removing any residual surface contaminant that the forceps may have picked up.
8. Seal the container with a Teflon-lined, screw-on-type cap.
9. Immediately label the container, identifying sample number, sample location, personnel who collected sample, sample description, and time and date of sampling. Record this and other information in the sample log and field notebooks.

5.3.1.1 Wipe Sampling QA/QC

A field blank should always be collected for each sampling episode to ensure the quality of the data.

This consists of a filter pad wetted with the chosen solvent (see Table 5.1), and placed into a prepared sample container. This will help identify potential introduction of contaminants through the sampling method and contributions from the pad, solvent, or sample container.

TABLE 5.1
SOLVENT SELECTION

<u>Analyte</u>	<u>Solvent</u>
Semi- and nonvolatile organics (PCBs, dioxin, dibenzofurans, pesticides)	Hexane
Metals (except Cr ⁺⁶)	10% HNO ₃
Cr ⁺⁶	DI water
Cyanide	0.125 M NaOH

Spiked samples may also be collected to better assess the data being generated. Spikes may be prepared by spiking a piece of foil of known area with the standard of the analyte of choice. The solvent containing the standard is allowed to evaporate and the foil is wiped in a manner identical to the other wipes.

Duplicate samples should also be collected. These are taken with about an inch between the sample areas.

5.3.1.2 Wipe Sampling Precautions

1. Excessive dust can interfere with this technique by absorbing the solvent and preventing proper wetting of the surface. To reduce this problem, the filter may be held over the sample jar and carefully rinsed during the sampling process.
2. Rough surfaces are very difficult to sample representatively. The texture of the sampled surface should always be noted in the field log.

5.3.2 Chip Sampling Procedure

Chip sampling is implemented for the collection of representative samples from porous surfaces. Materials such as brick, wood, and concrete are porous and therefore not suitable for using wipe sampling to determine contamination.

Included in this discussion are procedures for obtaining representative samples, QA/QC measures, proper recording of field notes, and recommendations for personal safety.

5.3.2.1 Sampling Equipment

The sampling of porous surfaces by chipping is generally accomplished through the use of a chisel and hammer or an electric hammer. The sampling device should be cleaned using pesticide-grade acetone (assuming that acetone is not a target compound) and hexane or methanol, then wrapped in clean aluminum foil. The sampler should remain in this wrapping until it is needed.

In addition to the sampler, other equipment needed includes:

- o Sample containers of proper size and composition, lab-clean
- o Bound field notebook
- o Chain-of-custody records
- o Seals for legal sample security
- o Sample labels
- o Camera and film
- o Plastic bags for contaminated items
- o Appropriate personnel safety equipment

5.3.2.2 Sampling Design and QA

Sampling situations vary widely, and therefore no universal sampling procedure can be recommended. Therefore, a sampling plan should be developed before any sampling operation is attempted.

This method of monitoring for surficial contamination works best for non-volatile species of analytes (i.e., PCB, PCDD, PCDF) on porous surfaces (i.e., cement, brick, wood).

A known area should always be identified and sampled (i.e., 100 sq. cm). This will facilitate calculations once the analytical results are received.

Consideration should be given to the selection of sampling points. Areas worthy of investigation may be selected based upon manufacturing processes or potential contamination caused by personnel practices.

5.3.2.3 Sampling Procedure

1. Choose appropriate sampling points and measure designated sampling area.

2. Record surface area to be chipped to facilitate later calculations.
3. Don a new pair of sample gloves.
4. Using a cleaned chisel and hammer, break up surface to be sampled. Try not to scatter pieces out of sampling-area boundary. Record how deep chips were taken.
5. Collect chipped pieces using a designated brush and dustpan.
6. Transfer sample from dustpan into container.

5.4 DUST SAMPLES

Dust samples are obtained by vacuuming a measured surface area. The sample then consists of the filter and rinsings from the insides of the vacuum. Small hand held vacuum units are typically used. The location and area of the sample must be recorded in field logs. The type of filter used must also be noted.

5.4.1 Sweeping

Sweeping are samples of primarily wind blown dust taken with dedicated brooms and dust pans from the dry surfaces of roads, gutters, driveways and other surfaces where loose dirt collects.

6.0 DRUM SAMPLING

One type of project OHM frequently undertakes is the drum job. After the initial planning, it consists of 14 phases:

1. Site preparation
2. Site survey for radioactivity, organic vapor concentrations, and drums which require special handling
3. Primary staging and numbering
4. Radiological survey covering each drum
5. Drum opening
6. Second radiological survey
7. Sampling
8. Compatibility testing
9. Separation into wastestreams based on disposal requirements
10. Bulk testing
11. Secondary staging
12. Sampling of bulk wastestreams for disposal analysis
13. Shipment of material off site

During many drum projects, several phases will be in progress simultaneously. Air-monitoring, dust-control, and organic-vapor-control operations should be in progress throughout the course of the job.

6.1 SITE PREPARATION

Proper site preparation involves, among other things, construction of primary and secondary staging areas. Proper staging areas reduce the amount of cleanup required because of inevitable spills and leaking drums.

6.2 INITIAL SITE SURVEY

The ERCS contract requires preliminary surveys at hazardous- waste sites for organic vapors, explosivity, and radiation. This protocol should be followed for non-ERCS jobs also, unless the characteristics of the site and the potential contents of the drums in question are reasonably well defined. The results of this survey, along with later air-monitoring data, should be recorded in a bound notebook with numbered pages, such as the OHM record books.

In addition to the preliminary monitoring, a chemist must search through the drums before they are staged for sampling to look for drums that require special handling.

These drums are labpacks, shock sensitives and explosives, air and water reactivities, radioactive materials, biological waste drums, and nickel or stainless-steel drums. These drums are then segregated and dealt with separately.

6.3 PRIMARY STAGING

There are three important aspects of of primary staging:

1. Staging configuration
2. Numbering
3. Overpacking leakers

A staging configuration must allow the samplers reasonable access to each drum for inspection, sampling, and overpacking, if necessary, while economizing on space. Rows of two drums each with 3- to 4-foot aisles between them are recommended. Another good arrangement uses three by two six-packs of drums arranged in rows that are three across, with 3- to 4-foot aisles between the rows and between the six-packs in a row.

Accurate numbering is critical. Mistakes in numbering, such as missing numbers or double numbering, are minimized by numbering after primary staging. This is true regardless of whether empties (drums containing 1 inch or less of material) are separated before or after staging. To avoid problems, staged empties should be numbered, unless the client decrees otherwise, and drum numbering should be strictly numerical and empties recorded as such on the drum log sheets.

If the drums are numbered in the staging area as they are staged, the marking on the drums and whether or not they are empty may be recorded in a log book. Drum log sheets may then be partially filled out in advance. This will make the sampling more efficient.

Personnel in the staging area should watch for leaking drums. These must be overpacked promptly, and the spill should be cleaned up.

6.4 RADIOLOGICAL SURVEY

The person conducting radiological surveys of the site and surveys over the drums should have a basic knowledge of the radiological survey meter used and of radiation.

There are three types of radiation which might be encountered in the field:

1. Alpha (α), which is stopped by clothing or a sheet of paper. While alpha radiation is the least penetrating type, it can be very dangerous if alpha-emitting radionuclides are ingested, inhaled, or enter the body through a puncture wound.
2. Beta (β), which is stopped by the steel wall of a drum.
3. Gamma (γ) or X-ray, which is only stopped by lead shielding, thick concrete, or steel.

The type of radiation detected depends on the probe being used. The metal-bodied probe with side window and a sliding cover for that window detects beta and gamma radiation. When the window is closed, beta radiation is shut out, and only gamma radiation is detected. The probe with the end window detects alpha, beta, and gamma radiation. The "pancake" probe detects alpha and beta radiation.

The survey meters OHM uses measure radiation in units of millirems per hour (mr/hr). The dose that one is exposed to is calculated by multiplying the hours of exposure by the average measured level of exposure, by the use of a personal dosimeter, or a film badge.

The background level for gamma radiation is between 0.008 and 0.02 mr/hr. Occasionally, the needle will briefly jump above this level, but it should not stay there. The Nuclear Regulatory Commission (NRC) defines a radiation area to be one in which there are 5 mr/hr or greater or an area where one can accumulate 100 mr of exposure in 5 days of normal work in the area. A high-radiation area has radiation at greater than 100 mr/hr.

When abnormally high readings are obtained, one must first ascertain that this is not caused by a short in the cord to the probe. If the readings are not caused by a short, one should follow the guidelines below.

If one sees sustained readings in the range of 0.2 to 2.0 mr/hr, one should continue the survey, but be cautious of higher levels. If one sees sustained readings above this range, secure the immediate area and contact the director of health and safety in Findlay and the site supervisor. Drums found to be radioactive should not be punched.

6.5 DRUM OPENING

Drum opening is normally accomplished with a Caterpillar 215 grappler using a brass-tipped punch. The staging area should be clear of personnel on the ground during punching operations.

On smaller jobs, drum opening is sometimes done by hand. This must be done carefully and should be preceded by careful screening for shock-sensitive materials and drums obviously under pressure. Before any drums are opened by hand, the Health and Safety Department or a chemist on site must be consulted. The "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" should also be consulted.

6.6 SURVEY OF OPEN DRUMS

After the drums are open, another radiological survey should be conducted. This is necessary because the drum tops block out all forms of radiation except gamma radiation.

6.7 DRUM SAMPLING

Drum sampling for solids, semisolids, and liquids; drum logging; cleanup; and drum-sampling supplies are discussed below.

6.7.1 Solids and Semisolids

Solids in drums are sampled by scooping the material up with the jar or with a tongue depressor. Often the material must first be broken up with a brass hammer or brass hammer and chisel, or a piece must be cut off with a razor knife. Tongue depressors must be disposed after each use. Nonexpendable sampling tools must be decontaminated between drums.

6.7.2 Sampling Liquids

Liquids in drums are sampled using 4-foot sections of glass tubing (8 to 12 mm ID) called pipets. The pipet is slowly lowered into the drum. When the bottom of the drum is reached, the sampler places his thumb over the end of the pipette and pulls it up. Any liquid or sludge layering in the drum should now be apparent as the tube is brought up. The contents of the tube are then released into an 8-ounce sample jar. The process is repeated until sufficient sample has been collected.

Sludge or solids underneath a liquid may be sampled by forcing the pipet into it. If the sludge does not run out into the jar, shaking the pipet or tapping it against the side of the jar may loosen it. If this fails, one may break the pipette and put the pieces which have the solid in them in the jar.

When ever pipete are used for sampling, samplers should wear Whizzard gloves.

After the sample has been taken, the outside of the jar should be wiped off and the drum number written on the lid and side of the jar. After this, the drum inspection log must be completed.

6.7.3 Drum Inspection Log Completion

The following information is required in the drum inspection log (see Figure 6.1 for example).

- o DRUM NO.: Number assigned exclusively to a particular drum (that number is marked on the drum)
- o PROJECT NO.: OHM assigned project number
- o DATE: Date the drum inspection log is filled out
- o TIME: Time in military hours the log is filled out
- o TYPE OF CONTENTS: State of material in the drum
- o COLOR: Color of material in the drum
- o pH: pH Value and method of measuring pH; usually done as part of lab compatibility analysis
- o DRUM SIZE: Size of drum, whether it is completely full of material or not
- o AMOUNT OF CONTENTS: Estimate of how much material is in the drum; if between two measurements, indicate the higher amount
- o SAMPLE METHOD: Tool used to transfer the sample into a sample container
- o DRUM MARKINGS: Any legible markings on the drum and any unusual physical characteristics of the drum



OHM

DRUM INVENTORY LOG

Form 0056
Field Tech Svcs
07/88

DRUM NO. _____

PROJECT INFORMATION

PROJECT LOCATION _____ PROJECT NUMBER _____
 PROJECT CONTACT _____ PHONE _____
 LOGGER _____ SAMPLER _____
 WEATHER _____ DATE _____ TIME _____

DRUM TYPE: FIBER ☐ STEEL ☐ POLY ☐ STAINLESS STEEL ☐ NICKEL ☐
 POLY-LINED ☐ RING TOP ☐ CLOSED TOP ☐ OVERPACKED ☐

DRUM CONDITION: MEETS DOT SPEC ☐ GOOD ☐ FAIR ☐ POOR ☐

DRUM SIZE: 85 ☐ 55 ☐ 42 ☐ 30 ☐ 16 ☐ 10 ☐ 5 ☐ OTHER _____

DRUM CONTENTS: AMOUNT FULL ☐ $\frac{3}{4}$ ☐ $\frac{1}{2}$ ☐ $\frac{1}{4}$ ☐ $< \frac{1}{4}$ ☐ MT ☐

PHYS. STATE					COLOR	CLARITY			LAYER THICKNESS	FIELD ANALYSIS			
LAYERS	LIQUID	SOLID	GEL	SLUDGE	USE STD COLORS	CLEAR	CLOUDY	OPAQUE	INCHES	pH	SU	PID	ppm
T										DOSIMETER		mrem/hr	
M										OTHER			
B										DRUM LABELS/MARKINGS			

MFG NAME _____
 CHEMICAL NAME _____
 ADDITIONAL INFORMATION _____

LABORATORY COMPATABILITY DATA

☐ Mark if Physical State and Color matches the above information. If not, stop analysis and notify project contact. Further work will not be paid for.

COMPATABILITY CAT. _____

ANALYSTS: _____

DATE PERFORMED: _____

RADIATION: POS ☐ NEG ☐ _____ mrem/hr

PHYSICAL STATE					COLOR	CLARITY			WATER SOL.	REACT	pH	HEX. SOL.	PER.	OXID.	CN	SUL.	BREL. STEIN	FLASH POINT	PCBs (20 ppm)	PCB TEST COMP
LAYERS	LIQUID	SOLID	GEL	SLUDGE	USE STD. COLOR	CLEAR	CLOUDY	OPAQUE	SOLUBILITY S. PS. I DENSITY H OR L	A - AIR W - WATER	STD UNIT	S OR I	+ OR -	+ OR -	+ OR -	+ OR -	+ OR -	< 60°C + or -	+ OR -	NUMBER
T																				
M																				
B																				

Comments: _____

PCB Conc. _____ PPM Flash Point _____ °C Compatibility Comp. Bulk # _____

Data Reviewer: _____ Data Review Date: _____

Field Reviewer: _____ Field Review Date: _____

- o ADDITIONAL COMMENTS: Any remarks the sampler may deem necessary about the sampling method or state of sample and/or drum that may be a useful reference in the future; important to note whether the drum has been overpacked

6.7.4 Cleanup after Drum Sampling

After a group of drums has been sampled, the sample jars should be collected. The sampling trash, sample gloves, paper towels, etc., is then bagged for disposal. The sampling pipettes should be collected in an empty pipette box and then smashed in a drum for glass waste.

6.8 DRUM SAMPLING SUPPLIES

Equipment needed for drum sampling is listed below.

- o Expendables Per Hundred Drums
 - 120 drum log sheets
 - 120 8-ounce jars with Teflon liners
 - 100 tongue depressors
 - 120 11-mm dip tubes
 - 400 pair sample gloves
 - 5 mean streaks
 - 2 rolls paper towels
 - 2 trash bags
 - 10 chain-of-custody forms
 - 1 quart hexane
 - 1 quart acetone
- o Required Equipment
 - 1 12-column book
 - 2 OHM record books
 - 1 utility knife
 - 1 brass bung wrench
 - 1 brass hammer with cutting edge
 - 1 brass chisel
 - 1 brass screwdriver
 - 1 stainless-steel trowel
 - 2 pair Whizzard Liners
 - 2 1/2 inch drive with 15/16 inch socket
 - 2 polyethylene squirt bottles
 - Level B protective equipment
 - 1 photoionization detector
 - 1 Geiger counter
 - 1 H₂S monitox with gas generator
 - 1 HCN monitox with gas generator
- o Optional Equipment
 - 1 brass-tipped drum punch

DRUM INVENTORY LOG INSTRUCTIONS

The drum inventory log has been designed as a two part form on a single sheet. The upper portion provides space for the documentation of sampling information, the lower portion for laboratory data. By locating all the available information on one sheet, the review of data for discrepancies is simplified.

Project Information

1. Project Location - Name assigned by OHM
(generally the client company's name and/or
street address of the facility/site)
2. Project Number - Assigned by OHM to each
project
3. Project Contact - The OHM employee responsible
for overseeing the sampling operation. This
person should be the individual to whom ques-
tions are to be directed or verbal results
given for review (i.e., senior sampling
technician, project chemist, or site super-
visor)

Project Information (Cont.)

4. Phone - Site phone or project managers phone number
5. Logger - Initials of individual responsible for filling in the sampling portion of the inventory log sheet
6. Sampler - Initials of individual(s) responsible for obtaining the sample
7. Weather - Weather conditions during sampling (e.g., temperature and/or precipitation)
8. Date - Date when sample is collected
9. Time - Time when sample is collected
10. Drum Type - Place a check mark () in the box or boxes which best describe the drum type and materials of construction
11. Drum Condition - Place a check mark () in the box indicating the integrity of the drum.
Meets DOT specifications means it is road worthy

Project Information (Cont.)

12. Drum Size - Place a check mark () in the box indicating the volume of drum when full. If drum is overpacked, the inner drum volume is provided
13. Drum Contents - Place a check mark () in the box indicating the volume of waste contained in the drum
14. Layers - This designates the layer as top, middle, or bottom for a multi-layered sample
15. Physical State - Place a check mark () in the box indicating the actual physical state of each layer
16. Color - The standard color description for each layer of the sample should be written in.
Acceptable color descriptions are:

blue	white	black
red	cream	orange
pink	yellow	gray
colorless	amber	purple
green	brown	green-blue

Project Information (Cont.)

17. Clarity - Check the clarity of each layer of the sample (clear, cloudy, or opaque)
18. Layer Thickness - Record the thickness of each layer in inches, an estimate of how deep the layer
19. pH - Record pH measurement in standard units (SU); 1 to 14
20. PID - Record the results for vapor analysis by photoionization detector (PID). The PID scale reads in ppm (0 to 2,000)
21. Dosimeter - For analysis of radiation with the dosimeter. Its scale readings should be checked to be sure the units are in mrem/hr
22. Other - This space is for additional analysis which may take place. The information should include the equipment used, the parameter being measured, and its concentration. Example:
Drager tube - HCN - 5 ppm
23. DOT Haz - Hazard category from placards or stencils on drum. Example: Corrosive Liquid

Project Information (Cont.)

24. UN/NA - Space for any UN or NA numbers which are stenciled or written on the drum. These numbers are always prefixed by either UN or NA
25. Chemical Name - Any chemical compound or key ingredient on the chemical name of the contents on the label or stenciled on the drum. Include all if more than one name is on the drum
26. Additional Information - This space is for additional information or comments for which no specific space is designated. It can include unusual comments or problems such as the contents are too hard to sample, drum color, or that colored crystals have formed on the drum

Laboratory Compatibility Data

A specific and detailed description of the laboratory compatibility procedures has been compiled as the OHM Compatability Testing Manual which has been included.

27. This box is to be check marked to be certain that physical state, number of layers, and

Laboratory Compatibility Data (Cont.)

color of the sample in the laboratory corresponds to that in the field. This is to ensure no obvious discrepancies between the material actually in the sampled container and that arriving at the laboratory is analyzed and reported (e.g., blurred or misread sample labels). If the sample and description do not match and no obvious answer is available (melting ice or solids settling out of solution) then no further work should be completed. The project contact should be notified to solve the problem by resampling.

28. Radiation - The opened sample jar should be tested with a dosimeter for radiation with a dosimeter before samples are removed and analyzed. The appropriate box check marked and the actual reading in mrem/hr. recorded. Readings above 0.05 mrem/hr. are considered above normal

NOTE: Categories 29 through 44 have boxes provided for top, middle, and bottom when multilayered samples are analyzed.

Laboratory Compatibility Data (Cont.)

29. Physical State - check mark the physical state for the sample (layer) involved

30. Color - The standard color description for each layer of the sample should be written in.
Acceptable color description are:

blue	white	black
red	cream	orange
pink	yellow	gray
colorless	amber	purple
green	brown	green-blue

31. Clarity - Check the clarity of each layer of the sample (clear, cloudy, or opaque)

32. Water Solubility - Each layer of the sample is checked for solubility as per 2.1.1 of the manual. The abbreviations S, PS, and I stand for soluble, partially soluble, and insoluble, respectively. The density abbreviations H and L stand for heavier and lighter, respectively

Laboratory Compatibility Data (Cont.)

33. Reactivity - Each layer of the sample is checked for solubility as per 2.1.1 of the manual. The abbreviations A and W stand for air reactive and water reative, respectively. If there is no reactivity, a negative sign would indicate this property was reviewed
34. pH - Each layer of sample is checked for pH according to Section 2.5 of the manual. Results are expressed in standard units (SU)
35. Hexane Solubility - Each layer of the sample is checked for organic solubility according to Section 2.1.2 of the manual. Results are expressed as positive or negative (+ or -)
36. Peroxides - Each layer of sample is checked for peroxides according to Section 2.2 of the manual. Results are expressed as positive or negative (+ or -)

Laboratory Compatibility Data (Cont.)

37. Oxidizing Material - Each layer of sample is checked for oxidizers according to Section 2.3 of the manual. Results are expressed as positive or negative (+ or -)
38. Cyanide - Each layer of the sample is checked for cyanides according to Section 2.7 of the manual. Results are expressed as positive or negative (+ or -)
39. Sulfides - Each layer of the sample is checked for sulfides according to Section 2.6 of the manual. Results are expressed as positive or negative (+ or -)
40. Bielstein or Halogen Testing - Each layer of the sample is checked for halogens according to Section 2.4 of the manual. Results are expressed as positive or negative (+ or -)
41. Flash Point - Each layer of the sample is checked for flammability according to Section 2.8 of the manual. Results are expressed as positive or negative (+ or -)

Laboratory Compatibility Data (Cont.)

42. PCB Screening - Each layer of the sample is checked for polychlorinated biphenyls according to Section 2.9 of the manual. Results are expressed as positive or negative (+ or -)
43. PCB Test Composite Number - In Section 2.9.2 of the PCB Screening section, composites of samples or sample/layer are created to speed the screening process. This box requires the composite group number each sample/layer is assigned to
44. Comments - This space is included to provide information which is not requested elsewhere and to expand on analytical observations which are unusual or important
45. PCB Concentration - When required, individual samples/layer PCB concentration(s) will be quantified in ppm. The highest sample layer concentration will be the concentration of interest

Laboratory Compatibility Data (Cont.)

46. Flash Point - When required, individual samples/layer precise flash point in degrees celcius will be obtained. The lowest sample layer flash point will be the temperature of interest
47. Compatibility Composite Bulk Number - This number indicates the sequence in which this sample was test bulked
48. Compatibility Category - When the analysis has been completed for each sample, the data is reviewed and the sample is classified into the most probable bulking group. A test bulking is performed to assure all material classified as similar physical and chemical characteristics are indeed compatible. Once this has been proven, the compatibility category is assigned (i.e., CNL - cyanide liquid)
49. Analysts - Provide the initials of the analysts so questions can be directed to the personnel who performed the work

Laboratory Compatibility Data (Cont.)

50. Date Performed - Provide the date analyses are performed
51. Data Reviewer - Signature of person reviewing all data at the laboratory
52. Data Review Date - Date of the data reviewer's signature
53. Field Reviewer - Signature of OHM personnel responsible for the final review of completed inventory log
54. Field Review Date - Date of field reviewer's signature



OHM

DRUM INVENTORY LOG

Form 0058
Field Tech. Svcs.
07/88

DRUM NO. _____

PROJECT INFORMATION

PROJECT LOCATION 1 PROJECT NUMBER 2
PROJECT CONTACT 3 PHONE 7
LOGGER 5 SAMPLER 6
WEATHER 7 DATE 8 TIME 9

DRUM TYPE: FIBER ☐ STEEL ☐ POLY ☐ STAINLESS STEEL ☐ NICKEL ☐
10 POLY-LINED ☐ RING TOP ☐ CLOSED TOP ☐ OVERPACKED ☐

DRUM CONDITION: 11 MEETS DOT SPEC ☐ GOOD ☐ FAIR ☐ POOR ☐

DRUM SIZE: 12 85 ☐ 55 ☐ 42 ☐ 30 ☐ 18 ☐ 10 ☐ 5 ☐ OTHER _____

DRUM CONTENTS: 13 AMOUNT FULL ☐ $\frac{3}{4}$ ☐ $\frac{1}{2}$ ☐ $\frac{1}{4}$ ☐ $<\frac{1}{4}$ ☐ MT ☐

14	PHYS. STATE				COLOR	CLARITY			LAYER THICKNESS
LAYERS	LIQUID	SOLID	GEL	SLOUDGE	USE STD. COLORS	CLEAR	CLOUDY	OPAQUE	INCHES
T		<u>15</u>			<u>16</u>		<u>17</u>		<u>18</u>
M									
B									

FIELD ANALYSIS

pH 19 SU PID 20 ppm
DOSIMETER 21 mrem/hr
OTHER 22

DRUM LABELS/MARKINGS

DOT HAZ 23 UN/NA 24

MFG NAME 25
CHEMICAL NAME 26
ADDITIONAL INFORMATION 27

LABORATORY COMPATABILITY DATA

28
☐ Mark if Physical State and Color matches the above information. If not, stop analysis and notify project contact. Further work will not be paid for.

COMPATABILITY CAT. 49ANALYSTS: 50DATE PERFORMED: 5129 RADIATION: POS ☐ NEG ☐ _____ mrem/hr

30 PHYSICAL STATE					31 COLOR	32 CLARITY			33 WATER SOL.	34 REACT	35 PH	36 HEX. SOL.	37 PERL.	38 OXID.	39 CHL.	40 SUL.	41 BIEL. STEIN.	42 FLASH POINT	43 PCB (IN ppm)	44 PCB TEST COMP.
LAYERS	LIQUID	SOLID	GEL	SLOUDGE	USE STD. COLOR	CLEAR	CLOUDY	OPAQUE	SOLUBILITY S. PS. I DENSITY W OR L	A - AIR W - WATER	STD UNIT	S OR I	+ OR -	+ OR -	+ OR -	+ OR -	+ OR -	+60°C -60-	+ OR -	NUMBER
T																				
M																				
B																				

Comments: 45PCB Conc. 46 PPM Flash Point 47 °C Compatibility Comp. Bulk # 48Data Reviewer: 52Data Review Date: 53Field Reviewer: 54Field Review Date: 55

7.0 TANK SAMPLING

The following subsections describe specific details associated with tank sampling.

7.1 DIFFICULTIES AND DANGERS

The sampling of tanks, vats, process vessels, tank cars, and other types of containers presents unique problems. Generally, containers of this type are closed except for small access ports, manways, or hatches on the larger vessels, or taps and bungs on smaller vessels. The physical size, shape, construction materials, and locations of access will limit the types of equipment and methods of collection.

When liquids are contained in sealed vessels, gas vapor pressures build up, sludges settle out, and density layerings develop. When containers are opened, the potential for explosive reactions or the release of noxious gases requires considerable safeguards. The vessels should be opened with extreme caution; preliminary sampling of any headspace gases is always warranted; and Level B protection is standard until the dangers are well understood.

Another source of danger is climbing on old rusty tanks, some of which may be 30 or more feet tall. Old and rusty metal ladders should not be trusted, nor should tank tops which may be rusted through. Even when the tank is in good condition, climbing on it with protective clothing which restricts one's movements, and an SCBA on one's back is dangerous. There are many situations where a cherry picker with a bucket should be used.

Tank entry for sampling is undesirable and unnecessary, except where it might be required for sampling solids not covered by liquid. Proper procedures for tank entry must be followed.

7.2 TANK INSPECTION

Proper tank inspection is necessary for safety and efficiency in sampling or working on the tank, and because the information generated may be input to a proposal.

It is important that accurate dimensions and their orientation be recorded on a tank inspection sheet (see Figure 7.1). The location, size, type, and condition of valves are important. Tank condition should be elaborated on. The height and size of the dike surrounding the tank should be noted. Manways, vents, vacuum breakers, and pressure relief valves should be noted.



OHM

TANK SAMPLING DATA SHEET

Form 3068
Field Tech Services
02/89

Logger:		Sampler:		Weather:							
Client:			Client Contact:								
Location			Date:								
Project No.			Time:								
TANK INFORMATION											
ORIENTATION: ☐ Vertical ☐ Horizontal			SHAPE: ☐ Spherical ☐ Cylindrical ☐ Rectangular								
LOCATION: ☐ Above Ground ☐ Underground			TYPE COVER: ☐ Concrete ☐ Asphalt								
CONDITION: ☐ Excellent ☐ Poor ☐ Good ☐ Leaking ☐ Fair			CONTROL DIKE: ☐ Excellent ☐ Poor ☐ Good ☐ Leaking ☐ Fair								
CONSTRUCTION: ☐ Metal ☐ Fiberglass ☐ Lined			SPECIALTIES: ☐ Heated ☐ Pressurized ☐ Insulated Jacket								
	LOCATION		SIZE		TYPE						
VALVE 1											
VALVE 2											
VALVE 3											
MANHOLE 1											
MANHOLE 2											
MANHOLE 3											
RECOMMENDATIONS: _____											
ACCESS: _____											
COMMENTS: _____											
DIAGRAM OF TANK: (Include Raw Measurements)											
LAYERS	PHYS. STATE				COLOR use std. colors	CLARITY			LAYER THK. (in)	VOLUME (gallons)	Capacity: _____
	LIQUID	SOLID	GEL	SLUDGE		CLEAR	CLOUDY	OPAQUE			
TOP											
MIDDLE											
BOTTOM											
DOT HAZ: _____									NFPA:		
UN/NA: _____											
CHEMICAL NAME: _____											

Tracing pipes connected to a tank will indicate whether it is connected to another reservoir of liquid. After all, one must bear in mind that any valve in the line may be open or broken. It is important to note whether tank jacketing or pipe insulation is asbestos. Tank liners, especially glass, should also be noted.

During the inspection, each tank should be assigned a unique number. This number should be painted on two or three sides of the tank. To aid visibility, the characters should be at least 1 foot tall.

7.3 HEADSPACE GASES

Headspace gases are the accumulated gaseous components found above solid or liquid layers in closed vessels. These gases may be the result of volatilization, degradation, or chemical reaction. Poorly ventilated or partially sealed areas can also act to concentrate gas vapors.

Component concentrations normally exceed those found in ambient measurements. Therefore, the previously described ambient methods must be modified for handling these higher concentrations and for the remote sensing of container contents. The anticipated higher concentrations can be dealt with by altering the instrument detector range, reducing the sample gas flow rate into the instrument, or utilizing a sample dilution system. These techniques are necessary for the prevention of saturation, poisoning, and/or gross deterioration of the detector element. When lengthy extensions are used, one must also take into account increased time lags for instrument response.

Most ambient measurement devices have sample intakes which are highly directional and localized. The use of an extension will allow the operator to maintain a safe position while obtaining samples from varying depths and distances within containers.

Poorly ventilated vessels can usually be sampled for headspace gases through small hatches or openings. Fully sealed vessels must be approached more cautiously since breaching may result in the uncontrolled release of pressurized gases or the potential for violent reactions with the ambient atmosphere. Any decision to open a sealed vessel should be based on sound need. The investigator must be cognizant of the inherent dangers, and take appropriate safety precautions.

The parameters which must be checked are oxygen content, explosiveness and toxicity. Oxygen content and explosiveness must be checked first, since the PID, which is used to measure organic vapors, is not intrinsically safe. Toxicity may be assessed from PID or OVA readings and/or also Dragger tube indications. Because vapors with various densities will stratify, readings must be taken at the top, middle and bottom of the tank. These readings should be recorded on the tank inspection sheet and in the field log.

Flame ionization detectors that use the sample gas stream as their combustion air may have insufficient oxygen for combustion and will likely require use of a dilution probe. The introduction of entrained droplets from the container contents should also be avoided. Careful handling of the extension tube to avoid close contact with the materials surface (and in some instances the use of a glass wool filter plug) will prevent material build up in the probe and detector.

7.4 SAMPLING OF HEADSPACE GASES IN PRESSURIZED VESSELS

When sampling for entrapped gases, sealed vessels present special problems. The container must be opened to accept a sample probe while still preventing uncontrolled release of its potentially hazardous contents. Further, this must be accomplished while still protecting the safety of the inspector.

On large vessels and tanks inspection valves and petcocks are normally available. Sealed drums, however, are not designed to contain gases that often develop as reaction products of the contents and have no such inspection provisions.

Leak-free sample tops can be installed on these drums by attaching a mechanism that will drill through a leak-tight fitting strapped to the drum (see Figure 7.2). The system consists of a battery-operated drill with a remote control switch. The drill is mounted on a simple spring-controlled frame which guides the drill bit through a Swagelok cross fitting. The Swagelok cross fitting is attached to a ball valve which, in turn, is attached to a mounting plate. The mounting plate underside is gasketed with closed cell Neoprene foam. The mounting plate is held against the container using standard steel packaging straps. The Swagelok cross fitting contains a Teflon seal which allows the drill bit to rotate without allowing gases from the container to escape during drum penetration.

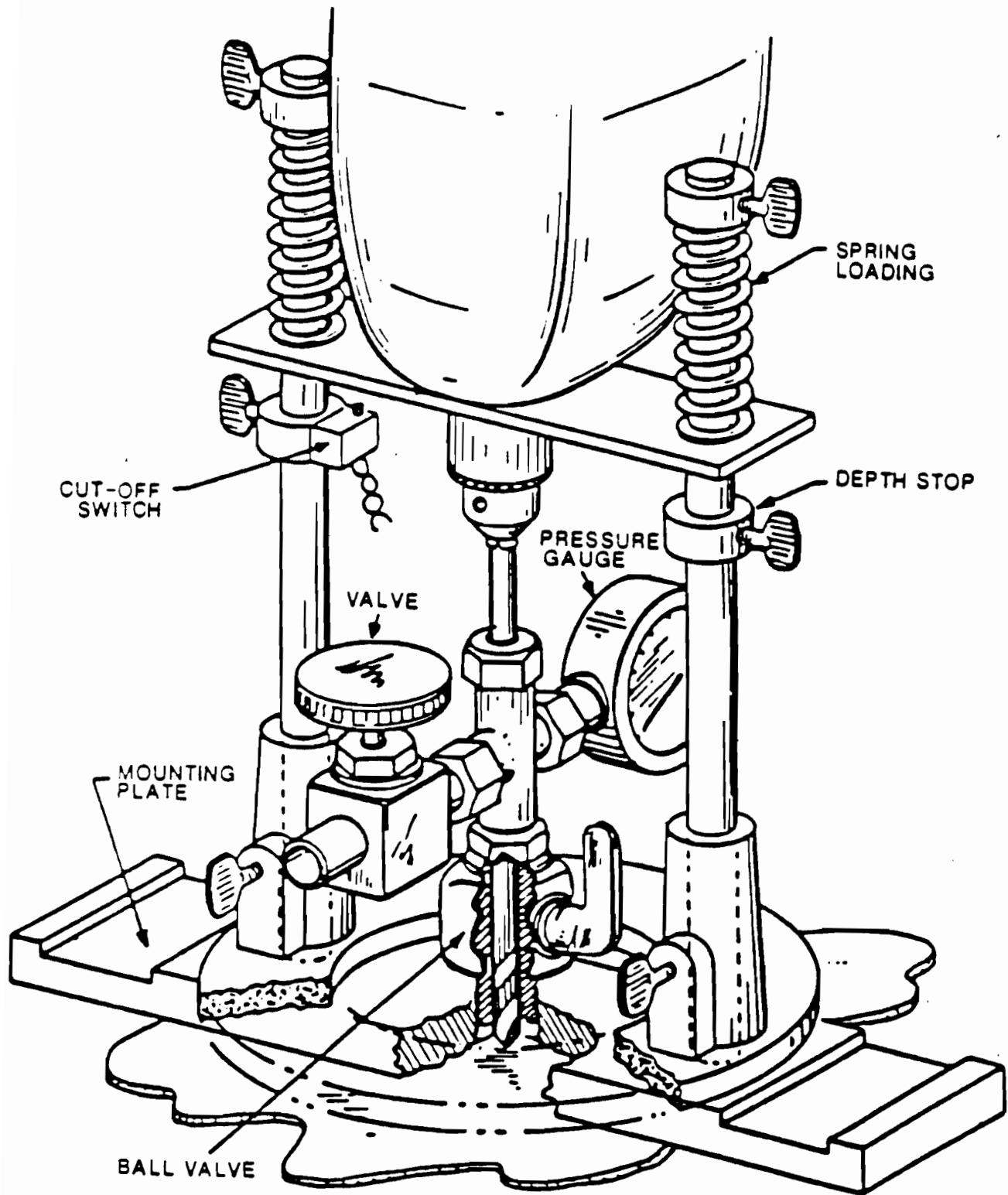


FIGURE 7.2

DRILLING MECHANISM

A pressure gauge is attached to one side of the Swagelok cross fitting while a needle valve is attached to the side opposite the gauge. The pressure gauge permits the waste handler to observe the internal pressure equalization prior to further opening of the container. A light is located on the remote control switch which indicates when the drum has been pierced. The electrical control system is interlocked so that drill operation automatically stops upon penetration of the container by the drill bit.

The whole assembly is activated remotely. Once the bit has penetrated the drum, contained gases flow between the drill bit and the inside of the fittings. Release of the gases is controlled by a needle valve. After sampling, the drill mechanism is pulled away from the container until the drill bit clears the ball valve.

The ball valve is then closed, and the piercing mechanism up to the ball valve is removed from the container. The ball valve and mounting plate are left intact to serve as a permanent seal for the opening. Monitors and detectors can then be adapted to the needle valve and the gas directed to the instrument.

This device has been used on 55-gallon drums but would also be applicable to other size drums and vessels. Fabrication specifications for this device are found in Appendix B of Characterization of Hazardous Waste Sites, A Methods Manual: Volume 2, Available Sampling Methods (2nd Edition), EPA/600/4-84/076.

7.4.1 Procedures for Use of Battery-Operated Drill

The following procedures apply to drill usage:

1. Assemble the drill assembly as described in the above mentioned document.
2. Brush clear any loose rust or dirt to assure a leak-free seal. Seat assembly against the drum side. Tighten mounting straps using portable packaging equipment.
3. Assure that all fittings are snug and needle valve is fully closed.
4. Deploy remote control cable to full extent and stand behind safety screen.
5. Activate drill.

6. After penetration is indicated by light on remote control unit, approach container while monitoring internal drum pressure with pressure gauge on sampler.
7. Attach desired monitor instrument for container content characterization by using an appropriate size Teflon tubing. After sampling, close needle valve. Extra caution is necessary for highly pressurized containers, as most monitors are designed to accept ambient pressure gases.
8. After proper quantification and/or identification of the contained gas, the safety officer should decide whether the gas can be loosened from the bit and removed from the guide assembly as outlined below.
 - a. Pull drilling mechanism away from container until the drill bit clears the ball valve. Close ball valve.
 - b. Loosen nut containing Teflon seal.
 - c. Unscrew bolts, holding drill assembly to mounting plate.
 - d. Remove drill assembly from mounting plate pulling drill bit through Teflon seal.
 - e. Remove cross fitting as unit from ball valve.

The remaining mounting plate and ball valve serve as a permanent seal until the container can be disposed properly.

7.5 DETERMINATION AND MEASUREMENT OF LAYERING

Determination and measurement of layering in tanks is essential to quantify each type of material in the tanks. There are a variety of methods to accomplish this, such as:

- o Tank gauging tape/ORS interface probe - These probes are able to distinguish between liquids which conduct electricity and those which do not. This allows one to distinguish aqueous layer from a light or heavy immiscible organic layer. The probe is lowered on a measuring tape. Consult manual for operating instructions. The standard probe must not be used with chlorinated organics. However, the units can be ordered with probes which are compatible with all solvents.

- o Sludge Judge - The Sludge Judge is an acrylic tube, in 5-foot sections, which has a check valve at the bottom and is marked off in feet. While it is too difficult to decontaminate to make it useful for sampling, it can be used to observe layering. However, it is degradable by exposure to organic solvents.
- o Stick with waterfinder paste - If one is certain that there is only a light organic layer, an aqueous layer, and sludge in the tank. The tank may be "stuck." The stick is coated on one side with water finder paste. Then it is lowered slowly into the tank. When the liquid surface is reached, the stick is marked at hatch level. When resistance is felt, indicating the top of the dense sludge, the stick is again marked. When the bottom of the tank is reached the stick is marked again. One must be careful because a dense immiscible solvent layer can cause a false bottom of sludge to be formed between it and the aqueous layer. This results from solids whose density is between that of water and of the dense solvent.
- o Depth Composite - A sample which is an accurate depth composite can give a good indication of layering. Measurements of layers in the sample can be scaled up to give rough measurements of the layers in the tank.
- o Frost Or Dew Line - Organic liquids generally have lower heat capacities than does water. As a result, on fall mornings, one can sometimes see dew or frost on a tank with a band that has no moisture on it corresponding to the location of an aqueous layer.

After measurements are taken, volumes can be calculated. This is straightforward in every case except that of a cylindrical tank on its side or a spherical tank. For horizontal cylindrical tanks, use the nomograph on the following page. For spherical tanks use Table 7.2.

To find the capacity of a cylindrical tank, find the diameter of the tank on Table 7.1 and find the corresponding per foot gallonage; multiply this gallonage by the height or length of the tank in feet. This will give the capacity in gallons.

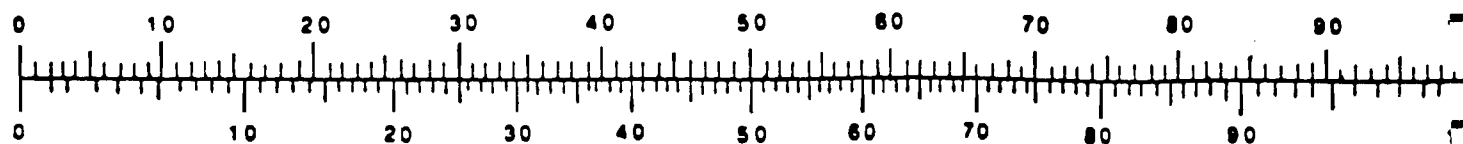
TABLE 7.1

VERTICAL TANKS
United States Gallons in Round Tanks
Inside Diameter for 1-Foot Depth

Tank Diameter	U.S. Gals.	Tank Diameter	U.S. Gals.	Tank Diameter	U.S. Gals.
2 ft	23	11 ft, 6 in	776	20 ft, 6 in	2,469
2 ft, 6 in	36	12 ft	846	21 ft	2,591
3 ft	52	12 ft, 6 in	918	21 ft, 6 in	2,715
3 ft, 6 in	71	13 ft	922	22 ft	2,843
4 ft	94	13 ft, 6 in	1,070	22 ft, 6 in	2,974
4 ft, 6 in	118	14 ft	1,151	23 ft	3,108
5 ft	146	14 ft, 6 in	1,235	23 ft, 6 in	3,244
5 ft, 6 in	177	15 ft	1,321	24 ft	3,384
6 ft	211	15 ft, 6 in	1,411	24 ft, 6 in	2,526
6 ft, 6 in	248	16 ft	1,504	25 ft	3,672
7 ft	287	16 ft, 6 in	1,599	25 ft, 6 in	3,820
7 ft, 6 in	330	17 ft	1,697	26 ft	3,971
8 ft	376	17 ft, 6 in	1,799	27 ft	4,283
8 ft, 6 in	424	18 ft	1,903	28 ft	4,606
9 ft	475	18 ft, 6 in	2,010	29 ft	4,941
9 ft, 6 in	530	19 ft	2,120	30 ft	5,287
10 ft	587	19 ft, 6 in	2,234	31 ft	5,646
10 ft, 6 in	640	20 ft	2,350	32 ft	6,016
11 ft	710				

FIGURE 7.3

% OF DIAMETER



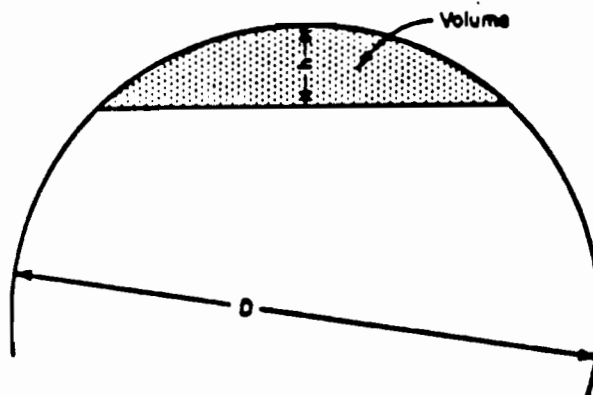
% OF VOLUME

TABLE 7.2
VOLUMES FOR SPHERICAL TANKS

h = segment height; D = sphere diameter

h/D	Segment vol. D^3	Segment vol. Sphere vol.	h/D	Segment vol. D^3	Segment vol. Sphere vol.	h/D	Segment vol. D^3	Segment vol. Sphere vol.	h/D	Segment vol. D^3	Segment vol. Sphere vol.
.01	0.000156	0.000298	.16	0.035923	0.066608	.51	0.119756	0.228718	.41	0.191877	0.366458
.02	0.000619	0.001184	.17	0.040251	0.076674	.52	0.126534	0.241664	.42	0.199509	0.381034
.03	0.001363	0.002646	.18	0.044787	0.085536	.53	0.133426	0.254636	.43	0.207188	0.395686
.04	0.002346	0.004672	.19	0.049522	0.094362	.54	0.140425	0.266192	.44	0.214981	0.410432
.05	0.003576	0.007258	.20	0.054454	0.104000	.55	0.147524	0.281738	.45	0.222868	0.425258
.06	0.005049	0.010368	.21	0.059573	0.113778	.56	0.154717	0.295488	.46	0.230458	0.440128
.07	0.006773	0.014114	.22	0.064875	0.123904	.57	0.161988	0.309394	.47	0.238265	0.455054
.08	0.008751	0.018176	.23	0.070353	0.134366	.58	0.169361	0.323456	.48	0.246099	0.470016
.09	0.011196	0.22842	.24	0.076001	0.145152	.59	0.176799	0.337662	.49	0.253946	0.485002
.10	0.014661	0.28000	.25	0.081812	0.156258	.60	0.184386	0.352008	.50	0.261799	0.500000
.11	0.017613	0.33638	.26	0.087788	0.167648						
.12	0.020809	0.39744	.27	0.093900	0.179334						
.13	0.024346	0.46308	.28	0.100160	0.191296						
.14	0.027914	0.53312	.29	0.106560	0.203522						
.15	0.031809	0.60750	.30	0.113097	0.216000						

* Given the segment height h and the sphere diameter D , first form the ratio h/D , and find from the table the value of (segment volume/ D^3); then multiply this latter value by D^3 , that is: (segment volume/ D^3) $\times D^3$ = segment volume.



7.5.1 Horizontal Tanks

When the total volume of a horizontal tank is known, and it is desired to determine its contents when partially full, the depth of liquid is determined as a percentage of the tank diameter and the corresponding percentage of the total tank volume is read from the nomograph in Figure 7.3.

Example Horizontal Tanks

$$\frac{\text{Tank Measurement (Inches)}}{\text{Tank Diameter (Inches)}} \times 100 = \text{Percent Diameter}$$

$$\text{Percent of Volume} \times \text{Tank Capacity (Gallons)} = \text{Volume (Gallons)}$$

7.5.2 Spherical Tanks

The capacity of a spherical tank is determined by the formula $V = (4/3)\pi r^3$, where r is the tank's inner radius. The volume of the contents of a partially full tank is determined as follows.

1. Find the tank diameter (D). The radius is half the diameter.
2. Determine the depth to the top of the product. If the depth to the top of the product is less than the radius, then h = depth to the top of the product. Otherwise h = D the depth to the top of the product.
3. Compute h/D , (i.e., percent of diameter).
4. Find value for h/D in Table 7.2 and corresponding entries for (segment volume/ D^3) and for (segment volume/sphere volume). If tank capacity is known, use the latter figure otherwise use the former.
5. Multiply the first figure from the table by D^3 or the tank capacity by the second figure to obtain segment volume.
6. If the product level is above the middle of the tank, the calculated volume is the airspace in the tank. To find the product volume, subtract the calculated volume from the tank capacity. If the product level is below the middle of the tank, the calculated volume is the product volume.

7.6 SAMPLING METHODS

There are basically three acceptable methods for sampling liquid wastes in tanks: bacon bomb, composite liquid waste sampler (COLIWASA), and dip tube. The bacon bomb is discussed in Section 5.1.5.1; the dip tube is discussed in Section 6.7.2; and the COLIWASA is discussed below.

There are also three basic types of sludge samplers acceptable for use in tanks: syringe, scoop, and gravity or messenger released corer. These are discussed in Section 5.2.3 on sludge sampling. Dry solids in tanks may be sampled according to the methods in Section 5.2.2.

7.6.1 Composite Liquid Waste Sampler (COLIWASA)

The COLIWASA is a much-cited sampler designed to permit representative sampling of multiphase wastes from drums and other containerized wastes. The sampler is commercially available or can be easily fabricated from a variety of materials including PVC, glass, or Teflon. In its usual configuration it consists of a 152-cm by 4-cm (inside diameter) section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper. A currently recommended model of the COLIWASA is shown in Figure 7.4; however, the design can be modified and/or adapted somewhat to meet the needs of the sampler.

The COLIWASA is primarily used to sample most containerized liquids. The plastic polycarbonate or PVC COLIWASA is reported to be able to sample most containerized liquid wastes except for those containing ketones, nitrobenzene, dimethylformamide, mesityl oxide and tetrahydrofuran. A glass COLIWASA is able to handle all wastes unable to be sampled with the plastic unit except strong alkali and hydrofluoric acid solution. Because of the unknown nature of most containerized waste, it would be advisable to eliminate the use of PVC materials and use samplers composed of glass or Teflon.

The major drawbacks associated with using a COLIWASA concern decontamination and costs. The COLIWASA is difficult, if not impossible, to decontaminate in the field and its high cost in relation to alternative procedures (glass tubes) make it an impractical throwaway item.

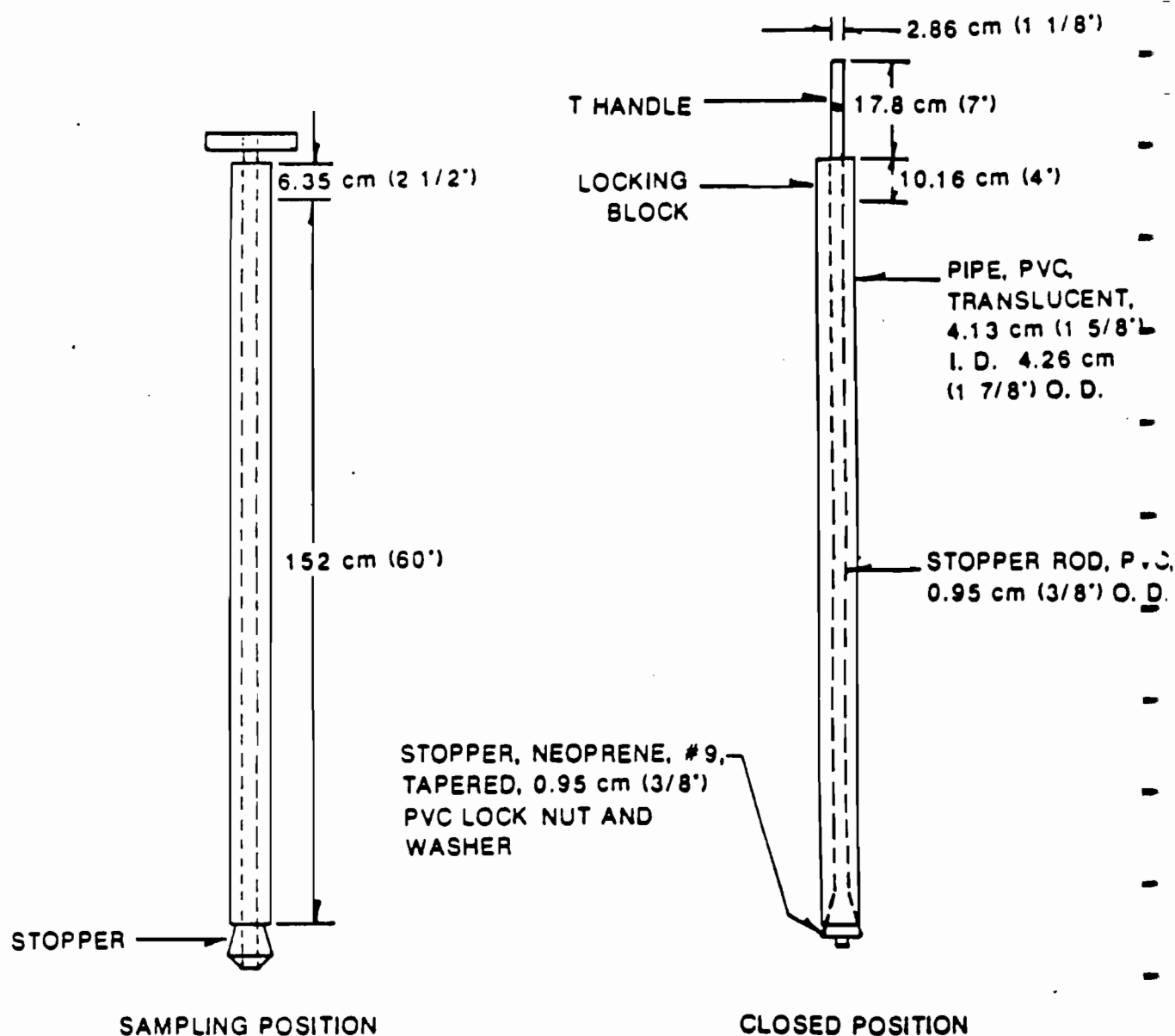


FIGURE 7.4

COMPOSITE LIQUID WASTE SAMPLER (COLIWASA)

It still has limited application value especially in instances where a true representation of a multiphase waste is absolutely necessary. For this reason, the procedure for its use is included.

o Procedures for Use

1. Choose the material to be used to fabricate the COLIWASA and assemble the sampler as shown in Figure 7.4.
2. Make sure that the sampler is clean.
3. Check to make sure the sampler is functioning properly. If necessary, adjust the locking mechanism to make sure the neoprene rubber stopper provides a tight closure.
4. Wear necessary protective clothing and gear; observe required sampling precautions.
5. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.
6. Slowly lower the sampler into the liquid waste. (Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sample tube is lower than that outside the sampler, the sampling rate is too fast and will result in a nonrepresentative sample).
7. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.
8. Slowly withdraw the sampler from the waste container with one hand while wiping the sampler tube with a disposable cloth or rag with the other hand.

9. Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container.
10. Cap the sample container with a Teflon-lined cap; attach label and seal; record in field logbook; and complete the chain-of-custody record.
11. Unscrew the T-handle of the sampler and disengage the locking block. Clean sampler on site or store the contaminated parts of the sampler in a plastic storage tube for subsequent cleaning. Store used rags in plastic bags for subsequent disposal.

**OHM COMPATIBILITY
TESTING MANUAL**

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May 13, 1992

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1.0 INTRODUCTION

OHM Remediation Services Corp. (OHM), a wholly owned subsidiary of OHM Corporation, has prepared this manual to specify procedures to be used during compatibility testing. The manual details a series of semi-quantitative and qualitative tests designed to identify physical and chemical characteristics of containerized waste. These characteristics are then used to determine the proper handling and disposal of the containerized waste.

The objectives of compatibility testing are to identify materials which require special safety handling procedures and to minimize the transportation and disposal cost of the containerized materials through on-site waste blending.

The compatibility testing scheme is designed to identify the following waste characteristics:

- Biological hazard
- Radioactive
- Air reactive
- Water reactive
- Matrix (i.e., aqueous versus organic)
- Acid
- Base
- Organic peroxide (potentially shock sensitive)
- Oxidizer
- Cyanide
- Sulfide
- Halogenated organic
- Flammable
- Polychlorinated biphenyl (PCB)

At the completion of the compatibility testing the containerized waste materials are separated into "compatibility categories." This task is performed using OHM's dbase software, specifically designed to aid field personnel with data management. Each container and/or layer in a container is then placed into a wastestream by the project chemist with the aid of a transportation and disposal coordinator.

Once the wastestreams have been determined, a simulated waste blending test is performed on each group. This test is designed to assure no unforeseen reactions will occur during the field blending of wastes. Also a composite of each wastestream must be made for use during disposal analysis.

2.0 DOCUMENTATION

When testing a large number of samples, it is necessary that the data management process is adequate to ensure that the analytical data generated for a sample is truly representative of the actual sample taken in the field and to ensure proper interpretation of this data. Good data management protocols may be difficult to maintain due to the large quantity of data that can be generated at a waste site. Therefore, it is imperative that the procedures outlined in this section be followed.

2.1 DRUM INVENTORY LOG

A complete tracking of records starts with the generation of a Drum Inventory Log (see Figure 2.1) at the time of sampling. The Drum Inventory Log has been designed as a two-part form on a single sheet which also serves as a chain-of-custody record for the sample. The upper portion provides space for the documentation of sampling information and the lower portion is for laboratory data. By locating all of the available information on one sheet, the review of both field and analytical data is simplified.

2.1.1 Field Data

The field data gathered during the sampling activities and recorded on a Drum Inventory Log include the following:

- Drum Number--Numbers only; at least 3 digits in length (001).
- Project Number--Assigned by OHM to each project.
- Page of --If the drum log is accompanied by Material Safety Data Sheets (MSDS) or other information, then the total number of pages is required. Mostly, will be page 1 of 1.
- Project Location--Name assigned by OHM (generally the client company's name) and/or street address of the facility/site.
- Project Contact--The OHM employee responsible for overseeing the sampling operation. This person should be the individual to whom questions are to be directed or to whom verbal results are submitted for review (i.e., project chemist, or site supervisor).
- Telephone--Site telephone or the telephone number of the supporting OHM office.

 OHM Corporation	DRUM INVENTORY LOG	DRUM NO. _____ PROJECT NUMBER _____ PAGE _____ OF _____
	PROJECT LOCATION _____ LOGGER _____ DATE _____ PROJECT CONTACT _____ SAMPLER _____ TIME _____ PHONE _____ WEATHER _____	

DRUM TYPE: FIBER ☐ POLY-LINED ☐ STEEL ☐ POLY ☐ STAINLESS STEEL ☐ NICKEL ☐									
LD TYPE: RINGTOP ☐ CLOSED TOP ☐									
DRUM CONDITION: MEET DOT SPEC. ☐ GOOD ☐ FAIR ☐ POOR ☐									
DRUM SIZE: 110 ☐ 85 ☐ 55 ☐ 42 ☐ 30 ☐ 16 ☐ 10 ☐ 5 ☐ OTHER _____									
DRUM CONTENTS: VOLUME FULL ☐ 3/4 ☐ 1/2 ☐ 1/4 ☐ <1/4 ☐ MT ☐									
OVERPACKED: NO ☐ YES ☐ Overpack Type: FIBER ☐ STEEL ☐ POLY ☐									

PHYS. STATE					COLOR	CLARITY			LAYER THICKNESS	FIELD ANALYSIS			
L	L	S	G	S	USE STD COLORS	C	C	O	INCHES	pH _____ SU _____ PID _____ ppm DOSIMETER _____ OTHER _____			
A	I	O	E	E		L	P						
Y	I	I	L	A		O	A						
R	D	D	G	R		D	Q						
S	D												
T													
M													
B													

MFG NAME _____

CHEMICAL NAME _____

ADDITIONAL INFORMATION _____

LABORATORY COMPATIBILITY DATA ☐ MARK IF PHYSICAL STATE AND COLOR MATCHES THE ABOVE INFORMATION. IF NOT, STOP ANALYSIS AND NOTIFY PROJECT CONTACT. FURTHER WORK WILL NOT BE PAID FOR.														COMPATIBILITY CAT: _____ ANALYSTS: _____ DATE PERFORMED: _____			
RADIATION: POS ☐ NEG ☐ _____ MREM/HR																	

PHYS. STATE					COLOR	CLARITY			WATER SOL	REACT	pH	HEX. SOL	PER	OXID	CN	SUL	BIEL-STEIN	FLASH POINT	PCBs (25ppm)	PCB TEST COMP
L	L	S	G	S	USE STD COLORS	C	C	O	SOLUBILITY SPSI DENSITY H OR L	A=AIR W=WATER	STD. UNIT	S OR I	+ OR -	+ OR -	+ OR -	+ OR -	+ OR -	<60°C + OR -	+ OR -	N U M B E R
A	I	O	E	E		L	P													
Y	I	I	L	A		O	A													
R	D		G	R		D	Q													
S	D																			
T																				
M																				
B																				

COMMENTS: _____

PCB CONC. _____ PPM FLASH POINT _____ °C COMPATIBILITY COMP. BULK # _____

DATA REVIEWER: _____ DATA REVIEW DATE: _____

FIELD REVIEWER: _____ FIELD REVIEW DATE: _____

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

- Logger--Name of individual responsible for filling in the sampling portion of the Drum Inventory Log.
- Sampler--Name of individual(s) responsible for obtaining the sample.
- Weather--Weather conditions during sampling (e.g., temperature and/or precipitation).
- Date--Date when sample is collected.
- Time--Time when sample is collected.
- Drum Type--An "x" should appear in the box which describes the material of construction.
- Lid Type--An "x" should appear in the box that describes the type of closure on the container.
- Drum Condition--An "x" should appear in the box indicating the integrity of the drum. "Meets DOT Specifications" means the drum can be shipped according to Department of Transportation (DOT) regulations.
- Drum Size--An "x" should appear in the box indicating the size of the drum (its volume in gallons when full). If the drum is overpacked, the inner drum size should be indicated, not the size of the overpack.
- Drum Contents--An "x" should appear in the box indicating the approximate volume of waste presently contained in the drum.
- Overpacked--An "x" should appear in the "yes" box if the container was overpacked, along with an "x" in the box which states the type of overpack utilized.
- Layers--This designates the layer as top, middle, or bottom for a multi-layered sample. If only one layer exists, complete only the line associated with the top layer, "T."
- Physical State--An "x" should appear in the box indicating the actual physical state of each layer as observed in the field.

- Color--The standard color description for each layer of the sample should be indicated. The only acceptable color descriptions are:

Amber (AMB)	Black (BLK)	Blue (BLU)
Brown (BRN)	Colorless (CLS)	Cream (CRM)
Gray (GRY)	Green (GRN)	Green-Blue (GBL)
Orange (ORG)	Pink (PNK)	Purple (PRP)
Red (RED)	Tan (TAN)	White (WHT)
		Yellow (YLW)

- Clarity--An "x" should appear in the box indicating the clarity of each layer of the sample.
- Layer Thickness--The thickness of each layer (in inches) is estimated and recorded in the appropriate space.
- pH--The field pH measurement is recorded in standard units (SU) 0 to 14.
- PID--The photoionization detector (PID) reading of the container head space is recorded. The PID scale reads 0 to 2,000 parts per million (ppm).
- Dosimeter--The result of the field radiation survey is recorded in this space. The dosimeter's scale units are in millirems per hour (mrem/hr).
- Other--This space is for recording additional analyses that may take place. The information should include the equipment used, the parameter being measured, and its concentration. Example: Drager tube - HCN - 5 ppm.
- DOT Haz--Hazard category from placards or stencils on drum. Example: Corrosive Liquid
- UN/NA--Space for any UN or NA numbers which are stenciled or written on the drum. These numbers are always prefixed by either UN or NA.
- MFG Name--Name, address, and telephone number of the company producing or distributing the chemical/product. If the space provided is inadequate, indicate that the information continues on the back of the log, and do so.

- Chemical Name--Any chemical compound, key ingredient, trade name, and/or chemical name of the contents appearing on the drum. Indicate whether the information was printed on a label or stenciled or handwritten on the drum. If the space provided is inadequate, indicate that the information continues on the back of the log, and do so.
- Additional Information--This space is for additional information or comments for which no specific space is designated. It may include any comments or unusual circumstances such as "the contents are too hard to sample," "drum color," or "colorless crystals have formed on the drum." If the space provided is inadequate, indicate that the information continues on the back of the log, and do so.

2.1.2 Laboratory Data

The Drum Inventory Log (see Figure 2.1) includes a section for laboratory compatibility data. Upon receipt of the samples by the laboratory the protocol listed below will be performed. The section number in which each procedure is described is indicated in parentheses.

- General Visual Inspection (see Section 4.1.1)
 - Determination of physical state for each layer
 - Determination of sample color(s) for each layer
 - Determination of sample clarity for each layer
- Visual inspection for biological hazards (see Section 4.1.2)
- Radiological survey (see Section 4.2)
- Sample reactivity (see Section 5.1)
- Sample solubility (see Sections 5.2.1 and 5.2.3)
- Sample density (see Section 5.2.1)
- Sample pH (see Section 5.2.2)
- Peroxide test (see Section 5.3)
- Oxidizer test (see Section 5.4)

- Halogen test (see Section 5.5)
- Sulfide test (see Section 5.6)
- Cyanide spot test (see Section 5.7)
- Flash point test (see Section 5.8)
- PCB screen (see Section 5.9)
- Optional test procedures (see Section 6.0)
- Data review and interpretation (see Section 7.0)
- Data classification (see Section 7.3)
- Wastestream classification (see Section 8.1)
- Waste blending test and disposal sample compositing (see Sections 8.2 and 8.3)

2.2 QUALITY ASSURANCE/QUALITY CONTROL

Mistakes are unavoidable at times and it is imperative that they do not go uncorrected. Therefore, it is necessary that documentation is meticulously kept and rechecked while data is being generated and recorded. The sooner a mistake is noticed, the easier it is to correct. Documentation should always be checked against the observation.

Since the Drum Inventory Log will be reviewed several times by a number of different people before the close of the project, it is a must that all data fields are completed at the time of data acquisition. A blank data field may indicate inadvertently skipped information, whereas an "N/A" or "NONE" implies that the data was not applicable or not found.

Once both the field and laboratory sections of the Drum Inventory Log are completed, the data is entered into the Drumlog dbase program. Before the Classify dbase program is used on the inputted data, a hard copy of the computer data should be compared to the raw data on each Drum Inventory Log to ensure that all data was inputted completely and correctly.

After inputted data is known to be free of errors, the data may then be classified. Any discrepancies between the field and laboratory information or between the compatibility results will be noted in the "Compatibility Category" field as a recheck.

The final entries are now made on the Drum Inventory Log, as needed. These entries are in response to the recheck. If a parameter was rechecked and a conclusion drawn, it should be noted, initialed, and dated in the appropriate section of the Drum Inventory Log.

3.0 GENERAL SAFETY CONSIDERATIONS AND EMERGENCY PROCEDURES

3.1 GENERAL RULES AND REGULATIONS

3.1.1 Accident Investigation

All accidents and injuries must be reported and investigated and all employees are expected to cooperate fully in the investigation process. The supervisor or project chemist must begin the investigation immediately following an accident. An Accident Report Form must be completed and signed by the injured party, site-safety officer, and site supervisor.

3.1.2 Aisles and Walkways

It is necessary to provide aisles and walkways that will permit the unobstructed movement of people. All entry and exit doors of the mobile laboratories must have steps with double handrails. The doorways must be clearly marked "Exit."

There must be unobstructed access to exits, emergency showers, eyewash stations, fire extinguishers, and other emergency equipment. Do not arrange equipment or store materials in such a way that protrudes into walkways.

Persons noticing defective walking surfaces that are trip or fall hazards are expected to report the conditions to their supervisor or project chemist.

3.1.3 Safety Showers and Eyewash Stations

Safety showers and eyewash stations must be tested weekly and the results documented.

3.1.4 Defective Equipment

Defective equipment must not be used. Be sure to "red tag" defective equipment. Note on the tag the problem, date, and name of person finding the defect.

3.1.5 Food and Beverages

The storage or consumption of food or beverages is strictly prohibited in the laboratory trailer. Signs are to be posted on entry doors stating this fact.

3.1.6 Posting of Proper Signs

Posting of proper signs is accomplished on site before work begins in the trailer. Signs required include "No Smoking or Eating in Trailer," "Authorized Personnel Only," and "Safety Glasses and Lab Coat Required." A map to the nearest hospital and emergency phone numbers are to be clearly posted as well.

3.1.7 Housekeeping

Good housekeeping in the workplace means the orderly arrangement of supplies, equipment, and chemicals. Good housekeeping also contributes to efficiency. Good housekeeping below the benchtop is as important as in the high-visibility areas.

Good housekeeping is best maintained by regular, periodic attention. Apparatus which are not in use should be placed in their proper storage areas. Reagents which are not in use or scheduled for immediate use should be stored properly or discarded.

Aisles, walkways, and floors in front of shelving must be kept clean, dry, and free of obstructions.

3.1.8 Hygiene in the Laboratory

Good hygiene in the laboratory is best maintained in a clean environment. To facilitate the maintenance of a clean work environment tape down bench liner paper wherever sample handling may occur (i.e., log-in area and exhaust hoods); clean up all spills as they occur, sweep and dust laboratory trailer daily (sample material can collect on dust and dirt particles, thus aiding in further spread of contamination and easier exposure to potentially toxic substances); and wash down benchtops, chemical containers, and hoods after use.

Personnel are required to wear gloves when necessary and wash hands frequently and prior to leaving the laboratory. Lab coats are to be worn while working in the laboratory, but must be removed before entering another designated area such as the crew or office trailer. The use of laboratory glassware for food or beverages is prohibited.

3.1.9 Ladders

Approved step stools or portable ladders must be used when it is necessary to climb above floor level. Climbing on chairs or other substitutes is prohibited. Always inspect a ladder before using it. If it is defective, red tag it, report it, and do not use it until it is properly repaired.

3.1.10 Smoking

No one is allowed to smoke or store smoking material in the mobile laboratories. This includes clients, visitors, and OHM personnel.

3.1.11 Transporting Chemicals

Toxic, corrosive, and flammable liquids should be transported in carriers which are large enough to hold the liquid if the container should break. Never hand carry glass containers larger than 1 gallon in size.

3.1.12 Unattended Operations

Laboratory operations which do not present any significant potential hazard are commonly carried out unattended. These include drying of samples in ovens and evaporation of liquids. However, when liquids are heated to the boiling point, when toxic and/or flammable substances are circulated or transferred, and when reactor systems are pressurized, an informed person should be present. In certain instances where technical requirements dictate long-term, continuous experiment, defined periods of operation may be approved for unattended operation.

3.1.13 Unsafe Conditions

It is the responsibility of all laboratory personnel to report unsafe conditions to the site supervisor, project chemist, or the site-health-and-safety officer.

3.1.14 Working Alone

Working alone in laboratory trailers is prohibited unless special arrangements for alarm systems or emergency communications are in effect.

3.1.15 Eye Protection

Safety glasses are required to be worn by all personnel while in a mobile laboratory. Chemical goggles should be worn when splashes are anticipated.

3.1.16 Face Protection

Face shields should be worn to protect the face from chemical splashes or hot liquids. NOTE: Face shields are not a form of eye protection and eye protection must be worn in addition to a face shield.

3.1.17 Hand Protection

Many tasks require gloves to protect the hands against chemical exposure, cuts, scratches, splinters, and excessive heat or cold. They should be worn, as appropriate.

3.1.18 Lab Coats

Lab coats are to be worn in the immediate vicinity of the laboratory trailer only. A place will be designated inside of the trailer for placement of lab coats. Lab coats are not to be worn in other support trailers such as lunch or office areas.

3.1.19 Visitors

Authorized visitors must wear safety glasses with side shields when entering mobile laboratories. Visitors are never to be left unescorted in a laboratory trailer at any time.

3.1.20 Material Safety Data Sheets

An MSDS is available for each chemical required for the operation of the laboratory trailer. All personnel assigned to work in the laboratory trailer must know where the MSDS are located and be familiar with their contents.

3.1.21 Compressed Gas Cylinders

All personnel must have complete knowledge of the properties of the gases being handled, including information on the toxicity, flammability, pyrophoricity, and reactivity and/or corrosiveness of the gas.

One of the most dangerous properties of any type of compressed gas cylinder is the physical hazard attributed to the contents under pressure. Even a cylinder containing an inert material must be handled with care since in the event of an uncontrolled release of the pressurized material the cylinder can become a missile, with enough force to penetrate thick concrete walls. This type of occurrence can happen if the cylinder valve is broken off due to mishandling. The following are general safety considerations to be observed when handling compressed gas cylinders:

- Always use a cylinder truck to move cylinders.
- Chain cylinders in place before removing the safety cap.
- Keep the cylinder cap in place when the cylinder is not in use.

- Store cylinders in a fire resistant, well ventilated, dry area which is free from sources of ignition or excessive heat.
- Do not store flammable gases near oxidizing gases.
- Do not store empty cylinders with full cylinders.
- Secure cylinders to prevent them from falling or being knocked over.
- All personnel should wear the appropriate protective equipment while handling cylinders (i.e., eye protection).
- All personnel should be trained to know what to do and who to call in the event of a leaking cylinder.

Two-stage regulators provide built-in protection that is not available in single-stage regulators and their use is required whenever the gas cylinder is pressurized above 800 pounds per square inch (psig) when full. Regulators are purposely designed to be interchangeable between different gasses to a limited extent only. Modifications to regulators by OHM field personnel is prohibited.

3.1.22 Cryogenic Materials

Solid carbon dioxide (dry ice) and liquid nitrogen are the cryogenic materials most commonly used in the mobile laboratories. The major hazard associated with cryogenic materials is frost bite. Avoid skin contact with these materials! If contact should occur, immediately immerse the area in lukewarm water to increase the local temperature and restore cellular respiration, then report for medical attention.

Always use cryogenic materials in equipment designed for the purpose, such as Dewar flasks, annealed glassware, etc.

Be extremely careful to avoid trapping these materials in a closed space. Possibly the most dangerous situation is between two valves in a metal pipe. The expansion force becomes sufficient to explode the pipe as the material converts from a liquid or solid to a gas.

3.1.23 Electrical

All electrical power supplied to laboratory trailers should be installed by an OHM-approved electrician. Switchboards, main disconnects, and panel boards should be labeled. All circuits must be grounded and wired in compliance with OSHA 29 CFR 1410.305(g).

Avoid handling electrical equipment with wet hands or while standing in a wet area, touching a water pipe, or working at a sink. Keep electrical equipment away from sinks.

Conduct distillations involving flammable liquids within the hoods. Should vapors escape, it is less likely that a flammable mixture will come in contact with electrical heating elements.

Keep combustible materials, including power cords and plastic tubing, away from electric heaters and hot plates.

Inspect the equipment that you use. Take it out of service if the power cord is frayed, cracked, or damaged, or if the switch acts abnormally.

In setting up apparatus within a hood, locate Variacs or powerstats outside of the hooded area if flammable liquids are involved. A spill or breakage might otherwise result in a serious fire or explosion.

3.1.24 Flammable Liquids

A maximum of 24 gallons (90.8 liters) of flammable solvent are allowed in or on a laboratory trailer at any one time.

Due to the unknown nature of samples, no more than two cases of samples (48 eight-ounce jars) will be stored in the trailer at any given time.

Always handle flammable liquids in areas with sufficient ventilation.

Never heat flammable liquids by direct flame or over an incandescent filament.

When bottles containing flammable liquids are hand carried outside of the mobile laboratory, secondary containers (i.e., pails) large enough to hold the contents in case of breakage should be used to hold the bottles. Safety carriers for acid and solvent bottles are available from the various scientific supply houses.

Waste flammable liquids should be poured into the hazardous-waste cans located in the mobile laboratories. Be sure to complete the paperwork that is with the can. (See the hazardous waste protocol in the Mobile Laboratory Manual.)

DO NOT BOIL-OFF OR EVAPORATE FLAMMABLE LIQUIDS BY USING AN ELECTRIC HOT PLATE. THIS PRACTICE IS DANGEROUS AND ITS UTILIZATION IN OHM LABORATORY TRAILERS IS PROHIBITED.

liquids are never to be stored in refrigerators unless the refrigerator is

ds

the possible loss of hood performance. Personnel who suspect unsatisfactory performance should report this to the site supervisor, project chemist, or

storage within a hood interferes with proper air flow. If a large piece of equipment is located within a hood, elevate it above the benchtop, if possible, to prevent air from being drawn in beneath.

Hood sash as a protective shield whenever appropriate. Otherwise, keep the sash at a proper calibrated position.

Containers

Containers as per OSHA regulations must be labeled. Containers of purchased materials are labeled by the supplier. It is the user's responsibility to preserve the original label in legible condition.

A container must never be refilled with another substance unless the original label has been removed or completely obscured and a new label applied.

Containers that will be kept for a length greater than one work shift must be clearly labeled with contents, main hazard, date prepared, and preparer's initials.

Do not touch the contents of an unlabeled container.

Waste

Waste generated in the laboratory will be disposed properly. The proper disposal method will be determined prior to the beginning of work.

Glassware

Glassware must be stored with care in drawers or cabinets to prevent breakage. Do not store glassware with heavy metal pieces so that they can bang against each other. Liquids and chemicals should be stored on low shelves or on the floor. Never store sharp or long pieces so that they protrude from shelves or present a hazard. Do not attempt to grasp them.

If a glass apparatus is taken out of service and stored, all liquids must be drained from it. Cleaning of glassware is detailed in Standard Operating Procedures (SOP), Cleaning of Laboratory Glassware.

Do not discard broken glass into ordinary trash receptacles, use a labeled broken glass receptacle.

Do not attempt to catch falling glassware!

In the event of an accident which causes breakage of a glass apparatus, do not try to pick up the pieces of glass. Use a dust pan and brush.

Flasks or bottles containing hot, condensable vapors should not be stopped, as the vacuum created upon cooling may cause implosion. Frozen stoppers of glass reagent bottles may be removed using a stopper puller or loosened by gentle tapping. The latter operation must be done only after covering with a cloth to prevent splashing, placing the bottle in a tray, and putting on appropriate protective clothing.

When inserting glass tubing or rod into stoppers or thick-walled rubber tubing, be sure that the end of the glass piece is fire polished and lubricate it with glycerin or water. Protect the hands with gloves, towel, or tubing grip and do not force the glass tubing or rod.

Always leave at least 10 percent air space above the liquid in a glass container that is to be closed. Too little air space may result in breakage as the temperature changes.

Large glass beakers and flasks (greater than 1 liter in size) should not be heated by direct contact with either flame or hot plate. The thermal stresses are likely to cause breakage.

3.1.29 Filling Pipets

Never fill pipets by mouth! Pipets should always be filled by mechanical means, never by mouth.

3.1.30 Chemical Disposal

All chemicals and wastes must be disposed properly. Sinks and drains cannot be used for the disposal of chemicals. DO NOT discard chemicals into waste cans. For more information contact the Regional Health and Safety Manager.

3.1.31 Chemical Storage

All chemicals must be stored in areas with proper identification of chemical classification (corrosive, flammable, oxidizer). Chemical compatibility should be the guidelines for chemical storage. A person knowledgeable in chemical classification should assume responsibility for chemical storage and questions should be referred to the Regional Health and Safety Manager. Do not store samples with laboratory chemicals. The limit is two cases of samples to be stored in a mobile laboratory at any given time.

3.2 EMERGENCY PROCEDURES

3.2.1 Chemical Contact or Exposure

Use an emergency shower to flush the affected skin area with plenty of water for at least 15 minutes. Remove contaminated clothing while flushing with water.

If a chemical splashes into the eyes, use an eye wash to flush the eyes with water for at least 15 minutes. Seek medical attention after flushing.

3.2.2 Clothing Fires

The key words are STOP, DROP, and ROLL. If your clothing should catch on fire, STOP running as soon as you are safely away from any fire, DROP to the ground, and ROLL.

An alternative means of extinguishing clothing fires is to use the emergency shower or the fire blanket.

3.2.3 Fires and Explosions

Always observe the following priorities when there is a fire or an explosion:

- Protect personnel
- Report the fire
- Evacuate the area

This means that personnel should be moved safely away from the fire, after which the fire should be reported.

Do not attempt to control the fire with a fire extinguisher unless:

- There is someone standing by as a safety watch.
- You know the supply of fuel available to the fire is small.
- You have been trained in the choice and use of fire extinguishers.

3.2.4 Task Specific Hazards

Laboratory trailer operations will vary considerably depending on the task required. Each task will have its own inherent hazards which are discussed in the Safety Considerations section of each procedure of this manual. The project chemist will be familiar with these hazards and cover them in the safety meetings.

3.2.5 Attendance At Safety Meetings

The project chemist should be a part of site management and must be aware of site operations to ascertain whether significant hazards are being introduced into the laboratory. Attendance at the morning safety meetings should be a priority for the project chemist or his designee.

All personnel working in the trailer will be familiarized with the location and operations of the fire extinguisher(s), first aid kit(s), and fire blanket(s) during the safety meetings.

4.0 SAMPLE LOG-IN PROTOCOL

4.1 VISUAL SURVEY

Upon receipt of the samples in the laboratory, the sample custodian will open the shipping containers and unpack the contents. Each sample will be visually examined for specific physical characteristics as detailed in this section.

4.1.1 General Sample Inspection

For each sample, the sample custodian will note the following:

- Physical state of each layer
- Determination of sample colors for each layer
- Determination of sample clarity for each layer
- Integrity of sample jars
- Number and size of sample jars per drum
- Confirmation that sample matches physical description given on Drum Inventory Log

If any samples are broken or depleted due to leakage; missing; or if discrepancies in the physical description or any other questionable observation is noted, then the project chemist should be promptly notified. If the sample passes the general inspection, then the sample custodian will record the results of this survey on the Drum Inventory Log and accept custody of the sample by signing and dating the chain-of-custody section of the Drum Inventory Log.

4.1.2 Biological Survey

An important part of the visual survey for the sample log is the biological survey. This is performed prior to the radiological survey and concurrently with the general sample inspection (see Section 4.1.1). The contents of the unopened containers will be inspected for evidence of biological materials such as hypodermic syringes, medical gauze, Petri dishes, cultures, blood, or animal tissues. If biological material is discovered, immediate notification will be made to the site supervisor, project manager, and site-health-and-safety officer. The sample jar should not be opened and no further compatibility testing should be performed.

4.2 RADIOLOGICAL SURVEY

If the sample has passed both the general and biological surveys, the sample will be surveyed for radiation.

4.2.1 Scope and Application

There are three types of radiation that may be encountered in the field:

- Alpha Radiation--A type of particle radiation easily stopped by material such as clothing, paper, or glass. While alpha radiation is the least penetrating type, it can be very dangerous if ingested, inhaled, or enter the body through a puncture wound or laceration.
- Beta Radiation--Another type of particle radiation more penetrating than alpha radiation, but cannot pass through material such as steel. Exposure to beta radiation may cause skin burns, and are harmful if they enter the body.
- Gamma Radiation (x-rays)--Gamma radiation, unlike alpha or beta, is electromagnetic in nature and intensely high in energy. Gamma rays are extremely penetrating and are best absorbed by dense material like lead and depleted uranium. Exposure to gamma rays may be lethal; complete protection is essential.

The type of radiation detected depends upon the probe being used. The metal-bodied probe with a side window and sliding cover detects beta and gamma radiation. When the window is closed, beta radiation is shut out and only gamma radiation is detected. The probe with the end window detects alpha, beta, and gamma radiation. The newer pancake-style probe will also detect alpha, beta, and gamma radiation.

The survey meter that is used measures the radiation in mrem/hr. This is a dose measurement equivalent to the hours of exposure multiplied by the average measured level of exposure, which is obtained by the use of a personal dosimeter or by a film badge. The following are accepted terms used to describe radiation levels:

- Background Radiation--The normal amount of naturally occurring radiation that exists without cause for alarm (between 0.008 and 0.02 mrem/hr).

- Radiation Area--Defined by the Nuclear Regulatory Commission (NRC) as an area in which there are 2 mrem/hr or greater present or an area where one can accumulate 100 mrems of exposure in 5 days of normal work in the area.
- High Radiation Area--Defined by the NRC as an area with radiation greater than 100 mrem/hr.

4.2.2 Safety Considerations

- All samples should be opened and analyzed in a hood as soon as possible. When handling possible radioactive samples the following precautions should be used:

- Limit the time spent handling radioactive material.
- Control spread of radioactive contamination.
- Put as much distance and protective equipment (i.e., lead shield) between yourself and the radioactive material

If a sample is determined to be radioactive, the sample will be sealed and removed from the laboratory. No further compatibility testing is required. The project chemist, project manager, and/or site supervisor, and the site-health-and-safety officer will be promptly notified. The project chemist will then shield and secure the sample in the most appropriate manner (i.e., if gamma radiation is present, then the sample might be placed in a lead container and labeled "Radioactive Waste").

4.2.3 Materials

- Dosimeter and probe(s) capable of measuring down to 0.02 mrem/hr for all types of radiation.

4.2.4 Method

- The probe of the dosimeter is held approximately 2 inches from the unopened sample jar. It is not uncommon for the dosimeter reading to briefly jump above background but not stay there. If this occurs do not be alarmed, this is not a positive reading for radiation.
- If sustained elevated readings (greater than 0.2 mrem/hr) occur, the sample will be secured and the project chemist, project manager, and/or site supervisor, and the site-health-and-safety officer will be immediately notified. The sample will then be

handled according to the type of radiation present and to the satisfaction of OHM's health-and-safety department and the client.

- If the readings are background or below, the lid of the sample jar is removed and the sample is again surveyed. Readings will be taken for all types of radiation, which will require the use of more than one probe or the use of the more sensitive pancake probe.
- Radiation survey results are recorded on the Drum Inventory Log as each sample is surveyed.
- If at least one of the samples is found to be radioactive, the work area and the person conducting the survey should be screened for radioactivity using the dosimeter. Be sure to survey the floor and the person's shoes for the presence of radiation.
- Even if no radiation is detected on your person or in the work area, decontamination procedures should still take place. First, decontaminate the work area by changing the bench paper, wiping down surrounding surfaces with soap and water, and sweeping. Then decontaminate yourself by removing and discarding protective clothing and washing your hands and face.

4.2.5 Interferences

Occasionally, background readings will jump to elevated levels due to sun spot activity.

5.0 COMPATIBILITY TEST PROCEDURES

The compatibility scheme detailed in this document consists of the following tests:

- Air reactivity
- Water reactivity
- Water solubility
- Density
- pH test
- Hexane/dichloromethane (DCM) solubility
- Peroxide test
- Oxidizer test
- Cyanide test
- Sulfide test
- Bielstein test
- Flash point test
- PCB screen

At the completion of the compatibility testing, the unknown containerized waste materials are separated into a combination of the following compatibility categories:

- Liq--Liquid
- Sol--Solid
- Aq--Aqueous
- Org--Organic
- Arxn--Air reactive
- Wrxn--Water reactive
- A--Acid
- B--Base
- CN--Cyanide
- Cl--Chlorinated
- Fl--Flammable
- Ox--Oxidizer
- Per--Peroxide
- S--Sulfide
- PCB--PCB contaminated
- RAD--Radioactive

5.1 SAMPLE REACTIVITY

Each layer of every sample is tested for its reactivity with air and water. The testing procedures are detailed in the following subsections.

5.1.1 Air Reactivity

Any sample which emits vapor, changes physical state, or ignites spontaneously in the presence of air is defined as air reactive.

5.1.1.1 Scope and Application

The objective of this test is to determine whether the sample is reactive upon exposure to air, thus requiring special care in handling of the sample and to give warning to site personnel that this container requires separation and special handling.

5.1.1.2 Method Summary

Each sample is checked for its reactivity with air by placing approximately 1/2 milliliter (ml) of liquid or 1/2 gram (g) of solid onto a spot plate and warming to approximately 120 degrees Fahrenheit (49 degrees Celsius).

5.1.1.3 Safety Considerations

All samples should be opened and analyzed in the hood as soon as possible. If a sample is determined to be air reactive, promptly notify the project chemist, project manager and/or site supervisor, and the site-health-and-safety officer. The project chemist will put the sample under a nitrogen or helium atmosphere and remove it from the laboratory. The sample may additionally be placed into a polyethylene bag that has been previously purged with nitrogen.

5.1.1.4 Materials

- Coors porcelain color reaction plate (Baxter Scientific Catalogue No. P7000-3)
- Hot plate (VWR Catalogue No. 33920-219)
- Nitrogen gas (purchase locally)

NOTE: ALL GASES SHOULD BE ZERO GRADE OR EQUIVALENT

- Polyethylene bags (Baxter Scientific Catalogue No. H131781016)
- Fire extinguisher (dry chemical type for A, B, and C fires)

5.1.1.5 Method

- Place approximately 1/2 ml of liquid or 1/2 g of solid onto a spot test plate
- Warm to approximately 120 degrees Fahrenheit (49 degrees Celsius)
- Observe the sample for 2 minutes. If visible vapors are released, if fire or defragration occurs, or the sample dramatically and permanently changes physical state, the sample is air reactive.

CAUTION: AIR REACTIVE SAMPLES SHOULD BE IMMEDIATELY REMOVED FROM THE WORK AREA BY THE PROJECT CHEMIST AND STORED IN A REMOTE, SECURE PLACE.

- If the sample is air reactive no further testing should be done unless authorized by the project chemist. All observations and results are recorded in the appropriate section of the Drum Inventory Log. All pertinent personnel are then notified.

5.1.1.6 Interferences

No known interferences exist for this procedure.

5.1.2 Water Reactivity

Any sample which generates excessive heat, emits fumes, explodes, changes physical state or spontaneously ignites upon contact with water is defined as water reactive.

5.1.2.1 Scope and Application

The objective of this test is to determine whether the sample is reactive upon exposure to moisture or water, thus requiring special care in handling of the sample and to give warning to site personnel that this container requires separation and special handling.

5.1.2.2 Method Summary

Each layer of every sample which was found not to be air reactive is checked for its reactivity with water by cautiously placing a small portion into a test tube containing distilled water. The sample is slowly and cautiously mixed and observed for any hazardous reactions.

5.1.2.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible. If a sample is determined to be water reactive, it will be sealed in a plastic bag previously purged with nitrogen or helium, removed from the laboratory, and placed in a secure, dry storage area. Prompt notification must be given to the project chemist, project manager and/or site supervisor, and the site-health-and-safety officer.

5.1.2.4 Materials

- Kimble culture tube with Teflon-lined screw cap, 16-by 125-millimeter (mm) (Baxter Scientific Catalogue No. T1346-5)
- Nitrogen gas (purchase locally)

NOTE: ALL GASES SHOULD BE ZERO GRADE OR EQUIVALENT

- Polyethylene bags (Baxter Scientific Catalogue No. H131781016)
- Fire extinguisher (dry chemical type for A, B, and C fires)

5.1.2.5 Method

- Place a small sample aliquot (about three drops of liquid or approximately 0.1 g of solid) into a culture tube containing 1 ml of distilled water.
- Slowly and cautiously mix the sample.
- Observe the sample. If visible vapors are released, fire or deflagration occurs, the sample solidifies, or a temperature rise is noted, the sample is water reactive.

CAUTION: WATER REACTIVE SAMPLES SHOULD BE IMMEDIATELY REMOVED FROM THE WORK AREA BY THE PROJECT CHEMIST AND STORED IN A REMOTE, SECURE PLACE.

- If the sample is water reactive, the pH of the water solution is taken and recorded in the proper section of the Drum Inventory Log. No further testing should be done unless authorized by the project chemist. All pertinent personnel are then notified.

5.1.2.6 Interferences

Air trapped in finely divided solids can give the appearance of gas evolution. Strong acids and bases may cause the water to heat up and steam or boil. This should be noted in the "Comments" section of the Drum Inventory Log and considered when classifying the drum for waste blending.

5.2 SOLUBILITY, DENSITY, AND pH

Each layer of every sample is tested for its solubility in water and a 1:1 hexane/DCM mixture. The procedures are detailed in the following subsections.

5.2.1 Water Solubility and Density

5.2.1.1 Scope and Application

The objective of this test is to determine if a sample layer is or is not aqueous, whether it has a density less than or greater than that of water (1.0 g/ml), and the polarity of organic and inorganic material.

5.2.1.2 Method Summary

Each layer of every sample is checked for water solubility by cautiously placing a small portion into a culture tube containing distilled water. The sample is thoroughly mixed and observations are made of the material's solubility and whether insoluble or partially soluble materials float or sink.

5.2.1.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible.

5.2.1.4 Materials

- Vortex II mixer (VWR Catalogue No. 58815-189)
- Kimble culture tube with Teflon-lined screw cap, 16-by 125-mm (Baxter Scientific Catalogue No. T1346-5)

5.2.1.5 Method

- Cautiously place a small sample aliquot (1 ml of a liquid or 1 g of a solid) into a culture tube containing approximately 1 ml of distilled water.

- Cap the culture tube and mix the sample using a vortex mixer.
- Observe the sample's solubility in water and record the solubility on the Drum Inventory Log as either S (soluble), PS (partially soluble), or I (insoluble).
- If the sample is PS or I, note whether it floats or sinks in the water. If the sample floats, record the density as L (lighter than water) and if the sample sinks, record the density as H (heavier than water).

5.2.1.6 Interferences

Most low molecular weight, polar, organic compounds, such as alcohols, are water soluble but are not considered an aqueous liquid. If the sample is soluble in both water and in a hexane/DCM mixture, the sample should be classified as an organic.

5.2.2 pH Testing

The pH test is a test to be performed on all samples whether or not they appear to be soluble in water. Samples that are apparently insoluble in water, yet have a pH of less than 2 or greater than 12 are actually partially soluble in water.

5.2.2.1 Scope and Application

The objective of this test is to determine if the sample is an acid (pH 2 or less) or basic (pH 12 or greater).

5.2.2.2 Method Summary

The pH of the sample is approximated using pH indicator strips or pH test strips.

5.2.2.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible.

5.2.2.4 Materials

- Kimble culture tube with Teflon-lined screw cap, 16-by 125-mm (Baxter Scientific Catalogue No. T1346-5)
- Vortex II mixer (VWR Catalogue No. 58815-189)

- EM quant pH strips, range 0 to 14 SU (VWR Catalogue No. EM-9590-3)
- Corning rainbow pH buffer pack (Baxter Scientific Catalogue No. 478574*EY)

5.2.2.5 Method

- Dip the pH test paper into the aqueous phase of the water solubility test culture tube.
- Compare the resultant color of the test paper or strip with the color chart on the package.
- Record the pH in the space provided on the Drum Inventory Log.

5.2.2.6 Quality Assurance/Quality Control

At the start of every shift or when a new box of pH paper is opened, check the pH of at least one buffer solution (pH 4, 7, or 10). Record the known pH of the buffer checked and the pH obtained from the pH paper on the back of the first Drum Inventory Log from that shift. Always remember to date and initial your quality control (QC) checks. If you cannot obtain a pH result ± 1 pH unit from the known buffer pH, notify the project chemist immediately. The project chemist will check the pH strips against a secondary standard. If the results are still greater than ± 1 pH unit from the known pH, then the open box of pH paper will be discarded. The lot number of pH paper discarded and the results obtained by the project chemist will be recorded, initialed, and dated along with the previous results. The use of the pH paper having the same lot number as the discarded box will be discontinued.

5.2.2.7 Interferences

Some organic chemicals will cause erroneous reading or deactivate the pH-sensitive dyes. Strongly colored sample aqueous extracts will affect accurate readings of the color development. Strong oxidizers will bleach the pH paper and interfere with the color determination and the oxidizing sample must be diluted to obtain an accurate pH reading.

5.2.3 Hexane/Dichloromethane (1:1) Solubility

Each layer of every sample will be tested for solubility in a 1:1 (v:v) hexane/DCM mixture.

5.2.3.1 Scope and Application

The objective of this test is to determine if the sample is inorganic or organic in nature.

5.2.3.2 Method Summary

A small portion of the sample is placed into a culture tube containing the hexane/DCM mixture. The sample is thoroughly mixed and its solubility is recorded on the Drum Inventory Log.

5.2.3.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible. The hexane/DCM mixture is flammable and should be used in an exhaust hood away from any ignition source. DCM (methylene chloride) has significant health effects for people with heart problems and its MSDS should be reviewed by all personnel before handling.

5.2.3.4 Materials

- Kimble culture tube with Teflon-lined screw cap, 16-by 125-mm (Baxter Scientific Catalogue No. T1346-5)
- Vortex II mixer (VWR Catalogue No. 58815-189)
- One-to-one (volume:volume) mixture of hexane (Baxter Scientific Catalogue No. 216-4*DK) and methylene chloride (DCM) (Baxter Scientific Catalogue No. 300-4*DK)

5.2.3.5 Method

- Cautiously place a small sample aliquot (1-ml or 1-g) into a culture tube containing approximately 1 ml of a 1:1 hexane/DCM mixture.
- Cap the culture tube and mix the sample using a vortex mixer.
- Observe the sample's solubility in the hexane/DCM mixture and record the solubility on the Drum Inventory Log as either S (soluble), PS (partially soluble) or I (insoluble).

5.2.3.6 Interferences

Some highly polar, organic substances may not be soluble in a hexane/DCM mixture and therefore, would be classified as inorganic. If the sample is a solid insoluble in both water and a hexane/DCM mixture but exhibits a positive flashpoint test, the sample should be treated as an organic. If the sample is a liquid and insoluble in both water and a hexane/DCM mixture, the sample should be treated as an organic.

5.3 PEROXIDE TEST

Test strips are used for the semi-quantitative determination of the presence of peroxides in each layer of every sample.

5.3.1 Scope and Application

The objective of this test is to determine the presence and approximate concentration of organic peroxides in waste samples. The presence of organic peroxides in concentrations greater than 5,000 ppm in a waste sample indicate that the sample and the container represented by the sample are potentially shock sensitive.

5.3.2 Method Summary

Peroxidase transfers peroxide oxygen into an organic redox indicator which is thereby converted into a blue oxidation product. The moisture required for checking of the hexane/DCM sample extract is obtained by placing a drop of distilled water into the reaction zone after immersion in the solvent. The method will work in either aqueous or organic liquids.

5.3.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible. If the result of an organic sample is greater than 5,000 ppm (0.5 percent), then the sample should be considered shock sensitive. The project chemist, site supervisor, and site-health-and-safety officer must be notified immediately. Properly trained personnel should remove the sample from the laboratory before work resumes on the remaining samples.

5.3.4 Materials

- 0.01 percent solution of hydrogen peroxide diluted from 30 percent hydrogen peroxide (VWR Catalogue No. JT2186-1)
- EM Quant peroxide test strips (VWR Catalogue No. EM-10011-1)

NOTE: KEEP PEROXIDE STRIPS TIGHTLY SEALED AND REFRIGERATED WHEN NOT IN USE. DO NOT USE TEST STRIPS PAST THEIR EXPIRATION DATE.

- 1N sodium hydroxide: 4 g sodium hydroxide pellets (Baxter Scientific Catalogue No. 7708-500*NY) dissolved in distilled water to 100 ml
- Amberlite IRA-400 (Baxter Scientific Catalogue No. 3403-500*NY)
- Hydrochloric acid, concentrated (VWR Catalogue No. JT9530-3)
- Potassium fluoride (Baxter Scientific Catalogue No. 6944-500*NY)
- Sodium chloride (Baxter Scientific Catalogue No. 7581-500*NY)

5.3.5 Method

- Immerse the test strip in the hexane/DCM extract of the sample from Section 5.2.3 for approximately 1 second.
- Add one drop of distilled water on the reaction zone.
- Compare the reaction zone with the color scale on the container for organic solvents and determine the peroxide content.
- If the sample result is greater than 100 ppm, transfer 0.5 ml of extract to a 25-ml volumetric flask and bring up to the final volume with a 1:1 hexane/DCM mixture (this is equivalent to a 1:50 dilution). Retest the dilution for peroxide content as previously described.
- If the sample dilution result is greater than 100 ppm, the sample may be shock sensitive. Stop work immediately and notify pertinent personnel (see Section 5.3.3, Safety Considerations).
- Record result as negative (-) or positive (+) on the Drum Inventory Log and if (+) indicate the approximate concentration in the comments section.

5.3.6 Interferences

A green to blue color of the reaction zone is produced at pH 5 to 6 in each of the following cases:

- Greater than 5 milligrams per liter (mg/l) Gold, (Au)³⁺
- Greater than 5 mg/l Cesium, (Ce)⁴⁺
- Greater than 250 mg/l Mercury, (Hg)¹⁺
- Greater than 10 mg/l Chromates, (CrO₄)²⁻
- Greater than 10 mg/l Ferric cyanide complex, [Fe(CN)₆]³⁻
- Greater than 40 mg/l Iodate (IO₃)⁻
- Greater than 2 mg/l Permanganate (MnO₄)⁻
- Greater than 20 mg/l Persulfate (S₂O₈)²⁻
- Greater than 5 mg/l Metavanadate, (VO₃)⁻

If interferences are suspected to be present, the following procedures can be used to eliminate the interferences:

- Adjust the pH of the sample to 5 to 6 with 1N hydrochloric acid (HCl) or 1N sodium hydroxide (NaOH). Add 1 g of amberlite IRA-400 to 1 ml of sample and mix thoroughly. Retest the solution after approximately 1 minute.
- Interference from gold can be eliminated by adjusting the pH to less than 1.5 with HCl and adding 1 g of amberlite IRA resin.
- Mercury can be precipitated out by adding sodium chloride.
- Cesium can be masked by adding a small quantity of potassium fluoride to the sample.

All of the above tests and adjustments are for water-based liquids ONLY. Spot tests for chromates and mercury, if requested, are explained in Section 6.0.

5.3.7 Quality Assurance/Quality Control

At the start of every shift or when a new tube of peroxide test strips is opened, check the strips by testing them in a 0.01 percent hydrogen peroxide solution and with distilled water. Record the results on the back of the first Drum Inventory Log of that shift. Always remember to date and initial your QC checks. If you cannot obtain a positive test result with the hydrogen peroxide solution or a negative result with the distilled water, immediately notify the project chemist.

5.4 OXIDIZER TEST

Test strips are used for the qualitative determination of the presence of oxidizers in each layer of every sample.

5.4.1 Scope and Application

The objective of this test is to determine the presence of strong oxidizing agents such as chlorine and chlorine dioxide. The results are used to identify wastes which may react violently with organic wastes. This test should be performed on undiluted aqueous samples or aqueous sample extracts.

5.4.2 Method Summary

A drop of aqueous sample or the aqueous sample extract is placed on a potassium iodide starch test paper which has been previously moistened with glacial acetic acid. A resultant blue to black color on the test paper indicates the possible presence of an oxidizer.

5.4.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible. Samples testing positive for oxidizers should be segregated from organic samples and the site supervisor should be notified that the same should be done to the corresponding waste containers.

5.4.4 Materials

- Coors porcelain color reaction plate (Baxter Scientific Catalogue No. P7000-3)
- Transfer pipets, 5 3/4-inch (Baxter Scientific Catalogue No. P5202-1)
- Pipet bulbs, 1-ml (Baxter Scientific Catalogue No. R5002-1)
- Potassium iodide (KI) test papers (Scientific Products Catalogue No. P1063-5).
- Acetic acid, glacial (VWR Catalogue No. JT9524-3)
- One percent (w/v) chloramine-T: dissolve 1 g of chloramine-T (Baxter Scientific Catalogue No. 0614-250*NY) in distilled water and bring to a final volume of 100 ml.

5.4.5 Method No. 1

- If the sample layer to be tested exhibits a dark color, use Method No. 2 for the analysis of oxidizers.
- Place a strip of KI starch paper in one spot of the spot plate.
- Moisten the paper with a drop of acetic acid.
- Transfer two drops of the aqueous sample extract or the aqueous sample onto the test paper.
- Wait approximately 5 minutes for color development.
- A blue to black color will appear if an oxidizer is present. Compare this color to your QC blank.
- Record the result on the Drum Inventory Log.

Strongly colored aqueous liquids or aqueous sample extracts may make it difficult to determine a color change of the test paper. In this case it is suggested to use the following method.

5.4.6 Method No. 2

- Add 1 ml of sample to 1 ml of 0.1N potassium iodide or sodium iodide solution in a culture tube.
- Acidify with 5 drops of acetic acid.
- Split this solution into two culture tubes.
- To one of these two culture tubes add three drops of starch solution (5 g in 800 ml water, heat to dissolve). Acidify with several drops of glacial acetic acid.
- Mix thoroughly and compare the contents of the two culture tubes. If the contents of the tube containing the starch solution is darker than the contents of the other culture tubes, then the sample is an oxidizer.
- Record the result on the Drum Inventory Log and note in the comments section that the spot test method was used.

5.4.7 Quality Assurance/Quality Control

At the start of every shift or when a new tube of potassium iodide starch indicator papers is opened, check the papers by testing them with a 1 percent chloramine-T solution and with distilled water. Record the results on the back of the first Drum Inventory Log of that shift. Always remember to date and initial your QC checks. If you cannot obtain a positive test result with the chloramine-T solution or a negative result with the distilled water, immediately notify the project chemist.

5.5 HALOGEN TEST

The Bielstein flame test for the presence of halogens in liquid and solid phase samples is detailed in this section.

5.5.1 Scope and Application

The objective of this test is to determine the presence of 1 percent or greater concentration of halogenated organic compounds in a sample. If the test is positive, special care must be used in screening the samples for PCBs. If the test is positive, further tests may be required as per the request of the client or of the transportation and disposal coordinator to determine the halogenated compound that is present.

5.5.2 Method Summary

A small portion of the sample is burned on a copper wire in a flame and the color of the flame is observed. The appearance of a green flame indicates the presence of at least 1 percent of a halogenated compound in the sample.

5.5.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible. When using an open flame in any laboratory make sure there are no flammable solvents or samples in your work area. Check the condition and location of your fire extinguisher and have a plan to handle an uncontrolled fire.

5.5.4 Materials

- Propane torch or Bunsen burner (purchase locally, MOSWL No. 94220-LDT or equivalent) (obtain one that has its own integral ignitor).

- Copper wire, 18-gauge or smaller (purchase locally): obtain a piece of copper wire approximately 6 inches in length. Bend over about 2 inches of the wire and twist it around itself. Continue twisting until a small loop exists at the twisted end of the wire.

NOTE: DO NOT USE COPPER TUBING; MATERIAL ON THE INSIDE WILL NOT BURN CLEAN AND CARRY OVER WILL OCCUR.

- Fire extinguisher (dry chemical type for A, B, and C fires).

5.5.5 Method

- Clean the copper wire loop and twists by holding in a flame from a propane torch until the wire glows orange. Cool by submerging the wire in a beaker of clean distilled water.

WARNING: IF A HOT WIRE IS INTRODUCED INTO A SAMPLE, AN EXPLOSION OR DEFRAGRATION MAY OCCUR.

- Retrieve some sample on the cooled, looped end of the copper wire.
- Place the sample on the loop in the flame from a propane torch and observe the color of the flame from the sample. Hold the loop in the flame until the wire glows orange to clean the loop for the next sample to be tested.
- The appearance of a green flame indicates the presence of halogens and a positive Bielstein result. Any other color observed in the flame is a negative Bielstein result, but the color of the flame should be noted in the comments section of the Drum Inventory Log.
- Record the Bielstein result on the Drum Inventory Log.

5.5.6 Interferences

A false negative result may occur due to very volatile compounds that evaporate completely before they can be heated sufficiently to cause decomposition. False positives may occur on acidic compounds, quinoline and pyridine derivatives, organic acids, urea, and copper cyanide.

5.5.7 Quality Assurance/Quality Control

At the start of every shift check the wire by testing it with a 1:1 hexane/DCM mixture to ensure a green flame is produced when heated. Also check the wire with distilled water for carry over and record the results on the back of the first Drum Inventory Log of that shift. Always remember to date and initial your QC checks. If you cannot obtain a positive test result with the hexane/DCM mixture or a negative result with the distilled water, immediately notify the project chemist.

5.6 SULFIDE TEST

The test for the presence of sulfides in liquid and solid phase samples is detailed in this section.

5.6.1 Scope and Application

The objective of this test is to quickly determine the presence of sulfides in waste materials. If sulfides are present they may cause interferences with other analyses, create a hazard during sample handling and field waste blending operations, and may be of special concern for disposal.

5.6.2 Method Summary

One drop of the aqueous sample or aqueous sample extract is placed on a lead acetate test paper previously moistened with a sodium acetate buffer solution. The presence of sulfides is indicated by a darkening of the test paper. The method detection limit is 4 mg/l.

5.6.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible. A hydrogen sulfide gas/hydrogen cyanide gas alarm (Monitox) unit should be placed in the hood to detect the presence of hydrogen sulfide gas. Samples that test positive for sulfide should be segregated from acidic samples and the site supervisor should be notified that the same should be done to the corresponding waste containers.

WARNING: HYDROGEN SULFIDE GAS IS EXTREMELY TOXIC. IF HYDROGEN SULFIDE GAS IS SUSPECTED OUTSIDE OF THE HOOD, LEAVE THE PREMISES IMMEDIATELY. MOST PEOPLE CAN DETECT THE ROTTEN EGG LIKE SMELL OF HYDROGEN SULFIDE AND IF SOMEONE DETECTS THIS ODOR, EVEN IN THE ABSENCE OF THE HYDROGEN SULFIDE GAS MONITOX ALARM, VACATE THE PREMISES.

5.6.4 Materials

- Compur Model 4100 hydrogen sulfide gas/hydrogen cyanide gas alarm (Monitox) unit and gas generator (MDA Model Nos. RA-530141 and RA-4100)
- Coors porcelain color reaction plate (Baxter Scientific Catalogue No. P7000-3)
- Transfer pipets, 5 3/4-inch (Baxter Scientific Catalogue No. P5202-1)
- Pipet bulbs, 1-ml (Baxter Scientific Catalogue No. R5002-1)
- Sodium acetate buffer: dissolve 41 g of sodium acetate trihydrate, $C_2H_3NaO_2 \cdot 3H_2O$ (Baxter Scientific Catalogue No. 7364-500*NY) in 500 ml of distilled water and adjust the pH to 4.5 with glacial acetic acid (VWR Catalogue No. JT9524-3)
- Nitrogen gas (purchase locally)

NOTE: ALL GASES SHOULD BE ZERO GRADE OR EQUIVALENT

- Lead acetate test strips (Scientific Products Catalogue No. SP-1063-2)
- 10 mg/l sodium sulfide standard, prepared weekly (VWR Catalogue No. EM-SX0770-1). Add 0.02 grams of sodium sulfide to 1 liter of distilled water. Add 5 ml of 1N NaOH to the solution.
- 1N Sodium hydroxide: 4 g sodium hydroxide pellets (Baxter Scientific Catalogue No. 7708-500*NY) dissolved in distilled water to 100 ml.
- A saturated solution of cadmium carbonate: 2 g cadmium carbonate (VWR Catalogue No. EM-CX0028-1) dissolved in 50 ml distilled water and 1 ml of concentrated hydrochloric acid (VWR Catalogue No. JT9530-3), adjust pH to approximately 7 with 1N sodium hydroxide and bring solution to a final volume of 100 ml.

NOTE: USE DISTILLED WATER THAT HAS BEEN DEOXYGENATED BY BUBBLING NITROGEN THROUGH IT TO PREPARE THE CADMIUM CARBONATE AND SODIUM SULFIDE SOLUTIONS.

5.6.5 Method

- Place a strip of lead acetate paper in one spot of the spot plate.
- Moisten the paper with two or three drops of acetate buffer.
- Transfer one drop of the aqueous sample extract or the aqueous sample onto the test paper.
- A darkening of the test paper indicates the possible presence of sulfide. If the test is positive, continue on to Step 5. If the test is negative, record the result on the Drum Inventory Log.
- To verify the presence of sulfides, add three drops of saturated cadmium carbonate solution to 1 ml of the aqueous sample extract or the aqueous sample.
- Mix the sample thoroughly and observe. The appearance of a yellow precipitate confirms the presence of sulfides in the sample. Record the result on the Drum Inventory Log and note in the comments section that the result was confirmed with the spot test.

5.6.6 Interferences

Very dark colored samples may make it nearly impossible to detect the darkening of the lead acetate test paper. If this circumstance arises, you should use the cadmium carbonate spot test method.

5.6.7 Quality Assurance/Quality Control

At the start of every shift or when a new tube of lead acetate test papers is opened, check the papers by testing them with a 10 mg/l sodium sulfide standard solution and with distilled water. Record the results on the back of the first Drum Inventory Log of that shift. Always remember to date and initial your QC checks. If you cannot obtain a positive test result with the sulfide standard solution or a negative result with the distilled water, immediately notify the project chemist.

5.7 CYANIDE TEST

Each layer of every sample is tested for the presence of cyanide. The cyanide spot test procedure is detailed in this section.

5.7.1 Scope and Application

The objective of this test is to quickly determine the presence of cyanide in most forms in a sample. If cyanide is present, precautions must be taken to ensure that acidification of the sample does not occur. The positive sample's corresponding container will require special handling and disposal.

5.7.2 Method Summary

Cyanide is reacted with chloramine-T in a buffered solution to produce cyanogen chloride. The cyanogen chloride is then reacted with pyridine-barbituric acid to form a distinctive red to purple color. When a sample is treated in this manner, the appearance of the red color indicates the presence of cyanide in the sample at a minimum of 1 ppm.

5.7.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible. A hydrogen sulfide gas/hydrogen cyanide gas alarm (Monitox) unit should be placed in the hood to detect the presence of hydrogen cyanide gas.

WARNING: HYDROGEN CYANIDE GAS IS EXTREMELY TOXIC. IF HYDROGEN CYANIDE GAS IS SUSPECTED OUTSIDE OF THE HOOD, LEAVE THE PREMISES IMMEDIATELY. MOST PEOPLE, BUT NOT ALL, CAN DETECT THE ALMOND/AMARETTO LIKE SMELL OF CYANIDE AND IF SOMEONE DETECTS THIS ODOR, EVEN IN THE ABSENCE OF THE MONITOX ALARM, VACATE THE PREMISES.

5.7.4 Materials

- Compur Model 4100 hydrogen sulfide gas/hydrogen cyanide gas alarm (Monitox) unit and gas generator (MDA Model Nos. RA-530341 and RA-4100)
- Kimble culture tube with Teflon-lined screw cap, 16-by 125-mm (Baxter Scientific Catalogue No. T1346-5)
- Transfer pipets, 5 3/4-inch (Baxter Scientific Catalogue No. P5202-1)
- Pipet bulbs, 1-ml (Baxter Scientific Catalogue No. R5002-1)
- Chloramine-T solution: dissolve 1.0 g of chloramine-T (VWR Catalogue No. JTE 494-6) in distilled water to a final volume of 100 ml. Prepare weekly.

- Pyridine-barbituric acid reagent: place 3 g of barbituric acid (VWR Catalogue No. EK 01090-5) in a 50-ml volumetric flask, then add 15 ml of pyridine (Baxter Scientific Cat. No. 332-4*DK). Next, add 3 ml of hydrochloric acid concentrate (Baxter Scientific Catalogue No. 5587-500*NY) and rinse down the sides of the flask with distilled water. Mix with a magnetic stirrer until all of the barbituric acid is dissolved. Lastly, bring to final volume with distilled water.
- Phosphate buffer: dissolve 138 g sodium phosphate, monobasic, $\text{NaH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$ (VWR Catalogue No. AC 49380-3) in distilled water to 1 liter. Prepare weekly.
- Hydrogen cyanide Drager tubes (Order No. CH25701)
- One thousand mg/l stock cyanide standard: dissolve 2.51 g potassium cyanide (Mallinckrodt Catalogue No 6881-125 grams) and 2 g of sodium hydroxide (Baxter Scientific Catalogue No. 7708-500*NY) in distilled water to 1 liter.
- Sulfuric acid, concentrated (Mallinckrodt Catalogue No. 6881-125 grams)
- One hundred-twenty-five-ml Erlenmeyer flask (Baxter Scientific Catalogue No. F4275-125)
- Two-hole rubber stopper (Baxter Scientific Catalogue No. R-5150-6)
- Latex tubing (Baxter Scientific Catalogue No. T6550-3)
- Vortex II mixer (VWR Catalogue No. 58815-189)
- Nitrogen gas (purchase locally)

NOTE: ALL GASES SHOULD BE ZERO GRADE OR EQUIVALENT

5.7.5 Method No. 1

- Add 1/2 ml of phosphate buffer to 1 ml or 1 g of sample in a culture tube. Securely cap and vortex.
- Check the resultant pH. If the pH is greater than 8, continue adding buffer until a pH of approximately 8 is obtained.

- Add 1 ml of chloramine-T reagent, securely cap and vortex.
- Add 1 ml of pyridine-barbituric acid reagent and vortex.
- Allow 8 minutes for full color development.
- The appearance of a pink to red color indicates the possible presence of 1 mg/l or more of cyanide.
- If the result is negative, record the result on the Drum Inventory Log. If the result is positive, confirm the result with Method No. 2.

5.7.5.1 Interferences For Method No. 1

Thiocyanates produce a positive result in the cyanide spot test. If thiocyanates are suspected, an aliquot of the sample should be retested after formaldehyde is added to remove the cyanide. If the result of the retesting has the same intensity of red color as the initial cyanide test, then the cyanide test is a false positive due to thiocyanate interference.

Nitrates may also cause a false positive result in the cyanide spot test, except that the color change is to blue or purple. If nitrates are suspected, the sample should be screened for nitrates by the method described in Section 6.0.

A false negative result may occur in the spot test in the presence of a highly-reduced sample. Chloramine-T is consumed by the reducing agent, thus requiring additional chloramine-T to react with the sample cyanide.

Also a false negative occurs in the spot test in the presence of 0.5 mg/l or more of aldehydes. Aldehydes convert detectable cyanide to nondetectable cyanohydrin.

5.7.6 Method No. 2

- Place a 5-g sample in the Erlenmeyer flask of the apparatus shown in Figure 5.1.
- Treat the sample with 5 ml of concentrated sulfuric acid and quickly replace the stopper.
- Slowly turn on the nitrogen flow. Adjust the nitrogen flow as to create only enough positive pressure to force the contained atmosphere through the Drager tube.

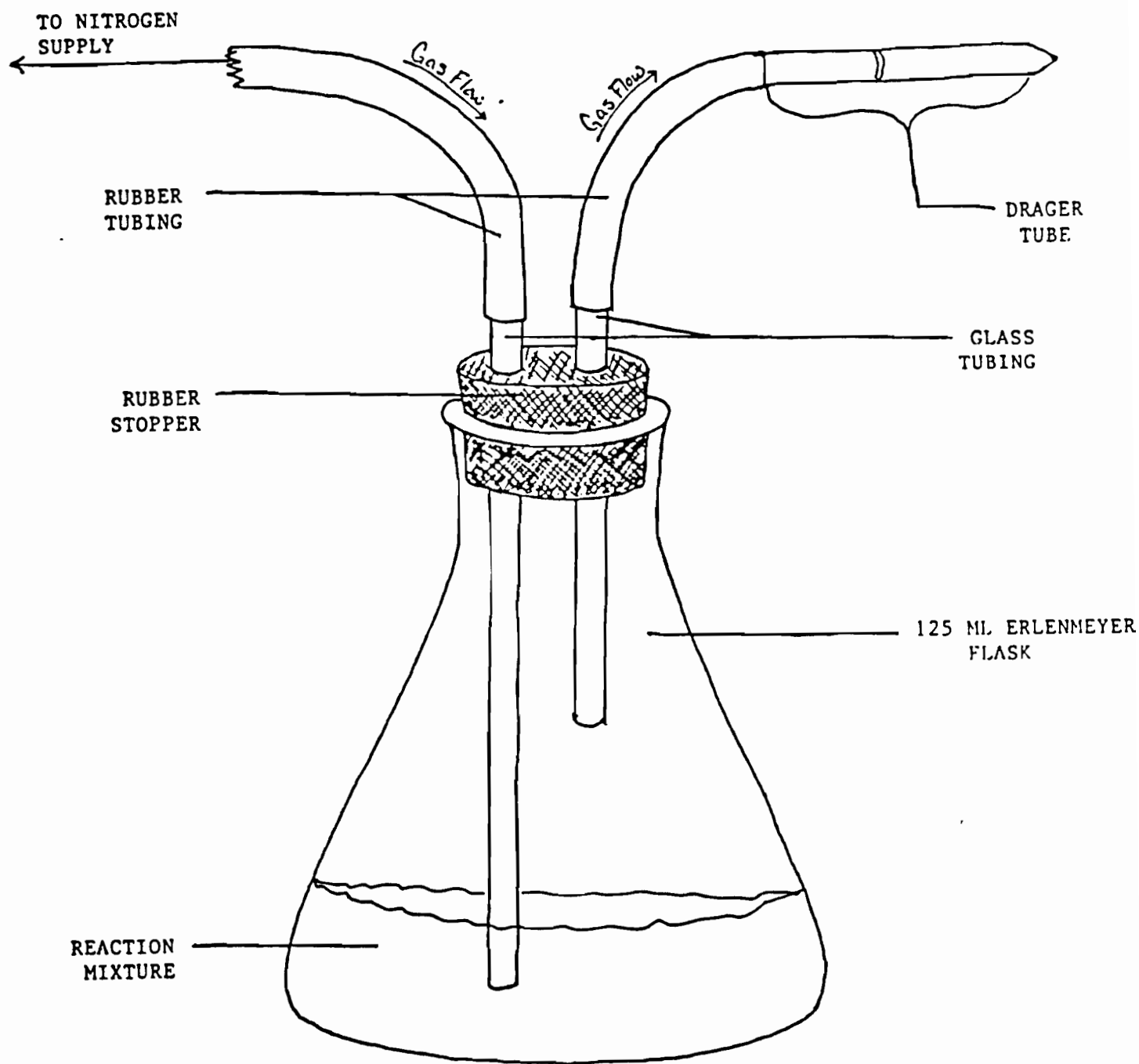


FIGURE 5.1

CYANIDE DRAGER TUBE TEST APPARATUS

NOTE: DRAGER TUBE SHOULD BE CONNECTED TO THE APPARATUS TUBING SO THAT THE GAS FLOW IS IN THE DIRECTION INDICATED BY THE ARROW ON THE DRAGER TUBE.

- Allow the nitrogen to purge the flask head space for at least 5 minutes or until a color change is noted in the Drager tube.
- If a red color appears and remains in the yellow indicating zone of the Drager tube, the sample has tested positively for cyanides. Record the result on the Drum Inventory Log and note that the presence of cyanide was confirmed with the Drager tube test.
- If the sample is not positive for cyanides, turn off the nitrogen, carefully remove the stopper and take the pH of the mixture in the flask.
- If the pH is greater than 4, repeat the procedure from Step 2.

NOTE: A DRAGER TUBE CAN BE REUSED IF THE RESULT OF EACH RUN IS MARKED ON THE TUBE.

- If the pH is less than 4, the sample is negative for cyanide. Record the result on the Drum Inventory Log and note that the cyanide result was confirmed with the Drager tube test.

5.7.6.1 Interferences For Method No. 2

Since both acidic and basic interfering gases are retained in the white precleanse layer, many possible interferences are excluded. One notable exception to this rule is hydrogen sulfide at concentrations greater than 100 ppm, the capacity for hydrogen sulfide on the precleanse layer. Hydrogen sulfide interference can be noted by the discoloration of the white precleanse layer to a dark brown. Also high concentrations of ammonia may break through the precleanse layer and change the indicating layer from yellow to red. Ammonia interferences can be determined if the start of the indicating layer changes back to yellow. Hydrochloric fumes give no interference up to 5,000 ppm. While nitrous fumes will uniformly change the indicating layer to dark orange, it does not interfere with the detection of hydrogen cyanide.

Acrylonitrile and methacrylonitrile are not indicated by the hydrogen cyanide Drager tube even when they are present in very high concentrations. It is, therefore, possible to determine if any free hydrogen cyanide is present in samples containing these substances.

5.7.7 Quality Assurance/Quality Control

At the start of every shift or when new reagents are prepared, check the cyanide spot test with the sodium cyanide standard and with distilled water. Record the results on the back of the first Drum Inventory Log of that shift. Always remember to date and initial your QC checks. If you cannot obtain a positive test result with the cyanide standard solution or a negative result with the distilled water, immediately notify the project chemist. Additionally, if the Drager tube test is required, test the response of the Drager tube using the cyanide standard in place of the sample.

5.8 FLASH POINT TEST

A flash point analysis is performed on each layer of every sample.

5.8.1 Scope and Application

The objective of this test is to determine the flammability of the sample and proper handling and disposal procedures necessary for the container represented by that sample.

5.8.2 Method Summary

A flash point analysis is performed using a closed cup Seta flash unit at a specified temperature (60 degrees Celsius, 140 degrees Fahrenheit).

5.8.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible. When using an open flame in any laboratory make sure there are no flammable solvents or samples in your work area. Check the condition and location of your fire extinguisher(s) and have a plan in the case of an uncontrolled fire.

5.8.4 Materials

- Transfer pipets, 5 3/4-inch (Baxter Scientific Catalogue No. P5202-1)
- Pipet bulbs, 1-ml (Baxter Scientific Catalogue No. R5002-1)
- Aluminum foil (purchase locally)
- Teflon tape, 4-inch width (Scientific Specialties Catalogue No. 79979)

- Seta flash unit (ERDCO Model SF-01) (Petrotest Model RT-1)
- Propane refill for Seta flash unit or Petrotest units
- p-xylene (Baxter Scientific Catalogue No. 1949-500*NY)
- Fire extinguisher (dry chemical type for A, B, and C fires)

5.8.5 Method

- Allow the cup of the flash unit to reach 60 degrees Celsius (140 degrees Fahrenheit). Turn on the gas, light, and adjust the pilot/test flame.
- Line the cup with aluminum foil. If the sample layer to be tested has a pH less than 2 or greater than 12, use Teflon tape to line the cup and note this on the Drum Inventory Log.
- Place approximately 1 g or 1 ml of sample in the cup.
- Close and latch the lid of the cup and turn on the flash tester timer (1 minute).
- When the timer goes off, pull open the slide that controls the flame position and observe closely.
- If flash or pop sound is observed, then the flash test is positive. Record the result on the Drum Inventory Log.

NOTE: A FLASH MAY BE MORE EASILY OBSERVED IF THE HOOD LIGHTS ARE SHUT OFF.

5.8.6 Interferences

Samples having an extremely high pH or a very low pH can react with the aluminum foil, producing hydrogen gas and a false flash. If this situation occurs, use Teflon tape to line the flash cup.

5.8.7 Quality Assurance/Quality Control

At the start of each shift check the performance of the Seta flash unit with p-xylene and distilled water. Record the results on the back of the first Drum Inventory Log of that shift. Always remember to date and initial your QC checks. If you cannot obtain a positive test result with the p-xylene or a negative result with the distilled water, immediately notify the project chemist.

5.9 PCB SCREEN

Each sample will be screened for the presence of PCBs using the procedure detailed in this section.

5.9.1 Scope and Application

The objective of this test is to determine if PCBs are present in the sample, thus requiring disposal at a TSCA permitted facility.

5.9.2 Method Summary

Each sample is extracted in a cold 1:1 hexane/DCM mixture composited, solvent exchanged, cleaned up via acid hydrolysis and sometimes silica gel or florisil procedures, and screened for PCB content greater than 25 ppm via gas chromatography with an electron capture detector (ECD) or Hall electrolytic conductivity detector.

5.9.3 Safety Considerations

All samples should be opened and analyzed in a hood as soon as possible. Hexane is flammable and should be used in an exhaust hood away from any ignition sources.

5.9.4 Materials

- Gas chromatograph with an ECD or Hall Detector (Tracor Model No. 540 or Hewlett-Packard 5890)
- Gas chromatograph packed columns:
 - 3 percent OV-1 on 100/120 mesh Supelcoport
 - Mixed phase (1.5 percent SP-2250 and 1.95 percent SP-2401) on 100/120 mesh Supelcoport

- Appropriate carrier and detector gases (purchase locally). See October 2, 1991, memo from Willis Moody for information on gases.

NOTE: ALL GASES SHOULD BE ZERO GRADE OR EQUIVALENT

- 2-propanol (Baxter Scientific Catalogue No. 323-4*DK)
- Ion exchange resins:
 - IRN 77 (Tracor Catalogue No. 115461-0001)
 - IRN 150 (Tracor Catalogue No. 115461-0002)
- Gas chromatograph Septa, 11-mm for Tracor 540's (Alltech Catalogue No. 79251 and Hewlett-Packard 5890)
- Ten-microliter (ul) gas chromatograph syringes (Hamilton 2700 Series FLEXIT, Model 2701, available through VWR or Baxter)
- Fifty-, 100-, 500-, and 1,000-ul gastight syringes (Baxter Scientific Catalogue Nos. 9662-3 or -4 or -38 or -39)
- Ten-, 25-, 50-, and 100-ml volumetric flasks (Baxter Scientific Catalogue Nos. F4671-10, F4660-25, or -50 or -100)
- Assorted volumetric pipets (Baxter Scientific Catalogue No. P4187-x, where x = pipet volume) (Corning Corex brand)
- Evaporation unit:
 - Reacti-vap evaporator (Cobert Catalogue No. 918780)
 - Reacti-therm heating module (Cobert Catalogue No. 918802)
 - Reacti-block B-1 (Cobert Catalogue No. 918802)
- Kimble culture tube with Teflon-lined screw cap (Baxter Scientific Catalogue No. T1346-5)
- Vortex II mixer (VWR Catalogue No. 58815-189)
- Hexane (Baxter Scientific Catalogue No. 216-4*DK)
- PCB standards kit (Supelco 1,000 ppb Catalogue No. 4-4830M)

- B & J plastic SPE columns, silica (Baxter Scientific Catalogue No. 9054*DK)
- B & J plastic SPE columns, florisil (Baxter Scientific Catalogue No. 9108*DK)
- Sulfuric acid, concentrated (VWR Catalogue No. JT9673-1)
- Benchtop centrifuge with fixed angle rotor (IEC Model Nos. 2355 and 302)
- Pyrex graduated conical centrifuge tubes (Baxter Scientific Catalogue No. C3924-12A)
- Test tube racks (Baxter Scientific Catalogue No. S9222-3)
- Hydrogen cyanide gas/hydrogen sulfide gas alarm (Monitox) units with gas generator (MDA Model Nos. RA-530341, RA-530141, and RA-4100)
- Transfer pipets, 5 3/4-inch (Baxter Scientific Catalogue No. P5202-1)
- Pipet bulbs, 1-ml (Baxter Scientific Catalogue No. R5002-1)

5.9.5 Method

- Composite 1-ml aliquots of the hexane/DCM sample extracts of no more than ten samples into a culture tube. Assign a composite number and record the composite and the sample numbers in that composite in the composite log (See Appendix A).
- Thoroughly mix the composite using the vortex unit and transfer a 1-ml aliquot to a labeled graduated centrifuge tube.
- Add 10 ml hexane to the composite aliquot and concentrate back down to approximately 1/2 ml to perform a solvent exchange.

NOTE: IF ANY DCM REMAINS IN THE FINAL EXTRACT, SEVERE PROBLEMS CAN OCCUR DURING GAS CHROMATOGRAPHY ANALYSIS.

- Acid hydrolyze the composite aliquot by slowly adding 1 ml of concentrated sulfuric acid to the composite and carefully mixing.

WARNING: ACID HYDROLYSIS OF SAMPLE EXTRACTS CAN EXHIBIT VIOLENT REACTIONS, USE EXTREME CARE. SAMPLES MAY HEAT UP ENOUGH TO CAUSE SOLVENT TO BOIL OUT OF THE TOP OF THE CULTURE TUBE. BE SURE YOUR ARMS AND HANDS ARE PROPERLY PROTECTED AND THE HOOD SASH IS PULLED DOWN LOW TO PROVIDE A SHIELD BETWEEN THE SAMPLE AND YOUR BODY.

- Allow layers to separate. The hexane layer will be the top layer. If two distinct layers do not form within 10 minutes, employ centrifuge to aid in separation.
- Remove the bottom acid layer with a transfer pipet and discard. If the acid layer appears mainly colorless, acid hydrolysis is complete. If the acid layer is colored, repeat this step until acid layer is clean.
- Transfer the hexane layer only to an autosampler vial, tightly cap, and refrigerate when not in use.

WARNING: DO NOT STORE ACID AND HEXANE LAYERS TOGETHER IN A CLOSED CONTAINER. CONTINUED REACTIONS BETWEEN THE ACID AND THE HEXANE MAY CAUSE PRESSURE TO BUILD UP AND THE VIAL MAY EXPLODE.

- Analyze final composite extract by gas chromatography. If the composite is BDL (below detection limit), record the composite number and result of each layer on every Drum Inventory Log whose sample was represented in the composite. If the sample was not BDL, each layer in the composite must be analyzed separately. Perform this analysis beginning with Step 3 on a 1-ml aliquot of an individual sample extract. Note that individual extracts are also assigned a composite number (See Appendix A).

NOTE: IF GAS CHROMATOGRAPHY ANALYSIS IS COMPLICATED BY SAMPLE MATRIX EFFECTS, THE CLEAN UP METHOD OUTLINED IN SECTION 5.9.6 SHOULD BE EMPLOYED.

5.9.6 Optional Cleanup Method

- Quantitatively transfer the 1 ml of acid hydrolyzed hexane extract onto a hexane pre-rinsed microflorisil or microsilica column and elute with 10 ml of hexane. Collect sample eluant in a labeled, graduated centrifuge tube.

- Concentrate the sample eluant to 1/2 ml on an evaporation unit.
- While rinsing down the sides of the test tube, bring extract up to a final volume of 1 ml.

5.9.7 Interferences

Solvents, reagents, glassware, and other sample processing hardware may yield interferences. All of these materials must be demonstrated to be free of interferences under the conditions of the analysis by analyzing method blanks. Interferences may also be co-extracted from samples. If analysis of an extract is prevented due to interferences, further cleanup of the sample may be necessary. Plastic laboratory equipment must be avoided because phthalates are commonly used as plasticizers and their esters are easily extracted. Phthalate esters pose a serious interference problem in the analysis of PCBs by gas chromatography.

5.9.8 Quality Assurance/Quality Control

At the start of every shift check the performance of the gas chromatograph with injections of an Aroclor standard and a hexane blank. Also check the extraction method by analyzing a method blank and a method spike with every batch (1 to 20 samples) of samples extracted. If you cannot obtain a good chromatogram with the Aroclor check standard or the blank hexane, immediately notify the project chemist. If your chromatograph is shown to be good with a check standard and you do not obtain a good chromatogram for a method blank or a method spike, the batch must be reextracted. Record the QC batch number of each composite in the composite log (See Appendix A).

Batch QC should be prepared in the same manner as the samples (i.e., if the optional clean up is employed on the samples, then the QC samples should also be cleaned).

6.0 OPTIONAL COMPATIBILITY TEST PROCEDURES

6.1 NITRATE TEST

6.1.1 Scope and Application

Nitrates exhibit a blue color development during the cyanide spot test. This color can appear to be a false positive for cyanide. Spot testing for nitrates can prevent false classification of materials as cyanides. The test can also be used to further identify a compound that is acidic or oxidizing. Nitric acid will show positive for an oxidizer and exhibit a low pH and therefore, the nitrate test can identify this particular problem.

6.1.2 Method Summary

Nitrates are reduced to nitrites by a reducing agent. In the presence of an acidic buffer, the nitrite is converted to nitrous acid which diazotizes an aromatic amine. This product couples with N-(1-naphthyl)ethylenediamine to form a red-violet azo dye.

6.1.3 Materials

- EM Quant nitrate test strips (VWR Catalogue No. EM-10020)
- Ten percent sulfamic acid: dissolve 10 g of sulfamic acid (VWR Catalogue No. EM-SX1140-2) in distilled water to a final volume of 100 ml

6.1.4 Method

- Remove a test strip from the tube and immediately replace the stopper.
- Dip the test strip into the aqueous sample extract to be tested.
- Remove the test strip and gently shake off the excess liquid.
- Allow 1 minute for full color development.
- Compare the reaction zone with the color scale on the test strip container.

NOTE: THE TEST STRIP HAS TWO REACTION ZONES. ONE IS FOR NITRATES AND NITRITES AND THE OTHER IS FOR NITRITES ONLY. IF THE NITRITE ZONE IS COLORED, THE NITRATE MAY BE A FALSE POSITIVE.

- Record the result in the comments section of the Drum Inventory Log. Give approximate concentration in ppm.

6.1.5 Interferences

As little as 0.5 mg/l of nitrites interfere by exhibiting a false positive for nitrates. The presence of color on the indicator zone for nitrites will serve as a warning for the presence of nitrites. The nitrite interference can be eliminated by adding one drop of 10 percent sulfamic acid to the test solution.

The presence of the following ions may weaken the color intensity of the nitrate reaction zone and therefore, give a low reading for the actual concentration of nitrates in the sample:

- Greater than 100 mg/l $[\text{Fe}_2(\text{CN})_6]^{4-}$
- Greater than 25 mg/l S^{2-}
- Greater than 100 mg/l SCN^-
- Greater than 500 mg/l SO_3^{2-}
- Greater than 250 mg/l $\text{S}_2\text{O}_3^{2-}$
- Greater than 100 mg/l $\text{S}_2\text{O}_4^{2-}$
- Greater than 250 mg/l $\text{S}_2\text{O}_5^{2-}$
- Greater than 500 mg/l Fe^{2+}
- Greater than 250 mg/l Fe^{3+}
- Greater than 50 mg/l VO^{2+}
- Greater than 500 mg/l Zr^{4+}

Oxidizing ions cause discoloration of the test zone to between light brown and orange brown.

More than 50 mg/l of Ag^+ , 50 mg/l of Hg^+ , and 100 mg/l of Hg^{2+} interfere by causing a gray coloration of the reaction zone.

6.2 CHROMATE TEST

6.2.1 Scope and Application

Chromates are common in plating wastes. Chromates will give a false positive for peroxides when testing is done in a water solution. This can be confirmed by detecting the presence of chromates. The presence of chromates in a liquid wastestream

considerably raises the cost of disposal. Hexavalent chromium is also highly toxic to humans. This test can also be used to test for trivalent chromium, provided that these are oxidized with sodium peroxide prior to analysis.

6.2.2 Method Summary

This test is based upon a redox reaction between chromate ions and diphenylcarbazide. Chromate ions oxidize diphenylcarbazide in acid solution to form diphenylcarbazone, which is further oxidized to form diphenylcarbadiazone. This rise to chromium III ions, together with the enol form of diphenylcarbazone, produces a red-violet complex.

6.2.3 Materials

- Twenty-five percent sulfuric acid (w/w), prepare with sulfuric acid, concentrate (VWR Catalogue No. JT9673-1)
- Chromate test strips (VWR Catalogue No. EM-10012-1)

6.2.4 Method

- Lower the pH of 5 ml of test solution to less than 1 with the addition of 25 percent sulfuric acid.
- Immerse the reaction zone of the test strip into the test solution.
- Allow 15 seconds for full color development.
- Compare the reaction zone color with the color scale on the test strip container.
- Record the result in the comments section of the Drum Inventory Log. Give approximate concentration in ppm.

6.2.5 Interferences

The following substances reduce chromate to chromium III. In the presence of lead, chromium III forms nearly insoluble lead chromate therefore, less chromate, if any, is detected.

- $[\text{Fe}(\text{CN})_6]^{4-}$
- S^{2-}
- SO_3^{2-}
- $\text{S}_2\text{O}_3^{2-}$

- $S_2O_4^{2-}$
- $S_2O_3^{2-}$
- As^{3+}
- Fe^{2+}
- Sb^{3+}
- Sn^{2+}
- VO^{2+}
- Molybdenum blue
- Ascorbate ions

The following ions produce an interfering discoloration:

- Greater than 10 mg/l IO_3^- (pink to brown)
- Greater than 10 mg/l IO_4^- (pink to brown)
- Greater than 10 mg/l MnO_4^- (grayish pink)
- Greater than 25 mg/l Molybdate (pink to violet)
- Greater than 5 mg/l VO_3^- (brown to ruby)
- Greater than 50 mg/l $[Fe(ND)_6]^{3+}$ (gray to grayish pink)

NOTE: PROCEDURES FOR REMOVING BOTH CATIONIC AND ANIONIC INTERFERENCES ARE AVAILABLE FROM EM QUANT.

6.3 MERCURY TEST

6.3.1 Scope and Application

Mercury and its derivatives are problem compounds for disposal firms. Disposal of mercury is expensive, if possible at all. The identification of mercury containing waste can save disposal costs by minimizing the volume of mercury containing material prior to waste blending.

6.3.2 Method Summary

Mercury salts, in acid solution, give violet to blue insoluble complex salts with diphenylcarbohydrazide and its oxidation product diphenylcarbazone. Organomercury compounds react with diphenylcarbazone in the same way as do inorganic mercury compounds. They may be detected by paper chromatography on filter paper impregnated with freshly prepared 1 percent alcoholic solution of diphenylcarbazone.

6.3.3 Materials

- Coors porcelain color reaction plate (Baxter Scientific Catalogue No. P7000-3)

- Whatman GF/A filter paper (Baxter Scientific Catalogue No. F2830-55)
- One percent alcoholic diphenylcarbazone solution: dissolve 1 g of sym-diphenylcarbazone (VWR Catalogue No. JTK617-2) in denatured ethanol (VWR Catalogue No. EM-EX0285S-1) to a final volume of 100 ml

6.3.4 Method

- Cut filter paper into strips.
- Place a strip of filter paper on a reaction plate and moisten with a drop of 1 percent alcoholic diphenylcarbazone solution.
- Place a drop of liquid sample, organic solid sample hexane/DCM extract, or inorganic solid sample aqueous extract on the pre-moistened filter paper.
- The appearance of a violet to blue fleck on the filter paper indicates the presence of mercury in the sample.
- Record your observations and conclusions in the comments section of the Drum Inventory Log.

6.3.5 Interferences

The sensitivity of this test is dependent upon the acidity of the test solution and decreases with increasing acidity. In neutral or very weak acid solutions, other heavy metals (copper, iron, and others) also give colored compounds with diphenylcarbazone. In more acidic solutions the presence of chromates and molybdates also give colored compounds with diphenylcarbazone. The interference of chromates is prevented by reducing them, by means of sulfurous acid or hydrogen peroxide, to nonreacting chromic salts. Molybdates may be masked with oxalic acid, since the complex molybdenum-oxalic acid does not react with diphenylcarbazone.

The presence of chlorides affects the test through the formation of slightly dissociated HgCl_2 or $[\text{HgCl}_4]^{2-}$ ions. For the same reason the diphenylcarbazone test is less sensitive when applied to a HgCl_2 solution.

6.4 TOTAL CHLORINE IN NEW AND USED PETROLEUM PRODUCTS (FIELD TEST KIT) METHOD 9077

6.4.1 Scope and Application

The test for total chlorine determines if a new or used petroleum product meets or exceeds requirements for total halogen measured as chloride. The method is specifically designed for used oils and provides analytical accuracy with on-site testing in under 10 minutes. The entire analytical sequence, including sampling, sample pretreatment, chemical reactions, extraction, and quantification, is combined in a single kit using predispensed and encapsulated reagents. The kit provides a quantitative result over a range of 300 to 4,000 micrograms per gram (ug/g).

6.4.2 Method Summary

The oil sample (approximately 0.4 g) is dispersed in a solvent and reacted with a mixture of metallic sodium catalyzed with naphthalene and diglyme at ambient temperature. This process converts all organic halogens to their respective sodium halides. All halides in the treated mixture, including those present prior to the reaction, are then extracted into an aqueous buffer, which is then titrated with mercuric nitrate using diphenylcarbazone as the indicator. The end point of the titration is the formation of the blue-violet mercury diphenylcarbazone complex. Bromide and iodide are also titrated and reported as chloride.

The quantitative kit involves a titration of the extracted sample with mercuric nitrate by means of a 1-ml microburette such that the end point is denoted by a change from pale yellow to red-violet over the range of the kit (300 to 4,000 ug/g). The chlorine concentration in the original oil is then read from a scale on the microburette.

6.4.3 Interferences

Free water, as a second phase, should be removed. However, this second phase can be analyzed separately for chloride content if desired.

6.4.4 Materials

- CLOR-D-TECT Q4000 (manufactured by Dexsil Corporation) containing:
 - Sampling tube
 - Polyethylene Test Tube No. 1 (white cap) with diluent solvent capsule and metallic sodium capsule

- Polyethylene Test Tube No. 2 (clear cap) with buffered aqueous extractant and diphenylcarbazone indicator capsule
- Microburette containing mercuric nitrate titrant
- Plastic filtration funnel
- Tissue

6.4.5 Method

A sample of oil representative of the source being sampled shall be collected according to appropriate SW-846 sampling methods. The collected sample should be kept head space free and refrigerated prior to preparation and analysis to minimize volatilization losses of organic halogens. Due to the toxic and/or carcinogenic substances contained in waste oils, the following field and laboratory safety procedures should be followed:

- Examine the kit to ensure that all components and all capsules (three) are in place and nothing is leaking. The liquid in Tube No. 2 should be approximately 1/2 inch above the 5-ml line. The capsules are not supposed to be completely full.
- Mount the test tubes in the holder provided. Unscrew the white cap from Tube No. 1. Work plunger on the empty syringe a few times so that it slides easily. Place tip of the syringe in oil sample and pull back on the plunger until it reaches the stop and cannot be pulled further. Remove the syringe from the sample and wipe the outside of the syringe with tissue. Dispense oil sample in Tube No. 1 by depressing the plunger. Replace cap on Tube No. 1 which now contains about 0.4 g of sample.

NOTE: ALWAYS CRUSH CLEAR CAPSULE FIRST; LOW RESULTS MAY OCCUR AND ALLOW A CONTAMINATED SAMPLE TO PASS WITHOUT DETECTION.

- Break lower (colorless) capsule of diluent solvent by squeezing the sides of the test tube. Shake tube vigorously for 30 seconds. Break upper (gray) capsule of metallic sodium. Shake tube vigorously for 20 seconds. Allow reaction to proceed for 60 seconds, shaking intermittently several times.

CAUTION: CAPSULES ARE MADE OF GLASS. WHEN CRUSHING CAPSULES, PRESS ONCE, FIRMLY IN THE CENTER. DO NOT TRY TO RECRUSH BROKEN GLASS, IT MAY COME THROUGH THE TUBE WALLS AND CUT FINGERS.

NOTE: METALLIC SODIUM IS A FLAMMABLE WATER REACTIVE SOLID; THE TEST TUBE WILL WARM UP IF WATER IS PRESENT. IF THE SAMPLE TURNS CLEAR TO LIGHT GRAY WHEN THE SODIUM CAPSULE IS CRUSHED, THE SAMPLE CONTAINS MORE THAN 25 PERCENT WATER; RESULTS MAY BE BIASED EXCESSIVELY LOW AND SHOULD BE DISREGARDED.

- Remove caps from both tubes. Pour the clear buffered solution from Tube No. 2 into Tube No. 1. Replace the white cap on Tube No. 1 and shake vigorously for 10 seconds. Vent the tube by partially unscrewing the cap. Close cap securely, shake for an additional 10 seconds, vent, tighten cap, and stand tube upside-down on the white cap. Let phases separate for 2 minutes.

NOTE: WHEN TRANSFERRING EXTRACTION SOLUTION FROM TUBE NO. 2 TO TUBE NO. 1, DO NOT LET CAPSULE FALL INTO TUBE NO. 1.

- Place filtration funnel into Tube No. 2. Position Tube No. 1 over funnel and open nozzle on cap. By squeezing the sides of Tube No. 1, dispense the clear aqueous lower phase through the filter and into Tube No. 2 to the 5-ml line. Discard Tube No. 1. Remove filter funnel and discard.
- Place the plunger rod in the titration burette and press gently until it clicks into place. Break off (do not pull off) the tip on the titration burette. Insert burette into Tube No. 2 and tighten cap. Break the colored capsule and shake gently for 10 seconds. Dispense titrant dropwise by pushing down on burette rod in small increments, shaking gently between increments. Continue adding titrant until solution turns from yellow to red-violet. Carefully titrate until a true red-violet color is observed.
- Record result immediately in the comments section of the Drum Inventory Log.

NOTE: RESULTS MUST BE RECORDED IMMEDIATELY BECAUSE THE COLOR FADES OVER TIME.

6.4.6 Quality Assurance/Quality Control

All method blanks and spikes will be carried through the sample preparation steps in Section 6.4.5. Each sample should be tested twice. If the results do not agree to within 10 percent relative percent difference, then a third test must be performed. Report the results of the two tests that agree.

7.0 DATA REVIEW AND INTERPRETATION

Once the compatibility testing is completed and before the waste blending testing is performed, it is imperative that the data be reviewed and properly interpreted. Data interpretation is probably the most difficult and most important task facing the chemist performing the compatibility analyses. OHM has developed a computer program written in dbase III Plus called Drumlog which can aid the chemist in performing the interpretation of the data. However, the program is still limited and cannot perform all of the steps necessary to properly interpret all of the data generated during the compatibility testing. The steps required to assure proper interpretation of the data consists of the following:

- Comparative review of sampling and compatibility data
 - Sample description
 - Field pH verses laboratory pH
 - Drum labels, UN/NA numbers, placards, and sampler comments
- Compatibility data review
 - Data accuracy
 - Data completeness
 - Chemical data review
- Classification
 - Compatibility classification of each layer
 - Multilayered data review and drum classification
 - Assigning drum to a waste classification category

These steps are detailed in the following sections.

7.1 COMPARATIVE REVIEW OF SAMPLING AND COMPATIBILITY DATA

Reviewing of the sampling data with the compatibility data must be performed on each drum that was sampled and analyzed. The review must be complete and thorough before even attempting to classify the sample. If the material in the sample jar does not represent the material in the drum then the compatibility data certainly cannot be used to determine the wastestream in which this material can be safely blended. Almost every incident which has occurred during a waste blending operation has been tracked back to

drum labels being ignored; field data and compatibility data not being reviewed; or the compatibility data, which did not accurately represent the waste in the drum. Therefore, it is imperative that the following steps be thoroughly followed.

7.1.1 Sample Description

The sample descriptions recorded by the sampler and analyst must be reviewed to ensure that the physical state, color, clarity, and number of layers match. If they don't match then the sample content needs to be examined in order to determine which description is correct. If the contents of the sample matches the sampler's description then either the wrong sample has been analyzed by the laboratory or the data has been transcribed incorrectly. If this has occurred then all of the data generated on that shift needs to be thoroughly reviewed by the project chemist for additional errors. All samples found to contain or suspected of containing errors need to be reanalyzed. Assuming that samples have been switched or data has been transcribed incorrectly is not an acceptable corrective action! **THEY MUST BE REANALYZED! REMEMBER, SOMEONE'S LIFE MAY BE DEPENDENT UPON YOUR DECISIONS!**

If the contents of the sample jar matches the chemist's description, then a sampling error has occurred. The samples must be compared to the actual materials found in the drums. A quality assurance (QA) audit must be made of at least a minimum of ten drums sampled prior to and after the drum where the sampling error was found. This audit should be performed by the senior sample technologist or project chemist on site. **ALL DRUMS ASSOCIATED WITH THE SAMPLING ERROR MUST BE RESAMPLED AND REANALYZED.**

7.1.2 Sample pH

Field pH readings are an optional test and are not always performed. However, a space is provided on the drum logs to record these pH readings if they are taken. If field pH readings are taken then they must not vary by more than ± 2 units with the pH reading reported by the laboratory. If they vary by more than two units then there may be a sampling or laboratory error associated with this sample. The first thing to do is to check the pH of both the sample and the material in the drum. If they still do not match, the drum must be re-sampled and analyzed. A QA audit must be performed by the senior sample technologist on at least a minimum of ten drums sampled prior to and after the drum in which the sampling error was found. The compatibility data generated for the shift where the sample was analyzed needs to be reviewed for additional errors. If additional errors are found, then the QA audit must be expanded to include all drums sampled on that shift. All drums associated with any error uncovered during this QA review must be re-sampled and analyzed.

7.1.3 Drum Labels and Comments

If a chemical name or a UN/NA number or placard has been recorded on the drum log, then the chemist must look up the chemical characteristics of this material. Particular attention needs to be paid to any handling precautions. If the literature indicates the chemical to be radioactive, highly reactive, shock sensitive, an organic peroxide former, or a strong oxidizer then confirmation testing must be performed to verify the validity of the information. If the literature indicates the material to be inert or non-reactive then the question becomes can disposal be simplified if the material can be handled as a known material? If it can then verification testing needs to be performed.

Field confirmation testing is more than simply comparing the color and physical state found in the literature versus the actual sample. Many times the contents of the drum may be off spec material or material mixed with other wastes which may give a different color, but still leave the material as highly reactive, as pure material. In fact, many reactive materials become even more reactive or shock sensitive if they have been contaminated. Therefore, it is imperative these samples be handled separately and with special attention from the project chemist. There are a wide variety of spot tests which can help verify the sample contents. An example is illustrated below:

A drum is labeled ammonium dichromate. The chemical dictionary describes ammonium dichromate as follows:

Color:	Orange
Physical State:	Crystalline solid
Hazards:	Decomposes upon slight heating
	Dangerous fire risk
	Strong oxidizer
	May explode in contact with organic material

From the literature description, it is readily apparent that if this sample is ammonium dichromate, then it will pose a problem if it is blended. Therefore, the first step is to compare the color and physical state of the sample to the literature description. If the sample matches the description found in the literature then this sample should be assumed to be ammonium dichromate until proven otherwise. If the description doesn't match, confirmation testing of the sample should still be performed. Some simple tests that could be performed to confirm the sample to be ammonium dichromate would be:

- Weighing .1 grams of sample into 100 ml of water and diluting 1:50 and using the EM Quant Chromate Test Strips. A positive result would indicate this to be a fairly pure product.

- Dissolve a small portion into water. Adjust the pH to 14 and test the head space for ammonia gas being liberated by using pH paper or an ammonia Drager tube.

There are several other tests that can easily be performed in a laboratory trailer which can generate data which can help the project chemist make a decision concerning the validity of the label.

If field confirmation testing indicates that the sample may contain the material indicated on the label and the sample content is suspected to be radioactive, highly reactive, shock sensitive or a potential peroxide former, then the sample should be immediately removed from the laboratory trailer to a secure area. The site supervisor and project manager should be notified. The drum should be flagged with caution tape and isolated from the work area.

Verification testing by a fixed base laboratory may be performed, but the laboratory performing this analysis must be made aware of the suspicions and the hazards associated with the sample. If the confirmation data does not match what would be expected then the material must be treated as an unknown and tested accordingly.

The comment section of the field data should be reviewed for any warning reported by the sample technicians (i.e., drum fumed during sampling). If there are any warnings then they must be taken into consideration when deciding whether or not this material can be safely blended.

Each of the above steps must be completed prior to preceding with the compatibility data review.

7.2 COMPATIBILITY DATA REVIEW

After the sample passes the above review, then the compatibility data must be checked for accuracy and completeness and evaluated for chemical reactivity prior to classification of each layer. Multilayered samples must be reviewed for interlayer compatibility and to assign a compatibility group to the sample.

7.2.1 Compatibility Accuracy

Prior to attempting to assign a compatibility classification to each layer, the data needs to be checked for accuracy. If the Drumlog program is being used or if laboratory data sheets were used, then transcription errors may have occurred and it is necessary for the data to be reviewed. Every place where the data has been documented it must be checked for transcription errors. If errors are found then they need to be corrected. If no errors are found then the data needs to be checked for completeness.

7.2.2 Completeness Review

If no transcription errors are found then the data needs to be checked for completeness. The completeness check is to assure that all of the compatibility tests have been performed on each sample. If any test data is missing then each sample needs to be analyzed for that parameter prior to classification.

7.2.3 Chemical Data Review

After the sample has passed the accuracy and completeness checks then the compatibility data needs to be checked to assure that the data makes sense from a chemical standpoint. These checks are listed below:

- Solubility data in comparison to the rest of the data
- pH data in comparison to the rest of the data
- Oxidizer test in comparison to the rest of the data

7.2.3.1 Solubility Data

When reviewing the results of the solubility data with the rest of the data generated during the compatibility testing, the physical state of each layer needs to be taken into consideration. Therefore, the following is broken into a section for liquids and a section for solids.

Liquids

The solubility tests performed on liquid layers are performed to determine if the layer is organic or inorganic. It is readily apparent that all aqueous solutions will be soluble in water if thoroughly mixed. If thorough mixing does not occur then strong brine solutions may appear to be insoluble in water. Therefore, it is imperative that the sample and water are thoroughly mixed. If the layer is soluble in hexane/DCM, it is considered to be organic, whether or not it is soluble in water. Where difficulties arise is when a layer is not soluble in hexane/DCM but appears to be organic from other test data. When this happens it is important for the chemist to do additional testing to determine if the sample is indeed organic or inorganic. Some of the common scenarios encountered during compatibility testing are detailed below:

- Water soluble and positive peroxides--If a sample is soluble in water and insoluble in hexane/DCM and tests positive for peroxides, then the sample needs to be tested further. The object of the peroxide test is to identify organic materials which can form shock sensitive peroxides. Some of the organic peroxidizable chemicals are water soluble, but would still be expected to be soluble in hexane/DCM. Therefore, check the sample's solubility data results and check to ensure that the

peroxide test was performed on the hexane/DCM layer and not the aqueous layer. Several metals and strong oxidizers interfere with the peroxide test strips. If the aqueous layer was tested instead of the hexane/DCM layer and this material was a strong oxidizer, mixing an oxidizer with organic peroxides could lead to an explosion or fire. Even if OHM is not doing on-site waste blending, this material may be mixed with other materials at the disposal facility. If the sample has been checked and still tests positive, verify that the sample is organic by placing a small portion into a flame and recording the observations in the comment section of the Drum Log. If the sample does not burn then there is an interference with the peroxide test and the peroxide test should be recorded as negative. If the sample violently deflagrates or burns and the peroxide level is greater than 5,000 ppm the sample should be classified as a shock sensitive.

- Water soluble and positive Bielstein--If a sample is soluble in water, insoluble in hexane/DCM, has a negative flash point, and gives a positive Bielstein test, then check the sample by the alternate chlorine test procedure and classify it in accordance to the alternate test results. Very few halogenated organic liquids have solubilities in water great enough to give a positive water solubility result.
- Water insoluble and hexane/DCM insoluble--If a liquid sample is insoluble in both water and hexane/DCM, then the solubilities need to be rechecked. Many times strong brine solutions appear to be insoluble in water, but upon thorough mixing of the sample it will dissolve in the water. No known liquid sample has been found to be soluble in both water and hexane/DCM. If one is found it would be an organic liquid.

In addition to the above scenario, many times the chemist will be faced with a material which is soluble in hexane/DCM, but other tests indicate inorganic qualities. In this scenario it is important for the chemist not only to recognize the importance of determining whether the material is organic or inorganic, but to recognize that if this material is organic then it is a potentially highly reactive chemical.

- Insoluble in water and soluble in hexane/DCM and tests positive for oxidizer, cyanide, or sulfides or has a pH of less than 2 or greater than 12--It is imperative that these results be confirmed. If the results are confirmed and the material is determined to be organic then this material should be considered potentially highly reactive material and may need to be excluded from any waste blending operations. If a decision is made to attempt to waste blend this material it should be the last sample added to the test blend

and should be first added to a small aliquot of the test blend. Extra care and time should be taken to ensure that a delayed reaction does not occur before adding this material to the test blend.

- Water insoluble, density greater than water, and negative Bielstein--If a sample is insoluble in water, heavier than water, soluble in hexane/DCM, and is reported as negative for the Bielstein test, then the sample should be analyzed by the alternate chlorine test procedure and classified in accordance to the alternate test results. Very few halogenated organic liquids have solubilities in water great enough to give a positive result. The sample should be classified in accordance to the alternate test results.

Solids

The solubility tests performed on solid layers are performed to help determine if the layer is organic or inorganic. However, many inorganic and organic materials are insoluble in both water and hexane/DCM. If the layer is soluble in hexane/DCM it is considered to be organic whether or not it is soluble in water. If the sample is soluble in water and insoluble in hexane/DCM, the sample is considered to be inorganic. Where difficulties arise is when a layer is insoluble in both water and hexane/DCM. The chemist must then make a determination as to whether the sample is organic or inorganic. The best way to make this determination is to observe whether the sample burns or melts when exposed to a flame. This observation should be made during the Bielstein test and recorded in the comments section of the Drumlog.

7.2.3.2 pH Data

In addition to the pH concerns already identified in the solubility sections, the pH data needs to be reviewed with respect to the following concerns:

- If a sample is reported as having a positive flash point and having a pH of less than 2 or greater than 12, then the chemist must ensure that the flash point tester was lined with 4-inch Teflon tape. Strong acids and bases can react with the aluminum foil or the metal cup of the flash point tester releasing hydrogen gas in sufficient quantities to give false positives. If the tests are confirmed to be positive with the Teflon tape, then the same precautions must be observed, as detailed in the previous solubility sections. This sample is potentially highly reactive.
- If a sample is reported to have a positive cyanide or sulfide test and a pH less than 4.5, then either there is an interference with the cyanide test or this sample may be releasing a toxic gas. The major interference encountered during the cyanide test is nitrates. Nitrates give a

blue to purplish color rather than the red color. However, very high concentrations of cyanide can give a similar color upon standing. Therefore, the sample should be checked for the presence of cyanide using the alternate cyanide test procedure. If the sample tests positive for cyanide with the alternate test procedure then the site supervisor must be notified that this drum may be releasing toxic fumes and that the head space of the drum needs to be checked for hydrogen cyanide or hydrogen sulfide gas. Drager tubes or monitoxes are commonly used.

- If the sample tests negative by the alternate procedure then the sample may be checked for nitrates with the EM Quant test strips. Otherwise the cyanide results should be changed to negative prior to classification.

7.2.3.3 Oxidizer Data

In addition to the oxidizer concerns already identified in the solubility sections, the oxidizer data needs to be reviewed in respect to the following concerns:

- If a sample is reported as having a positive flash point and a positive oxidizer, then the chemist must ensure that the flash point tester was lined with 4-inch Teflon tape. Strong oxidizers can react with the aluminum foil or metal cup of the flash point tester to release hydrogen gas in sufficient quantities to give a false positive. If the tests are confirmed to be positive with the Teflon tape, then the same precautions must be observed, as detailed in the previous solubility sections, as to the sample's potential reactivity.
- If a sample is reported as having a positive cyanide or sulfide test and a positive oxidizer, then an interference with the cyanide test or sulfide test may be present. Most strong oxidizers will react to destroy cyanide or sulfide such as sodium hypochlorite or hydrogen peroxide. Two commonly found oxidizers which will not react with cyanide are nitrates and chromates. Nitrates also interfere with the cyanide test. Nitrates will give a blue to purplish color with the cyanide test rather than the red color. However, very high concentrations of cyanide can give a similar color upon standing. Therefore, the sample should be checked for the presence of cyanide using the alternate cyanide test procedure. If the sample tests positive for cyanide with the alternate test procedure, then the sample should be classified as a cyanide. If the sample tests negative for the presence of cyanide with the alternate procedure, then the sample should be classified as an oxidizer.

7.3 CLASSIFICATION PROTOCOLS

All samples identified as biological waste, radioactive waste, air reactive, water reactive, and organic peroxides should be classified as follows:

Biological Waste	Bio
Radioactive Waste	Rad
Air Reactive	ARxn
Water Reactive	WRxn
Organic Peroxides	Exp

All of these drums require special handling and all future plans for these drums must be developed on a site-by-site and drum-by-drum basis.

Once the specially handled drums have been segregated and the above reviews completed, classification can begin. The classification process consists of first assigning a classification group to each layer, reviewing the chemical compatibility of multiple-layered samples, and then assigning a compatibility group to the multiple layered samples. OHM's Drumlog program is capable of doing the data review and layer classification, however, the project chemist must perform the drum classification for drums containing multiple layers.

7.3.1 Drum Layer Compatibility

Each layer in the sample is assigned a compatibility classification. This classification is usually in the form of a code or an abbreviation for each test which is reported to be positive. The codes are assigned in a specific order of priority. Assignment of these codes must be in accordance to the following sequence:

RAD	Radioactive
EXP	Shock Sensitive
A Rxn	Air Reactive
W Rxn	Water Reactive
PCB	Polychlorinated Biphenyls
Fl	Flammable
Ox	Oxidizer
Cn	Cyanide
S	Sulfide
Cl	Chlorinated
A	Acid
B	Base
Org	Organic

Aq	Aqueous
Liq	Liquid
Sol	Solid

An example of the type of code which may appear in the Compatibility Group Field would be "FIClOrgLiq." This would translate to Flammable Chlorinated Organic Liquid.

The assignment of the layer compatibility classification code is the same whether there is one layer or three layers. Each layer is assigned its individual compatibility classification code.

7.3.2 Multilayered Data Review

Once the compatibility classification code has been assigned to each layer of a multilayered sample, the data needs to be reviewed to ensure that the layers within the same sample are chemically compatible or make sense from a chemical standpoint. These checks are listed below:

- In samples with two liquid layers, occasionally both layers will be soluble in water. In this situation it is obvious that one layer is a water soluble organic while the other layer is an aqueous layer saturated with the organic layer. It is important to identify which layer is organic and which layer is inorganic.
- If one layer is determined to be organic and the other layer tests positive for oxidizer or has a pH of less than 2 or greater than 12, it is imperative that these results be confirmed. If the results are confirmed and the sample contains an organic layer in contact with an oxidizer, an acid, or a strong base, then this sample should be considered potentially highly reactive and the layers may need to be separated or excluded from any waste blending operations. If a decision is made to attempt to waste blend this material, it should be the last sample added to the test blend and should be first added to a small aliquot of the test blend. Extra care and time should be taken to ensure that a delayed reaction does not occur after adding this material to the test blend.
- If the top layer is determined to be an aqueous liquid and a second liquid layer is determined to be an organic layer with a negative Bielstein, then the second layer should be analyzed by the alternate chlorine test procedure and classified in accordance to the alternate test results.

- If a multilayered sample is reported as having one layer with a positive oxidizer test or a pH less than 2 or greater than 12 and a second layer as having a positive flash point, then the chemist must ensure that the flash point tester was lined with 4-inch Teflon tape prior to performance of the flash point test. Strong oxidizers, acids, or bases can react with the aluminum foil or the aluminum cup of the flash point tester, releasing hydrogen gas in sufficient quantities to give false positives for the flash point test. If the results are confirmed and the sample contains an organic layer and a strong oxidizer, acid, or base layer, then this sample should be considered potentially highly reactive and the layers may need to be separated or excluded from any waste blending operations. If a decision is made to waste blend this material it should be the last sample added to the test blend and should first be added to a small aliquot of the test blend. Extra care and time should be taken to ensure that a delayed reaction will not occur after adding this material to the test blend.
- If a multilayered sample is reported as having one layer positive for the cyanide or sulfide test and having a pH less than 4.5, then either there is an interference with the cyanide test or this sample may be releasing a toxic gas. The major interference encountered during the cyanide test is nitrates. Nitrates give a blue to purplish color rather than the red color. However, very high concentrations of cyanide can give a similar color upon standing. Therefore, the sample should be checked for the presence of cyanide using the alternate cyanide test procedure. If the sample tests positive for cyanide with the alternate test procedure then the site supervisor must be notified that this drum may be releasing toxic fumes and that the head space of the drum needs to be checked for hydrogen cyanide or hydrogen sulfide gas. Drager tubes or monitoxes are commonly used.

If the sample tests negative by the alternate procedure, then the sample may be checked for nitrates with the EM Quant test strips. Otherwise, the cyanide results should be changed to negative prior to classification.

- If a multilayered sample is reported as having one layer with a positive cyanide or sulfide test and another layer testing positive as an oxidizer, then an interference with the cyanide or sulfide test may be present. Most strong oxidizers such as sodium hypochlorite or hydrogen peroxide will react to destroy cyanide or sulfide. Two commonly found oxidizers which will not react with cyanide are nitrates and chromates. Nitrates also interfere with the cyanide test. Nitrates will give a blue to purplish color with the cyanide test rather than the red color. However, very high concentrations of cyanide can give a similar color

upon standing. Therefore, the sample should be checked for the presence of cyanide using the alternate cyanide test procedure. If the sample tests positive for cyanide with the alternate test procedure then the sample should be classified as a cyanide. If the sample tests negative for the presence of cyanide with the alternate procedure then the sample should be classified as an oxidizer.

7.3.3 Multilayered Drum Compatibility Assignment

Separation of the multilayered drums into separate waste groups is usually performed only when incompatible layers exist in the same drum. Normal protocols followed are to evaluate the compatibility of each layer in the sample and to assign a compatibility classification code to the container. During the waste blending test all of the layers in that sample will be test blended.

The following guidelines have been established to aid the chemist in selecting the drum compatibility classification:

- If one layer of a multilayered sample tests to be radioactive, biological waste, air reactive, water reactive, or shock sensitive then the drum classification should be same as the layer classification. The handling hazards of these wastestreams outweigh all other potential hazards.
- If one layer of a multilayered sample contains PCBs then the drum classification should be PCB due to the PCB contact rule. However, the handling hazards associated with radioactive, biological waste, air reactive, water reactive, or shock sensitive would take precedent, but the fact that the material in the drum is PCB contaminated will still need to be addressed during disposal.
- If one layer of a multilayered sample is flammable and the other layers are not radioactive, biological waste, air reactive, water reactive, shock sensitive, or contain PCBs, the drum classification should be considered flammable. The only exception to this guideline would be chlorinated organics. The chlorinated organic wastestream is separated from other organic wastestreams due to a higher disposal cost. Incineration is the usual disposal option for both organic and chlorinated organic wastestreams. The addition of flammables to the chlorinated wastestream will not affect the disposal cost. However, if chlorinated organics are added to the flammable organic wastestream, the cost of disposal may be affected. If flammable materials are added to non-flammable wastestreams, then proper safety protocols and grounding procedures must be followed during the waste blending and pumping of any flammable wastestream.

- If one layer of a multilayered sample tests as a strong oxidizer and the other layers are not radioactive, biological waste, air reactive, water reactive, shock sensitive, PCBs, or flammable, then the drum classification should be oxidizer. Oxidizers are very reactive and should not be blended with any other materials, including other oxidizers.
- If one layer of a multilayered sample is found to contain cyanide and the other layers are not radioactive, biological waste, air reactive, water reactive, shock sensitive, PCBs, flammable, or an oxidizer, the drum classification should be cyanide.
- If one layer of a multilayered sample is found to contain sulfides and the other layers are not radioactive, biological waste, air reactive, water reactive, shock sensitive, PCBs, flammable, oxidizer, or cyanide, the drum classification should be sulfide.
- If one layer of a multilayered sample is found to contain chlorinated organics and the other layers are not radioactive, biological waste, air reactive, water reactive, shock sensitive, PCBs, flammable, oxidizer, cyanide, or sulfides, the drum classification should be as a chlorinated organic.
- If one layer of a multilayered sample is found to contain an acid and the other layers are not radioactive, biological waste, air reactive, water reactive, shock sensitive, PCBs, flammable, oxidizer, cyanide, sulfides, or a chlorinated organic, the drum classification should be as an acid.
- If one layer of a multilayered sample is found to contain a base and the other layers are not radioactive, biological waste, air reactive, water reactive, shock sensitive, PCBs, flammable, oxidizer, cyanide, sulfides, or a chlorinated organic, the drum classification should be as a base.
- If the major layer of a multilayered sample is found to be an organic and the other layers are not radioactive, biological waste, air reactive, water reactive, shock sensitive, PCBs, flammable, oxidizer, cyanide, sulfides, a chlorinated organic, an acid, or a base, the drum classification should be as an organic.
- If the major layer of a multilayered sample is found to be aqueous and the other layers are not radioactive, biological waste, air reactive, water reactive, shock sensitive, PCBs, flammable, oxidizer, cyanide,

sulfides, a chlorinated organic, an acid, a base, or an organic, the drum classification should be as aqueous.

- If the major layer of a multilayered sample is found to be a liquid and none of the other layers test positive for the previously-mentioned classifications, then the drum classification should be as a liquid.
- If the major layer of a multilayered sample is found to be a solid and none of the other layers test positive for the previously-mentioned classifications, then the drum classification should be as a solid.

8.0 WASTE BLENDING

A waste blending test is used to determine if the drums included in a wastestream are truly compatible. Whether the wastes are to be blended on site or to be sent in drums to a disposal facility, a waste blending test must be performed for waste profile purposes.

8.1 FORMULATION OF WASTE GROUPS

After all drums have been classified into compatibility groups, waste groups can be formulated for the waste blending test. Most often it is more cost effective to blend several similar compatibility groups into one wastestream or waste group. An example of combining similar compatibility groups may be the blending of flammable organic liquids with nonflammable organic liquids. Therefore, the program is designed to allow the user to place a wastestream disposal code into the Bulk Group field. The usual codes used in identifying the wastestreams are listed below:

A	= Acid
Aq	= Aqueous
B	= Base
Cl	= Chlorinated
CN	= Cyanide
Fl	= Flammable
I	= Inorganic
Liq	= Liquids
O	= Organic
P	= Peroxide
PCB	= PCB contaminated
A_Rxn	= Air reactive
W_Rxn	= Water reactive
RAD	= Radioactive
Sol	= Solid
S	= Sulfide
OX	= Oxidizer

Combinations of some of these codes can be used to describe discrete wastestreams. Wastestreams for individual sites and clients can differ dramatically. Therefore, it is imperative that the project chemist, transportation and disposal coordinator, project manager, and client representative are all involved in the determination of the wastestreams prior to the onset of waste blending tests and sample compositing for disposal.

For the above listed groups some degree of caution must be utilized when blending together samples that fall into these various categories. Some, though by no means all, of the problems that can occur during blending of samples from certain groups are as follows:

- Acid Group--Not all acids are compatible with each other. For instance concentrated acetic acid when mixed with concentrated nitric acid can result in a potentially violent reaction. Again, concentrated nitric acid and concentrated hydrochloric acid can react when mixed together and produce a toxic gas release. Concentrated sulfuric acid when mixed with water or other acids usually releases large amounts of heat which can result in relatively violent reactions. The key to blending acidic samples is to monitor the temperature of the mix during blending operations and to carefully look for signs of a gas being released as each sample is added to the mixture.
- Acid Oxidizer Group--The same comments apply here as with the acid group. It is sometimes possible to combine/blend this group with the acid group or oxidizer group. A test blending would need to be done. **HANDLE AND BLEND OXIDIZING ACIDS WITH CAUTION. INCORRECT/IMPROPER BLENDING CAN RESULT IN DANGEROUS AND/OR UNSTABLE MIXTURES.**
- Organic Acid Group--This group is not generally compatible with other acid groups.
- Base Oxidizer Group--This group usually is incompatible with all other groups except the base groups and aqueous groups. **HANDLE AND BLEND OXIDIZING BASES WITH CAUTION. INCORRECT/IMPROPER BLENDING CAN RESULT IN DANGEROUS AND/OR UNSTABLE MIXTURES.**
- Cyanide, Cyanide Base, and Flammable Cyanide Groups--Use extreme caution when handling and blending samples in these three categories. Any gas released during blending will probably be hydrogen cyanide gas. **VERIFY THAT THE LABORATORY HOOD USED FOR BLENDING OF WASTES HAS AN ADEQUATE LEVEL OF AIR FLOW THROUGH IT. THE FLAMMABLE CYANIDE GROUP MAY FIT BETTER WITH THE FLAMMABLE ORGANIC GROUP.**

- Flammable Sulfide, Sulfide, and Sulfide Base Groups--Use caution when handling and blending samples from these categories. A hydrogen sulfide gas release can sometimes occur when blending these samples. Verify that the laboratory hood is operating properly. The flammable sulfide group may blend safely with the flammable organic group.
- Oxidizer Group--This group is probably one of the most dangerous groups to conduct blending operations. The blending of this group should not be performed without the expressed written permission of a senior project chemist or the regional field analytical manager. **USE EXTREME CAUTION WHEN BLENDING OXIDIZING SAMPLES. SOME SAMPLES MAY NOT BE COMPATIBLE WITH OTHER SAMPLES IN THIS CATEGORY. IMPROPER/INCORRECT BLENDING CAN RESULT IN DANGEROUS AND/OR UNSTABLE MIXTURES.** Always use small amounts of material when doing waste blending tests on oxidizers.

If large containers of oxidizing materials are found on the site, it is recommended that they be disposed of individually and that **no waste blending tests be done on them.**

- Peroxide Group--This group is potentially shock sensitive. **BLENDING OF THIS GROUP IS EXTREMELY DANGEROUS AND SHOULD NOT BE PERFORMED UNDER ANY CIRCUMSTANCES. NEVER COMBINE PEROXIDES WITH OXIDIZERS. THIS WILL CREATE DANGEROUS, POTENTIALLY UNSTABLE AND/OR EXPLOSIVE MIXTURES.**
- PCB Group--These samples are always blended with each other. Never mix PCB-contaminated waste with non-PCB contaminated waste.
- Air Reactive, Water Reactive, and Radioactive Groups--Never mix samples from these groups with samples from other groups. Never field bulk materials in these waste groups with other waste groups. Air reactive wastes usually cannot be bulked with other wastes and must be disposed of on a container by container basis. The same is true for water reactive wastes. Radioactive wastes shall not be bulked with other waste. Disposal of radioactive wastes will usually be on a container by container basis. Disposal of radioactive wastes is a complex and expensive process.

The Waste Test Blending Compatibility Chart (see Figure 8.1) lists possible recommended ways of combining various wastestreams and can be used as a guide to performing waste blending tests in the field.

8.2 THE WASTE BLENDING TEST

Once the wastestreams have been determined and the bulk group codes have been entered, the dbase program can be used to generate lists of the drums in each wastestream for waste blending tests and the generation of composite samples for disposal analysis. Do not create composite samples until after waste blending tests are accomplished.

8.2.1 Method Summary

Aliquots proportional to the drum volume are blended and the sequence recorded on the Waste Blending Test Log (see Figure 8.2). If any reaction occurs during the mixing of the samples, the reaction is evaluated. A small reaction in the test bulk may indicate an uncontrolled reaction when performed full scale in the field. If the reaction exceeds the set parameters, then the waste blending test is started over and the last sample that caused the reaction is omitted. Once the Blending Test is completed for a waste group the data is transferred to the Field Waste Blending Log (see Figure 8.3). This log is used by the waste blending supervisor to conduct actual waste blending operations.

8.2.2 Safety Considerations

This procedure should be performed in a hood and should be done with the smallest sample volumes that are practical. Due to the possibility of violent reactions, a safety shield should be used. Also, since the blending of some material may cause the release of toxic fumes, hydrogen sulfide gas/hydrogen cyanide gas alarm (Monitox) units should be placed in the immediate work area.

8.2.3 Materials

- Magnetic stirrer (Corning P/N 6795310 or equivalent)
- Magnetic stirring bars (Baxter Scientific Catalogue No. S8302-22)
- Digital Type K thermocouple thermometer (Cole-Parmer Catalogue No. L-08528-40) (Baxter Scientific Catalogue No. T2950-51)



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WASTE BLENDING TEST
COMPATIBILITY
CHART

FIGURE 8.1

No.	COMPATIBILITY	
1.	ACIDS	1
2.	ACID OXIDIZERS	B HG 2
3.	ACID, ORGANICS	I HG HG 3
4.	AQUEOUS	O O I 4
5.	BASE	HV HV HV HV 5
6.	BASE OXIDIZER	HV HV HV B B 6
7.	CHLORINATED	D D D D D 7
8.	CYANIDES	TG TG TG B B H D 8
9.	CYANIDE BASES	TG TG TG B B H D B 9
10.	FLAMMABLE ACIDS	HG HG H D HG HG HD TG TG 10
11.	FLAMM AQUEOUS	HG HG HG B HG HG B D H HG 11
12.	FLAMM BASES	HV HV HV D HD HD B D D HG B 12
13.	FLAMM CYANIDES	TG TG TG D D HD B D D TG B B 3
14.	FLAMM ORGANICS	HG HG HG D HG HG D D D H D H D 14
15.	FLAMM SULFIDES	TG TG TG D D H D D D TG D D D B 15
16.	ORGANICS	HG HG HG HG D HG D D D H D H D B 16
17.	OXIDIZERS	HV HV VE D D VE VE VE VE VE VE VE VE VE 17
18.	PEROXIDES	VE VE VE VE VE VE VE VE VE VE VE VE VE VE VE 18
19.	PCBs	D D D D D D D D D D D D D D D VE VE 19
20.	REACTIVE, AIR	VE VE VE VE VE VE VE VE VE VE VE VE VE VE VE VE VE 20
21.	REACTIVE, WATER	VE VE VE VE VE VE VE VE VE VE VE VE VE VE VE VE VE 21
22.	RADIOACTIVE	D D D D D D D D D D D D D D D D VE D VE VE 22
23.	SULFIDES	TG TG TG B B H D B B TG D D D D D D VE VE VE VE D 23
24.	SULFIDE BASES	TG TG TG D B H D H B TG D D D D D D VE VE VE VE D B 24

B = BLEND TEST
 D = DISPOSAL PROBLEM
 E = EXPLOSIVE MIXTURE
 G = GAS RELEASE
 H = HEAT EVOLUTION
 I = INCOMPATIBLE
 O = ORDER BLENDED IMPORTANT
 P = PRECIPITATION
 TG = TOXIC GAS EVOLUTION
 V = VIOLENT REACTION

THIS CHART INDICATES GROUPS WHICH MAY POSSIBLY BE SAFELY BLENDED. TEST BLENDING MUST BE PERFORMED IN ACCORDANCE TO THE PROTOCOLS DETAILED IN SECTION 8.0 OF OHM'S COMPATIBILITY MANUAL. COMBINING OF TWO SEPARATE TEST BLENDING GROUPS AND CALLING THE TWO GROUPS BLENDABLE IS NOT ACCEPTABLE PRACTICE. THE TWO GROUPS MUST BE TESTED AS A SINGLE WASTE STREAM. ALL BLENDING TESTS MUST BE PERFORMED UNDER CONTROLLED LABORATORY CONDITIONS BEFORE FIELD BLENDING WILL BE ALLOWED.



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FIGURE 8.2

WASTE BLENDING TEST LOG

WASTE STREAM _____

PROJECT NAME:

PROJECT NUMBER:

PROJECT LOCATION:

PROJECT MANAGER:

PROJECT CHEMIST:

BLENDING SUPERVISOR:

DATE BLENDING TEST PERFORMED: / / PERFORMED BY:

WASTE STREAM NUMBER:

SUPERVISED BY:

CAUTION ALL WASTE BLENDING MUST BE PERFORMED IN LISTED SEQUENCE!

VARIATION FROM THE SEQUENCE ORDER MUST BE APPROVED BY THE

PROJECT CHEMIST AND PROJECT SUPERVISOR OR PROJECT MANAGER!

S E Q N O	DRUM No.	TEST BLENDING DATA				S E Q N O	DRUM No.	TEST BLENDING DATA					
		TEMP RISE °C	GAS EVOL Y N	HAZ RXN Y N	APPROVED TO BLEND			TEMP RISE °C	GAS EVOL Y N	HAZ RXN Y N	APPROVED TO BLEND		
1			☐	☐	☐	26			☐	☐	☐	☐	
2			☐	☐	☐	27			☐	☐	☐	☐	
3			☐	☐	☐	28			☐	☐	☐	☐	
4			☐	☐	☐	29			☐	☐	☐	☐	
5			☐	☐	☐	30			☐	☐	☐	☐	
6			☐	☐	☐	31			☐	☐	☐	☐	
7			☐	☐	☐	32			☐	☐	☐	☐	
8			☐	☐	☐	33			☐	☐	☐	☐	
9			☐	☐	☐	34			☐	☐	☐	☐	
10			☐	☐	☐	35			☐	☐	☐	☐	
11			☐	☐	☐	36			☐	☐	☐	☐	
12			☐	☐	☐	37			☐	☐	☐	☐	
13			☐	☐	☐	38			☐	☐	☐	☐	
14			☐	☐	☐	39			☐	☐	☐	☐	
15			☐	☐	☐	40			☐	☐	☐	☐	
16			☐	☐	☐	41			☐	☐	☐	☐	
17			☐	☐	☐	42			☐	☐	☐	☐	
18			☐	☐	☐	43			☐	☐	☐	☐	
19			☐	☐	☐	44			☐	☐	☐	☐	
20			☐	☐	☐	45			☐	☐	☐	☐	
21			☐	☐	☐	46			☐	☐	☐	☐	
22			☐	☐	☐	47			☐	☐	☐	☐	
23			☐	☐	☐	48			☐	☐	☐	☐	
24			☐	☐	☐	49			☐	☐	☐	☐	
25			☐	☐	☐	50			☐	☐	☐	☐	

TO THE BEST OF MY KNOWLEDGE THE INFORMATION GIVEN ON THIS FORM IS
CORRECT AND ERROR FREE EXCEPT WHERE NOTED IN THE COMMENTS SECTION.

SIGNATURE (PROJECT CHEMIST)

DATE: / /



OHM Corporation

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FIGURE 8.3
FIELD WASTE BLENDING LOG

WASTE STREAM _____

PROJECT NAME:				PROJECT NUMBER:					
PROJECT LOCATION:				PROJECT MANAGER:					
PROJECT CHEMIST:				BLENDING SUPERVISOR:					
DATE BLENDING TEST PERFORMED: / /				PERFORMED BY:					
CHAMBER BLENDING PERFORMED:				SUPERVISED BY:					
CAUTION ALL WASTE BLENDING MUST BE PERFORMED IN LISTED SEQUENCE!									
VARIATION FROM THE SEQUENCE ORDER MUST BE APPROVED BY THE									
PROJECT CHEMIST AND PROJECT SUPERVISOR OR PROJECT MANAGER!									
S E Q N O	DRUM No.	F O U N D	B L E N D E D	C O M M E N T S	S E Q N O	DRUM No.	F O U N D	B L E N D E D	C O M M E N T S
1		☐	☐		26		☐	☐	
2		☐	☐		27		☐	☐	
3		☐	☐		28		☐	☐	
4		☐	☐		29		☐	☐	
5		☐	☐		30		☐	☐	
6		☐	☐		31		☐	☐	
7		☐	☐		32		☐	☐	
8		☐	☐		33		☐	☐	
9		☐	☐		34		☐	☐	
10		☐	☐		35		☐	☐	
11		☐	☐		36		☐	☐	
12		☐	☐		37		☐	☐	
13		☐	☐		38		☐	☐	
14		☐	☐		39		☐	☐	
15		☐	☐		40		☐	☐	
16		☐	☐		41		☐	☐	
17		☐	☐		42		☐	☐	
18		☐	☐		43		☐	☐	
19		☐	☐		44		☐	☐	
20		☐	☐		45		☐	☐	
21		☐	☐		46		☐	☐	
22		☐	☐		47		☐	☐	
23		☐	☐		48		☐	☐	
24		☐	☐		49		☐	☐	
25		☐	☐		50		☐	☐	
TO THE BEST OF MY KNOWLEDGE THE INFORMATION GIVEN ON THIS FORM IS									
CORRECT AND ERROR FREE EXCEPT WHERE NOTED IN THE COMMENTS SECTION.									
SIGNATURE (BLENDING SUPERVISOR)								DATE: / /	

- Type K thermocouple probe (Cole-Parmer Catalogue No. L-08516-55) or Type K TFE-coated thermocouple probe (Cole-Parmer Catalogue No. L-08516-57)**
- Glass jars or other open containers
- Hydrogen cyanide gas/hydrogen sulfide gas alarm (Monitox) units and gas generator (MDA Model Nos. RA-530341, RA-530141, and RA-4100)
- Safety shield, Nalgene brand, P/N 63503024 (from various vendors)
- Clamps (for ring stand) (used to hold monitox units and thermocouple probes)
- Ring stand(s) (used to hold monitox units and thermocouple probes)
- Pyrex Class A graduated cylinders, 10-ml, 50-ml, 100-ml and 500-ml (Baxter Scientific Catalogue No. C9087-x, where x = cylinder volume)
- Pyrex graduated Griffin beakers, 30-ml, 50-ml, 150-ml, and 400-ml (Baxter Scientific Catalogue No. B2650-x, where x = beaker volume)
- Tongue blades (Baxter Scientific Catalogue No. S1600-1)
- Disposable, 10-ml serological pipets (Baxter Scientific Catalogue No. P4650-110)
- Pipet filler (Baxter Scientific Catalogue No. P5310)
- Glass stir rods, 10-mm diameter (Baxter Scientific Catalogue No. S8205-6)
- Teflon stir rods, 5/16-inch diameter (Baxter Scientific No. 58210-7)

****NOTE:** These are special rapid response probes with 1 second response rates. Do not substitute other probes for them without consulting with Midwest Technical Personnel in Findlay.

8.2.4 Method

- If you are blending liquids, place a magnetic stir bar in the glass jar and put it on the magnetic stirrer. Securely position the thermocouple probe on the inside wall of the container so that the probe tip is in contact with the liquid. Use a ring stand and clamp to accomplish this.
- Place the Monitox alarm units near the mouth of the container using ring stands and clamps.
- Add an aliquot of the liquid proportional to the drum volume of the first sample to the container (e.g., for a 55-gallon drum add 5.5 ml or 1 ml for every 10 gallons).
- If you are blending liquids, start the magnetic stirrer and adjust the speed so that a vortex can be seen in the sample, but no splashing occurs.
- Add a proportional aliquot of liquid from the second drum sample in the same wastestream. Add the liquid to the fluid in the beaker just upstream from the thermocouple probe. If you are blending solids, mix thoroughly with a glass or Teflon-coated stirring rod.
- Allow one minute of mixing and observe mixture for temperature increase, gas evolution, and physical state change. For solids, place the thermocouple probe in the mixture before and after mixing to detect any temperature rise. Leave the probe in the solids mixture in intimate contact with the materials for about 1 minute.
- Record the drum number, layer(s), sequence, date and time, and any noted reactions in the Waste Blending Test Log Book.

NOTE: IF THE TEMPERATURE RISE IS GREATER THAN 5 DEGREES CELSIUS, IF THE EVOLUTION OF GAS IS NOTED, OR IF POLYMERIZATION OCCURS, THE SAMPLE IS INCOMPATIBLE WITH THIS WASTESTREAM AND SHOULD BE EXCLUDED. START THE WASTE BLENDING TEST PROCEDURE OVER FOR THAT WASTESTREAM.

- Continue addition of proportional aliquots of the sample and continue record keeping until all samples in that bulk group have been tested.

8.2.5 Interferences

No interferences for this procedure are known.

8.3 COMPOSITING FOR DISPOSAL ANALYSIS

The volume of the composite sample needed for disposal analysis for each wastestream should be determined by the transportation and disposal coordinator. Enough disposal composite must be generated to obtain the analytical data necessary to characterize the wastestream and to send to disposal firms for approval of the waste.

8.3.1 Method Summary

Aliquots of the liquid proportional to the drum volume are blended and the sequence recorded. Samples which caused a notable reaction in the waste blending test are excluded. Sample volumes added to the disposal composite are calculated from the known total end volume.

8.3.2 Safety Considerations

This procedure should be performed in a hood and a safety shield should be used. Also since the blending of some material may cause the release of toxic fumes, hydrogen sulfide gas/hydrogen cyanide gas alarm (Monitox) units should be placed in the immediate work area.

8.3.3 Materials

- Magnetic stirrer (Corning P/N 6795310 or equivalent)
- Magnetic stirring bars (Baxter Scientific Catalogue No. S8302-22)
- Safety shield, Nalgene brand, P/N 63503024
- Clamps (for ring stands)
- Ring stands
- Digital Type K thermocouple thermometer (Cole-Parmer Catalogue No. L-08528-40) (Baxter Scientific Catalogue No. T2950-51)

- Type K thermocouple probe (Cole-Parmer Cat. No. L-08516-55) or Type K TFE-coated thermocouple probe (Cole-Parmer Catalogue No. L-08516-57)
- Large open container, i.e., stainless-steel bucket (purchase locally or through scientific vendors)
- Hydrogen cyanide gas/hydrogen sulfide gas alarm (Monitox) units and gas generator (MDA Model Nos. RA-530341, RA-530141, and RA-4100)
- Pyrex Class A graduated cylinders, 10-ml, 50-ml, 100-ml and 500-ml (Baxter Scientific Catalogue No. C9087-x, where x = cylinder volume)
- Pyrex graduated Griffin beakers, 30-ml, 50-ml, 150-ml, and 400-ml (Baxter Scientific Catalogue No. B2650-x, where x = beaker volume)
- Tongue blades (Baxter Scientific Catalogue No. S1600-1)
- Disposable, 10-ml serological pipets (Baxter Scientific Catalogue No. P4650-110)
- Pipet filler (Baxter Scientific Catalogue No. P5310)
- Glass stir rods, 10-mm diameter (Baxter Scientific Catalogue No. S8205-6)
- Teflon stir rods (Baxter Scientific Catalogue No. S8210-7)

8.3.4 Method

- If you are compositing liquids, place a magnetic stir bar in the container and put it on the magnetic stirrer. Securely position the thermocouple probe on the inside wall of the container so that the probe tip is in contact with the liquid.
- If you are compositing liquids, start the magnetic stirrer and adjust the speed so a vortex can be seen in the sample, but no splashing occurs.
- Place the Monitox alarm units near the mouth of the container.

- Add an aliquot of the liquid proportional to the percent of the drum to the wastestream volume of the first sample to the container. (e.g., for a drum that is 5.5 percent of the total composite volume of 1,000 ml, add 55 ml of that sample to the composite).
- Add a proportional aliquot of the liquid from the second drum sample in the same wastestream. If you are compositing solids, mix thoroughly with a glass stirring rod.
- Allow 1 minute of mixing and observe mixture for temperature increase, gas evolution, and physical state change. For solids, place the thermocouple probe in the mixture before and after mixing to detect any temperature rise. Leave the probe in the solids mixture in intimate contact with the materials for about 1 minute.
- Record the drum number, layer(s), sequence, date and time, and any noted reactions in the Disposal Composite Log Book.

NOTE: IF THE TEMPERATURE RISE IS GREATER THAN 5 DEGREES CELSIUS, IF THE EVOLUTION OF GAS IS NOTED, OR IF POLYMERIZATION OCCURS, THE SAMPLE IS INCOMPATIBLE WITH THIS WASTESTREAM AND SHOULD BE EXCLUDED. START THE COMPOSITE PROCEDURE OVER FOR THAT WASTESTREAM.

- Continue addition of proportional aliquots of the sample and record keeping until all samples in that bulk group have been composited.

NOTE: DISPOSAL COMPOSITES MAY BE GENERATED CONCURRENTLY WITH THE WASTE BLENDING TEST WITH THE PRECAUTION THAT A SAMPLE IS NOT ADDED TO THE COMPOSITE UNTIL IT IS OBSERVED TO BE COMPATIBLE WITH THE WASTESTREAM.

8.3.5 Interferences

Glassware and other sample processing hardware may yield interferences pertinent to disposal analysis. All of these materials must be thoroughly decontaminated prior to use. Interferences may also occur from cross contamination. Plastic laboratory equipment should be avoided because phthalates are commonly used as plasticizers and their esters cause interferences in some analytical methods.

APPENDIX C
PROFESSIONAL PROFILES



PROFESSIONAL PROFILE

PAUL J. KECSKEMETY

<u>TITLE</u>	Director, Projects and Proposals
<u>ACADEMIC</u>	M.B.A., Financial Management, University of Michigan, 1974
<u>BACKGROUND</u>	B.S., Civil Engineering, Michigan State University, 1969
<u>EXPERTISE</u>	Financial and engineering/construction management of large multidisciplinary projects

Mr. Kecskemety joined OHM bringing with him over 17 years' experience in the design, engineering, and construction industry. He has worked on domestic and international projects associated with commercial building, and infrastructure, pulp and paper, mining and metals, refinery and chemicals, and pipelines and power generation.

In his current capacity, Mr. Kecskemety is responsible for OHM's Northeast Region project operations and proposal development. This includes project development, from initial contract negotiations, proposal scoping, and the formulation of pricing strategies, to the coordination and direction of division management and Regional project management. Other direction is given with regard to safety performance and personnel and equipment resource management.

An overview of Mr. Kecskemety's prior experience is provided herein.

As an operations manager, he was responsible for the profitable execution of commercial building projects valued at \$170 million including strategic planning, project development, organizational restructuring, client relations, and project execution.

Construction manager responsible for the development, management, and operation of industrial construction projects with a total value of \$180 million in the eastern United States. Responsibilities include prime-contract formulation and negotiation, execution planning, organizational development and staffing, strategic planning, and client development.

Project manager responsible for the execution of all project commercial and operational activities associated with the engineering, procurement, and construction of a \$40-million-dollar grassroots lumber processing facility project in Greenville, North Carolina.

Business development manager responsible for development of industrial construction prospects including the development of bidding strategy, negotiation of commercial terms, and execution planning. Also responsible for developing marketing approaches and strategies, forecasting project awards, preparing qualifications and proposals to prospective clients.

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Manager of project controls responsible for the direction and guidance of the corporate project controls philosophy, computer systems and programs, as well as project staffing, and coordination and execution of cost, schedule and materials controls programs. Also responsible for corporate financial reporting and analysis; long-range planning, proposal development including execution planning and analysis of proposal commercial terms and profitability and bidding strategy. Annual revenue in excess of \$300 million.

Project control manager responsible for planning and implementing overall project financial, schedule and material control programs for a \$300-million-dollar, lump-sum, EPC crude oil pipeline project in Columbia, South America.

Cost/schedule manager responsible for planning and implementing engineering, procurement and construction cost, schedule and material control programs for a 2-unit, 2500 MWE PWP power plant valued at \$5.5 billion.

Business services manager responsible for division financial reporting and analysis, proposal development, including project execution and planning, and analysis of proposal commercial terms, bidding strategy and risk assessment. Total annual revenue in excess of \$800 million.

Operations supervisor responsible for multi-project functional guidance and supervision including project staffing, procedures, proposal pricing and strategy, and estimate preparation and review. He has supervised the review, coordination and implementation of project control execution and planning on multiple EPC industrial projects ranging in value from \$50 million to \$500 million.

Project control manager for a \$200-million-dollar Grassroots Chlor AlkaliEDC project in Louisiana. Responsible for project cost and schedule control and supervision of field computer applications.

Division controller liaison responsible for the preparation and analysis of corporate operating and financial reports, risk analysis, investment strategies, and corporate financial procedures of executive management.

Project control supervisor responsible for \$100-million-dollar gold/uranium processing project in South Africa. Responsible for implementation of all field cost schedule progress and performance monitoring and control systems.

SPECIALIZED . OHM site safety and related training
TRAINING

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PROFESSIONAL PROFILE

KEVIN J. McMAHON, C.I.H.

<u>TITLE</u>	Regional Manager, Health and Safety
<u>ACADEMIC</u>	M.S., Environmental Health Science, Hunter College, 1984
<u>BACKGROUND</u>	B.S., Environmental Health Science, Hunter College, 1980
<u>EXPERTISE</u>	Industrial hygiene, hazardous waste site audits, and field operations

Mr. McMahon joined OHM in 1987 with over 7 years of previous experience as an industrial hygienist in community, construction, and hazardous waste operations.

As manager of the Health and Safety Department for OHM's Northeast Region for the past 2 years, his primary duties include conducting site and facility health and safety audits, developing and implementing site safety plans, establishing industrial hygiene consulting with outside companies, and proposal writing. On certain projects, he assumes the duties of site safety officer responsible for hazard recognition, evaluation, and control in both construction and industrial settings. Other responsibilities include coordination of medical surveillance programs, marketing assistance, and employee training.

Prior to joining OHM, Mr. McMahon served as a senior industrial hygienist in the private sector. He developed and implemented comprehensive industrial hygiene programs including employee exposure monitoring to chemical and physical stressors, employee training, respiratory and personal protection, and ventilation certification. He also assisted in the development/implementation of chemical hazard, communication training programs including a chemical safety trainer's course and manual. He was responsible for training approximately 3,000 employees.

As an industrial hygienist for the New York State Department of Health, Mr. McMahon managed the data collection and surveillance activities of the Heavy Metals and Occupational Lung Disease Registries. He undertook investigations of potential occupational and environmental health problems in industry and the community and developed recommendations to correct or alleviate the health impact of the exposure.

Mr. McMahon was also a senior industrial hygienist for the New York State Department of Labor. In this capacity, he advised industries on compliance with OSHA standards, identified health hazards, and recommended methods of control.

He also served as an industrial hygiene consultant on the recognition, evaluation, and control of occupational and environmental health problems and performed industrial hygiene studies including air quality, ventilation, noise surveys, respirator fit testing, and preparation of material safety data sheets. He also conducted community environmental health studies (e.g., ambient and indoor air quality, noise, stack sampling, and waste disposal).

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PROFESSIONAL
CERTIFICATIONS
& AFFILIATIONS

Industrial Hygienist, American Board of Industrial Hygiene, 1986

Defensive Driving Instructor, NSC

Member, American Board of Industrial Hygiene

Member, American Academy of Industrial Hygiene

Member, American Industrial Hygiene Association

Member, American Conference of Governmental Industrial Hygienists

SELECTED
PUBLICATIONS

Tunnessen, Jr., W. W., K. J. McMahon, and M. Baser, 1987, "Acrodynia: Exposure to Mercury from Fluorescent Light Bulbs," Journal of Pediatrics, Vol. 79(5), pp. 786-789.

McMahon, K. J., 1985, "Insidious Inhalations," The Sciences, p. 12.

McMahon, K. J. and P. E. McManus, 1988, "Occupational Noise Exposure in the Printing Industry," Am Ind Hyg Assoc Journal, Vol. 49(1), pp. 34-37.

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PROFESSIONAL PROFILE

JOHN SEIFERT

TITLE Foreman

EXPERTISE Landfill cap and closure; large-scale earth moving/deep excavation projects

Mr. Seifert joined OHM in 1986 and has 6 years of experience in hazardous waste site remediation. His background includes supervision of heavy equipment operators and work crews, installation of water treatment systems and design of excavation sumps/wells. Mr. Seifert has considerable experience on projects requiring large-scale excavation and earth moving including PCB oil pit excavation and multi-acre landfill cap, closure and regrade.

Mr. Seifert has served on numerous emergency response actions, especially in USEPA ERCS Region III. Among the projects with which Mr. Seifert has been involved are:

- o Foreman on USPEA Region III Emergency Response actions involving spill cleanup, drum and hot spot excavation. Currently assigned to diesel fuel spill located in Crum, West Virginia conducted during February 1992.
- o General Foreman on a project for an automotive manufacturer in Chicago, Illinois. Project involved excavation of five PCB oil contaminated pits 700 feet long by 50 feet wide by 27 feet deep. Installed water treatment system and excavation sumps for PCB oil/water accumulation. Site heavy equipment comprised of Cat 936 and 950 loaders, Cat 215 and 225 trackhoes, Bobcats and mini-excavators and well as various tractor trailers and dump trucks. Project conducted May - July 1990.
- o Foreman on a 9 acre landfill cap and closure for a client in Bloomington, Indiana. Project involved cutting trenches to divide the landfill into 1-acre grids, covering the grids with a 6-inch sand layer and plastic cap, and backfilling the trenches with crushed stone. Carbon filters were emplaced to vent methane gas. Project conducted July - September 1987.
- o Foreman at the West Virginia Ordnance Works in Point Pleasant, West Virginia. Project scope included excavation, decontamination, and backfilling of 38,000 feet of TNT-contaminated industrial sewer lines which ran at depths of 4-25 feet and crossed underneath ponds and a landfill; landfill capping with up to 2 feet of clay and 6 inches of topsoil; excavation of 650 cubic yards of asbestos-contaminated soil. On site approximately 4 months during the period August 1987 to June 1988.

SPECIALIZED OSHA 8-Hour Supervisory Training
TRAINING OSHA 8-Hour Refresher Training

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PROFESSIONAL PROFILE

JEFF DOLL

TITLE Foreman

EXPERTISE Facility decontamination, dewatering, asbestos removal

Mr. Doll has over 5 years experience in hazardous waste remediation and cleanup. His background includes sludge dewatering, drum staging and sampling, cleanup of PCB and heavy metal-contaminated soil and debris, decontamination of PCB and heavy metal-contaminated facilities, and installation/operation of water treatment systems.

Among projects with which Mr. Doll has been involved are:

- o Foreman of crew involved in cleanup of tanker spill for a confidential railroad client in Sheperdsville, Kentucky. Responsible for supervision and daily reports on project conducted in November 1991.
- o Nightshift Foreman for a tank sludge dewatering project for an automotive manufacturer in Dayton, Ohio, during October 1991.
- o Foreman of filter press crews at a major manufacturer's dock site in Lake Charles, Louisiana, from August to September 1991.
- o Foreman of an 8-person crew at a site in Chicago, Illinois. Responsible for drum sampling, bulking, cleaning vats and solids/water treatment. Project was conducted February to July 1991.
- o Foreman of 6-person crew at electronics manufacturer site in Edmore, Michigan. Project involved cleaning mercury contaminated debris from facility during period December 1990 to February 1991.
- o As Foreman, supervised 6-person crew at major oil producer's site in Casper, Wyoming. Supervised setup and operation of air stripper system and off gas scrubber system. Trained client's employees. Project duration was August to December 1990.
- o Project Foreman on small dewatering project for oil company at site in Marietta, Ohio, during January to August 1990.
- o Foreman at site for confidential client in Astubula, Ohio. Facility was constructed on closed landfill and required various drainage and vent pipe installation. Supervised a crew of four from October to December 1989.
- o Night shift foreman for water treatment system installation in Duluth, Minnesota. Project was conducted from August to October 1989.
- o Foreman of 10-person crew during decontamination of chemical manufacturer's plant in Moundsville, West Virginia. Responsible for cleaning tanks, asbestos removal and high-pressure water blasting on project from July 1988 to July 1989.
- o As a laborer on a project for an oil company site in Chillicothe, Illinois, assisted in cleanup of 2 million gallon oil spill in two ponds. Project conducted from May to July 1988.
- o Laborer at PCB-contaminated site in Churubusco, Indiana, from December 1987 to March 1988. Responsibilities involved excavating (to a 3 foot depth) and loading out contaminated soil; excavation of drainage ditches, sanitary sewer lines, process piping, and a sludge lagoon.

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- o Laborer at chemical manufacturing site in Albany, New York, contaminated with lead and chromium. Provided facility cleanup and high pressure water blasting. Project was conducted from October to November 1987.
- o Laborer at pesticide-contaminated site in Minot, North Dakota. Assisted in setup and operation of water treatment system. Project involvement was from April to August 1987.
- o Laborer at PCB-contaminated facility for realty firm in Edgewater, New Jersey. Former manufacturing facility was being converted to residential housing. Project involved large-scale building decontamination. Project duration was from August 1986 to March 1987.

SPECIALIZED
TRAINING

OSHA 40-hour training (29 CFR 1910.120)
OSHA 8-hour refresher training
OHM/Findlay College - Supervisor Training
NOVA - Asbestos training

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DAVID TIEDMAN

OHM REMEDIATION SERVICES CORP.

TITLE

Site Supervisor

EXPERIENCE

Mr. Tiedman is qualified as a Response Manager Level I based on his six years of direct on-scene multidisciplinary field experience in hazardous waste site cleanup and waste disposal activities and his B.S. degree in Earth Science. The contaminated media involved in these actions include air, water soil, containers, oil and chemicals. All six of his years of on-site experience include direct supervision of multidisciplinary (professional and labor) oil and chemical cleanup personnel.

Mr. Tiedman's on-site experience includes development and execution of approved work plans, development of detailed cost estimates and approved site and spill safety plans, application of heavy equipment and field construction requirements, working in confined spaces, performance of assessments and evaluations at hazardous waste sites, and scheduling.

Mr. Tiedman's supervisory experience includes familiarity with and fulfilling OSHA requirements relative to site work, coordinating transportation and disposal of hazardous wastes, soliciting and receiving bids for services and materials, recommending the lowest qualified bidder, working with a client and/or OSC, acting as site safety officer, report preparation, previous experience on EPA projects, preparing 1900-55s (or RCMS), and over two years as a foreman at a hazardous waste site.

Mr. Tiedman's experience with environmental technologies includes:

o Wastewater treatment	o Decontamination
o Ground-water treatment	o Derailments
o Underground recovery	o Drum repacking
o Dewatering	o Drum recovery
o Filtration	o PCB cutting/bulking
o Compatibility testing	o Pesticide clean-up
o Contaminant sampling	o Mercury decontamination
o Hazardous-waste disposal	o Tank dismantlement
o Certified tank tester	o Tank cleaning
o Stabilization and fixation	o Tank shearing
o Heavy equipment operation	o Cold cutting
o Air monitoring	o Organic/inorganic and
o Soil excavation	heavy metals handling

Mr. Tiedman joined OHM in 1990 and has served as a foreman and site supervisor. An overview of his project experience with OHM is provided below:

Site Supervisor: Mr. Tiedman is the site supervisor at a trail derailment at Gouverneur, New York. As the site supervisor, he is responsible for the cleanup of 5,000 gallons of diesel fuel and 40 tons of aluminum oxide powder. Mr. Tiedman is directing a crew consisting of a hydrologist, 4 recovery technicians and subcontractors. Overall he is supervising 12 personnel on this project which began in November 1991.

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Site Supervisor: At a site in Rensselaer, New York, Mr. Tiedman was assigned as the site supervisor in charge of the cleaning of a 10,000 gallon aboveground storage tank. The tank contained paranitrotoluene. He direct a 4 man crew in all site activities which included cleaning and scraping, sampling, disposal and site restoration. Project duration was October through November 1991.

Site Supervisor: Mr. Tiedman was the supervisor of an emergency team responding to a spill of 1,000 pounds of antimony trioxide in Selkirk, New York. The accident occurred in December of 1991 when, during the unloading of a railcar, the antimony trioxide was spilled along the railroad tracks. Mr. Tiedman directed a three man crew in the containerizing, staging, loading, transportation and disposal of the spilled material.

Site Supervisor: Mr. Tiedman led a response team of 10 persons on a decontamination project in December 1991. The site was a aerospace production facility in Syracuse, New York. The project was to clean up a PCB contaminated building. The project tasks included dismantling and disposing of ceiling tiles and the ventilation system, and scarification of walls, floors and upper ceiling components. Mr. Tiedman provided site verification, sampling programs and implemented site safety procedures.

Site Supervisor: Mr. Tiedman supervised the excavation of soil for bioremediation a result of a diesel fuel spill at a rail yard in Gouverneur, New York. Approximately, 640 tons of contaminated soil were excavated, staged, and disposed. Mr. Tiedman supervised a crew of equipment operators, recovery technicians and subcontractors. The project began and was completed during January 1991.

Site Supervisor: Mr. Tiedman directed a response for the solidification of 19 drums containing PCBs at a production facility in Glens Falls, New York. Mr. Tiedman managed a three man crew in removing, staging, solidifying and disposing of the drums. He also coordinated the sampling and analysis and transportation and disposal of the 1,045 gallons of hazardous waste materials.

Site Supervisor: Mr. Tiedman managed a decontamination operation in Syracuse, New York. The project involved the procedures of hand scrubbing floors and walls to remove cyanide salts and epoxy powder in two rooms, decontamination of the drain system and recovery, packaging, staging, transport and disposal of the wastewater generated during the cleanup operation. This project was performed in February 1992.

Site Supervisor: Mr. Tiedman supervised a project in Utica, New York, for a production facility involving the decontamination of a 20- by 40-foot assembly area contaminated with PCBs. Mr. Tiedman supervised five laborers and coordinated all on-site work including an extensive wipe-sampling program. Decontaminating techniques included hand scrubbing of walls, floors and ceiling. Mr. Tiedman provided site verification, sampling programs and implemented site safety procedures. He directed the transportation and disposal of wastewater generated during the decontamination process. The project was completed on schedule in January 1992.

ACADEMIC BACKGROUND

B.S., State University at Brockport, New York, Earth Science, 1981

SPECIALIZED TRAINING

OSHA 40-hour Site Safety Training
OSHA 8-hour Supervisory Training
Petro-tite, UST Testing
American Red Cross CPR, First Aid, and Rescue Techniques

RONALD S. PROHASKA

OHM REMEDIATION SERVICES CORP.

TITLE

Project Manager

EXPERIENCE

Mr. Prohaska is qualified as Response Manager Level I based on his 12 years of direct, on-scene multidisciplinary field experience in hazardous waste site cleanup and waste disposal activities. The contaminated media involved are air, water, soil, containers, oil, and chemicals. All 12 of his years on-site experience include direct supervision of multidisciplinary (professional and laborer) oil and chemical cleanup personnel.

Mr. Prohaska's on-site experience includes development and execution of approved work plans, development of detailed cost estimates and approved site and spill safety plans, application of heavy equipment and field construction requirements, working in confined spaces, performance of assessments and evaluations at a hazardous waste site, and scheduling.

His supervisory experience includes familiarity with and fulfilling OSHA requirements relative to site work, coordinating transportation and disposal of hazardous wastes, soliciting and receiving bids for services and materials, recommending the lowest qualified bidder, working with a client and/or OSC, acting as Site Safety Officer, report preparation, previous experience on ERCS jobs, preparing 1900-55s (or RCMS), and (12) years as a site manager at a hazardous waste site.

His experience with environmental technologies includes:

o Wastewater treatment	o Drum repackaging
o Dewatering	o Drum recovery
o Compatibility testing	o PCB cutting/bulking
o Contaminants sampling	o Pesticide clean-up
o Hazardous-waste disposal	o Tank dismantlement
o Radioactive-waste recovery/ disposal	o Tank cleaning
o Shock-sensitive/explosive/ reactives handling and disposal	o Tank shearing
o Air monitoring	o Cold cutting
o Soil excavation	o Compressed-gas cylinder identification/handling/ neutralization
o Decontamination	o Organic/inorganic and heavy metals handling
o Onsite incineration	

Mr. Prohaska's projects include the following:

Project Manager: For a USEPA Region III site in Douglasville, Pennsylvania, Mr. Prohaska managed the closure of a water oil recovery facility contaminated with PCBs, VOCs and heavy metals wastestreams. Mr. Prohaska coordinated the efforts of a project supervisor, a health and safety officer, a health and safety technician, two equipment operators, six recovery technicians, and an administrative assistant. The scope of work involved the cleaning and demolition of storage tanks, material handling and packaging, transportation and disposal of waste, project safety and regulatory compliance. This closure effort generated 3,000 drums of waste. The period of performance was from June 1991 to January 1992.

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Assistant Project Manager: At an USEPA site in Lasalle, Illinois, Mr. Prohaska was the assistant project manager for the construction and test burn of a 30 ton per hour mobile thermal destruction unit. Mr. Prohaska managed an eleven man crew consisting of engineers, health and safety personnel, technicians, equipment and control operators, and chemical technicians. The project scope was the thermal destruction of 20,000 cubic yards of PCB contaminated soils. Mr. Prohaska was committed to this project from November 1990 through test burn completion in March 1991.

Project Manager: From mobilization to demobilization, Mr. Prohaska managed the decontamination and demolition of a aircraft rework facility at the Norfolk Naval Air Station, Norfolk, Virginia. He coordinated the efforts of inhouse and subcontracted personnel in the removal of 500 tons of heavy and mixed waste contaminants inclusive of PCBs, dioxin, halogenated and nonhalogenated solvents, radium, heavy metals, and asbestos. He also managed the daily operations, transportation and disposal of waste, daily interface with Navy representatives, sampling and analytical services, cost control, work plans and submittals, and regulatory compliance. This project was performed from March 1991 to June 1991.

Project Manager: For the City of New York (five boroughs), Mr. Prohaska simultaneously managed the remediation of five (5) wastewater treatment facilities to allow facility expansion. Mr. Prohaska managed remediation crews consisting of operators, technicians, safety officers and project supervisors. He coordinated the daily operations, cost control, safety, sampling and analytical procedures to remove 1,000 drums and approximately 1,000 tons of contaminants consisting of PCBs, solvents, acids, caustics, oil, grease, soils, and debris in compliance with regulatory requirements. This project was started in October 1989 and was completed on schedule in December 1989.

Project Manager: At an USEPA Region II site in New Jersey, Mr. Prohaska oversaw the daily operations, sampling and analysis, cost control, project safety and regulatory compliance for the closure of an abandoned landfill. Mr. Prohaska managed the work efforts of over 100 employees inclusive of technicians, engineers, equipment operators, and recovery technicians. This remediation project which ran from July 1989 through December 1989 involved the excavation, transportation and disposal of 13,000 tons of soil contaminated with PCBs, heavy metals and HOC.

SPECIALIZED TRAINING

OSHA 40-hour Site Safety Training
OSHA 8-hour Supervisor Training
Chemical and Explosive Ordnance Training, U.S. Army

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ROBERT VANDENBERG

OHM REMEDIATION SERVICES CORP.

TITLE

Site Supervisor

EXPERIENCE

Mr. Vandenberg is qualified as a Response Manager Level I based on his 5 years of direct on-scene multidisciplinary field experience in hazardous waste site cleanup and waste disposal activities. The contaminated media involved in these actions include air, water, soil, containers, oil and chemicals. All 5 of his years of on-site experience include direct supervision of multidisciplinary (professional and labor) oil and chemical cleanup personnel.

Mr. Vandenberg's on-site experience includes development and execution of approved work plans, development of detailed cost estimates and approved site and spill safety plans, application of heavy equipment and field construction requirements, working in confined spaces, performance of assessments and evaluations at hazardous waste sites, and scheduling.

Mr. Vandenberg's supervisory experience includes familiarity with and fulfilling OSHA requirements relative to site work, coordinating transportation and disposal of hazardous wastes, soliciting and receiving bids for services and materials, recommending the lowest qualified bidder, working with a client and/or OSC, acting as site safety officer, report preparation, previous experience on government projects, and over two years as a foreman at a hazardous waste site.

Mr. Vandenberg's experience with environmental technologies includes:

o Wastewater treatment	o Derailments
o Underground recovery	o Pesticide clean-up
o Dewatering	o Tank dismantlement
o Filtration	o Tank cleaning
o Contaminant sampling	o Tank shearing
o Hazardous-waste disposal	o Tank cutting
o Soil excavation	o Organic/inorganic and
o Decontamination	heavy metals handling

Site Supervisor: Supervised operations involving the total ECRA decommissioning of a 27 acre site in Kearny, New Jersey including all storage tanks, sewer lines, asbestos materials and waste management. Contaminants involved fuel oil, diesel oil, sulfuric acid, lime, and DOP. Responsibilities included the supervision of 2 foremen and 25 recovery technicians, preparation and implementation of work plans, site health and safety plan, administration, procurement, client coordination, financial management, T&D coordination, work scheduling, and heavy equipment requirements. Actively participated in all meetings for this project from initiation in October 1990 to completion in April 1992.

Site Supervisor: Supervised emergency response team responding to a leaking drum removal project in Newark, New Jersey in January of 1992. Mr. Vandenberg managed the response crew, which consisted of a foreman and 2 recovery technicians, in removing, staging and overpacking the leaking drum (oxidizer), and coordinated the transportation and disposal of the material

Site Supervisor: Mr. Vandenberg was the supervisor of an emergency response team, consisting of one chemist and five recovery technicians, responding to a 200 gallon polypropylene pellet spill into a section of the Erie Canal in Magoden, New York during May 1991. Mr. Vandenberg mobilized the response crew coordinated subcontracting efforts, developed the work, site safety and health plan, interfaced with the NYSDEC OSC. He directed all site activities which included booming and cleaning the canal for 2 miles on each bank and disposal of the spilled material in accordance with NYSDEC regulations.

Site Supervisor: For a site in Tonawanda, New York, Mr. Vandenberg was in charge of the excavation of 700 yd³ of soil and clay contaminated with heavy metals (chrome). He directed a three man crew for all site activities which included sampling, excavation, T&D, backfill, compaction and site restoration. Project duration was March through April 1991.

Site Supervisor: Mr. Vandenberg led an emergency response team consisting of one chemist, engineer and 4 recovery technicians on a decontamination project at Owen Sound, Ontario, Canada. The task was to remediate a polychlorinated naphthalene spill at a tire production facility. The project tasks included the installation and 24 hour per day/7 day per week operation of a 200 gal per min water treatment system. The system was operated and maintained from September 1990 to February 1991. After receiving satisfactory analytical results the treated water was discharged into Georgian Bay. In addition Mr. Vandenberg performed a inplant survey to identify the source of contamination. He was also responsible for monitoring and adjusting flow rates and for tracking cost factors.

Site Supervisor: At a steel plant in Nanticoke, Ontario, Canada, Mr. Vandenberg supervised the design, installation and operation of a solid waste material handling system. This system treated dusts, lime and coke at a rate of 200 tons per day. During this seven month project, June 1989 through January 1990 Mr. Vandenberg supervised a engineer, a chemist, two foreman, a mechanic and eighteen recovery technicians. He was additionally responsible for design improvements, financial records, quality control, site safety and health and production rates.

SPECIALIZED TRAINING

OSHA 40-hour Site Safety Training
OSHA 8-hour Supervisory Training
Steel mill site safety
First aid and CPR training

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APPENDIX D
QA/QC PLAN FOR LABORATORY ANALYSIS

QUALITY ASSURANCE PROGRAM PLAN

Prepared By

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

APRIL 1992

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1.0 INTRODUCTION

1.1 BACKGROUND

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

ASC is a wholly-owned subsidiary of O.H.Materials Corp. which is ranked as the nation's fifth largest firm offering environmental services relating to hazardous waste cleanup and remediation.

1.2 HISTORY

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

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

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

1.3 INTRODUCTION TO QUALITY ASSURANCE

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

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

2.0 STATEMENT OF POLICY

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

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

3.0 ORGANIZATION AND RESPONSIBILITY

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

3.1 CORPORATE ORGANIZATION

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

3.2 LABORATORY ORGANIZATION

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

3.3 CLIENT PROJECT ORGANIZATION

Figure 3.3 outlines the organization between ASC and the CLIENT.

3.4 RESPONSIBILITIES

Specific responsibilities are summarized in the following sections.

3.4.1 Laboratory Manager

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

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

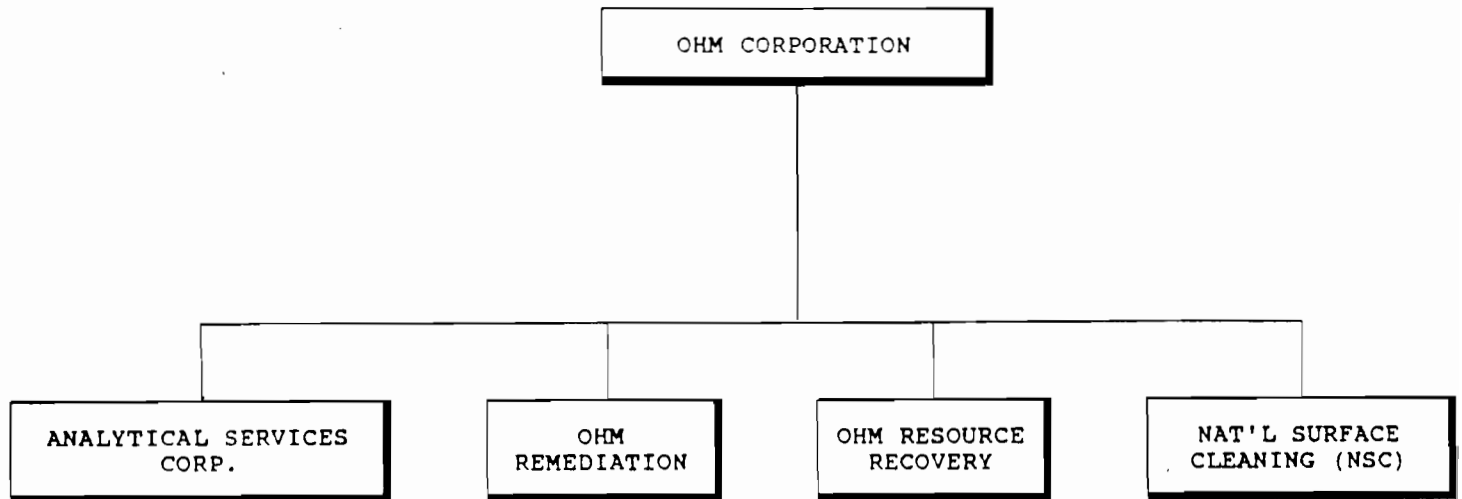


FIGURE 3.1 - OHM CORPORATE ORGANIZATION

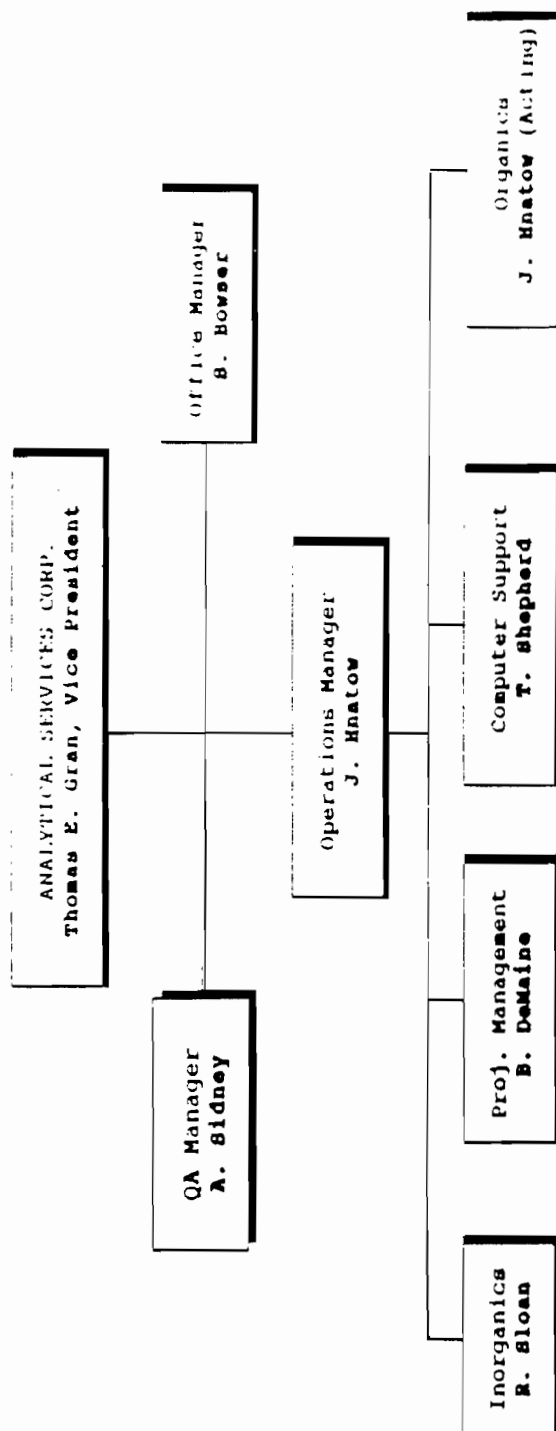


FIGURE 3.2 - ASC ORGANIZATION

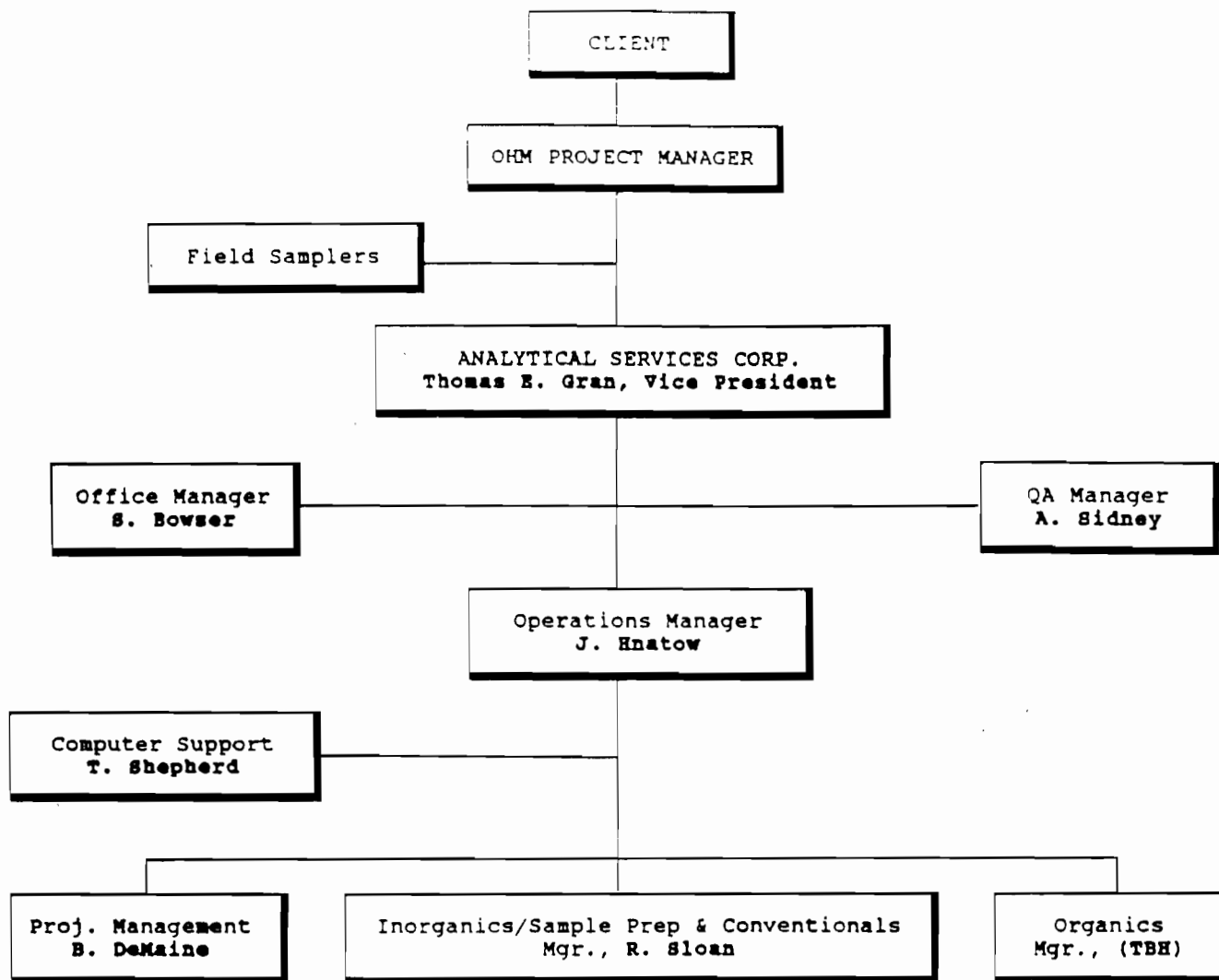


FIGURE 3.3 - CLIENT PROJECT ORGANIZATION

3.4.2 Laboratory Quality Assurance Officer

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

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

3.4.3 Laboratory Department Manager

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

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

3.4.4 Laboratory Section Supervisors

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

4.0 QUALITY ASSURANCE OBJECTIVES

4.1 DEFINITION OF TERMS

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

4.1.1 Quality Assurance

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

4.1.2 Quality Control

A quality control program includes the following:

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

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

4.1.3 Quality Assessment

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

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

4.1.3.1 Quality Assessment Procedure

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

- o Internal Performance Audits: conducted by the use of control samples, replicate measurements, and the use of reference materials in conjunction with control charts.
- o External Performance Audits: conducted by the use of inter-laboratory checks such as:
 - Participation in laboratory evaluation programs
 - Participation in round-robin method and performance evaluation studies
 - Participation in performance evaluation samples available from the EPA
 - Analysis of split samples and comparison of the results with other laboratories

4.1.4 Data Quality (Reference 2)

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

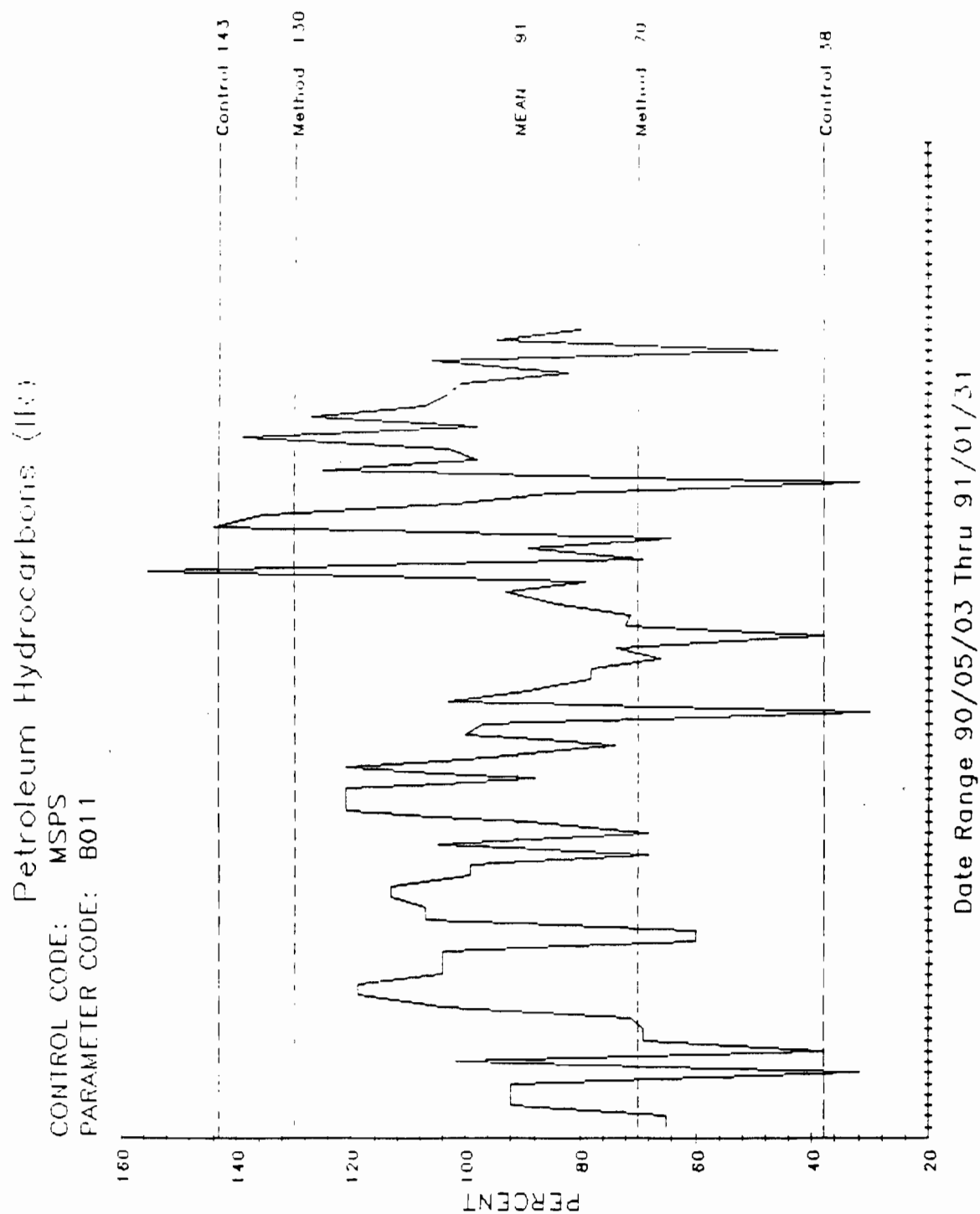


FIGURE 4.1 - LABORATORY CONTROL CHART

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

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

4.2 QUALITY ASSURANCE OBJECTIVES

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

- o Data should be accurate in terms of their agreement with a reference or true value;
- o Data should be precise in that there is agreement among the individual measurements made under similar conditions;
- o Data should be complete in terms of the amount of data available versus the amount of data evaluated;
- o Data should be comparable to prior relevant data for evaluation and testing purposes;

- o Data should be representative of the overall population or data base of parameter measurements;
- o Data should be reproducibly obtainable under similar conditions, whether generated by ASC or by another firm;
- o There should be a continual improvement in overall laboratory performance.

All of the above objectives are ensured by the QA/QC program which monitors all phases of data generation ranging from sample handling to the actual analysis and data reporting that involve measurements of both inorganic and organic constituents. These procedures will be followed by all laboratory personnel and will be regularly audited by the QA Manager or his/her designee (see Section 11.0, Performance and Systems Audits).

4.3 QUALITY ASSURANCE APPROACH RELATING TO MEASUREMENT OF DATA

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

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

4.3.1 Accuracy

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

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

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

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

4.3.2 Precision

The laboratory uses sample duplicates or matrix spike and matrix spike duplicates to assess precision. These sample pairs are analyzed at a frequency of one pair per batch of twenty samples or less depending upon matrix and method of analysis. A more frequent analysis is performed on a method-specific basis if necessary. The basic precision statistics obtained from the multiple batch frequency may be compared to develop a graph assessment using control limits for a given sample matrix.

Analytical precision is expressed as a percentage of the differences between results of matrix spike duplicate samples for a given analyte. Relative Percent Difference (RPD) is calculated as follows:

$$\text{RPD} = [\text{MS Result} - \text{MS Duplicate Result}]100/\text{Mean of MS and MS Duplicate Results}$$

where:

MS = Matrix Spike

4.3.3 Completeness

For the data to be valid, it must meet all the acceptance criteria including accuracy, precision, and any other requirement specified by the analytical method used. Data validation procedures are employed to minimize the amount of bad data getting through data collection.

4.3.4 Representativeness

Data generated by the laboratory shall be representative of the overall population of samples collected and analyzed. It shall be representative of the laboratory data base of accuracy, precision measurements of the particular parameter(s), matrix, and analytical method. If the same results are reproducible, the data can be said to accurately represent the environmental condition.

4.3.5 Comparability

Data generated shall be used to evaluate completeness of extensive monitoring programs and testing purposes based on previous data measurements of the parameter(s), matrix, and analytical method. It shall be compared to data sets recorded in the past to check for historical consistency. In order to maximize its usefulness, data shall be reported in appropriate units and in a consistent manner. Appropriate units are in accordance with the requirements stated in the October 26, 1984, proposed rules 40 CFR, Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants. Data should be reproducible under similar conditions whether generated by the laboratory or by another firm.

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

4.4 REFERENCES

1. "Principles of Environmental Analysis," *Analytical Chemistry*, Volume 55, pp 2210 - 2218, December 1983.
2. DER Guidelines for Preparing Quality Assurance Plans, DER - QA-001185, Florida Department of Environmental Regulation, January 1986.

TABLE 4.1 - LABORATORY QA OBJECTIVES

LABORATORY QA OBJECTIVES

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

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

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

LABORATORY QA OBJECTIVES

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

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

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

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

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

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

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

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

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

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

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

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

LABORATORY QA OBJECTIVES

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

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

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

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

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

LABORATORY QA OBJECTIVES

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

LABORATORY QA OBJECTIVES

TABLE 4.1 - LABORATORY QA OBJECTIVES (Continued)

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

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

5.0 SAMPLING PROCEDURES

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

6.0 SAMPLE CUSTODY

6.1 INTRODUCTION

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

6.1.1 Sample Label

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

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

A typical sample label is illustrated in Figure 6.1.

6.1.2 Sample Custody

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

6.1.3 Chain-of-Custody Records (COC)

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

JOB # _____	Sample # _____
DATE: _____	
Time: _____	
Sample: _____	

Taken by: _____	
Witness: _____	

FIGURE 6.1 - SAMPLE LABEL



CHAIN-OF-CUSTODY RECORD

Form 0019
Field Technical Services
Rev 08/89

No. 93626

O H MATERIALS CORP • P O BOX 551 • FINDLAY OH 45839-0551 • 419-423-3526										
PROJECT NAME				PROJECT LOCATION				ANALYSIS DESIRED (INDICATE SEPARATE CONTAINERS)		
PROJ NO		PROJECT CONTACT		PROJECT TELEPHONE NO		NUMBER OF CONTAINERS				
CLIENT'S REPRESENTATIVE				PROJECT MANAGER SUPERVISOR						
ITEM NO	SAMPLE NUMBER	DATE	TIME	COMP	GRAB	SAMPLE DESCRIPTION (INCLUDE MATRIX AND POINT OF SAMPLE)				REMARKS
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
TRANSFER NUMBER	ITEM NUMBER	TRANSFERS RELINQUISHED BY		TRANSFERS ACCEPTED BY		DATE	TIME	REMARKS		
1										
2										
3										
4								SAMPLER'S SIGNATURE		

LAB COPY

FIGURE 6.2 - CHAIN-OF-CUSTODY RECORD

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

6.2 LABORATORY OPERATIONS

Delivery of the samples to the laboratory will be accomplished by direct transfer, overnight courier, or common carrier as dictated by the specific project. Sample delivery by either special courier or common carrier will require a custody seal on the sample chest. Should the samples arrive with the seal broken, it should be written on the COC and the samples will not be processed until a thorough investigation has been completed. Upon arrival at the laboratory, all sample containers are opened and inspected. Field sampling personnel or the project manager are notified on the same day of any problems concerning the samples or documents associated with the shipment. If samples arrive on Saturday and the field personnel are unavailable, notification will be made on the next working day.

6.2.1 Sample Receipt

All samples will be received by the Sample Custodian or in his/her absence by any member of the laboratory staff. All samples received will be considered to be hazardous samples, thus all shipping containers should be opened in the walk-in exhaust hood located in the sample receipt area of the laboratory. If the cooler is not opened in the hood the sample receipt personnel must wear respirators. Labcoats and gloves are required personnel protective equipment during the cooler and sample inspection steps.

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

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

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

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

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

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

If the sample tags are present:

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

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

PROJECT PROBLEM SHEET

DATE: _____ TIME: _____

TO: _____

FROM: _____

Project #: _____ COC#: _____

=====

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

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

Other Remarks:

PROBLEM CONTACT NAME: _____

ACTION TO BE TAKEN:

CC: _____

(C:\WP50\FORMS\401-1)

(03-21-91)

FIGURE 6.3 - PROJECT PROBLEM SHEET

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

Following the inspection of the shipping containers, sample bottles, and accompanying documentation, the Sample Custodian will place the samples in the walk-in cooler and deliver the written documentation, including the COC, the Project Problem Sheet, etc., to the Client Services personnel. The Client Services personnel will review all of the sample documentation and compare it with any documentation previously supplied by the client. If necessary, the Client Services personnel will make the necessary contacts to verify any discrepancies and carry out the client's directives. All communications by the Client Services personnel will be documented in logbooks assigned to each person. The information recorded will consist of the following items:

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

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

6.2.2 Sample Storage

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

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

- o The Sample Custodian will remove any samples from the storage areas for shipment off site when necessary.
- o Ensure that the volatile samples are stored separately from other samples.
- o Ensure that standards are not stored with any samples.

6.2.3 Long-Term Storage/Sample Disposal

Upon completion of the analysis, the samples will remain stored in either the walk-in cooler or the volatile refrigerator for an additional thirty days. After thirty days, the samples will be moved to the waste disposal room where they will be properly disposed of according to internal disposal procedures. The samples may be stored for a longer period of time if arrangements have been made prior to movement to the waste disposal room. The samples may also be returned to the jobsite if necessary.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

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

7.1 GAS CHROMATOGRAPH FOR VOLATILE ORGANIC ANALYSIS

Prepare calibration standards at a minimum of five concentration levels for each parameter. One of the external standards should be at a concentration near but above the Minimal Detection Limit (MDL) and the other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the detector. These standards should be prepared fresh on a routine basis. Analyze each calibration standard and tabulate area responses versus the concentration in the standard. The results can be used to prepare a calibration curve for each compound. Alternatively, if the ratio of response to concentration (calibration factor) is a constant over the working range [$< 20\%$ relative standard deviation, (RSD)], linearity through the origin can be assumed and the average ratio or calibration factor can be used in place of a calibration curve. The working calibration curve or calibration factor must be verified on each working day by the measurement of one or more calibration standards. If the response for any parameter varies from the predicted response by more than $\pm 15\%$, the test must be repeated using a fresh calibration standard. Alternatively, a new calibration curve or calibration factor must be prepared for that parameter.

7.2 GAS CHROMATOGRAPH FOR EXTRACTABLE ORGANIC ANALYSIS

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

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

curve. The working calibration curve or calibration factor must be verified on each working day by the measurement of one or more calibration standards. If the response for any parameter varies from the predicted response by more than $\pm 15\%$, the test must be repeated using a fresh calibration standard. Alternatively, a new calibration curve or calibration factor must be prepared for that compound.

7.3 ICP ATOMIC EMISSION AND ATOMIC ABSORPTION SPECTROPHOTOMETER FOR TRACE METALS ANALYSIS

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

7.4 SPECTROPHOTOMETER FOR COLORIMETRIC DETERMINATIONS

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

7.5 CALIBRATION STANDARDS AND TRACEABILITY

Standards for the analysis of trace metals will be purchased stock standards each at a concentration of approximately 1000 ppm. These standards, where possible, are traceable to NIST reference materials. Working standard solutions will be made on a daily basis from the stock standard.

Standards for the organic analyses will be prepared from purchased stock standard solutions offered by commercial vendors who are certified in the EPA's CRADA program. The initial calibration standards and the continuing calibrations standards will be diluted from standards purchased from two different CRADA sources. Standard preparations are recorded in a standard log book. Unique standard identification numbers are assigned to each standard and these are recorded in the standard logbook along with other information such as: identity of the person preparing the standard, solvents used, amount of standard diluted and the dilution solvent amount, percent purity of the standard, date, name of the standard, and concentration of the standard.

8.0 ANALYTICAL PROCEDURES

Please refer to Table 4.1 for the USEPA approved analytical procedures that ASC performs.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

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

9.1 DATA REDUCTION

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

9.1.1 Conventional Parameters

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

9.1.2 Trace Metal Parameters

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

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

Where:

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

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

Where:

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

9.1.3 Organics

9.1.3.1 Chromatograph Results

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

9.1.3.2 Gas Chromatograph/Mass Spectrometry Results

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

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

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

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

GC Volatiles

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

where:

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

$$\text{CF} = \text{As}/\text{AMT}$$

where:

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

GC/MS Volatiles

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

where:

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

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

where:

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

GC Extractable

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

where:

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

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

GC/MS Extractable

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

where:

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

9.2 DATA VALIDATION

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

- o A minimum three-point calibration and one calibration check standard. The calibration check standard must be made up from a different source than that of the initial calibration standards.
- o One reagent blank per analytical batch (i.e., one per twenty samples).
- o Laboratory control samples on a per batch basis.
- o Sample duplicates or matrix spike and matrix spike duplicate samples are analyzed per sample batch.

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

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

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

- o Review of the sample documents for completeness by the analyst at each step of the analysis.
- o Daily review of the batch documentation by the section supervisor.
- o Daily review of performance indicators such as blanks, surrogate recoveries, matrix spike and matrix spike duplicate results by the section supervisor.
- o On-screen review of data results prior to report generation.
- o Review and approval of the final report by the lab manager and/or the QC Officer.

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

In general, the analysts and the laboratory section supervisors are responsible for reviewing the data relative to instrument calibration, standard preparations, method blanks, raw data, calculations, and transcriptions. The analyst normally reviews 100% of the raw analytical data generated including the calibration data and all calculations. Upon completion of the analyst review, a second level of the raw data review is performed by either the section supervisor or the department manager where data quality indicators such as method blanks, replicate analyses, and spike recoveries are reviewed for acceptance. At the next level of data quality review, the QA Officer is generally responsible for a complete review of about 15% of the data generated on a monthly basis. The emphasis is on the data acceptability relative to the laboratory, program, or project data-quality objectives. All analytical problems encountered during sample analysis must be properly addressed to provide explanations to the data users.

9.3 DATA REPORTING

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

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

An example of a typical cover page is shown in Figure 8. Immediately following the cover page is a listing of the methods used by the laboratory to complete the work. These method summaries appropriately describe the analytical method or list the reference from

which the analytical method was derived. Typical method summaries are shown in Figure 9. After the method references, the analytical data is reported. An example of a typical report page is shown in Figure 10. A copy of the original COC is also included in the final report for reference purposes.

ANALYTICAL REPORT

CLIENT:

ATTN:

PROJECT:

SAMPLE(s):

SAMPLE TYPE(s):

ANALYSIS PERFORMED:

DATE RECEIVED:

JOBLINK(s):

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

Reviewed and
Approved by:

Thomas E. Gran, Ph.D., Vice President

Date: _____

DATA SUMMARY REPORT		
		DATE: 08/14/91
		PAGE: 1
Company: OHM REMEDIATION SERVICES CORPORATION		
Sample Point ID: 1		
ASC Sample Number: JG9177		
Sample Date: 910805		
Facility Code: 011178		
Parameters	Units	
RCRA TCLP Leachate Metals Analysis, (ME52)		
Arsenic	mg/L	< 2.50
Barium	mg/L	< 2.50
Cadmium	mg/L	< 0.125
Chromium	mg/L	0.918
Lead	mg/L	< 2.50
Mercury	mg/L	< 0.001
Selenium	mg/L	4.65
Silver	mg/L	< 0.500
RCRA TCLP Leachate (ZHE) Volatile Analysis, MS, (MV50)		
Benzene	mg/L	108.0
Carbon tetrachloride	mg/L	< 50.0
Chlorobenzene	mg/L	< 50.0
Chloroform	mg/L	< 50.0
1,4-Dichlorobenzene	mg/L	< 50.0
1,2-Dichloroethane	mg/L	< 50.0
1,1-Dichloroethylene	mg/L	< 50.0
Methyl ethyl ketone	mg/L	< 50.0
Tetrachloroethylene	mg/L	< 50.0
Trichloroethylene	mg/L	< 50.0

FIGURE 9.2 - DATA SUMMARY REPORT

RCRA TCLP LEACHATE BASE/NEUTRAL/ACID ANALYSIS, MS, (MS52)

Company Name Facility Sample Point ASC Sample No.
OHM REMEDIATION SERVICES CORPORATION 011178 1 JG9177

Compounds	Sample Results mg/L	Bias Corrected Results mg/L	Detection Limits mg/L	Blank Results mg/L	Batch Number	Bias Recov
Hexachlorobenzene	ND	-	100	ND	Q4C3169	267
Hexachloroethane	ND	-	100	ND	Q4C3169	117
Hexachlorobutadiene	ND	-	100	ND	Q4C3169	93.7
Lindane	ND	-	100	ND	Q4C3169	159
Methoxychlor	ND	-	100	ND	Q4C3169	-
2-Methylphenol	ND	-	100	ND	Q4C3169	99.7
4-Methylphenol	ND	-	100	ND	Q4C3169	102
Nitrobenzene	ND	-	100	ND	Q4C3169	87.5
Pentachlorophenol	ND	-	100	ND	Q4C3169	138
						252
Pyridine	ND	-	100	ND	Q4C3169	-
2,4-Dinitrotoluene	ND	-	100	ND	Q4C3169	98.8
2,4,5-Trichlorophenol	ND	-	100	ND	Q4C3169	116
2,4,6-Trichlorophenol	ND	-	100	ND	Q4C3169	150

3-Methyl- and 4-methylphenol coelute and are reported as the total

FIGURE 9.3 - REPORT PAGE

10.0 LABORATORY QUALITY CONTROL CHECKS

This section outlines the typical procedures followed by the laboratory personnel ensuring that the appropriate quality control requirements have been met. Obviously the specific QC procedures may change according to the requirements of a particular job site, however, the following should be considered as minimum requirements.

10.1 LABORATORY OPERATIONS

Responsibility for internal QC checks rests with the Laboratory Group Supervisor and with the analyst. The Department Manager will monitor the performance of the analyst and the laboratory group supervisor for implementation of proper QC checks and will approve all data.

- o Initial calibration and calibration verification--a minimum of 5 standards and a blank for the standard curve: *Analysis of the mid-range standard to verify calibration.*
- o Continuing calibration verification: *Analysis of mid-range standard at a minimum frequency of 10% (check standards).*
- o Procedural blank analysis: *A procedural blank (method blank) will be prepared and analyzed with each batch of samples or with every 20 samples prepared, whichever is more frequent.*
- o Matrix spike analysis: *At least 1 spiked sample will be prepared and analyzed for each batch of samples prepared or for each 20 samples analyzed, whichever is more frequent.*

10.2 QUALITY CONTROL SAMPLES

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

11.0 PERFORMANCE AND SYSTEM AUDITS

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

11.1 LABORATORY PERFORMANCE AUDITS

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

11.1.1 Internal Performance Audits

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

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

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

11.1.2 External Performance Audits

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

- o Participation in laboratory evaluation programs (see Table 11.1)
- o Participation in performance evaluation samples available from USEPA (see Table 11.1)

TABLE 11.1 - LABORATORY EVALUATION PROGRAMS

Proficiency Evaluation Program	Regulatory Agency or Client
USEPA WS Drinking Water Program	Kansas State DHE Louisiana State DHH New Jersey State DEP Ohio EPA Pennsylvania State DER Wisconsin State DNR
USEPA WP Wastewater Program	California State DOHS New Jersey DEP New Jersey DEP A280 New York DOH
Hazardous Waste Program	California State DOH Chem. Waste Management Approved Envirosafe Approved Kansas State DHE USACE Approved

ASC currently holds a USDA Permit for Importing Soils

11.2 LABORATORY SYSTEM AUDITS

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

12.0 PREVENTIVE MAINTENANCE

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

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

12.1 PH METERS AND COMBINATION PH ELECTRODES

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

12.2 ANALYTICAL BALANCES

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

12.3 ATOMIC ABSORPTION SPECTROPHOTOMETERS AND INDUCTIVELY COUPLED ARGON PLASMA SPECTROPHOTOMETERS

Routine maintenance of the AA's includes inspection of all hoses and O-rings for wear and replacement as necessary. The spray chamber is removed, totally disassembled at regular intervals, and each component is thoroughly cleaned. The furnace graphite shield, chimney, rinse chamber, rinse bottle, and syringe are regularly cleaned. The spray chamber and nebulizer are cleaned daily by aspirating at least 50ml of H₂O. The liquid in the trap is flushed and changed. The burner is cleaned with hot water. The lamp window and quartz windows of the furnace assembly are cleaned as required.

12.4 GAS CHROMATOGRAPHS

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

12.5 SPECTROPHOTOMETERS

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

12.6 CONDUCTIVITY METER

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

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

12.7 GAS CHROMATOGRAPH/MASS SPECTROMETERS

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

12.8 CONTINGENCY PLANS FOR MINIMIZATION OF UNSCHEDULED DOWNTIME

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

In addition, all of the HP analytical and computer equipment is under service contract as well as the FTIR, ICP, AA, and ion chromatograph instrumentation. The facility also has a back-up generator which can maintain power at 2/3rds capacity indefinitely.

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

13.1 LABORATORY DATA

13.1.1 Accuracy Control

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

Accuracy samples consist of blank (or method) spikes and matrix spike samples. The blank spike is a laboratory generated inert matrix sample (deionized water, playground sand, or TCLP fluid) which is spiked with the targeted analytes of interest and processed with the analytical batch. When one of the samples in the batch has two additional aliquots prepared and spiked with the targeted analytes, these two aliquots are referred to as the matrix spike and matrix spike duplicate. The percent recoveries for the matrix spike (not the matrix spike duplicate since it is used for precision only) and blank spikes are calculated and stored for statistical purposes. The calculation for the percent recoveries for the blank spike and matrix spike are listed below:

Blank Spike:

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

Matrix Spike:

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

Where:

SRR = Spiked sample result

SR = Sample result

SA = Spike added

After seven recoveries have been completed, the mean and standard deviation is calculated and the method control limits are set using the following equations:

$$\text{Upper control limit} = p + 2Sp$$

$$\text{Lower control limit} = p - 2Sp$$

Where:

p = average percent recovery

Sp = standard deviation

Once the control limits have been established they are used to determine if an analysis is out of control. This is done by comparing the spike sample percent recoveries against the control limits. If the recoveries fall outside the control limits, then the system should be evaluated for corrective action. The control limits are determined for each method and matrix as required.

13.1.2 Precision Control

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

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

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

Where:

D1 = Determination #1

D2 = Determination #2

The RPD will be entered into the lab's data system and will be used to define the precision of the analysis.

14.0 CORRECTIVE ACTIONS

The laboratory corrective actions may be initiated due to any and all problems detected which effect or potentially effect the quality of the work effort devoted to the project. Upon notification of a problem, or when a potential problem is identified, any individual may notify the QA Manager or Operations Manager. At this time, a thorough investigation of the reported problem is immediately performed to determine if corrective actions should be initiated.

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

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

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

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance reports are generated on a monthly basis. The QA Manager is responsible for preparing the reports and submitting them to the Vice President of Analytical Services. A copy is also distributed to upper level laboratory managers for their information and use. This report details the activities pursued by the QA Manager during the month and includes items such as: results of system or performance audits, certification issues, internal QA (i.e., control limits), results of any data assessments, and documentation of any corrective actions that were initiated during the reporting period. Other quality items are included as the need arises.

16.0 PERSONNEL QUALIFICATIONS

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

TABLE 16.1 - ASC LABORATORY PERSONNEL

EMPLOYEE	Degree	Years of Exp.	Admin	GC/VOA	GC/SVA	GC/MS VOA	GC/MS SVA	AA/ICP	Prep*	Comp Sys
A. Aloqaili	HS+	5							X	
M. Balko	HS	<1							X	
C. Begin	HS	5							X	
S. Bentjen	MS	5		X	X				X	
S. Bowser	AD+	29	X							
C. Breitigan	HS+	3							X	
T. Cina	BS+	8		X	X	X	X	X	X	
S. Clark	HS+	7							X	
C. Clawson	HS	3							X	
M. Conry	Ph.D.	3		X	X	X	X			
W. Davidson	HS	20	X							
S. Dean	HS+	4							X	
W. DeLong	BS	3						X	X	
B. DeMaine	BS+	12	X	X	X	X	X	X	X	
E. Dillon	HS	3							X	
S. Dotson	HS+	3							X	
S. Earl	BA	11		X	X		X		X	
R. Firestone	HS	5							X	
G. Gallelo	BS	10	X	X	X	X	X		X	
T. Gran	Ph.D.	19	X	X	X	X	X	X	X	
J. Hnatow	BS	10	X	X	X	X	X		X	
D. Jensen	HS+	4							X	
J. Johnson	HS+	7		X					X	
J. Kelly	BS	3		X	X				X	
D. Kinder	BS	4						X	X	
G. Knieriem	BS+	9	X	X	X		X		X	
C. Koehler	HS	2							X	

EMPLOYEE	Degree	Years of Exp.	Admin	GC/ VOA	GC/ SVA	GC/MS VOA	GC/MS SVA	AA/ ICP	Prep*	Comp Sys
L. Lauck	HS+	6							X	
D. Lease	BS	2		X	X					
T. McKee	BS	2							X	
B. Parker	HS	3							X	
J.L. Powell	HS	3							X	
J.S. Powell	HS	4							X	
M. Radabaugh	BS	7	X	X	X			X	X	
W. Renner	HS+	8	X							
A. Schimmel	HS+	4							X	
T. Shepherd	AD	6	X							X
A. Sidney	BS	17	X		X			X	X	
R. Sloan	BS+	16	X	X	X			X	X	
L. Stewart	BS	8		X	X	X			X	
D. Swan	HS+	9						X	X	
A. Vodicka	BS+	8		X	X				X	
J. Warren	HS	9							X	
L. Whitaker	AD	4	X						X	
T. Wymer	HS	<1							X	



HUNTINGDON ANALYTICAL SERVICES
ENVIRONMENTAL DEPARTMENT
QUALITY ASSURANCE PROGRAM PLAN

HUNTINGDON ANALYTICAL SERVICES
DIVISION OF EMPIRE SOILS INVESTIGATIONS, INC.
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Huntingdon
Analytical Laboratory

Analytical Services Division

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Huntingdon Analytical Services (HAS).

HAS was started from Huntingdon Research Centre (HRC) which is the largest contract testing laboratory on one site in the world. HRC is highly respected throughout the world for its toxicology and analytical chemistry prowess dating back to the early 1950's. This wealth of experience was used to position HAS to play a leadership role in contract laboratory testing in the US.

The technological and state-of-the-art equipment and instrumentation are housed in modern, 53,000 square feet facility located in Middleport, NY. The HAS building was specifically designed for routine analytical work as well as for research and development investigations. The building has an uninterruptible power supply for continuous operations, cold storage areas for samples, and segregated operation areas to minimize the possibility of sample contamination.

The Environmental Services Section performs a wide variety of organic, metals, inorganic, and water quality analyses. These tests are usually required under a number of federal, state, and local laws.

Typical matrices involve sediments, soils, sludges, surface water, drinking water, wastewater effluents, groundwater, leachates, industrial waste characterizations, process waters, hazardous or toxic wastes, and fuel oils. Through Empire Soils, this section has sampling abilities and equipment that can cover a wide geographic area.

Typical analytes involve priority pollutants, pesticides, PCB's, volatile organics, semi-volatile organics, purgeable aromatics, purgeable halocarbons, trihalomethanes, metals, water quality, TCLP, and hazardous waste characterization.

3.0 **PURPOSE AND SCOPE**

The purpose of this document is to demonstrate the analytical capabilities and dedication to quality of the HAS Environmental Laboratory.

4.0 **ORGANIZATIONAL RESPONSIBILITIES AND AUTHORITIES**

The General Manager is responsible for all laboratories located in the Middleport facility. These responsibilities include overall quality, staffing, equipment, profit/loss, and client services. The General Manager reports to the President of Empire Soils Investigations, Inc.

The QA Officer works with the Corporate QA Manager and reports to the General Manager. The QA Officer is responsible for the overall data quality. This includes the set up, maintenance and adherence to the appropriate Standard Operating Procedures, maintenance of staff training records, and adherence to the criteria of the certification programs.

The Laboratory Director is directly accountable for all phases of operations. These include staff, space, equipment, client services and data quality. The Director reports to the General Manager.

The Laboratory Supervisors report to the Laboratory Director. Their duties include staffing, analytical production within the specified protocol and data quality.

The Chemists and Technicians are the key-individuals responsible for data quality. Factors contributing to this include analytical technique, adherence and maintenance of QA/QC procedures, and accountability for the data they generate. They report to the Laboratory Supervisors.

The Sample Custodians are responsible for maintaining the sample integrity and sample security. This begins from time of sample receipt and ends with sample destruction. The Custodian's report to the Laboratory Director.

The following organizational chart shows these relationships.





HUNTINGDON ANALYTICAL SERVICES
ENVIRONMENTAL DEPARTMENT
QUALITY ASSURANCE PROGRAM PLAN

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Huntingdon
Analytical Laboratory

Analytical Services Division

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1.0 INTRODUCTION

Huntingdon International Holdings

HUNTINGDON ANALYTICAL SERVICES (HAS) is a Division of Empire Soils Investigations, Incorporated. Empire is part of the growing and successful HUNTINGDON INTERNATIONAL HOLDINGS plc Group of Companies. Current group members include the following which have more than 2000 employees located at over 50 offices and laboratories throughout the world.

1. EMPIRE SOILS INVESTIGATIONS, INC. based in Middleport, NY.
Huntingdon Analytical Services, a Division also based in Middleport, NY.
Asteco, Inc. a wholly owned Subsidiary also based in Middleport, NY.
2. TWIN CITY TESTING CORPORATION, based in St. Paul, MN
Three wholly owned Subsidiaries of TCT:
Patzig Testing Laboratories Co., Inc., based in Des Moines, IA.
Nebraska Testing Corporation, based in Omaha, NB.
Kansas City Testing Laboratories Co., Inc., based in Kansas City, MO.
3. CHEN-NORTHERN, based in Denver, CO.
4. HERZOG ASSOCIATES, INC., based in Mill Valley, CA.
5. HUNTINGDON RESEARCH CENTRE Ltd, based in Huntingdon, ENGLAND.
6. SOUTHWEST LABORATORIES, based in Houston, TX.

Huntingdon International Holdings (HTD-NYSE) companies have been providing a wide variety of environmental, biological, chemical, engineering, analytical, and physical testing services for many years. Typical private clients include world leading companies in the industrial product, industrial chemical, oil, utility, pharmaceutical, veterinary, consumer product, medical device, food, agrichemical, engineering, and biotechnology industries. government clients cover the entire range of federal, state, county, and municipal sectors.

Huntingdon Analytical Services (HAS).

HAS was started from Huntingdon Research Centre (HRC) which is the largest contract testing laboratory on one site in the world. HRC is highly respected throughout the world for its toxicology and analytical chemistry prowess dating back to the early 1950's. This wealth of experience was used to position HAS to play a leadership role in contract laboratory testing in the US.

The technological and state-of-the-art equipment and instrumentation are housed in modern, 53,000 square feet facility located in Middleport, NY. The HAS building was specifically designed for routine analytical work as well as for research and development investigations. The building has an uninterruptible power supply for continuous operations, cold storage areas for samples, and segregated operation areas to minimize the possibility of sample contamination.

The Environmental Services Section performs a wide variety of organic, metals, inorganic, and water quality analyses. These tests are usually required under a number of federal, state, and local laws.

Typical matrices involve sediments, soils, sludges, surface water, drinking water, wastewater effluents, groundwater, leachates, industrial waste characterizations, process waters, hazardous or toxic wastes, and fuel oils. Through Empire Soils, this section has sampling abilities and equipment that can cover a wide geographic area.

Typical analytes involve priority pollutants, pesticides, PCB's, volatile organics, semi-volatile organics, purgeable aromatics, purgeable halocarbons, trihalomethanes, metals, water quality, TCLP, and hazardous waste characterization.

2.0 QUALITY ASSURANCE POLICY

HAS is fully dedicated to the principles of maintaining high quality analytical operations. We comply fully with the regulations and standards of the New York State Department of Health Environmental Laboratory Approval Program (NYS DOH ELAP), New York State Department of Environmental Conservation and the U. S. Environmental Protection Agency Contract Laboratory Program (US EPA CLP).

All HAS staff will be provided formal training in the principles of Quality Assurance and the applications of those principles to analytical projects. Management will insure that all employees have appropriate training and experience for the job they are expected to perform. It is also managements responsibility to insure adequate facility space, instrumentation, and other resources necessary for the production of high quality data.

3.0 **PURPOSE AND SCOPE**

The purpose of this document is to demonstrate the analytical capabilities and dedication to quality of the HAS Environmental Laboratory.

4.0 **ORGANIZATIONAL RESPONSIBILITIES AND AUTHORITIES**

The General Manager is responsible for all laboratories located in the Middleport facility. These responsibilities include overall quality, staffing, equipment, profit/loss, and client services. The General Manager reports to the President of Empire Soils Investigations, Inc.

The QA Officer works with the Corporate QA Manager and reports to the General Manager. The QA Officer is responsible for the overall data quality. This includes the set up, maintenance and adherence to the appropriate Standard Operating Procedures, maintenance of staff training records, and adherence to the criteria of the certification programs.

The Laboratory Director is directly accountable for all phases of operations. These include staff, space, equipment, client services and data quality. The Director reports to the General Manager.

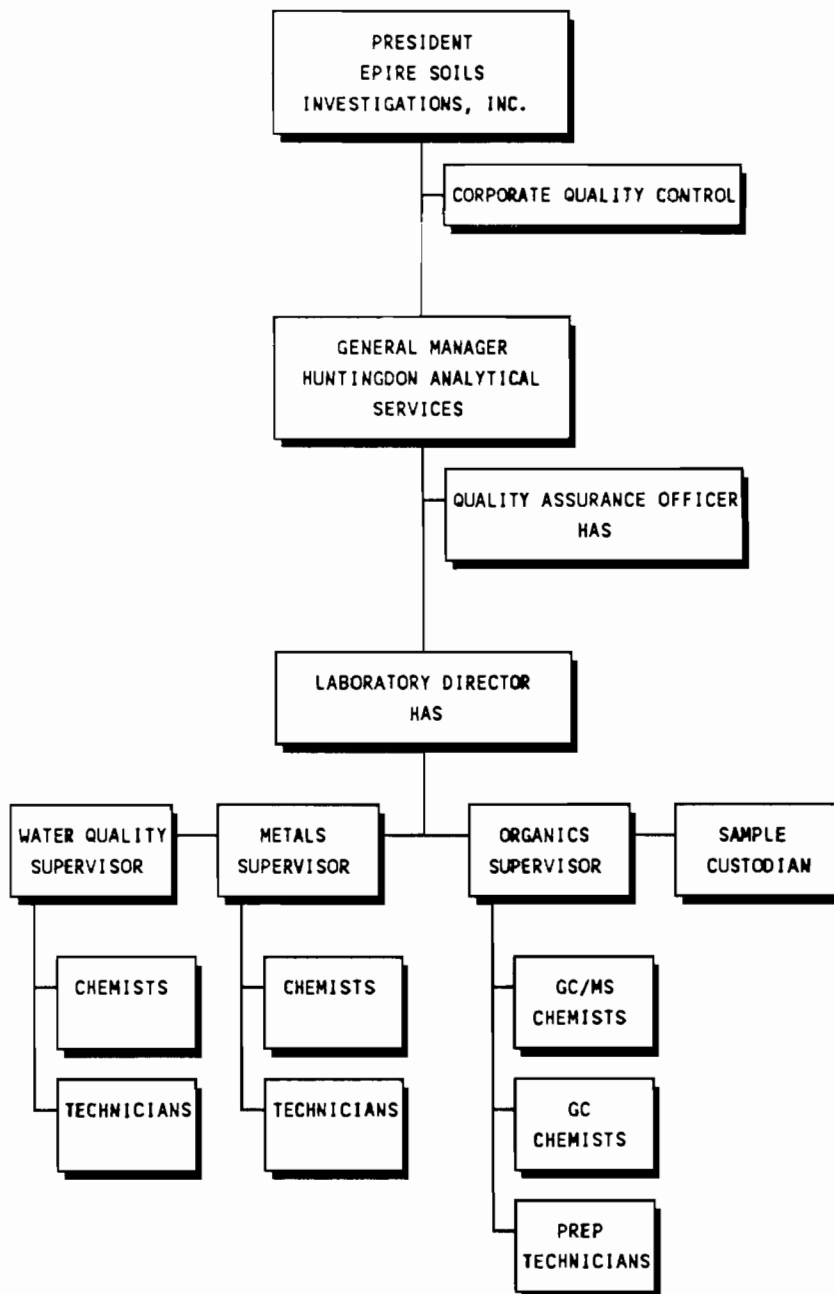
The Laboratory Supervisors report to the Laboratory Director. Their duties include staffing, analytical production within the specified protocol and data quality.

The Chemists and Technicians are the key-individuals responsible for data quality. Factors contributing to this include analytical technique, adherence and maintenance of QA/QC procedures, and accountability for the data they generate. They report to the Laboratory Supervisors.

The Sample Custodians are responsible for maintaining the sample integrity and sample security. This begins from time of sample receipt and ends with sample destruction. The Custodian's report to the Laboratory Director.

The following organizational chart shows these relationships.

HUNTINGDON ANALYTICAL SERVICES
ORGANIZATIONAL CHART



Environmental Staff totals 15 individuals. A summary of all personnel follows along with resumes of key personnel.

Summary of Laboratory Personnel Qualifications

<u>Name</u>	<u>Title</u>	<u>Education</u>	<u>Years of Experience</u>	
			<u>Others</u>	<u>HAS</u>
David Anderson	GC Chemist	AAS	14	3
Chris Bergstrom	GC Chemist	BA		1
Paul Bernard	Water Quality Chemist	BS	8	3
Dennis Besco	Sample Custodian			3
Andrew Clifton	General Manager, Director Environmental	BS	17	
Todd Covell	Organics Supervisor	BS	3	4
Elaine Gawron	Metals Technician	AAS		4
Carol Houenstein	Organic Prep Technician	AAS		1
Bryan Mastin	Client Services	BS	2	2
Michael Potter	Metals Chemist	AAS	4	2
Lisa Reyes	QA Officer	BS	5	3
Mark Silsby	Water Quality Technician	BS		
Joseph Venturo	GC Chemist	BS		2
Norton Webb	Water Quality Technician		25	2
David Willy	GC/MS Chemist		10	3

Reserved for Resume of

Andrew P. Clifton

Andrew P. Clifton Resume
(Continued)

Bryan E. Mastin
Environmental Project Client Services

Summary of Current Position

As Project Client Service Manager of the Environmental Department of Huntingdon Analytical Services, Middleport, New York, Mr. Mastin is responsible for most interactions between the laboratory and the environmental clients. He is also responsible for quoting prices, coordinating all aspects of report preparation, scheduling projects, and reviewing all documents for final report preparation.

Summary of Qualifications

Mr. Mastin has several years of experience which includes inorganic chemical analysis, project management, client service and laboratory activity scheduling. His current position requires the integration of all the above experiences.

Experience

January 1991-Present	Environmental Project Client Services Huntingdon Analytical Services (HAS) P.O. Box 250 Middleport, New York 14105
Jan. 1990-January 1991	Water Quality Chemist Huntingdon Analytical Services (HAS) P.O. Box 250 Middleport, New York 14105
May 1989-January 1990	Water Quality Monitor New York State Office of Parks, Recreation and Historic Preservation Genesee Region Letchworth State Park Castile, New York 14427
June 1988-January 1989	Ironworker Mucher Erectors Duncan Street Extension Warsaw, New York 14569

Education

B.S. General Science, Houghton College, 1989

Paul F. Bernard
Supervisor of Inorganics

Summary of Current Position

Responsible for all aspects of operation of the Water Quality Department. Duties include scheduling, training, quality control and report generation.

Summary of Qualifications

Mr. Bernard has several years of experience which includes inorganic chemical analysis, project management, client service and laboratory activity scheduling. His current position requires the integration of all the above experiences.

Experience

1991-Present	Supervisor of Inorganics Huntingdon Analytical Services (HAS) P.O. Box 250 Middleport, New York 14105
1989 - 1990	Water Quality Chemist Huntingdon Analytical Services (HAS) P.O. Box 250 Middleport, New York 14105
1981 - 1989	Medical Laboratory Technologist MDS Health Group, Inc. Olean, New York

Education

B.S. Biology, Edinboro University of Pennsylvania, 1981

Todd M. Covel
Supervisor of Organics

Summary of Current Position

Responsible for overall supervision of organic sample preparation, GC analysis and GC/MS analysis. Required to review and approve all analytical reports.

Summary of Qualifications

Mr. Covel has several years of experience which includes organic chemical analysis, project management, client service and laboratory activity scheduling. His current position requires the integration of all the above experiences.

Experience

1988 - 1991	GC/MS Chemist Huntingdon Analytical Services (HAS) P.O. Box 250 Middleport, New York 14105
1986 - 1988	ASCP Registered Medical Technologist St. Joseph's Intercommunity Hospital Cheektowaga, New York
1985 - 1986	Medical Technologist St. Mary's Hospital Rochester, New York

Education

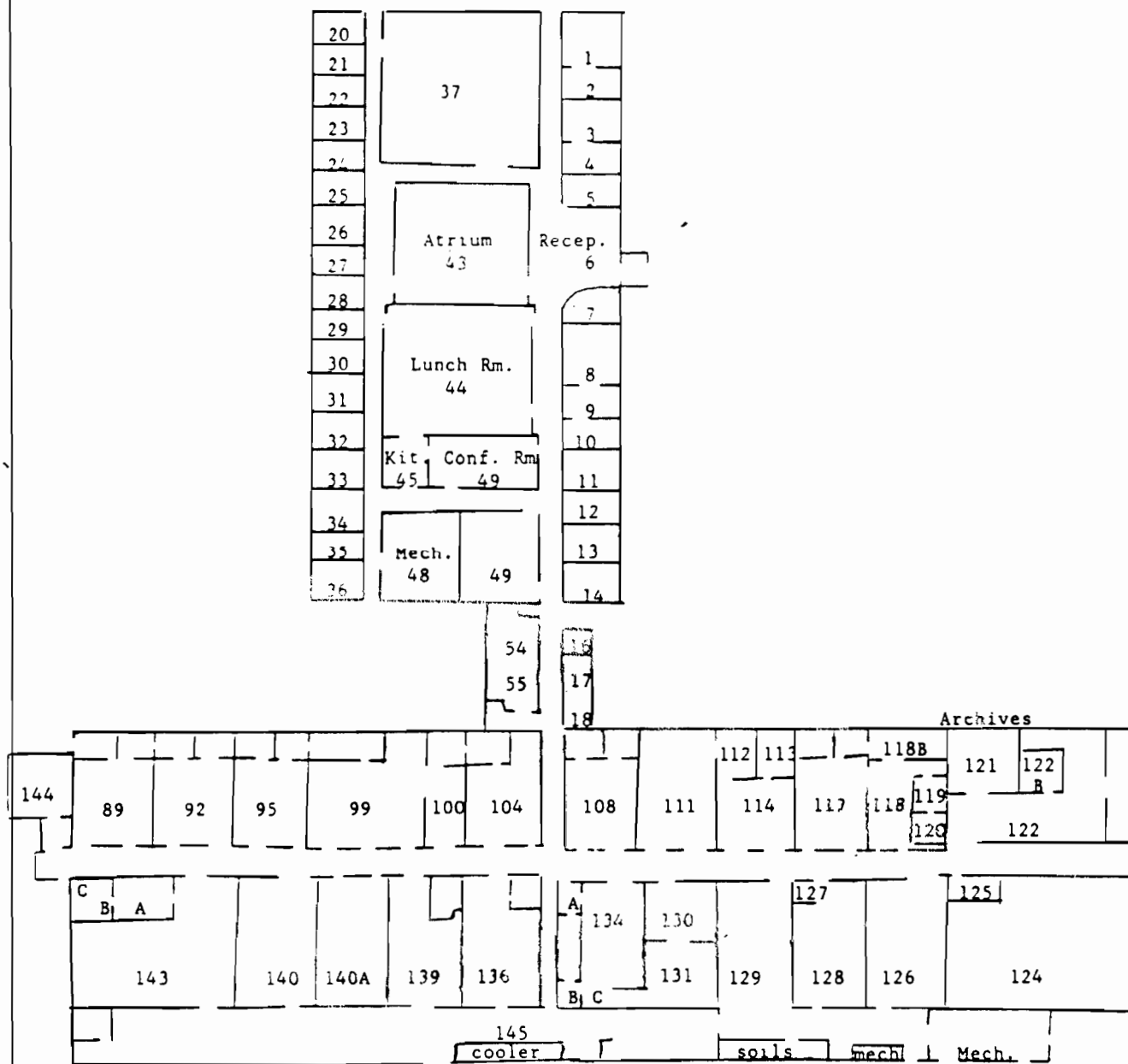
B.S. Medical Technology, State University College At Fredonia, NY, 1986

5.0 FACILITY LAYOUT

It is HAS company policy that adequate laboratory space shall be provided for sample receipt, storage preparation, analysis and disposal. These spaces shall be sufficiently separate and distinct as to maintain sample security and integrity. This space is designated by room numbers 89-145 on the attached facility layout (Figure 5.1).

It is also policy that adequate space shall be provided for the administration, supervision and direction of the testing facility. This space is designated as room numbers 1 to 30 on the attached facility layout.

Figure 5.1 Facility Layout
Total Square Footage - 54,000



6.0 **LABORATORY EQUIPMENT**

Reliable, quality equipment is essential to the generation of good usable data. HAS has sufficient duplication of equipment as to minimize the risks associated with downtime. An equipment inventory is attached.

HUNTINGDON ANALYTICAL SERVICES EQUIPMENT INVENTORY

Quantity	Description	Serial Number
2	Fisher 103 Temp Oven	#2712, #2711
1	VWR 1230 Heating Bath	#12301086
1	GCA Ignitability Cup	#108T-5
1	Boekel TDS Bath	#08290-05
3	Gast Vacuum Pump	#1189, #0487, #0687
1	Dohrman DC-80 Total Carbon Analyzer Model 3300	#N7F2085T
1	Milton Roy Spectronic 501	#G0983428
3	VWR Model 320 Stir Plate	#35863446, #3590162B, #359024
1	Mettler Balance PM4600	#H16534
12	Glas-Col Cyanide Heater	#120684, #120678A, #120534A #120584A, #120678A, #120534A #120584A, #120666A, #120671A #113886A, #120225A, #113902A #119401A, #120327A, #120537A
1	Branson 1200 Sonicator	#B-136037
1	Orion Research Conductance Meter	#101279
1	Orion Research Expandable Ion Analyzer EA920	#0021A
10	Electromantle	None Found
1	Hach COD Heater	#870108678
1	Labconco TKN Digestion Heater	None Found
1	Mettler AE160 Balance	#E01657
1	Bomb Calorimeter Plain	#5565
1	PARR Bomb Ignition Unit	#1086
1	YSI DO Meter	#18006328
1	VWR BOD Incubator	#20201286
1	Walk-in Cooler	None Found
1	Refrigerator - Standards Storage	None Found
1	Thermo Jarrel Ash Video 12E w/ 188 Graphite Furnace	#2104
1	Perkin Elmer Z5100PC w/ HGA 600 Graphite Furnace	#6601
1	Fisher/Spectro Products Hg3 Mercury Cold Vapor Analyzer	#4619
1	Thermo Jarrel Ash ICAP 61	#11782
1	Lab-Line Instruments Magne stir	#1185-025
1	Fisher Scientific IR 6000 Hotplate	#20700145
1	Thermolyne 2200 Hotplate	#24710006
1	Lab-Line Instruments 1268 Hotplate	#1186-0189
2	Nuora II Stir Plate	#30627076, #30628060
1	Centra Centrifuge	#23623188
1	Tekmar Sonic Disruptor	#9315
1	Branson Sonifier 450	#BI90019
2	GE Refrigerators	None Found
1	Fischer Isotemp Oven 300 Series	
1	VWR Vortexer 2 Model 6-560	#144676
1	Precision Vari-Heat	#12AT-9
1	Gelman Little Giant Pressure/Vacuum Pump	#389-7

Quantity	Description	Serial Number
1	Mettler PM4600 Balance	#681795
1	Blue M Water Bath	#MW-5071
1	Boekel Water Bath	#1111-8-17
1	Hewlett Packard 5890 GC	#2650A17050
1	ELCD Detector Model 4420	#SN1956B
1	PID PI-52 Controller (HNu)	#720027
1	PS/Electrometer	#05813
1	Tekmar LSC 2000	#88106017
1	ALS2032	#8815007
1	Hewlett Packard 5890 GC	#2950A27139
1	O.I. Analytical Purging Unit MPM-16	#90-113-8
1	O.I. Analytical Heating Unit MHC-16	#90-045
1	O.I. Anal. 4460A Sample Concentrator	#90-594-F
1	O.I. Anal. Model 4420 ELCD	#90-046
1	O.I. Anal. Model 4430 PID	#90-506
1	Hewlett Packard Chem Station	
	VGA Monitor	#MC-41116410
	Keyboard	#6882562
	PC	None Found
	Hewlett Packard LaserJet Series II	#867377
1	Hewlett Packard 5890 GC	#2843A20813
	Autosampler 7673A	--
	Injector	#2843A11384
	Carousel	#2718A0962
	Controller	#2847A12807
	Integrator	#2841A06932
	D A Convertor PE, DCI 2000	#DCIN 687927B
2	Electron Capture Detectors	#LS282,LS293
1	Hewlett Packard 5890 GC	#2643A11812
	Autosampler 7673A	--
	Injector	#2537A01086
	Carousel	#2718A07490
	Controller	#2803A11060
	Integrator	#2804A02837
	D A Convertor PE, DCI 2000	#DCIN 687927B
1	Electron Capture Detector	#L2087
1	Flame Ionization Detector	None
1	Hewlett Packard 5890 GC	#2518A05635
	Autosampler 7673A	#2718A07679
	Injector	
	Carousel	
	Controller	#2803A10881
	Integrator	#2641A00811
1	Electron Capture Detector	#L0239
1	Flame Ionization Detector	None
1	Hewlett Packard 5890 GC	#2643A10467
	HNu PID PI-52	#2701A27073
	O.I. Analytical ELCD	#539-6-317
1	Hewlett Packard Integrator 3393	#2546A02199
1	D A Convertor PE, DCI 2000	#DCIN 944608B
1	Tekmar LSC-2	#2387

Quantity	Description	Serial Number
1	Tekmar ALS	#1101
1	Finnigan Incos 50 Mass Spectrometer with Data System	#IN0110
1	Hewlett Packard 5890 GC	#2728A12699
	Hewlett Packard Controller	#2803A10875
	Hewlett Packard Tower	#2704A09548
	Hewlett Packard Turret	#2718A07706
1	Data General Computer	
	Monitor	#Y4A 009785
	Computer 10,20,30	#U0018958,C1218681,C1337398
	Tape Back-up	#QS133323
1	Printronix MVP Printer	#M021251
1	VG TRIO-1 Mass Spectrometer	#4043
1	Hewlett Packard 5890 GC	#2436G06552
1	Tekmar ALS	#1181
1	Tekmar LSC-2	#120
1	Remcor System Cooler	#2019
2	Edwards Vacuum Pumps	#25529,25681
1	Computer	
	Quadram Monitor CM1401	#89077752
	Erie TT04 Keyboard	#0400430
	Computer Intel ECSI3012-VG	#P70001561
	Tecmar QT-150E Tape Unit	#C8812014054
	Epson EX800 (P84PA) Printer	#03006410
1	VG TRIO-2 Mass Spectrometer	#1013
1	Hewlett Packard 5890 GC	#2436G02540
1	Tekmar ALS 2016	#88155008
1	Tekmar LSC 2000	#88337010
1	Tekmar ALS 2032	#88349002
1	Kikusui COS-1611 Oscilloscope	#6050191
1	Neslab CFT-75 System Cooler	#87BML47610-14
1	Topaz Line Noise Suppressor 91007-21	None
4	Edwards Vacuum Pumps	#19238,18499,19226,19087
1	Computer	
	Digital Monitor VR241-A	#YSJ078283
	Digital LK201AA Keyboard	#BOG180GHCT
	Digital Micro Pop 11/73 Tape Unit	None
	Printronix MVP Printer	#M23179
1	Nephelometer	#17891
1	Lachet 2100 Automater Chem. Station	
	Random Access Sampler 1120-000	#126179
	Pump 1120-000	#125388
	Injection Module 1600-000	#125650
	Colorimeter 1300-000	#125352
	Heat Bath 1500-000	#126198

7.0 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 sample consumption or destruction.

A sample is considered in custody under the following conditions:

1. It is in your actual possession, or
2. It is in your view, after being in your physical possession, or
3. It was in your possession and then you locked or sealed it to prevent tampering, or
4. 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. An example chain-of-custody is attached as Figure 7.1.

[illegible]

7.0 **CHAIN-OF-CUSTODY** (Continued)

Laboratory chain-of-custody is initiated as samples are received and signed for by the Sample Custodian at HAS. Documentation of sample whereabouts continues as samples are signed in and out of the secure storage area for analysis using In-House Chain-of-Custody forms in the Sample Logbook (Figure 7.2).

After analysis, extracts and any remaining samples are held in the secure storage area to await disposal.

Figure 7.2

STORAGE _____

[illegible]

Disposal/Date/Initials _____

7.1 Laboratory Security

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

The laboratory area is designated as a secure area. Authorized personnel only are allowed to enter the secure areas. Visitors to the laboratories must be accompanied by HAS staff members.

7.2 Duties and Responsibilities of the Sample Custodian

Duties and responsibilities of the Sample Custodian shall include but not be limited to:

1. Receiving samples.
2. Inspecting sample shipping containers for presence/absence and condition of:
 - a. Custody seal, locks, "evidence tape". etc.;
 - b. Container breakage and/or container integrity.
3. Recording sample conditions and preservations.
4. Signing appropriate documents shipped with samples (i.e., air bills, chain-of-custody record(s), etc.).
5. Verifying and recording agreement or non-agreement of information and sample documents (i.e. sample tags, chain-of-custody records, traffic reports, air bills, etc.) in appropriate logbooks or on appropriate forms. If there is non-agreement, appropriate laboratory personnel are notified and a discrepancy report is filed with the project (Figure 7.3).
6. Initiating the paper work for sample analyses.

Duties and Responsibilities of the Sample Custodian
(Continued)

7. Marking or labelling samples with laboratory sample numbers as appropriate, and cross referencing laboratory numbers to client identification.
8. Placing samples, sample extracts, and spent samples into appropriate secured storage areas.
9. Controlling access to samples in storage and assuring that laboratory procedures are followed when samples are removed from and returned to secure storage.
10. Monitoring chain-of-custody of samples in the laboratory.
11. Monitoring storage conditions for proper sample preservation such as refrigeration temperature and prevention of cross-contamination.
12. Returning shipping containers to the proper sampling teams.
13. Sending shipping containers, prepared sample bottles and sampling instructions to clients who request them.

Figure 7.3

HUNTINGDON ANALYTICAL SERVICES
DISCREPANCY/DEFICIENCY REPORT FORM

TO: Laboratory Manager

FROM:

DATE:

RE: Sample I.D. No. _____
Batch No. _____

EXPLANATION:

cc: Client report file

7.3 Sample Receipt

Sample shipments are received at HAS 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 Receipt Logbook.

When the Sample Custodian is not available to receive samples, the sample container is signed for by a HAS staff member, and the time, date and name of the person receiving the container are recorded on the chain-of-custody. 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.

7.4 Sample Identification

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

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

aa - bbbb- ccc

"aa" Represents the last two digits of the current year;

"bbbb" Represents a four digit project number which is assigned sequentially when a sample group is received at HAS;

"ccc" Represents the individual sample number within the group.

7.5 Sample Storage

Samples at HAS are stored in a walk-in cooler within the secured area. After sample receipt and log-in procedures are completed, the Sample Custodian places the samples in their original containers in the sample storage area. Volatile organic samples are stored in a separate locked, refrigerator to minimize sample cross-contamination. No other type of sample may be stored in this refrigerator. Metals only samples are kept in a secured ambient storage area.

Cooler and refrigerators are maintained at 0°-5°C. A daily temperature log is kept by the Sample Custodian for each refrigerator. Temperatures are recorded twice a day. (Figure 7.4).

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 in the sample logbook. 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 sample are retained in the secured area until they may be disposed of. Broken or damaged samples are promptly disposed of in a safe manner, and the disposal documented. Samples that are consumed during analysis are also 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.

Figure 7.4

HUNTINGDON ANALYTICAL SERVICES

DAILY QC CHECKS

DATE: _____

<u>MEASUREMENT</u>	<u>READING</u>	<u>SPECIFICATION</u>	<u>INITIALS</u>
<u>DI WATER (umhos/cm):</u>			
.001 M KCl Check	_____	125 - 169	_____
General Chemisty DI	_____	2.0 (1)	_____
Carboys #1	_____	2.0 (1)	_____
Carboys #2	_____	2.0 (1)	_____
<u>TEMPERATURE, °C</u>			
TSS Oven	_____ AM	103° - 105°	_____
	_____ PM		
TDS Oven	_____ AM	178° - 180°	_____
	_____ PM		
Wet Chem Refrigerator	_____ AM	0.5° - 5°	_____
	_____ PM		
BOD Incubator	_____ AM	19° - 21°	_____
	_____ PM		
Walk-in Cooler (A)	_____ AM	0° - 5°	_____
	_____ PM		
VOA Refrigerator (C)	_____ AM	0° - 5°	_____
	_____ PM		
VOA Standards Refrig.	_____ AM	0° - 5°	_____
	_____ PM		
VOA Room Temperature	_____ AM	15° - 28°	_____
	_____ PM		

Comments: _____

NU: Not in Use

* Notify supervisor if out of specification.

(1) Call for service - do not use the water if more than twice this level.

8.0 Calibration Procedures and Frequency

8.1 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 the individual analytical methods. 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.

Some examples of calibration procedures for various instrument systems are as follows:

GC - An initial calibration is performed using five 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 when other major changes in the chromatographic system takes place.

For CLP-type analyses, continuing calibration takes place at the beginning and once every five samples throughout the seventy-two hour analytical sequence. The percent difference in calibration factors for each standard must not exceed 20% (15% for any standard compound used for quantification).

8.1 Instruments (Continued)

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 have a percent difference of 25% or less in response factors for calibration check compounds.

Prior to analysis of any samples, GC/MS systems are tuned to USEPA specifications for BFB and DFTPP, for volatile and semi-volatile analyses respectively. Verification of tuning criteria occurs every twelve hours of instrument run time.

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.

AA - Five 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 ten samples to verify the initial calibration of the instrument. If a check standard falls outside the control limit of $\pm 10\%$ from the initial calibration, the instrument is recalibrated. Calibration blanks are analyzed at the beginning and end of the analysis.

8.2 Standards and Reagents

Primary sources of standard reference materials used for calibration, calibration checks, and accuracy control are the USEPA and National Bureau of Standards (NBS) repositories. Reliable commercial manufacturers represent a secondary source.

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 EPA or traceable to EPA.

Standards are periodically analyzed 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 laboratory department.

Reagents such as solvents are analyzed routinely to maintain purity. Each analytical run sequence begins with a solvent blank.

8.3 Analytical Procedures

The analytical methods used at HAS are contained in the documents cited below.

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, 16th and 17th Edition, APHA, Washington, DC 1985.

8.3 Analytical Procedures (Continued)

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

Contract Laboratory Program. Organic SOW Protocol, USEPA, 3/90 Revision.

Contract Laboratory Program. Inorganic SOW Protocol, USEPA, 3/90 Revision.

Analytical Toxicology Laboratory Handbook, New York State Department of Health, August 1982.

Analytical Services Protocol, New York State Department of Environmental Conservation, Sept. 1989.

9.0 MDL AND IDL STUDIES

The consistency of the methodology, analyst technique and instrumental stability are checked by performing a MDL/IDL study. The procedure used to determine each MDL is published in the Code of Federal Regulations, 40 CFR 136, Appedndix B, "Definition and Procedure for the Determination of the Method Detection Limit", July 1, 1990. The IDL study consists of analyzing seven low level spikes of the same concentration over a three day period and multiplying the standard deviation by three. This, of course, represents the possible detection limit of an interference-free matrix.

10.0 Analytical Standard Operation Procedures

Standard Operating Procedures (SOP) are designed to provide a simplified, concise methodology for use at the bench. SOPs are updated biannually and revised when necessary.

11.0 Data Reduction, Validation, and Reporting

11.1 Data Reduction

Instrumental print-outs, terminal readings, chromatograms, strip chart recordings, and physical measurements provide raw analytical data that are used to calculate concentrations of analytes through the application of appropriate equations. Equations are generally given within the analytical methods previously cited. Data reduction may be performed manually by scientists or automatically by computerized data systems on the instruments.

11.2 Data Validation

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

Validation includes data review at both the technical and editorial levels. Technical review evaluates the application of analytical protocols and resultant effects on the data generated. Editorial review assesses the content, lucidity, conciseness, and completeness of the data report.

11.3 Data Reporting

Interpretation of raw data and calculation of results are performed by a scientist experienced in the analytical methodology. Upon completion of data reduction, the technician signs for the reported results on the raw data. The supervisor reviews and verifies the results. Another chemist, experienced in the same discipline, reviews the data. The director, who is responsible for the data generated in that laboratory, often performs the second tier of report review or may independently review data and completed report forms. Members of the QA staff also check the results on selected sets of data.

At a minimum, each data point is checked by two scientists experienced with the analytical methodology. Records are maintained for all data, even for those results that are rejected as invalid.

12.0 LABORATORY QUALITY CONTROL

To maintain data quality, it is critical that daily internal QC practices are established, monitored and maintained. These practices are indicators to changing analytical conditions. Monitoring these internal controls limits the possibility of generating unusable data.

These QC checks are as follows:

12.1 Routine QC Practices - Organics Laboratory

- Trip blanks are routinely analyzed, to detect contamination during sample shipping, handling and storage.
- Method blanks, at a minimum of one in every 20 samples/or batch to detect contamination during analysis.
- One sample matrix spike every 20 samples.
- 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.

- Initial multi-level calibration of instruments, to establish calibration curves.
- Daily calibration of instruments.
- Daily tuning of GC/MS systems to EPA specifications, for consistency in data generation.
- Control limits to determine acceptability.

12.2 Routine QC Practices - Metals Laboratory

- Analysis by ICP (inductively coupled plasma spectroscopy) for most metals.
- Analysis by Zeeman effect graphite furnace atomic absorption spectroscopy for low concentrations of certain metals; As, Pb, Se, Tl.
- Initial and Continuing Calibration blanks, and method 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/batch of samples, to determine accuracy.
- One sample spike every 10 samples to determine accuracy and matrix effects.
- One sample spike duplicate every 10 samples, to determine precision and matrix effects.
- Performance evaluation samples from EPA, to verify continuing compliance with EPA QA/QC standards.
- Control limits to determine acceptability.

12.3 Routine QC Practices - Classical Chemistry Laboratory

- One method 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 sample spike every 20 samples, to determine accuracy and matrix effects.
- One sample duplicate every 10 samples, to determine precision and matrix effects.
- 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.
- Control limits to determine acceptability.

13.0 PERFORMANCE SYSTEM AUDITS

As a participant in several certification programs and various contracts, the HAS laboratory is frequently subjected to rigorous performance evaluations and on-site inspections by regulatory agencies and commercial clients. The HAS 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.

The HAS 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 designated laboratory practices. (Figure 11.1).

Figure 11.1 QA Inspection Report



QUALITY ASSURANCE

Distribution:

QA Files _____
Environmental Manager _____
General Manager _____

ENVIRONMENTAL INSPECTION
REPORT

Inspector: _____	No. _____
Processes Inspected: _____	Dates: Inspection _____ to Manager _____ from Manager _____ Reinspection _____
Department: _____	

QA FINDINGS

RESPONSE/ACTION OF DEPARTMENT MANAGER

QA Manager: _____	Date: _____	Departmental Manager: _____	Date: _____

HAS 029

14.0 **CERTIFICATION PROGRAMS**

HAS participates in several certification approval programs. The programs include potable water, non-potable, and solid-hazardous waste and air samples.

Copies of these certificates and/or certified parameters list is attached as Appendix B.

15.0 **PREVENTATIVE MAINTENANCE**

Preventative maintenance is a routine practice at HAS for each analytical instrument. Scheduled preventative maintenance minimized instrument downtime and consequent interrupting of analysis. The laboratory personnel at HAS 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.

HAS maintains an inventory of replacement parts required for preventative maintenance and spare parts that often need replacement, such as electron multipliers, fuses, ferrules, nebulizers, torches, contact rings, etc.

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 15.1.

INSTRUMENT MAINTENANCE RECORD

Figure 15.1

Instrument: _____

Serial Number: _____

Operator: _____

Date: _____

Description of Problem:

Description of Repair:

Service Engineer Signature _____

Date _____

16.0 ROUTINE PROCEDURES USED TO ASSESS DATA QUALITY

Precision, accuracy, and completeness are typical terms associated with data quality.

16.1 Precision

Precision is frequently determined by the comparison of replicates, where replicates result from an original sample that has been split for identical analyses.

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 $n=2$).

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

or

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

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 into two for identical analyses -- the percent difference (%D) between the two samples may be used to estimate precision:

$$\% D = [(D_1 - D_2) / ((D_1 + D_2)/2)] \times 100$$

%D = percent difference

D_1 = first sample value

D_2 = second sample value (duplicate)

16.2 Accuracy

The determination of accuracy of a measurement requires a knowledge of the true or accepted value for the signal being measured.

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

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

where: $\bar{X}$ = average observed value of measurement

T = True value

16.3 Completeness

Determining whether a data base is complete or incomplete may be quite difficult. To be considered complete, the data set must contain all QC check analysis 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 data bases is sufficient.

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

$$\% \text{ completeness} = \frac{\text{Valid data obtained}}{\text{Total data planned}} \times 100$$

17.0 **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.

Personal experience often is most valuable in alerting the bench scientist to suspicious results or malfunctioning equipment. Specific QC procedures are designed to help analysts determine the need for corrective actions. Corrective actions taken by scientists in the laboratory help to avoid the collection of poor quality data.

Examples of conditions may warrant corrective actions are given below:

1. Tuning or calibration of instruments outside of specifications.
2. QC data for precision and accuracy outside of acceptance limits.
3. Undesirable trends in concentration, surrogate and spike recoveries, response factors or relative percent difference.
4. Abnormal variation in detection limits.
5. Check sample results out of range.

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:

1. Identify and define the problem.
2. Assign responsibility for investigating the problem.
3. Investigate and determine the cause of the problem.
4. Determine a corrective action to eliminate the problem.
5. Assign and accept responsibility for implementing the corrective action.
6. Establish effectiveness of the corrective action and implement it.
7. Verify that the corrective action has eliminated the problem.

Its implementation is later verified through a laboratory audit.

18.0 **QUALITY ASSURANCE REPORTS TO MANAGEMENT**

The Director of Quality Assurance submits a QA report each quarter to the General Manager and the Laboratory Director. The report may contain detailed information on the QA activities during the previous three months including:

1. Summary of systems and audits.
2. Performance evaluation samples analyzed and scores received.
3. Status of certifications.
4. Laboratory QA/QC review.
5. Problems and corrective actions.
6. Comments and recommendations.

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

19.0 **LABORATORY DOCUMENTATION**

All information relative to a specific report or job is retained in each job file. This information will include all raw data, copies of data reduction, copy of the final report, chain-of-custody, discrepancy reports, and client contacts. These files are retained in a secured Archive Room for 10 years. After 10 years, the client is contacted to determine the need for extended storage.

20.0 **SAMPLE STORAGE AND DISPOSAL**

All samples are preserved and stored in accordance with NYS DOH ELAP procedures (Appendix A). As discussed in the Sample Custody Section, the samples are secured upon receipt at the HAS laboratory facility. All samples are retained for 30 days from the issue of the final report. As part of the final report review, the Laboratory Director reviews sample results and designates the method of disposal on a Sample Destruction Authorization (Figure 20.1). The Sample Custodian places the authorization sheet in a tickle file. When 30 days have elapsed, the samples are disposed of as indicated, the authorization is signed, dated and filed.

This system provides an efficient and prompt method of disposal which minimizes sample backlog or misplacement.

Figure 20.1

SAMPLE DESTRUCTION AUTHORIZATION

TO: Sample Custodian

FROM: Hazardous Waste Manager _____
(Signature)

DATE: _____

RE: Job Number: _____

The samples for the above captioned job number should be disposed of as indicated below:

Sanitary Sewer	Sample Nos. _____
Sanitary Landfill	Sample Nos. _____
Acid Solution	Sample Nos. _____
Basic Solution	Sample Nos. _____
Chlorinated	Sample Nos. _____
Non-Chlorinated	Sample Nos. _____
Solid Waste - PCB	Sample Nos. _____
Flammable Solid	Sample Nos. _____
Solid - Metal	Sample Nos. _____
Aqueous	Sample Nos. _____
Liquid - PCB	Sample Nos. _____
Pump Oil	Sample Nos. _____
Possibly Consumed	Sample Nos. _____

When destruction is accomplished, sign and date this form and file in the project report file.

(Custodian Signature)

(Date)

APPENDIX A

Sample Containers, Preservation and Holding Times

ENVIRONMENTAL LABORATORY APPROVAL PROGRAM
CERTIFICATION MANUAL

<u>SUBJECT</u>	<u>DATE</u>	<u>PAGE</u>	<u>ITEM NO.</u>
Sample Collection: Requirements For Environmental Analyses/Water	9/25/90	5 of 5	242

<u>ANALYTE</u>	<u>CONTAINER</u>	<u>PRESERVATION</u>	<u>MAXIMUM HOLDING TIME</u>
Pesticides	6, Teflon-lined cap	Cool, 4°C, Cool, 4°C, pH 5-9, 0.008% Na ₂ S ₂ O ₃ for residual chlorine if aldrin is to be determined	72 hours 7 days until extraction 40 days after extraction
Polynuclear Aromatic Hydrocarbons	6, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ for residual chlorine only, store in dark	7 days until extraction 40 days after extraction
Haloethers	6, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ for residual chlorine only	7 days until extraction 40 days after extraction
Chlorinated Hydrocarbons	6, Teflon-lined cap	Cool, 4°C	7 days until extraction 40 days after extraction
2,3,7,8-Tetra- chlorodibenzo- p-Dioxin	6, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ for residual chlorine only	7 days until extraction 40 days after extraction
<u>Radiological Tests:</u>			
Alpha	P, G	HNO ₃ to pH<2	6 months
Beta	P, G	HNO ₃ to pH<2	6 months
Radium	P, G	HNO ₃ to pH<2	6 months
<u>Microscopical Tests:</u>			
Asbestos	P	Cool to 4°C 20 mg/l Hg as HgCl ₂	48 hours 6 months

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CERTIFICATION MANUAL

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Sample Collection: Requirements For Environmental Analyses/Water	9/25/90	4 of 5	242

<u>ANALYTE</u>	<u>CONTAINER</u>	<u>PRESERVATION</u>	<u>MAXIMUM HOLDING TIME</u>
Phenols	6, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ for residual chlorine	7 days until extraction 40 days after extraction
Benzidines	6, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ for residual chlorine	7 days until extraction 7 days after extraction if stored under inert gas
Phthalate Esters	6, Teflon-lined cap	Cool, 4°C	7 days until extraction 40 days after extraction
Nitrosamines	6, Teflon-lined cap	Cool, 4°C, store in dark, 0.008% Na ₂ S ₂ O ₃ for residual chlorine For diphenylnitrosamine add 0.008% Na ₂ S ₂ O ₃ and adjust pH 7-10 with NaOH within 24 hours of sampling	7 days until extraction 40 days after extraction
Nitroaromatic and Isophorone	6, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ for residual chlorine, store in dark	7 days until extraction 40 days after extraction
PCBs	6, Teflon-lined cap	Cool, 4°C	7 days until extraction 40 days after extraction

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Sample Collection: Requirements For Environmental Analyses/Water	9/25/90	3 of 5	242

<u>ANALYTE</u>	<u>CONTAINER</u>	<u>PRESERVATION</u>	<u>MAXIMUM HOLDING TIME</u>
Residue, Nonfilterable	P, G	Cool, 4°C	7 days
Residue, Volatile	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days
Sulfide	P, G	Cool, 4°C, add zinc acetate plus sodium hydroxide to pH>9	7 days
Surfactants	P, G	Cool, 4°C	48 hours
Temperature	P, G	None	Analyze Immediately
<u>Organic Tests:</u>			
Purgeable Halocarbons plus Benzyl Chloride and Epichlorohydrin	G, Teflon- lined septum	Cool, 4°C, Ascorbic Acid (25 mg/40 ml) for residual chlorine	14 days
Purgeable Aromatics	G, Teflon- lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ for residual chlorine	7 days
		Preserve as above and HCl to pH<2	14 days
Acrolein and Acrylonitrile	G, Teflon- lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ for resi- dual chlorine	14 days for acryloni- trile, 3 days for acrolein
		Preserve as above and pH to 4-5	14 days

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Sample Collection: Requirements For Environmental Analyses/Water	9/25/90	2 of 5	242

<u>ANALYTE</u>	<u>CONTAINER</u>	<u>PRESERVATION</u>	<u>MAXIMUM HOLDING TIME</u>
Hardness	P, G	HNO ₃ to pH<2 H ₂ SO ₄ to pH<2	6 months
Hydrogen ion (pH)	P, G	None	Analyze Immediately
Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days
Metals, except chromium VI and mercury	P, G	HNO ₃ to pH<2	6 months
Chromium VI	P, G	Cool, 4°C	24 hours
Mercury	P, G	HNO ₃ to pH<2	28 days
Nitrate	P, G	Cool, 4°C	48 hours
Nitrate-nitrite	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days
Nitrite	P, G	Cool, 4°C	48 hours
Oil and Grease	G	Cool, 4°C, HCl or H ₂ SO ₄ to pH<2	28 days
Organic carbon	P, G	Cool, 4°C, HCl or H ₂ SO ₄ to pH<2	28 days
Orthophosphate	P, G	Filter immediately, Cool, 4°C	48 hours
Phenols	G	Cool, 4°C H ₂ SO ₄ to pH<2	28 days
Phosphorus (elemental)	G	Cool, 4°C	48 hours
Phosphorus, total	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable	P, G	Cool, 4°C	7 days

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Sample Collection: Requirements For Environmental Analyses/Water	9/25/90	1 of 5	242

<u>ANALYTE</u>	<u>CONTAINER</u>	<u>PRESERVATION</u>	<u>MAXIMUM HOLDING TIME</u>
<u>Bacteriological Tests:</u>			
Coliform, Total and Fecal	P, G	Cool, 4°C	6 hours
Coliform, Total and Fecal in chlorinated samples	P, G	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃	6 hours
Fecal Streptococci	P, G	Cool, 4°C	6 hours
<u>Inorganic Tests:</u>			
Acidity	P, G	Separate bottle completely filled to the exclusion of air, Cool, 4°C	14 days
Alkalinity	P, G	Separate bottle completely filled to the exclusion of air, Cool, 4°C	14 days
Ammonia	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days
Biochemical oxygen demand	P, G	Cool, 4°C	48 hours
Bromide	P, G	None	28 days
Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours
Chemical oxygen demand	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days
Chloride	P, G	None	28 days
Color	P, G	Cool, 4°C	48 hours
Cyanide, total and amenable to chlorination	P, G	Cool, 4°C, NaOH to pH>12, 0.6g ascorbic acid	14 days
Fluoride	P	None	28 days

ENVIRONMENTAL LABORATORY APPROVAL PROGRAM
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Sample Collection: Requirements For Public Drinking Water	9/25/90	3 of 3	241

<u>ANALYTE</u>	<u>CONTAINER</u>	<u>PRESERVATION</u>	<u>MAXIMUM HOLDING TIME</u>
<u>Microscopical Tests:</u>			
Asbestos	P	Cool, 4°C	48 hours
		Preserved in 20 ppm Hg as HgCl ₂	6 months
<u>Radiological Tests:</u>			
Gross Alpha	P, G	HCL or HNO ₃ to pH < 2	Not Applicable
Gross Beta	P, G	HCL or HNO ₃ to pH < 2	Not Applicable
Strontium-89	P, G	HCL or HNO ₃ to pH < 2	2 months
Strontium-90	P, G	HCL or HNO ₃ to pH < 2	Not Applicable
Radium-226	P, G	HCL or HNO ₃ to pH < 2	Not Applicable
Radium-228	P, G	HCL or HNO ₃ to pH < 2	Not Applicable
Cesium-134	P, G	HCL or HNO ₃ to pH < 2	Not Applicable
Iodine-131	P, G	None	7 days
Tritium	P, G	None	Not Applicable
Uranium	P, G	HCL or HNO ₃ to pH < 2	Not Applicable
Photon Emitters	P, G	HCL or HNO ₃ to pH < 2	Not Applicable

**ENVIRONMENTAL LABORATORY APPROVAL PROGRAM
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Sample Collection: Requirements For Public Drinking Water	9/25/90	2 of 3	241

<u>ANALYTE</u>	<u>CONTAINER</u>	<u>PRESERVATION</u>	<u>MAXIMUM HOLDING TIME</u>
Silver	P,6	HNO ₃ to pH<2	6 months
Sodium	P,6	HNO ₃ to pH<2	6 months
Sulfate	P,6	Cool, 4°C	7 days
Total Filterable Residue	P,6	Cool, 4°C	7 days

Organic Tests:

Pesticides: Endrin Lindane Methoxychlor Toxaphene	Glass with foil or Teflon- lined cap	Cool, 4°C	14 days until extraction and 30 days after extraction
Herbicides: 2,4-D 2,4,5-TP (Silvex)	Glass with foil or Teflon- lined cap	Cool, 4°C	7 days until extraction and 30 days after extraction
Trihalomethanes: Bromodichloromethane Bromoform Chlorodibromomethane Chloroform	Glass with Teflon- lined Septum	0.008XNa ₂ S ₂ O ₃	14 days
Volatile Halocarbons: Chloromethane Vinyl Chloride Chlorethane Bromoethane	Glass with Teflon- lined Septum	Ascorbic Acid (25 mg/40 ml) added to empty sample bottle	14 days
Volatile Aromatics:	Glass with Teflon- lined Septum	1:1 HCl to pH<2 Cool, 4°C	14 days
Microextractables:	Glass with Teflon- lined Septum	Cool, 4°C	28 days

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<u>ANALYTE</u>	<u>CONTAINER</u>	<u>PRESERVATION</u>	<u>MAXIMUM HOLDING TIME</u>
<u>Bacteriological Tests:</u>			
Coliform (Total)	P, G	0.008% $\text{Na}_2\text{S}_2\text{O}_3$	30 hours
Standard Plate Count	P, G	0.008% $\text{Na}_2\text{S}_2\text{O}_3$	30 hours
<u>Inorganic Tests:</u>			
Alkalinity	P, G	Separate bottle completely filled to the exclusion of air, cool, 4°C	14 days
Arsenic	P, G	HNO_3 to pH<2	6 months
Barium	P, G	HNO_3 to pH<2	6 months
Cadmium	P, G	HNO_3 to pH<2	6 months
Calcium	P, G	HNO_3 to pH<2	6 months
Chloride	P, G	None	7 days
Chromium	P, G	HNO_3 to pH<2	6 months
Color	P, G	Cool, 4°C	48 hours
Fluoride	P, G	None	28 days
Lead	P, G	HNO_3 to pH<2	6 months
Mercury	G P	HNO_3 to pH<2 HNO_3 to pH<2	38 days 14 days
Nitrate By Ion Chromatography	P, G	Cool, 4°C	48 hours
Chlorinated Supplies	P, G	Cool, 4°C	28 days
Non-chlorinated Supplies	P, G	H_2SO_4 to pH<2	14 days
pH	P, G	None	1 hour
Selenium	P, G	HNO_3 to pH<2	6 months

APPENDIX B

Certificates and Certified Parameters

NEW YORK STATE - DEPARTMENT OF HEALTH
 ENVIRONMENTAL LABORATORY APPROVAL PROGRAM (ELAP)
 WADSWORTH CENTER FOR LABORATORIES AND RESEARCH
 EMPIRE STATE PLAZA - RM. D-224
 P.O. BOX 509
 ALBANY, NY 12201-0509
 (518) 474-8519

Page
 1

May 22, 1992

ELAP LABS CERTIFIED FOR NYSDEC ASP (Contract Laboratory Protocol)

INORGANICS PCBs & PESTS VOLATILES SEMI-VOLATILES

10026 NYSDEC ENVIRONMENTAL INC R. ROBERT K WYETH 10 HAZELWOOD DRIVE SUITE 106 AMHERST, NY 14228 (716)691-2500	X	X	X	X
10142 VVIROTEST LABORATORIES INC R. RONALD BAYER 315 FULLERTON AVE NEWBURGH, NY 12550 (914)562-0890	X	X	X	X
10145 GENERAL TESTING CORPORATION J. MICHAEL PERRY 710 EXCHANGE STREET ROCHESTER, NY 14608 (716)454-3760	X	X	X	X
10155 3G LABS - ENVIRONMENTAL DIV A. DAVID R HILL 5000 BRITTONFIELD PKY-SUITE300 SARASOTA, FL 34231 (813)437-0200	X	X	X	X
10186 ALSON LABORATORIES M. F JOSEPH UNANGST 6601 KIRKVILLE ROAD SYRACUSE, NY 13057 (315)432-0506	X	X	X	X
10195 TEST ENVIRONMENTAL INC R. REMO GIGANTE 60 SEAVIEW BLVD RT WASHINGTON, NY 11050 (516)334-7770	X	X	X	X

May 22, 1992

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4

ELAP LABS CERTIFIED FOR NYSDEC ASP (Contract Laboratory Protocol)
INORGANICS

PCBs & PESTS

VOLATILES

SEMI-VOLATILES

10833
HUNTINGDON ANALYTICAL SERVICES
MR. TODD COVEL
140 TELEGRAPH RD
MIDDLEPORT, NY 14105
(716)735-3400

X

X

X

X

10848
RECRA ENVIRONMENTAL-MARYLAND
DR. WALTER E MILLER
8320 GUILFORD RD BLDG F
COLUMBIA, MD 21046
(301)381-2288

X

X

X

10867
NET MID-ATLANTIC INC
MR. ROBERT E MAXFIELD
THOROFARE DIVISION, 100 GROVERD
THOROFARE, NJ 08085
(609)848-3939

X

X

X

X

11000
ENERGY & ENV ENGINEERING INC
MR. NICHOLAS P CORSO
PO BOX 215
EAST CAMBRIDGE, MA 02141
(617)666-5500

X

X

X

X

11103
ENVIROSYSTEMS INC
DR. MOHAN KHARE
9200 RUMSEY ROAD -SUITE 8102
COLUMBIA, MD 21045
(301)964-0330

X

X

X

11121
COAST-TO-COAST ANAL SRVCS INC - ME DIV
MS. D ELIZABETH HARROLD
P O BOX 720 - 340 COUNTY RD
WESTBROOK, ME 04092
(207)874-2400

X

X

NEW YORK STATE DEPARTMENT OF HEALTH

DAVID AXELROD, M. D. COMMISSIONER



Expires 12:01 AM April 1, 1991
ISSUED April 1, 1991
REVISED January 10, 1992

INTERIM CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

Lab ID No.: 10833

Director: DR. RICHARD RONAN

Lab Name: HUNTINGDON ANALYTICAL SERVICES

Address: 140 TELEGRAPH RD

MIDDLEPORT NY 14105

is hereby APPROVED as an Environmental Laboratory for the category

ENVIRONMENTAL ANALYSES NON POTABLE WATER

All approved subcategories and/or analytes are listed below:

Chlor. Hydrocarbon Pesticides :	Polynuclear Aromatics :	Wastewater Miscellaneous :	Mineral :
4,4'-DDD	Acenaphthene	Boron, Total	Alkalinity
4,4'-DDE	Anthracene	Cyanide, Total	Calcium Hardness
4,4'-DDT	Acenaphthylene	Color	Chloride
alpha-BHC	Benzo(a)anthracene	Phenols	Fluoride, Total
Aldrin	Benzo(a)pyrene	Oil & Grease Total Recoverable	Sulfate (as SO ₄)
Beta-BHC	Benzo(b)fluoranthene	Hydrogen Ion (pH)	Hardness, Total
Chlordane Total	Benzo(ghi)perylene	Sulfide (as S)	Wastewater Metals III :
delta-BHC	Chrysene	Surfactant (MBAS)	Cobalt, Total
Dieldrin	Dibenzo(a,h)anthracene	Organic Carbon, Total	Molybdenum, Total
Endrin aldehyde	Fluoranthene	Acrolein and Acrylonitrile (ALL)	Tin, Total
Endrin	Fluorene	Benzidines (ALL)	Titanium, Total
Endosulfan I	Indeno(1,2,3-cd)pyrene	Chlorophenoxy Acid Pesticides (ALL)	Thallium, Total
Endosulfan II	Naphthalene	Chlorinated Hydrocarbons (ALL)	Demand (ALL)
Endosulfan sulfate	Phenanthrene	Haloethers (ALL)	Wastewater Metals I (ALL)
Heptachlor	Pyrene	Wastewater Metals II (ALL)	Nitroaromatics and Isophorone (ALL)
Heptachlor epoxide	Nitrosoamines (ALL)	Nutrient (ALL)	Polychlorinated Biphenyls (ALL)
Lindane	Phthalate Esters (ALL)	Priority Pollutant Phenols (ALL)	Purgeable Aromatics (ALL)
Methoxychlor	Purgeable Halocarbons (ALL)	Residue (ALL)	TCLP Additional Compounds (ALL)
Toxaphene			

Lawrence S. Sturman

Lawrence S. Sturman, M.D., Ph.D., Acting Director

Herbert W. Dickerman, M.D., Ph.D., Director

Wadsworth Center for Laboratories and Research

Serial No.: 10587

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Must be conspicuously posted. Valid certificate has a red serial number.

NEW YORK STATE DEPARTMENT OF HEALTH

DAVID AXELROD, M. D. COMMISSIONER



Expires 12:01 AM April 1, 1991
ISSUED April 1, 1991
REVISED January 7, 1992

INTERIM CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

Lab ID No.: 10833

Director: DR. RICHARD RONAN
Lab Name: HUNTINGDON ANALYTICAL SERVICES
Address : 140 TELEGRAPH RD
MIDDLEPORT NY 14105

is hereby APPROVED as an Environmental Laboratory for the category

ENVIRONMENTAL ANALYSES/SOLID AND HAZARDOUS WASTE

All approved subcategories and/or analytes are listed below:

Characteristic Testing :	Miscellaneous :	Chlorophenoxy Acid Pesticides (ALL)	Chlor. Hydrocarbon Pesticides (ALL)
Corrosivity	Cyanide, Total	Chlorinated Hydrocarbons (ALL)	Haloethers (ALL)
Ignitability	Hydrogen Ion (pH)	Metals I (ALL)	Metals II (ALL)
Reactivity	Sulfide (as S)	Nitroaromatics Isophorone (ALL)	Polynuclear Aroa. Hydrocarbon (ALL)
TCLP	Polychlorinated Biphenyls (ALL)	Phthalate Esters (ALL)	Priority Pollutant Phenols (ALL)
Toxicity	Purgeable Aromatics (ALL)	Purgeable Halocarbons (ALL)	

Lawrence S. Sturman

Lawrence S. Sturman, M.D., Ph.D., Acting Director
Herbert W. Dickerman, M.D., Ph.D., Director

Wadsworth Center for Laboratories and Research

Serial No.: 10582

Property of the New York State Department of Health. Valid only at the address shown.
Must be conspicuously posted. Valid certificate has a red serial number.

NEW YORK STATE DEPARTMENT OF HEALTH

DAVID AXELROD, M. D. COMMISSIONER



Expires 12:01 AM April 1, 1992
ISSUED April 1, 1991
REVISED January 16, 1992

INTERIM CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

Lab ID No.: 10833

Director: DR. RICHARD RONAN

Lab Name: HUNTINGDON ANALYTICAL SERVICES

Address : 140 TELEGRAPH RD

MIDDLEPORT NY 14105

is hereby APPROVED as an Environmental Laboratory for the category

ENVIRONMENTAL ANALYSES/ POTABLE WATER

All approved subcategories and/or analytes are listed below:

Drinking Water Non-Metals :
Alkalinity
Calcium Hardness
Chloride
Color
Corrosivity
Fluoride, Total
Nitrate (as N)
Hydrogen Ion (pH)
Solids, Total Dissolved

Drinking Water Metals (ALL)

Pesticide/Herbicides (ALL)

Volatile Aromatics (ALL)

Serial No.: 10598

Lawrence S. Sturman, M.D., Ph.D., Acting Director

Herbert W. Dickerman, M.D., Ph.D., Director

Wadsworth Center for Laboratories and Research

Property of the New York State Department of Health. Valid only at the address shown.

Must be conspicuously posted. Valid certificate has a red serial number.



STATE OF NEW JERSEY

DEPARTMENT OF
ENVIRONMENTAL PROTECTION

Certifies That

Huntingdon Analytical Services
PO Box 250
Middleport, NY 14105

having duly met the requirements of the

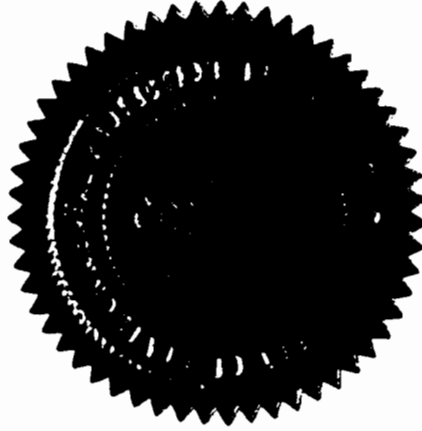
*Regulations Governing Laboratory Certification
And Standards Of Performance N.J.A.C. 7:18 et. seq.*

is hereby approved as a

State Certified Water Laboratory

*To perform the analyses as indicated on the Annual Certified Parameter List
which must accompany this certificate to be valid*

73640
PERMANENT CERTIFICATION NUMBER
February 2, 1989
DATE



Christine J. Day
ACTING COMMISSIONER
DEPARTMENT OF ENVIRONMENTAL PROTECTION

This certification is subject to unannounced laboratory inspections as specified by
N.J.A.C. 7:18-2.11(d) and agreed to by the Laboratory Manager on filing the application

TO BE CONSPICUOUSLY DISPLAYED AT THE LABORATORY WITH THE ANNUAL CERTIFIED PARAMETER LIST.

Let's protect our earth



STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF QUALITY ASSURANCE
ANNUAL CERTIFIED PARAMETER LIST FOR 1991-1992

HUNTINGDON ANALYTICAL SERVICES (73640) IS CERTIFIED TO PERFORM THE ANALYSES
BELOW UNTIL JUNE 30 1992.

DRINKING WATER LABORATORY CERTIFICATION

LIMITED CHEMISTRY

- 934 NITRATE, AUTO CD REDUC
- 935 FLUORIDE-ELECTRODE
- 944 TURBIDITY
- 945 CHLORINE RESIDUAL
- 946 CHLORIDE, POTENTIOMETRIC
- 947 CHLORIDE, HG OR AG NITRAT
- 948 COLOR, PLATINUM COBALT
- 951 PH, GLASS ELECTRODE
- 952 TOT DISS SOLIDS, TOT RES
- 953 HARDNESS, EDTA
- 956 SULFATE, GRAVIM OR TURBID

METALS

- 903 CU, ATOMIC ABSORPTION
- 904 FE, ATOMIC ABSORPTION
- 906 ZN, ATOMIC ABSORPTION
- 912 HG, MANUAL COLD VAPOR

DRINKING WATER LABORATORY CERTIFICATION

METALS

915 BA, GRAPHITE FURNACE
916 CD, GRAPHITE FURNACE
917 CR, GRAPHITE FURNACE
918 PB, GRAPHITE FURNACE
920 SE, GRAPHITE FURNACE
922 CU, GRAPHITE FURNACE
923 FE, GRAPHITE FURNACE
924 MN, GRAPHITE FURNACE
925 ZN, GRAPHITE FURNACE
961 BARIUM, ICAP
962 CADMIUM, ICAP
963 CHROMIUM, ICAP
964 LEAD, ICAP
966 COPPER, ICAP
967 IRON, ICAP
968 MANGANESE, ICAP
969 ZINC, ICAP

WATER POLLUTION LABORATORY CERTIFICATION

LIMITED CHEMISTRY

00076 TURBIDITY
00030 COLOR

WATER POLLUTION LABORATORY CERTIFICATION

LIMITED CHEMISTRY

00095 SPECIFIC CONDUCTANCE
00299 DISS OXYGEN-ELECTRODE
00300 DISS OXYGEN-WINKLER
00310 BOD-5 DAY
00340 COD
00400 HYDROGEN ION-PH
00410 ALKALINITY
00436 ACIDITY
00500 TOT SOLIDS
00505 TOT VOLATILE SOLIDS
00530 SUSP SOLIDS
00545 SETT SOLIDS-VOLUMETRIC
00556 OIL AND GREASE
00605 ORGANIC NITROGEN
00610 AMMONIA NITROGEN
00615 NITRITE
00625 TOT KJELDAHL NITROGEN
00630 NITRATE
00650 PHOSPHORUS, TOT AS PO4
00660 ORTHOPHOSPHATE AS PO4
00680 ORGANIC CARBON, TOTAL
00720 CYANIDE, TOTAL

WATER POLLUTION LABORATORY CERTIFICATION

LIMITED CHEMISTRY

00722 CYANIDE, AMEN TO CHLOR

00740 SULFITE

00745 SULFIDE

00900 HARDNESS

00940 CHLORIDE

00945 SULFATE

00951 FLUORIDE, TOTAL

32730 PHENOLS

38260 SURFACTANTS

50060 CHLORINE RESIDUAL

70300 TOT DISS SOLIDS

METALS

00915 CALCIUM (ICAP)

00916 CALCIUM (AA)

00925 MAGNESIUM (ICAP)

00927 MAGNESIUM (AA)

00929 SODIUM (ICAP)

00930 SODIUM (AA)

00935 POTASSIUM (ICAP)

00937 POTASSIUM (AA)

01000 ARSENIC (ICAP)

WATER POLLUTION LABORATORY CERTIFICATION

METALS

01002 ARSENIC (AA)
01005 BARIUM (ICAP)
01007 BARIUM (AA)
01010 BERYLLIUM (ICAP)
01012 BERYLLIUM (AA)
01025 CADMIUM (ICAP)
01027 CADMIUM (AA)
01030 CHROMIUM (ICAP)
01032 CHROMIUM VI (AA)
01034 CHROMIUM (AA)
01035 COBALT (ICAP)
01037 COBALT (AA)
01040 COPPER (ICAP)
01042 COPPER (AA)
01045 IRON (ICAP)
01046 IRON (AA)
01049 LEAD (ICAP)
01051 LEAD (AA)
01055 MANGANESE (ICAP)
01056 MANGANESE (AA)
01059 THALLIUM (AA)
01060 MOLYBDENUM (ICAP)

WATER POLLUTION LABORATORY CERTIFICATION

METALS

01062 MOLYBDENUM (AA)
01065 NICKEL (ICAP)
01067 NICKEL (AA)
01075 SILVER (ICAP)
01077 SILVER (AA)
01085 VANADIUM (ICAP)
01087 VANADIUM (AA)
01090 ZINC (ICAP)
01092 ZINC (AA)
01097 ANTIMONY (AA)
01102 TIN (AA)
01105 ALUMINUM (ICAP)
01106 ALUMINUM (AA)
01145 SELENIUM (ICAP)
01147 SELENIUM (AA)
01152 TITANIUM (AA)
71900 MERCURY (COLD VAPOR)

ORGANICS

601 PURGEABLE HALOCARBONS (GC)
602 PURGEABLE AROMATICS (GC)
608 PESTICIDES & PCBS (GC)

WATER POLLUTION LABORATORY CERTIFICATION

ORGANICS

624 PURGEABLES (GC/MS)

625 B/N, ACIDS & PEST (GC/MS)

09032 PENTACHLOROPHENOL

99007 PESTICIDES

39330 ALDRIN

39380 DIELDRIN

39360 DDD

39365 DDE

39370DDT

39410 HEPTACHLOR

39350 CHLORDANE

THIS LIST MUST BE CONSPICUOUSLY DISPLAYED WITH THE PERMANENT
CERTIFICATE AT THE LABORATORY

DEPARTMENT OF ENVIRONMENTAL RESOURCES

OFFICE OF ENVIRONMENTAL PROTECTION

BUREAU OF LABORATORIES

COMMONWEALTH OF PENNSYLVANIA

Certifies that

Huntingdon Analytical Services, Inc.
P.O. Box 250, 140-144 Telegraph Rd.
Middleport, NY 14105
I.D. # 68-357

having duly met the requirements of
Chapter 109, Subchapter H, Safe Drinking Water Rules and Regulations
issued under the Pennsylvania Safe Drinking Water Act of May 1, 1984
(P.L. 206, No. 43), (35 P.S. 55721.1-721.17)
is hereby approved as a

Certified Drinking Water Laboratory

To perform the following analyses:

Inorganic
Trace Metals, Nitrate/Fluoride, Sodium/Corrosivity

Organic
Herbicides/Pesticides, Total Trihalomethanes

Expiration Date: 9/1/92

Certificate not transferable
surrender upon revocation
to be conspicuously displayed at the laboratory



Floyd Kefferd, Bureau Director
Bureau of Laboratories



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

January 13, 1992
Laboratory NO. 68-357
Certified Mail P 514 427 671

Huntingdon Analytical Services
PO Box 250
Middleport, NY 14105

Dear Mr. Ronan:

The analytical program at your laboratory based on the on-site evaluation now conforms with the mandatory requirements specified in the "Procedures for the Approval and Certification of Drinking Water Laboratories in the Commonwealth of Pennsylvania".

LABORATORY CERTIFICATION STATUS

Certified in the areas below in compliance with the Pennsylvania Safe Drinking Water Act.

Trace Metals

Nitrate/Fluoride

Sodium/Corrosivity

Herbicides/Pesticides

Not Certified in the areas below in compliance with the Pennsylvania Safe Drinking Water Act.

Total Trihalomethanes

Certified status for this not certified subcategory may be granted upon successfully analyzing the next regularly scheduled water supply performance evaluation study.

Certification status may be affected by past and future evaluation studies.

RECEIVED

JAN 21 1992

HUNTINGDON ANALYTICAL SERVICE

SIGNATURE

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