112147

Table 4

Routes and Symptoms of Exposure to the Inorganic Compounds of Concern

Compound	Routes of Exposure	Symptoms of Exposure
Cyanide	Inhalation, ingestion, absorption, eye/skin contact	Weakness, headaches; confusion, nausea, vomiting eye and skin irritation; slow gasping respiration
Copper	Inhalation, ingestion, skin or eye contact	Irritation to the skin, dermatitis, conjunctivitis; turbidity of the cornea,
Cadmium	Inhalation, ingestion	Irritation to the respiratory tract; anosmia; chest pains; sweating; chills
Fluoride	Inhalation, ingestion, eye and skin contact	Irritation to skin, eyes, mucous membranes, and lungs; bronchospasms; laryngospasm; pulmonary edema; sore throat; chest pains

The design of drilling rigs creates the potential for contact with overhead electric lines and underground utility lines. The rig will not be operated within 15 feet of electric lines. Underground utility lines will be located and avoided.

In the event of an accident the nearest medical assistance will be sought as specified in the Emergency Contacts section below.

Site Health and Safety Preparation and Contingency Plan

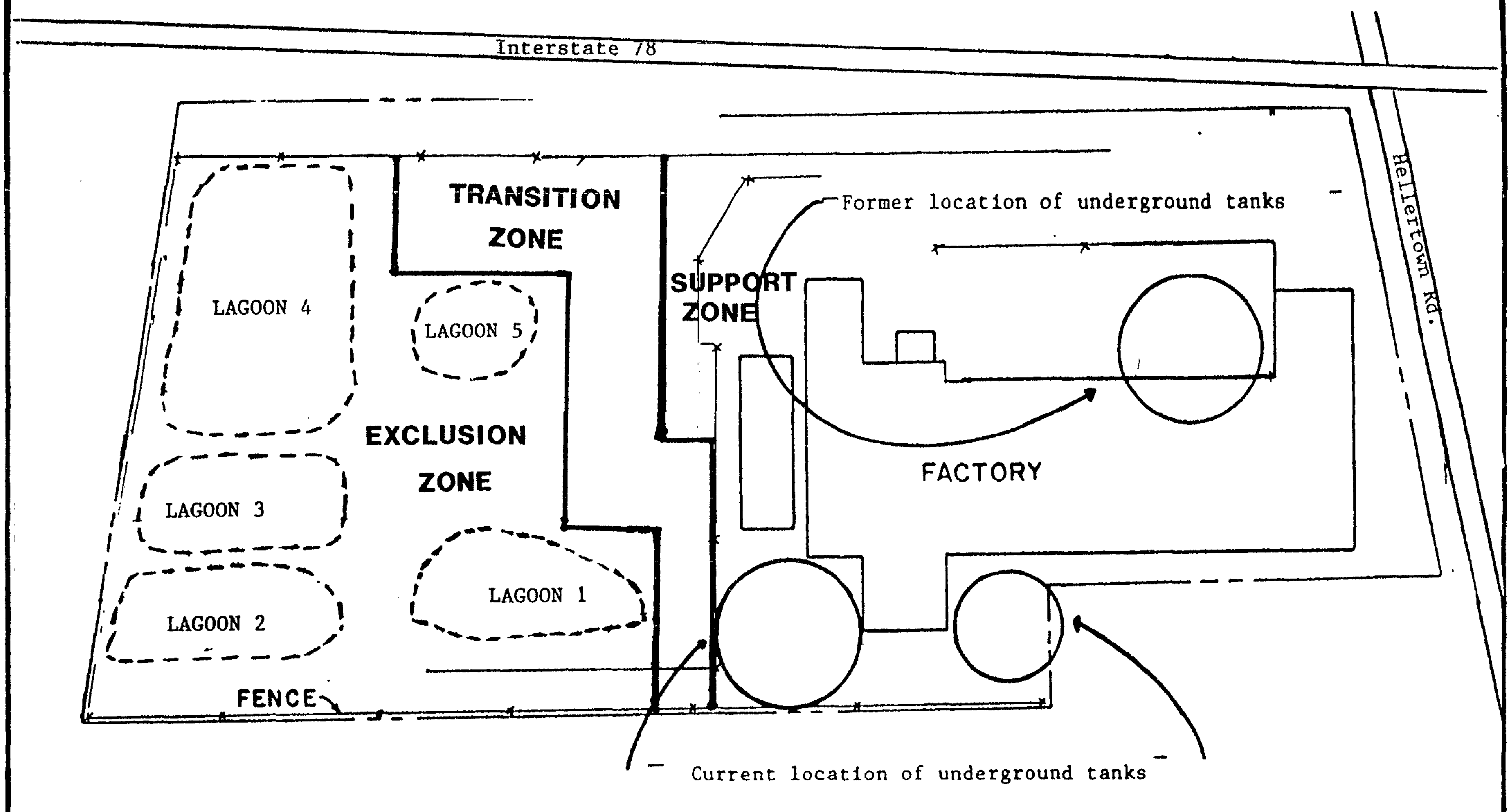
Safety Zones

There will be three designated safety zones at the site. The zones will be clearly delineated during all field work. The clean zone will consist of the property entrance from Main Street to the west fence line just west of and surrounding the site buildings. The transition zone will be adjacent to the clean zone, west of the fence line which runs along the west side of the buildings, and east of the lagoons. Personnel and equipment decontamination will conducted in the transition zone. The exclusion zone will be the lagoon areas which contain waste materials (Figure 3).

Site Security and Access

The site access will be restricted to allow only the site management team and contractors involved in field work and the property owners. Contractors will be allowed onsite only with the approval of the site manager and only with designated safety equipment. Contract personnel will be accompanied by an ESC employee when entering the exclusion and transition zones. Visitors such as state or federal personnel will be required to comply with all safety procedures.

Access to the site will be through the site entrance from Main Street near the security guard station. The site security



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ESC

FIGURE—3

SAFETY ZONES
HELLERTOWN MANUFACTURING CO.

guard will be on duty from 8:00 a.m. to 4:00 p.m. City authorities will be notified of activities at the site. Access control will be set up to regulate entry and exit from the transition and exclusion zones.

Basic Safety Practices

The site health and safety officer will be responsible for informing all site personnel of basic safety practices and rules. The following specific practices will be required:

- Eating, drinking, smoking, and chewing gum or tobacco, or any activity that increases the probability of hand-to-mouth transfer or ingestion of material is prohibited in the transition and exclusion zones.
- Alcohol or drug consumption is prohibited onsite.
- Personnel will enter contaminated zones only with designated protective equipment and the permission of the site manager.
- Personnel will avoid contact with obvious contaminated objects and areas by not kneeling on, sitting on, walking through, or picking up any objects or materials that may be contaminated or that are not necessary to complete the task at hand.
- Hands and face will be thoroughly washed upon leaving the work area and before eating, drinking, or other activities.

- Wearing contact lenses while wearing full-face respirators is prohibited.
- Facial hair that interferes with a satisfactory fit of respiratory protective equipment will not be permitted.
- Personnel will maintain contact with the site safety officer.

Support Services

Facilities for washing hands and face will be provided in the clean zone. Potable water will be supplied at the site. Drinking water and disposable cups will be available in the clean zone. A first aid kit will be available onsite. The drilling rig will be equipped with a fire extinguisher.

Reporting Exposure and Injury Incidents

All incidents involving personal injury or exposure to potentially hazardous materials during any field activity will be documented and reported immediately to the ESC project manager and health and safety director. A standard incident report is used for this purpose.

Contingency Plan

Before beginning site work, all personnel will be familiarized with the contingency plans for emergencies. All site team members will be provided with a site safety plan which lists emergency contacts and directions to the nearest hospital.

Emergency Contacts

Fire Department:	215/838-7777
Police Department:	215/838-7049
Ambulance Service:	215/838-7777
Poison Control Center:	215/838-7041

Hospital
St. Luke's Hospital
801 Ostrum Street
Bethlehem, PA
215/691-4141

Directions to hospital from site:

Go from site driveway left on Main Street (Hwy 412) to Third Street in Bethlehem. Take Third Street to Delaware Street and turn left. Turn right onto Ostrum from Delaware Street. Hospital is located at the bottom of the hill (Figure 4). St. Luke's Hospital has an Occupational Medicine Section equipped to handle emergencies that might occur at the site. ESC has received confirmation from the hospital of their capability to treat site injuries and their approval to bring potential injured personnel to St. Luke's for treatment.

Plant Utilities:

Plant water and sewer lines discharge into the city main line which runs along the center of Main Street (HWY 412) east of the plant building (Figure 5). All plant electrical lines are aboveground.

ESC Project Manager (Catherine Price)	703/821-3700
ESC Health and Safety Director (Mark Lunsford)	703/821-3700

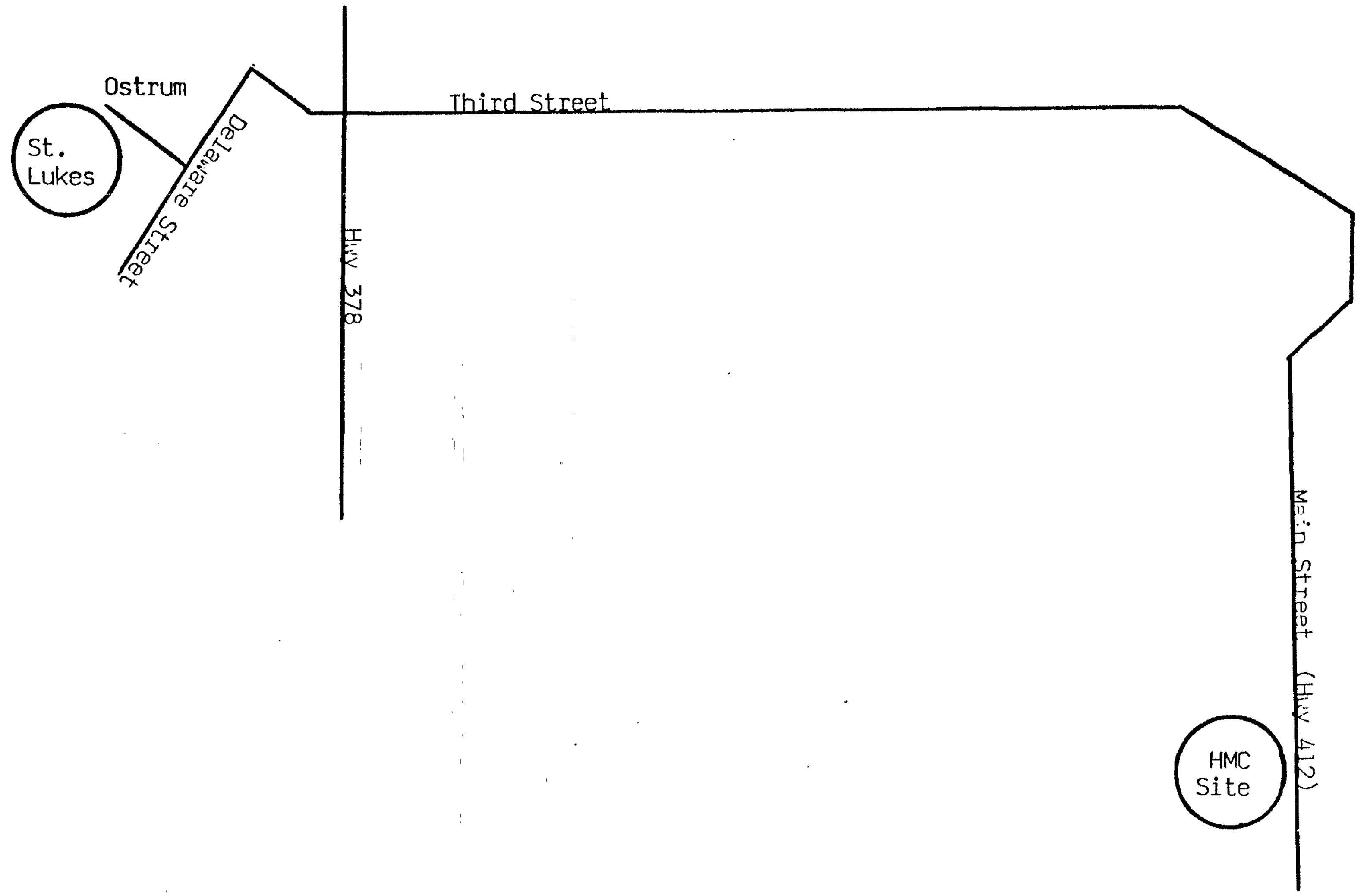

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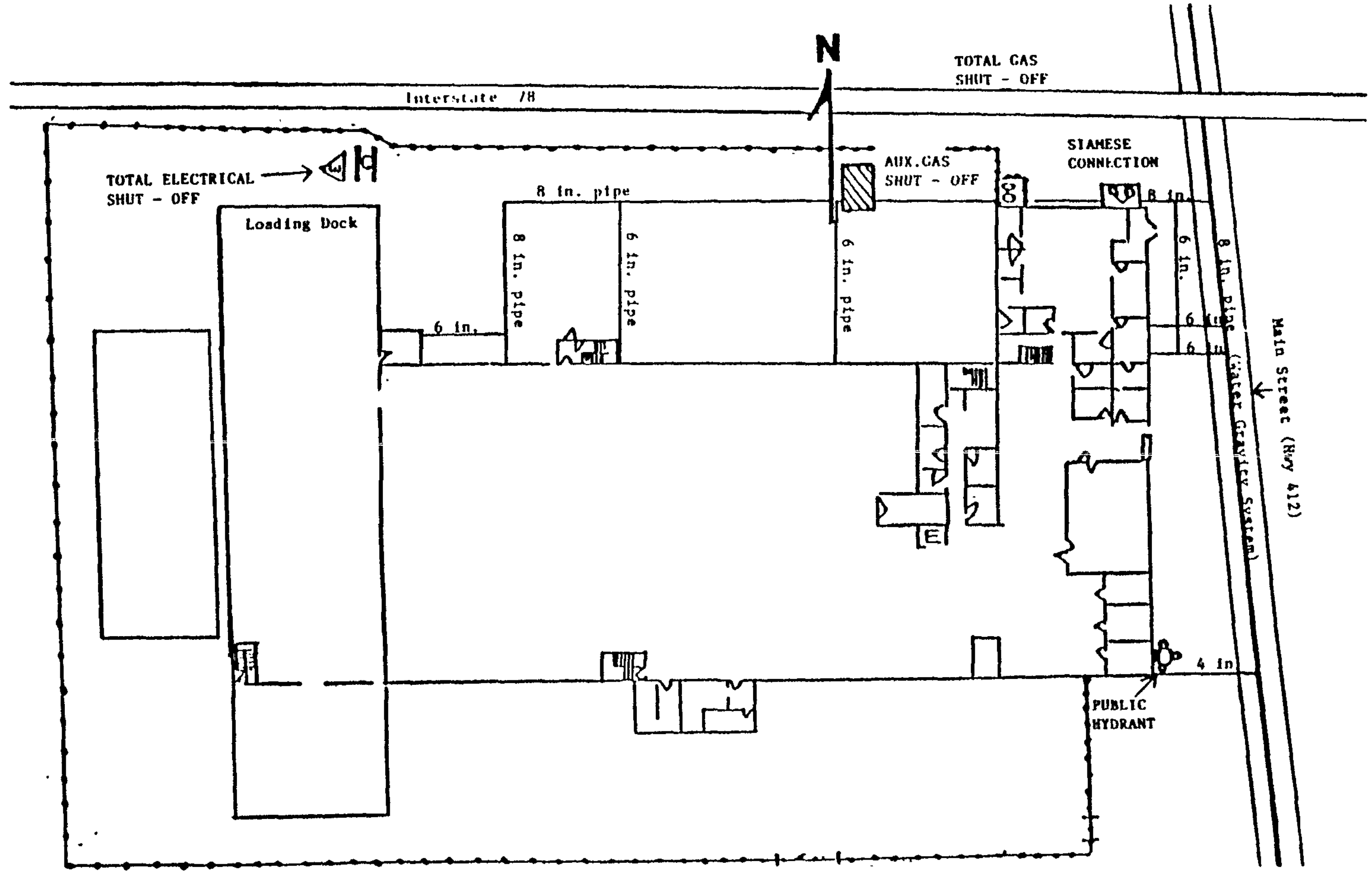
Figure 4

Route to hospital from Hellertown Manufacturing Co.



Pipes are underground

Electrical lines are aboveground

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FIGURE 5

Plant Utilities

Hellertown Manufacturing Company
Hellerttown, Pennsylvania

Personal Protective Equipment

Level C personal protective equipment may be specified for personnel operating drilling rig and sampling equipment, and collecting and packaging samples. Level C personal protective kits will consist of the following equipment to be worn if necessary within the exclusion zone.

- full-face ultratwin air purifying respirator
- organic and dust respirator cartridges
- Tyvek coveralls
- steel-toed and steel-shank work boots
- outer booties
- inner gloves (latex or PVC)
- outer gloves (butyl rubber or neoprene and cloth)
- hardhats

Level D personal protective kits will consist of the same items listed for Level C. Respirators will be available but not worn unless organic vapors reach the action level. Contractors will provide their own personal protective equipment.

The face-to-facepiece seal of the respirator affects its performance. The site safety officer will be responsible for ensuring that a good seal is obtained. After each day's use, the respirators will be inspected, cleaned, and stored. Damaged equipment will be immediately replaced. Back-up equipment will be kept onsite for replacement as necessary.

The following equipment will be discarded and replaced daily:

- respirator cartridges
- Tyvek coveralls
- outer booties
- inner surgical gloves

Level of Protection

Level D protection will be worn by personnel in the work area unless air monitoring equipment indicates organic vapors in the atmosphere are at a level of 5 ppm above the ambient background level. In this case the level of protection will be upgraded to level C. An HNu or OVA will be used to determine if the organic vapor level in the atmosphere requires Level C protection.

All personnel entering the exclusion zone will wear the following equipment:

- Tyvek coveralls
- steel-toed and steel-shank protective boots (rubber, neoprene, etc.) or leather protective boots with boot covers
- safety glasses
- inner gloves (latex or PVC)

Anyone working in the vicinity of an operating drilling rig will wear the following equipment in addition to those listed above:

- hardhat
- outer gloves (butyl rubber, neoprene, etc)

Anyone entering the transition zone will wear the following:

- steel-toe and steel-shank protective boots

Anyone handling waste materials during any activity will wear both inner and outer gloves.

Onsite Safety Equipment

Several pieces of safety equipment will be provided within the immediate vicinity of the work area. An Hnu meter will be used to detect organic vapors. A first aid kit will be kept at the command station. Water hoses will be located at the site to allow rapid wash down of personnel to remove contaminants and to reduce body temperature.

Air Monitoring Procedures

Air monitoring will be performed during drilling operations and soil borings. Air monitoring will be done using an organic vapor analyzer (OVA) or a photoionization detector. Cyanide and vinyl chloride will be monitored using Draeger tubes. If organics are detected in the breathing zone at 1 ppm above background, Level C protection will be used. If sustained readings of greater than 1 ppm of vinyl chloride or 5 ppm other organics above background are encountered, personnel will be withdrawn from the work zone pending characterization of the contaminants present. If respirators are required, combination respirator cartridges (MSA GMA-H & GMC-H) will be used. These cartridges provide protection in atmospheres containing less than 1,000 ppm (0.1%) of organic vapors according to MSA specifications. Cartridges will be changed daily or when there is odor break through.

It is not ESC's policy to have its staff perform Level B work. If it is determined that conditions warrant Level B protection, work will stop until the driller meets Level B protection standards. ESC will then determine whether a separate sampling subcontractor will be retained to conduct Level B sampling operations or whether the drillers will conduct the sampling with ESC maintaining an oversight role (observing from outside the immediate work zone).

The HNu or OVA will be calibrated as a minimum at the start of each operating day by the site safety officer or when the instruments supply erratic readings. Instructions for the calibration of the HNu are provided below.

HNu Calibration

The calibration of the HNu analyzer can be readily checked by the use of an HNu small disposable cylinder containing isobutylene with a regulator. At the factory, the analyzer is first calibrated on the desired gas standard at the specified concentration. Then a measurement is made using isobutylene. The ppm reading along with the span setting using isobutylene is recorded in the report. In service, the analyzer calibration can be checked and readjusted if necessary by using this cylinder and regulator as follows:

1. The analyzer is connected to the regulator and cylinder with a short piece (butt connection) of tubing. The calibration gas in the cylinder consists of a mixture of isobutylene and zero air. Isobutylene is nontoxic and safe to use in confined areas. There are no listed exposure levels at any concentration. The regulator sets and controls the flow rate of gas at a value preset at the factory. This will be about 250 cc/min. It is important that the tubing be clean to avoid interferences with the calibration reading. Do not use the cylinder below about 30 psig as readings below that level can deviate up to 10% from the rated value. Zero the unit on standby.

2. With the SPAN setting at 5.0 and function switch at 0-200, open the valve on the cylinder until a steady reading is obtained.

3. If the reading is the same as the recorded data (76), the analyzer calibration for the original species of interest is still correct.

4. If the reading has changed, adjust the SPAN setting until the reading is the same.

5. Shut off the cylinder as soon as the reading is established.

6. Record and maintain the new SPAN setting. Then recalibrate the analyzer on the species of interest as soon as possible.

7. Whenever the analyzer is recalibrated, it is to be immediately checked with the small cylinder and the reading recorded. This can be used for checking later in the field.

Site Control Measures

The following site control measures will be required to minimize potential contamination of workers, protect the public from potential site hazards, and to prevent unauthorized access to the site. The work crew will use onsite facilities as a change area, rest area, and operations base. A portable lavatory will be located in the clean zone near the building. Sampling equipment will be decontaminated in the transition zone near the west end of the buildings.

Before site sampling begins, a physical barrier will be erected to block the entrance to the transition zone to restrict access by the general public. The exclusion and transition zones will be identified by using caution tape. All site personnel must enter through the established contamination reduction area. A sign in sheet will be kept in the clean zone to document all persons entering and leaving the site. The decontamination line will be set up in the contamination reduction area.

Decontamination Procedures

Personal Decontamination

Individuals entering the transition zone after contact with waste materials in the exclusion zone will follow procedures outlined below:

- Segregated Equipment Drop - Deposit equipment used in the contamination zone (tools, sampling devices, containers, monitoring instruments, clipboards, etc.) in different containers with plastic liners located on a plastic drop cloth.
- Tape Removal - Remove tape around boots and gloves and deposit in the designated container.
- Boot Cover Removal - remove boot covers and deposit in designated container.
- Outer Glove Removal - Remove outer gloves and deposit in designated container. These gloves may be reused if subsequent sampling is required on successive days.
- Protective Coverall Removal - remove protective coverall and place in plastic lined container.
- Safety Boot Removal - Remove safety boots and suspend away from all surfaces or deposit in plastic lined container.
- Respirator Removal - If respirator has been used, remove face piece. Avoid touching face with gloves. Hang respirator away from potentially contaminated surfaces or

deposit on plastic liner. Respirator may be reused if subsequent sampling is to occur the same day. Cartridges are to be removed and disposed of in designated container at the end of the day. Respirators are to be washed and rinsed in the containers provided for that specific purpose.

- Inner Glove Removal - Remove inner gloves and place in container for disposal
- Field Wash - Wash and rinse hands and face in containers provided for this purpose.
- Redress - Put on clean protective clothing

Equipment Decontamination

A decontamination pad sufficient in size to accommodate decontamination of all major pieces of equipment will be set up onsite prior to initiation of sampling. All downhole drilling and sampling equipment will be decontaminated by steam cleaning before beginning each boring. Well casing and other well construction materials will be steam cleaned before installing in bore holes.

Other sampling equipment will be decontaminated before each sample using the following procedures:

- wash with nonphosphate detergent and water solution
- rinse with tap water
- rinse with distilled water
- rinse with acetone

- air dry
- rinse with distilled water

New bailer rope will be used at each well and used rope will be properly discarded after use.

Standard Operating Procedures

1. Park vehicles in designated area of clean zone.

2. Provide a copy of the Health and Safety Plan to all site personnel. Each individual will be required to sign a statement that they have read this document and are familiar with its contents.

3. During the pre-work safety meeting the project manager or safety manager will provide the following information:
   - a description of the site and known problem areas
   - the level of personal protection required
   - emergency medical information
   - the location of the first aid kit, lavatory, telephones, drinking water, and potable water

4. Lay out and check safety gear.

5. Don safety gear in order:
   - Tyvek coverall
   - steel toed work boots
   - tape suit legs to boots
   - outer booties
   - air purifying respirator

- raise hood
- hardhat
- inner gloves
- outer gloves
- tape outer gloves to suit sleeves

6. Select a buddy to act as safety backup.

7. Check your buddy's equipment and have him check yours for rips, tears, and malfunctions. Pay special attention to respirators, making sure that seals are good and that cartridges are securely in place.

8. If any equipment or gear gets damaged or if your suit tears badly - GO BACK.

9. If you experience physical discomfort, breathing difficulties, lightheadedness, dizziness, or other abnormalities - GO BACK.

10. On return, have your buddy check for external accumulation of contamination and remove it. Also check gear for damage.

Air Purifying Respirator Usage

1. Inspections
    a. Inspect before each use to be sure it has been adequately cleaned

b. Check material condition for signs of pliability, deterioration or distortion.

c. Examine cartridges and be sure they are the proper type for the intended use, that the expiration date has not passed, and that they have not been opened or previously used.

d. Check face shield for cracks or fogginess.

2. Loosen all harness strap adjustments

3. Place chin in chin cup and draw evenly back on strap adjustments. Bottom two straps first, then the two top straps, and the center strap last.

4. Check to determine that the respirator is centered evenly on the face and that the straps are not uncomfortably tight.

5. Check for proper facial seal or leaks.

   a. To conduct a negative pressure test, close the inlet part with the palm of the hands and inhale for a few seconds. Any inward rushing of air indicates a poor fit. Note that a leaking face piece may be drawn tightly to the face to form a good seal, giving a false indication of adequate fit.

   b. To conduct a positive pressure test, gently exhale while covering the exhalation valve to ensure that a positive pressure can be built up. Failure to build a positive pressure is an indication of poor fit.

Cleaning the Air Purifying Respirator

Respirators will be cleaned daily by washing with a mild disinfectant solution followed by a thorough rinse and air drying. NEVER ALLOW A RESPIRATOR TO DRY WITH THE STRAPS PLACED FORWARD ACROSS THE FACESHIELD AS THIS MAY CAUSE CHANGES IN THE FACE TO RESPIRATOR SEAL SURFACE. The specific procedures to be employed are as follows:

1. Remove all cartridges, filters, gaskets and seals not permanently attached to their seats.

2. Loosen harness adjustment straps.

3. Remove exhalation valve cover

4. Remove inhalation and exhalation valves

5. Remove protective faceshield cover.

6. Wash facepiece either in a cleaner/sanitizer powder mixed with warm water or a mild soap/disinfectant solution, preferably in a water temperature of 120 to 140 degrees fahrenheit. Wash

components separately from facepiece. Heavy soil may be removed from the facepiece surface using a medium soft brush.

7. Remove all parts from the wash solution and rinse twice in warm water.

8. Air dry all parts in a designated clean area.

9. Pat facepiece, valves, and seats to remove any remaining soap residue, water or other foreign material with a clean, damp, lint free cloth.

10. Reassemble respirator.

11. Place respirator in a plastic bag and the respirator box and/or otherwise store the respirator to prevent malfunction due to exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures, and impact.

Heat Stress and Heat Stress Monitoring

Heat stress is one of the most common and potentially serious illnesses at hazardous waste sites where personal protective equipment is worn; therefore, regular monitoring and other preventive precautions are vital. Shelter from the sun will be provided during rest periods. If necessary, work will be performed during the cooler night hours. Table [5] lists the signs and symptoms of heat stress. The initial work schedule will be

Table 5

Signs and Symptoms of Heat Stress

Heat Rash	Heat rash may result from continuous exposure to heat or humid air
Heat Cramps	Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include muscle spasms, pain in the hands, feet and abdomen.
Heat Exhaustion	Heat exhaustion is caused by increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include paleness; cool, moist skin; heavy sweating; dizziness; nausea; fainting.
Heat Stroke	Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms include red, hot, and usually dry skin; lack of or reduced perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma.

Source: EPA 1985

approximately 90 minutes of work and 15 minutes of rest. These schedules will be modified based on the following monitoring stated in NIOSH, et al.(1985).

- Heart rate will be measured during a 30 second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the next work cycle will be shortened by one-third without changing the rest period. If the heart rate still exceeds 110 beats per minute at the next rest period, the next work cycle will be shortened by one-third.
- Oral temperature will be measured using a clinical thermometer (three minutes under the tongue) or similar device at the end of the work period before drinking.
- If oral temperature exceeds 99.6° F (37.6° C), the next work cycle will be reduced by one-third without changing the rest period. If oral temperature still exceeds 99.6° F at the beginning of the next rest period, the next work period will be shortened by one-third. A worker will not be permitted to wear a semipermeable or impermeable garment when his or her oral temperature exceeds 100.6° F (38.1° C)
- Body water loss will be measured, if possible. Weight will be measured on a scale accurate to ±0.25 lb at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. The body water loss should not exceed 1.5 percent total body weight loss in a work day.

Medical Surveillance

All ESC personnel working at sites with contaminated soils are included in a medical monitoring program. The purpose of the medical monitoring program is to identify any illness or problem that would put an employee at an unusual risk from exposures; to assure that each employee can safely utilize negative pressure respirators and withstand heat stress; to establish and maintain a medical data base for employees in order to monitor any abnormalities which may be related to work exposure and could potentiate injury risk for the employee or others in the performance of job functions. The medical monitoring program includes:

- a baseline physical examination
- medical determination of fitness of duty including work restrictions after any job-related injury or illness or nonjob-related absence lasting more than three working days
- the review of each site-specific Health and Safety Plan and potential exposure list to determine the need for specific biological and medical monitoring
- annual and exit physical examinations with attention given to specific exposures or symptoms

Baseline Physical Examination

A baseline physical examination will be performed on each employee engaged in hazardous waste activities. The purpose of this examination is the identification of any illness or problem that would put an employee at unusual risk from certain exposures; to certify the safe utilization of negative pressure respirators (OSHA Safety and Health Standard 29 CFR 1910.134); and the development of a data base for the assessment of exposure related events detected through periodic medical monitoring. Variable data such as age, sex, race, smoking, prior employment and exposure history, etc., which may have a bearing upon the occurrence of subsequent events once employment begins, will be gathered.

The content of the Baseline Physical Examination will include:

- medical, occupational, and fertility history
- physical examination stressing neurological, cardiopulmonary, musculoskeletal, and skin systems
- electrocardiogram
- PA and lateral chest x-ray
- pulmonary function test (FEV1, FVC, FEV 25-75)
- audiogram
- a multi-chemistry blood panel including kidney and liver function tests, CBC with differential, and urinalysis
- tests deemed necessary by symptoms or exposure history
- red blood cell cholinesterase
- physical parameters including blood pressure and visual acuity testing

Annual Physical Examination

An examination and updated occupational history will be performed on an annual basis during the anniversary month of the baseline physical examination. This examination serves to identify and prevent illness caused by cumulative exposure to toxic substances.

The Annual Physical Examination will include:

- personal work history (based on specific project histories)
- physical examination stressing neurological, cardiopulmonary, musculoskeletal, and skin systems
- pulmonary function test (FEV1, FVC, FEV 25-75)
- a multi-chemistry blood panel including kidney and liver function test
- audiogram
- tests deemed necessary by symptoms or exposure
- optional wellness profile

Return to Work Examination

Any job-related illness or injury will be followed by a medical examination to determine fitness for duty or possible job restrictions based upon the physical findings of the examiner. A similar examination will be performed following three missed workdays due to a nonjob-related illness or injury requiring medical intervention.

Exit Physical Examination

The content of the Baseline Physical Examination will include:

- personal work history (based on specific project histories)
- medical, occupational, and fertility history
- physical examination stressing neurological, cardio-pulmonary, musculoskeletal, and skin systems
- pulmonary function test (FEV1, FVC, FEV 25-75)
- electrocardiogram
- PA and lateral chest x-ray
- audiogram
- multi-chemistry blood panel including kidney and liver function tests, CBC with differential, and urinalysis
- tests deemed necessary by symptoms or exposure history
- red blood cell cholinesterase
- physical parameters including blood pressure and visual acuity testing

Appendix C - Quality Assurance Project Plan

ESC

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QUALITY ASSURANCE PROJECT PLAN FOR THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN FOR THE HELLERTOWN MANUFACTURING COMPANY HELLERTOWN, PENNSYLVANIA PROPOSED NPL SITE

PREPARED

BY

ENVIRONMENTAL STRATEGIES CORPORATION

JANUARY 10, 1989

REVISED
MAY 23, 1989
REVISED
AUGUST 28, 1989

REGIONAL OFFICES
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Quality Assurance Project Plan Distribution List

Revised August 28, 1989

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Quality Assurance Project Plan
For
Remedial Investigation/Feasibility Study Work Plan
Hellertown Manufacturing Company, Hellertown, Pennsylvania
Proposed NPL Site

Prepared
by
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January 10, 1989
Revised August 28, 1989

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1.0 Introduction

This Quality Assurance Project Plan (QAPP) is intended to provide quality control guidance for the collection of data during the field activities of the Remedial Investigation (RI) for the Champion Spark Plug's (Champion) Hellertown Manufacturing Company (HMC) site in Hellertown, Pennsylvania. The QAPP addresses the elements specified for inclusion in QAPPs as outlined in the EPA guidance document, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, December 29, 1980." This document is being submitted to EPA concurrently with the RI/FS Work Plan in compliance with Section 8, Work To Be Performed, of the CERCLA Administrative Order by Consent (ACO) between Champion and EPA, US EPA Docket no. III-88-11-DC.

1.1 Project Schedule

The project schedule for the Remedial Investigation at the HMC site is shown in Figure 1-1. Work will be initiated at the site upon EPA approval of the Work Plan, QAPP, and other related plans.

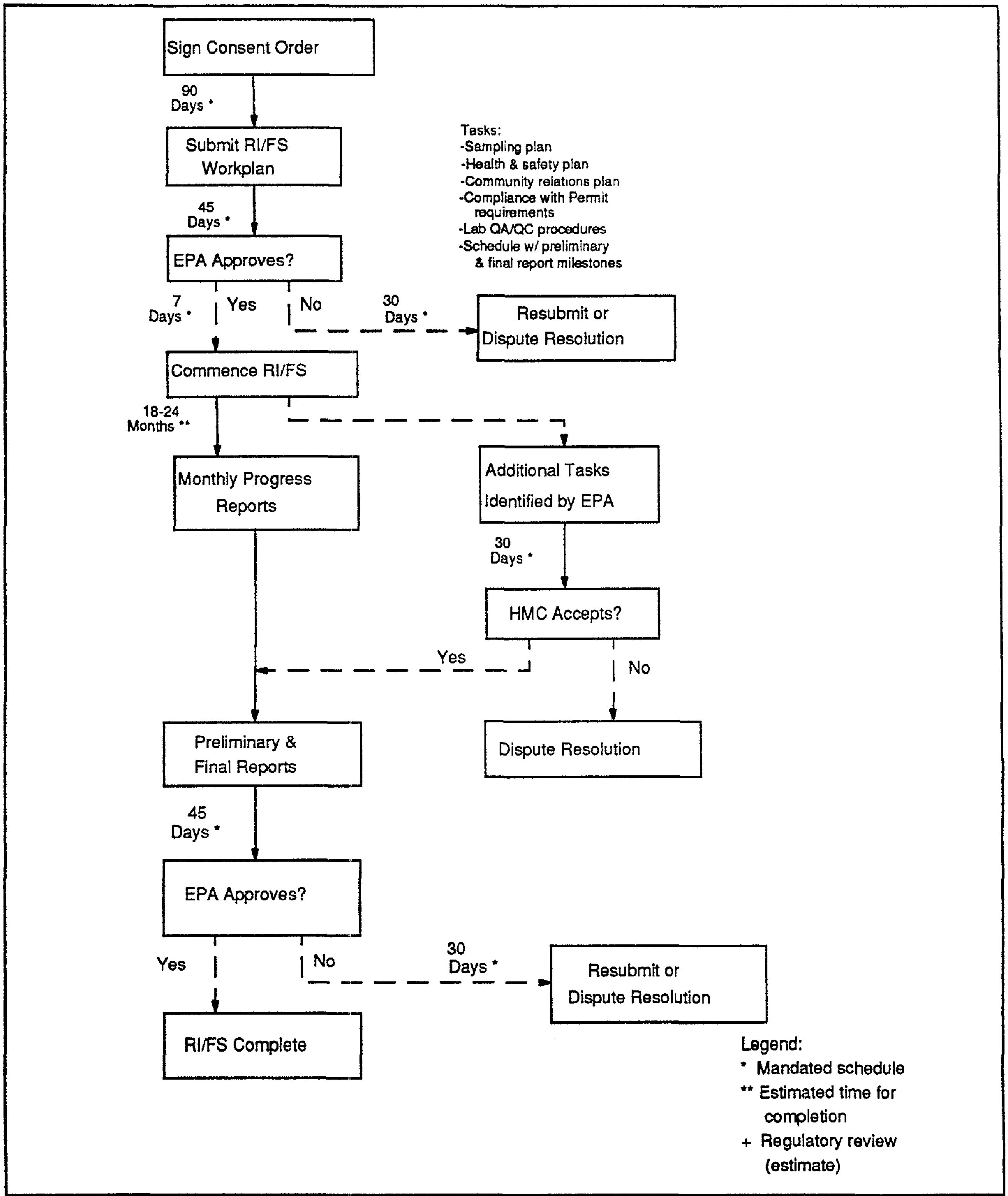

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Figure 1-1
Project Schedule
Phase II RI/FS

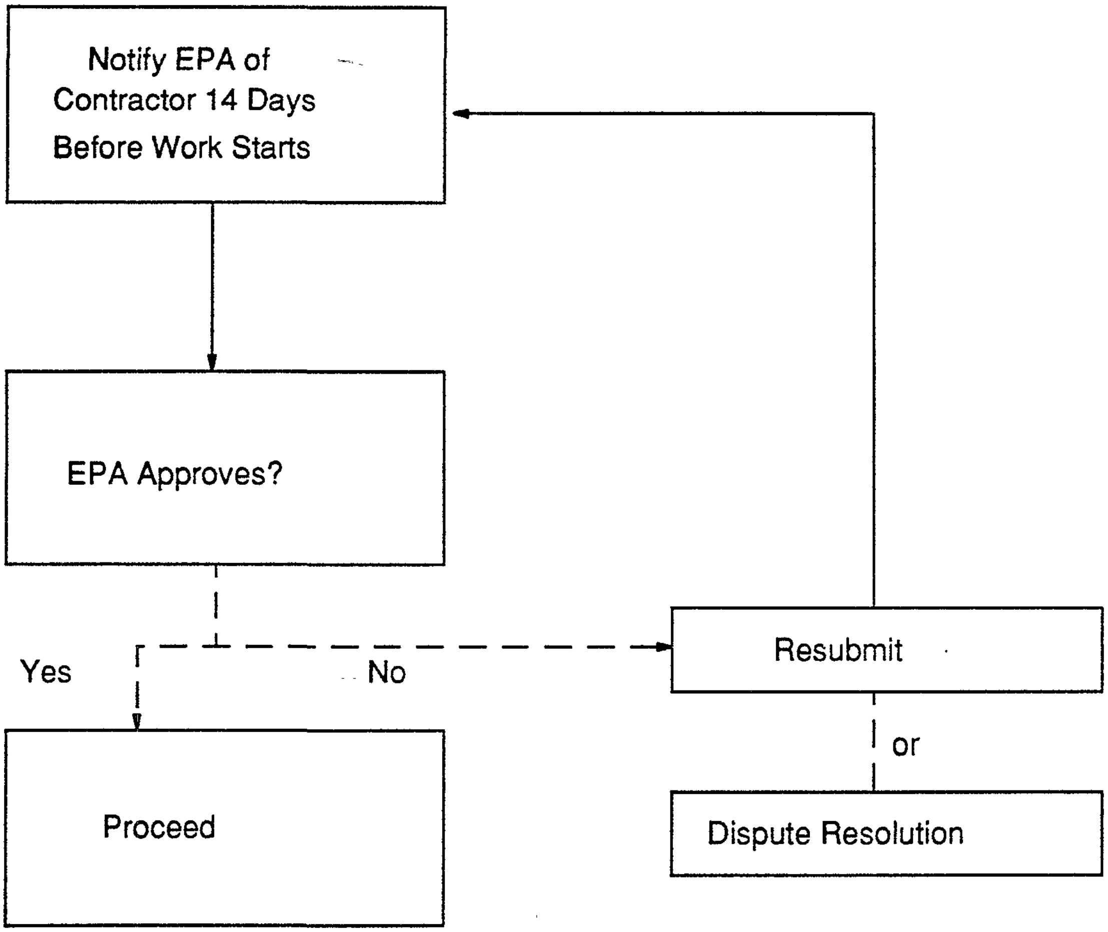

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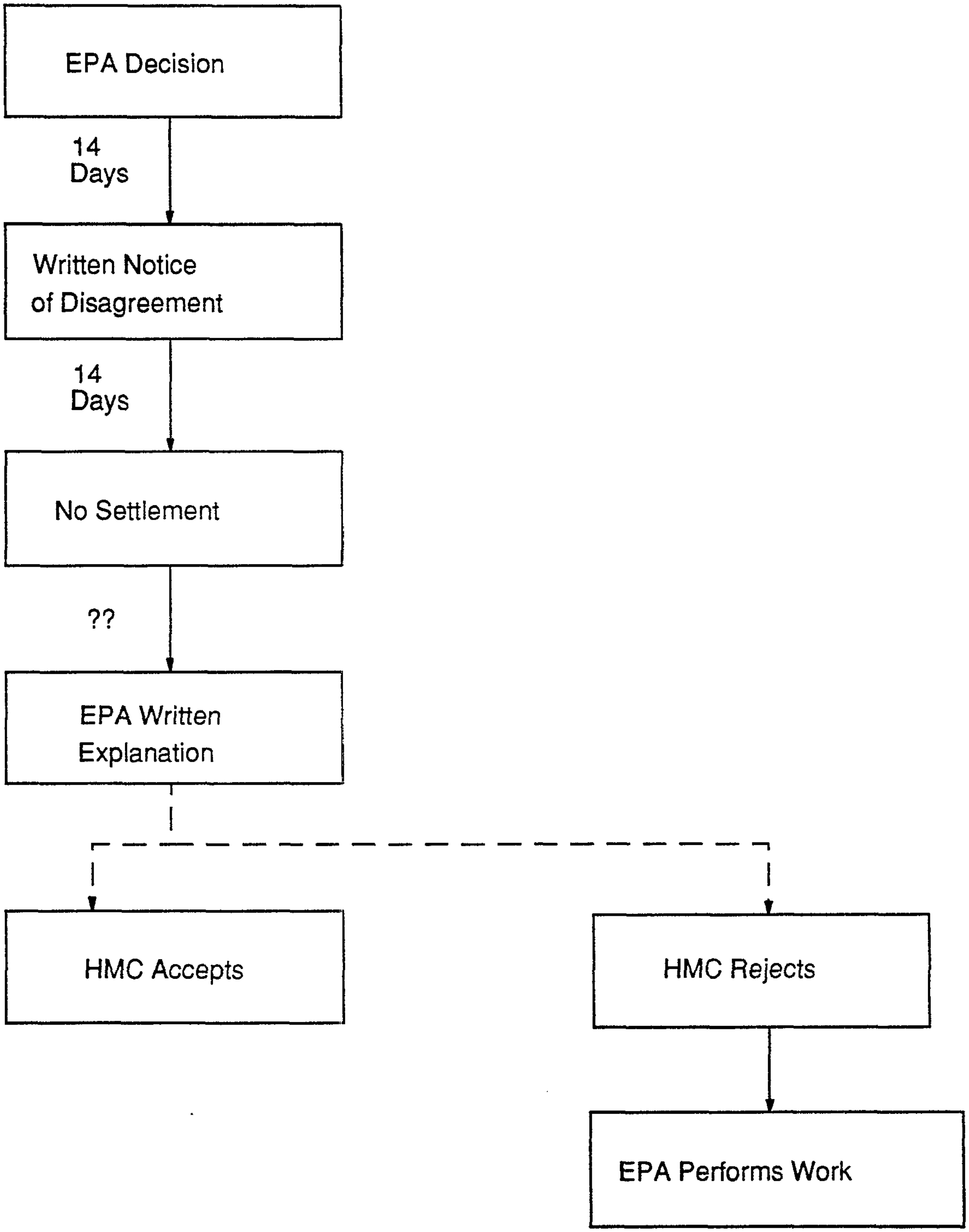
Figure 1-2
Project Schedule
Contractor Approval



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Project Schedule
Dispute Resolution
Figure 1-3

2.0 Scope of Quality Assurance Project Plan

This QAPP is prepared in compliance with the U.S. Environmental Protection Agency's (EPA's) mandatory program requirements and serves to:

- Communicate to the persons expected to execute the various activities exactly what is to be done, by whom, and when.
- Provide a culmination to the planning process to ensure that the design includes the necessary provision for quality data (e.g., suitable methods of field operations and collecting field measurements).
- Provide a historical record that documents the investigation in terms of 1) the methods used, 2) calibration standards and frequencies planned, and 3) auditing planned.
- Provide a document that can be used by the Project Officer, Program Manager or QA Auditor to assess if the activities planned are being implemented and their importance for accomplishing the goal of quality data.

The QAPP is primarily concerned with the Quality Assurance (QA) and Quality Control (QC) aspects of the procedures involved in the collection, preservation, packaging, and transport of samples; field testing; recordkeeping; data management; chain-of-custody procedures; laboratory analyses; and other necessary matters to assure that the investigation, once completed, will yield data whose integrity can be defended.

To facilitate the understanding and implementation of the QAPP, the terms Quality Assurance (QA) and Quality Control (QC) are defined. Quality Assurance refers to the conduct of all planned and systematic actions necessary to satisfactorily perform all site-specific task activities and to provide information and data confidence as a result of such activities. The QA for task specific activities includes the development of procedures, auditing, monitoring, and surveillance of the performance.

Quality Control (QC) refers to the activity performed to determine if the work activities are in conformance with the requirements. This includes such activities as first time inspections of the work activities in the field (e.g., verification that items and materials are installed in conformance with applicable codes and design specifications). Generally, the QC activities for field investigations of this project include subsurface drilling, sampling, labeling, field testing, chain-of-custody, sample handling, packaging, preservation, shipping, recordkeeping, and documentation. QC is concerned with the day-to-day efforts to verify that site-specific activities are in conformance with approved plans, procedures, and specifications. QA is an overview monitoring of the performance of QC activities through audits rather than first-line inspections.

The mandatory QA elements addressed in this QAPP are:

1. Title page

2. Table of contents
3. Project description
4. Project organization
5. QA objectives and criteria
6. Sampling procedures
7. Sample custody
8. Calibration procedures and frequency
9. Analytical procedures
10. Data reduction, validation, and reporting
11. Internal QC checks
12. Performance and system audits
13. Preventive maintenance
14. Specific standard operating procedures (SOPs) used to assess data precision, accuracy, representativeness and completeness
15. Corrective action for out-of-control situations
16. QA reporting procedures

An attempt is made to address various elements within the scope of investigation(s) for which this QAPP is prepared.

3.0 Project Description

3.1 Introduction to Project

This QAPP is a companion document for the Phase II Remedial Investigation and Feasibility Study (RI/FS) Work Plan to be conducted at the HMC site located in Hellertown, Pennsylvania (Figure 3-1). The objective of the Phase II consists of the preparation and implementation of an RI/FS Work Plan.

3.1.1 Project Origin

The project was initiated based on an Administrative Order By Consent entered into by Champion and the EPA in February 1988.

3.1.2 Date of Project Initiation

Field activities for Phase II will begin within 7 days of EPA's approval of task 1 of the RI/FS Work Plan.

3.1.3 Project Management

Overall project management is by Michael J. Murphy, Chairman and CEO of ESC, and Terry Rife, Manager of Safety and Environmental Compliance at the Champion Spark Plug Company. Technical management is by Richard E. Freudenberger, Senior Vice President of ESC.

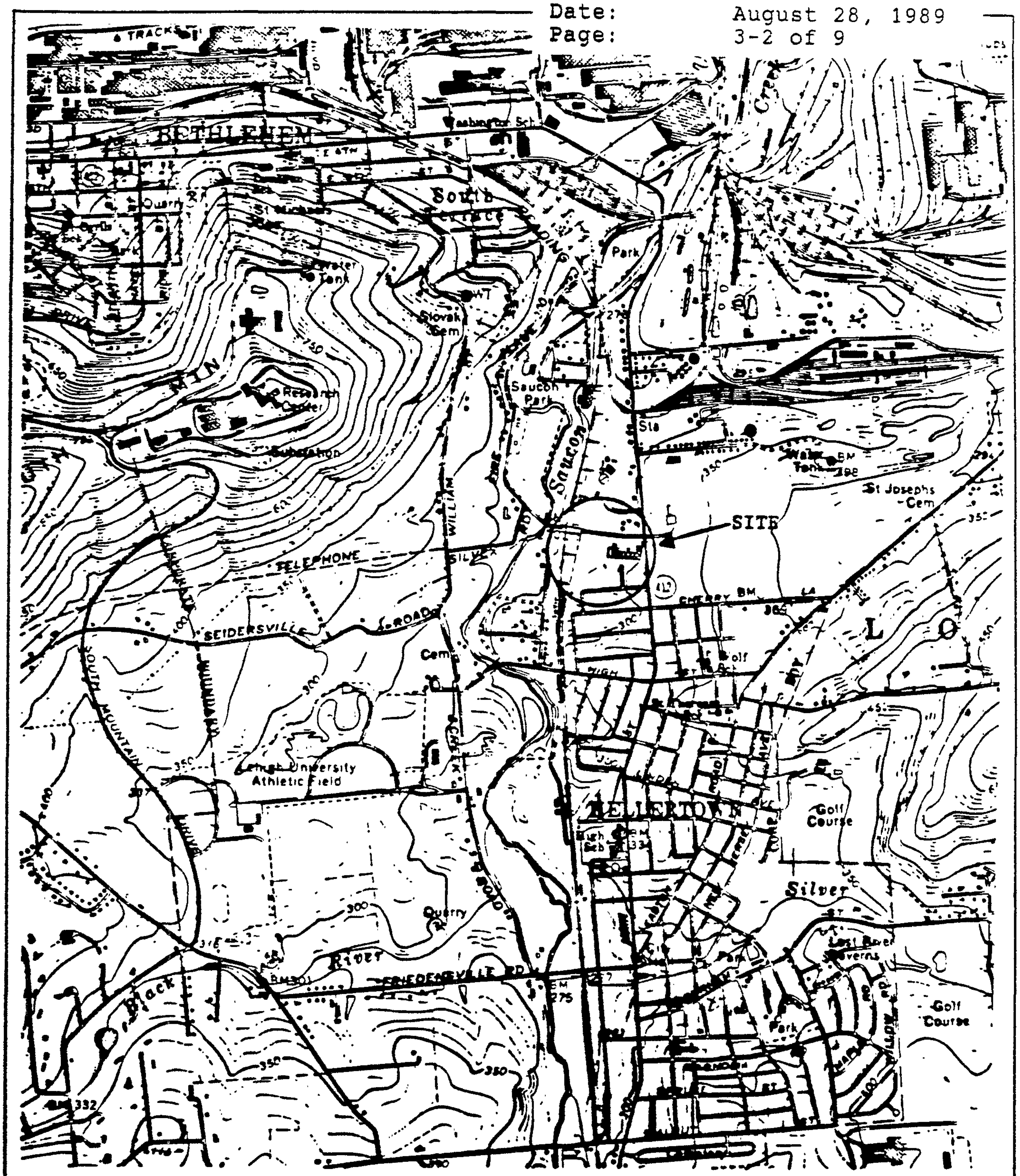

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Figure 3-1

Location of Hellertown Manufacturing Company

3.1.4 Quality Assurance Officers

The ESC Quality Assurance Officer for Phase II is David Badio. The Quality Assurance Officer for Cambridge Analytical Associates is Claire Killough.

3.2 Background

The following sections describe the history of the site, previous investigations, the overall objective of the investigation of which the activities covered by this QAPP are part, and the specific objectives and scope of these activities.

3.2.1 Site Description

Through its former subsidiary, the Hellertown Manufacturing Company (HMC), the Champion Spark Plug Company owned an inactive manufacturing complex in Hellertown, Pennsylvania, which was closed in October 1982. The site is located about 1.5 miles southeast of Bethlehem, Pennsylvania. The site is bounded on the east by Main Street, on the west by Conrail railroad tracks, on the north by Interstate 78 and Silvex Road, and on the south by residences and commercial businesses (Figure 3-2). The site was originally developed as a spark plug manufacturing facility in 1918 and was dedicated to the manufacture of spark plugs until it was closed in October 1982.

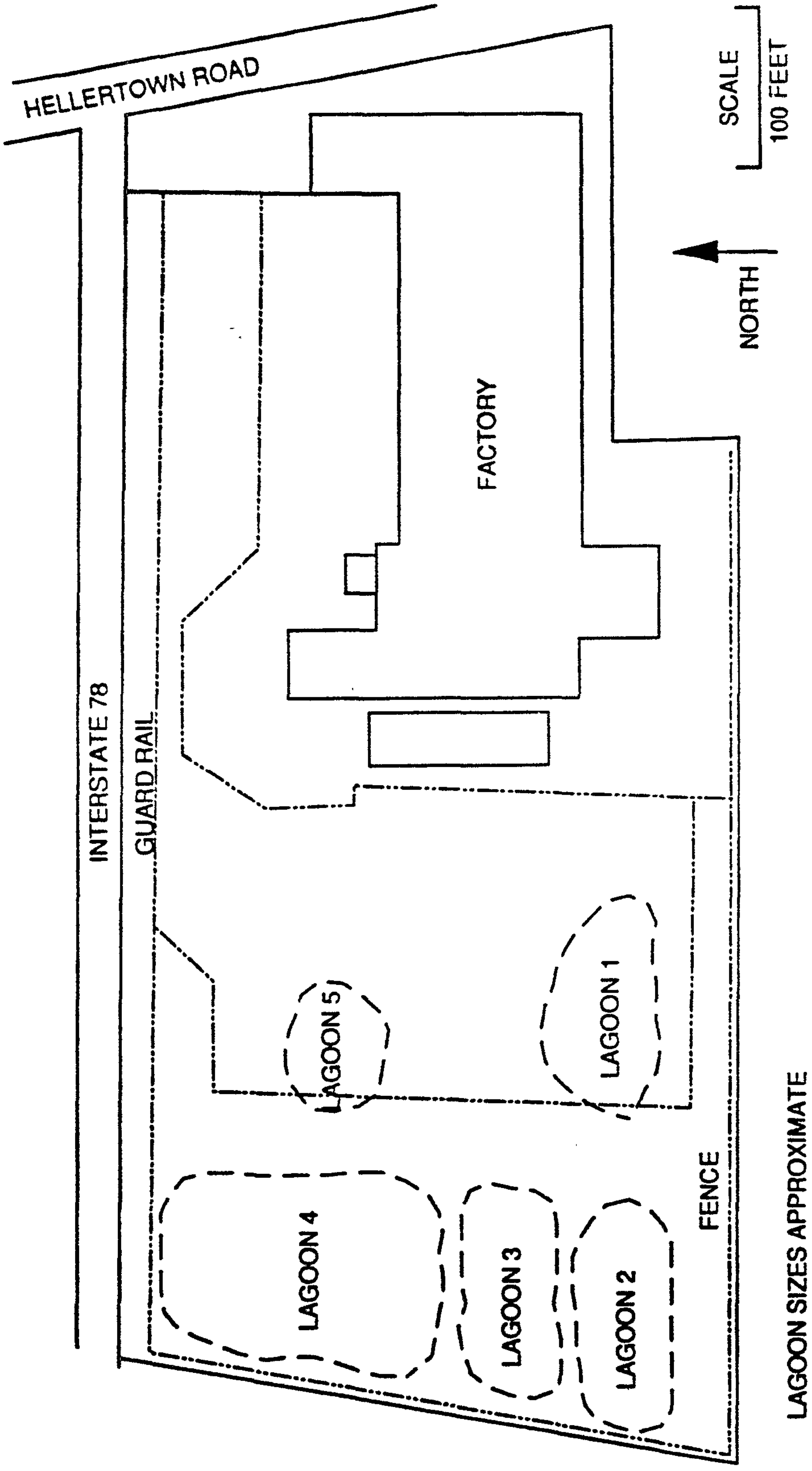

Figure 3-2

Map of the Hellertown Manufacturing Site

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The site covers 8.75 acres and consists of a 124,000-sq ft building, a metal storage shed, five wastewater treatment lagoons, and a water treatment system. The lagoons received a variety of materials throughout the history of the plant including high temperature bluing wastewater, low temperature blackening wastewater, electroplating wastewater and other metal treating residuals. Investigations into the groundwater quality in 1984 revealed degraded groundwater.

The lagoons were closed in 1975 under the direct supervision of the Reading office of the Pennsylvania Department of Environmental Resources (PADER). Telephone communications with the PADER and investigative work performed by the PADER for Potential Hazardous Waste Site designation of the plant caused Champion to assess the potential for the site to cause environmental impairment. Monitoring wells were installed and sampled in December 1984 and January 1985.

Subsequently, due to the detection of 1,2-dichloroethane and trichloroethylene in samples from the wells, the PADER (in a meeting on May 2, 1985) made demands on Champion to prepare a work plan that would address further study of the site. After several iterations, a work plan acceptable to the PADER was prepared.

An ongoing investigation is being performed voluntarily by the HMC at the request of the PADER to determine the horizontal and vertical extent of the contaminated soils and groundwater at the site. In spite of Champion's continuing and extensive investigations at the site and its responsiveness to the PADER, the

HMC facility was proposed to be added to the Superfund National Priorities List (NPL) on January 22, 1987. A summary of the investigative work performed thus far follows.

Four existing monitoring wells were sampled and analyses were performed on or about June 24, 1986, and November 10, 1986. Five additional wells were installed in January and February 1987 and the four existing wells and three of the five newly installed wells were resampled on August 11, 1987. Two offsite private wells, the Kniha well and the Reichard well, were sampled on August 12, 1987. Only the Reichard well is used for potable water. The original plan called for sampling of two other offsite wells, the Sheesly Concrete Company well and a Lehigh University well. Neither of these wells could be located and may no longer exist or be accessible to sampling.

A total of 87 soil samples were collected from 19 borings in the filled-in surface impoundments onsite during the June 1986 sampling episode. These soil samples were collected above and below an inferred sludge layer in an attempt to identify potential contamination sources. In addition, surface water upstream and downstream from the site on the closest significant surface water feature (Saucon Creek) was sampled during June 1986 and analyzed. Two additional soil samples were collected from two borings in the filled-in surface impoundments and one soil sample was collected from a former truck washing area during the February 1987 sampling episode.

Investigations thus far confirm the presence of small amounts of chlorinated organic compounds in groundwater downgradient from the main plant building on the site. Since this area is in proximity to the western property line, there is some potential that contaminants are migrating beyond the property boundary. The results of the soil boring study to date do not confirm the presence of a contamination source that could produce the observed groundwater quality effects. The most concentrated constituents, polycyclic aromatic hydrocarbons (PAHs), were detected in the soils in one group of the surface impoundment borings. These constituents do not appear to present a threat to environmental receptors since they are generally insoluble and since the buried contaminants are precluded from becoming airborne.

3.2.2 Objectives of the Present Investigation

The activities covered by this QAPP will provide information to meet the objectives of Phase II, the RI/FS Work Plan.

1. The objectives of the Phase II RI/FS Work Plan are to:
   - Perform additional site characterization to locate the source(s) of contamination
   - Assess routes of exposure to plant, animal, and human populations and the resulting impacts
   - Screen remedial alternatives for technical and economic feasibility

3.2.3 Scope of Work

The specific activities covered by the QAPP are covered in the ACO.

3.3 Related Documents

This QAPP is to be used with the following documents:

- RI/FS Work Plan for Phase II - HMC Hellertown, PA
- Sampling and Analysis Plan (Appendix A of the Work Plan)
- Health and Safety Plan - HMC Hellertown, PA

3.4 Monitoring Plan and Design Rationale

The monitoring plan included in the Sampling and Analysis Plan addresses the potential contamination at the site. The monitoring plan is based on:

- the requirements in the ACO and known sources of contamination
- site groundwater hydrology
- site surface hydrology
- the locations of site-specific and offsite areas of concern

3.4.1 Parameters and Frequency of Sampling

Sampling of the groundwater, surface water, soil and stream sediment will be conducted as specified in the RI/FS Work Plan. **[Sampling procedures for filtered and unfiltered groundwater samples have been included in the Work Plan.]**

3.5 Design of Sampling Plans

The design of the sampling plans for the Phase II RI/FS Work Plan is outlined in the RI/FS Work Plan.

3.6 Data Usage

Data will be used to define the nature, degree, and extent of study area contamination. The information will be used in evaluating the remedial measures that may be necessary at the site.

4.0 Project Organization and Responsibility

The organizational structure for implementing Phase I and Phase II is provided in Figure 4-1. Environmental Strategies Corporation (ESC) is the principal consultant to HMC and will be responsible for the performance of all services required to implement each phase, including field operations, laboratory testing, data management and office analysis and reporting. Mr. Michael J. Murphy, Chairman and CEO of ESC, will be ESC's Project Director. He has the authority to commit the firm's resources to accomplish the project objectives. He will have ultimate responsibility for ESC and subcontractor performance and with the Project Manager will form the ESC management team for the project.

ESC's Project Manager is Richard E. Freudenberger, Senior Vice President. He will be responsible for the direction and management of all ESC's field, laboratory, and office activities, as well as the activities of ESC's subcontractors. Mr. Freudenberger has the responsibility and authority to procure the necessary support services and equipment for implementing each phase of the effort. He will also be responsible for staffing, scheduling, and reporting all of ESC's activities and will report directly to ESC's Project Director.

ESC's Quality Assurance Officer (QAO), David Badio, Senior Scientist of ESC, is responsible for all aspects of quality assurance and quality control related to implementing each phase. He will coordinate with the ESC Team Leader. The ESC Team Leader,

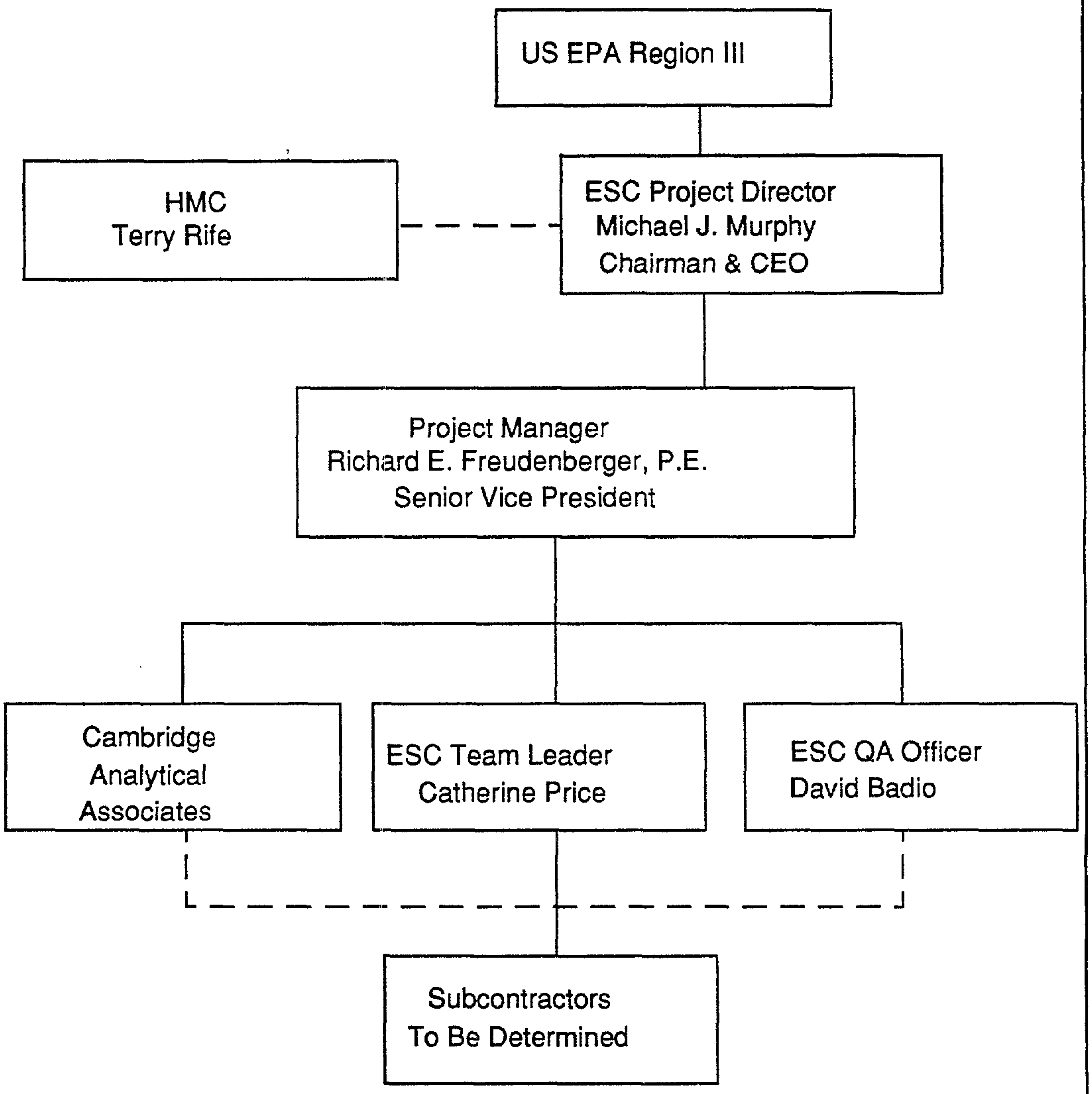

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Figure 4-1

Project Organizational Structure

Table 4-1

Names and Addresses of Key Personnel

Michael Murphy	Environmental Strategies Corporation 8521 Leesburg Pike Suite 650 Vienna, Virginia 22180 (703) 821-3700
Richard Freudenberger	Environmental Strategies Corporation 8521 Leesburg Pike Suite 650 Vienna, Virginia 22180 (703) 821-3700
David Badio	Environmental Strategies Corporation 8521 Leesburg Pike Suite 650 Vienna, Virginia 22180 (703) 821-3700
Catherine Price	Environmental Strategies Corporation 8521 Leesburg Pike Suite 650 Vienna, Virginia 22180 (703) 821-3700
Ann Delong	EPA Region III 841 Chestnut Street Philadelphia, PA 19107 (215) 597-0985
Nancy Kilar	Cambridge Analytical Associates 1106 Commonwealth Avenue Boston, Massachusetts 02215 (617) 232-2207

Catherine Price, will be responsible for the direction of day-to-day activities onsite. Ms. Price will oversee ESC's field and laboratory activities and will report directly to the Project Manager. The Laboratory QAO, Claire Killough, will report directly to ESC's Project Manager or Project Director when corrective action is required as a result of compliance and performance audits. The qualifications of the ESC personnel are included in Appendix B.

EPA's Region III Central Regional Laboratory (CRL) will provide the necessary QA/QC oversight support to EPA Region III. Patricia J. Krantz, Chief of the QA Section, CRL, EPA Region III, and Ann Delong, Enforcement Project Coordinator, EPA Region III, are assumed to be serving as the day-to-day contacts for ESC during implementation of Phase II of the ACO.

Cambridge Analytical Associates (CAA) and its subcontractors will provide all of the proposed chemical testing services on soil, water, sediment, or other samples and will be under direct contract with ESC. CAA participates in EPA's Contract Laboratory Program (CLP) for both organic and inorganic analyses. The laboratory representative, Nancy Kilar, will report to the ESC Project Manager or his designee to facilitate coordination of all planned sampling and chemical testing activities.

The responsibility of key ESC personnel based on Figure 4-1 is described below:

1. **Michael J. Murphy - Project Director**

All activities carried out will be under the overall direction of the Project Director. The Project Director's responsibilities include, but are not limited to:

- overall project coordination and implementation
- final review of all project reports

2. **Richard E. Freudenberger - Project Manager**

ESC will use contractor services at various times throughout the implementation of the Phase II efforts for subsurface drilling, soil sample collection, and groundwater investigations to expedite satisfactory completion. The Project Manager will be responsible for all contractor performance drilling and well installation and well development before groundwater sampling. The Project Manager will report to the ESC Director and will coordinate with the QAO. The Project Manager's responsibilities include, but are not limited to:

- field operations and testing
- laboratory analysis
- data processing activities
- all other project-related activities

3. **Catherine Price - Team Leader**

The team leader performs background research, selects the team, prepares the sampling plan, briefs the team, and generates deliverables and reports.

4. **Mark Lunsford - Health and Safety Officer and David Boylan - Alternate.**

The Health and Safety Officer is responsible for:

- preparing and ensuring that the Health and Safety plan is followed
- ensuring that all site activities are performed in a safe manner to eliminate danger to personnel performing the field activities
- providing guidance to the injured for immediate medical attention
- filing personnel injury reports to the Project Manager

5. **David Badio - Quality Assurance Officer**

The Quality Assurance Officer will be responsible for meeting quality assurance goals during investigations. He will serve as overall QAO for all sampling and analyses. In addition, the QAO will be responsible for ensuring that all coeldne probe to the detctors designate a project QA officer where relevant and that each contractor complies fully with all aspects during each phase of the effort. In particular, the QAO will work closely with the drilling contractor(s) QAO and contract analytical laboratory QAO to ensure that all QA/QC requirements are being met. The QAO's overall responsibilities include, but are not limited to:

- field operations QC
- sampling QC
- laboratory QC
- data processing QC
- data quality review
- performance auditing
- systems auditing
- overall QA

The various Principal Investigators and their major areas of responsibility are outlined below. They are responsible for the performance of task(s) through the task leaders and the maintenance of superior quality work.

CAA participates in EPA's CLP. Laboratory capability statements for CAA and its subcontractors are provided in the Quality Assurance Project Plan which is included as Appendix A. Nancy Kilar, serves as the laboratory representative for day-to-day contacts. Quality Assurance/Quality Control for each operation and designated QC representative are shown below:

Overall QA/QC	David Badio, ESC
Sampling Operations and Sampling QC	Mark Lunsford and David Badio, ESC
Laboratory Analyses and Laboratory QC	David Badio, ESC Claire Killough, CAA
Data Review	Richard Freudenberger, ESC Catherine Price, ESC David Badio, ESC
Performance and System Audits	David Badio, ESC
Lab Audit	David Badio, ESC

5.0 Quality Assurance Objectives and Criteria

5.1 Objectives of Quality Assurance Plan

This Quality Assurance Plan was developed conforming to EPA's "Guidance on Remedial Investigations under CERCLA" EPA/ 500/G-85/002, June 1985. The QA plan addresses evidentiary considerations by defining how the acquisition and handling of samples and the reporting and review of data will be documented. Examples of the documentation include field notebook records, chain-of-custody forms, CLP-specified formats for data reporting, and the requirements for a "sign off" by the laboratory manager and QA reviewer on data packages. These forms of documentation could be used, if necessary, to support the integrity of the data generated. The objectives of this QAPP are to address:

- the procedures involved in the sampling, collection, preservation, packaging, and transport of soil, surface water, sediment, groundwater, and other samples
- field testing
- recordkeeping
- data management
- chain-of-custody procedures
- precision, accuracy, and completeness conformance for sample analysis and data management by CAA under the U.S. EPA Contract Laboratory Program (CLP) and other EPA approved analytical methods
- QA/QC analytical procedures by CAA.

Data generated during the field activities of the RI will be used to further define the extent of contamination and to conduct the Risk Assessment.

5.2 Data Quality Requirements and Assessments

The overall Data Quality Objectives for the operations are to provide data of known quality and which are suitable to determine whether hazardous substances are present in soil, sediment, ground or surface water, or air at the site at concentrations presenting a threat or a potential threat to public health, welfare, or the environment. Data quality is determined by sampling strategy and performance, analytical methodology, laboratory performance, and data assessment and review. From a practical standpoint, ESC has considered three basic data uses: screening, engineering, and confirmational analyses. Within each data use, many practical considerations will indicate the specific source of laboratory analysis.

The proposed sampling strategies are designed to provide comparable data from different matrices and to determine the levels present and distribution and fate of the target compounds. Some proposed methodologies are analyte-specific and others are class-specific. Quality control procedures (such as calibration) that will enable monitoring of the laboratory's performance of the procedure are described for each methodology. Other QC operations, such as blanks, spikes, and blind and designated duplicates, are specified. These will monitor overall performance and allow estimation of the precision and accuracy of the data. Recognized EPA guidelines will be used to review the completeness of the data generated and adherence to statement of work QC requirements and to determine data usability. The requirements and assessments applicable to the analytical laboratory for soil, water and sediment sample analyses are described in this section. Data quality requirements and assessment for field measurements are discussed in Section 9.0.

5.2.1 Chemical Analyses and Quality Assurance Protocols

Chemical analyses of samples collected during Phase II will be performed using CLP and other EPA-approved methods and protocols. As a result, both CLP and non-CLP methodologies are addressed in the QA/QC Plan. The various samples to be collected will be analyzed for the parameters indicated in Table 5-1. The data quality objectives for precision and accuracy will be based on the methods employed. Table 5-2 specifies the Contract Required Quantitation Limits (CRQLs) for the CLP Organic compounds. Contract Required Detection Limits (CRDLs) for the TAL metals are specified in Table 5-3. Table 5-4 specifies the analytical methods for non-CLP parameters. The method detection limits for the non-CLP parameters are specified in the laboratory's QAPP (Appendix A).

Coordination between ESC and the laboratory will be emphasized. When the laboratory encounters problems such as difficult sample

Table 5-1

Analytical Parameters to be Measured for Various Matrices

Matrix	Laboratory Parameter	Field
Surface Water	TCL volatile organics	Flow rate
	TCL BNA extractables	EH
	TAL metals	Dissolved oxygen
	Total suspended solids	Temperature
	Total dissolved solids	pH
	Total alkalinity	
	Hardness	
	Total organic halogens	
Groundwater	TCL volatile organics	Flow rate
	TCL BNA extractables	Specific conductivity
	TAL (metals and cyanide)	Recharge rate
	Total organic halogens	Hydraulic conductivity
	Total dissolved solids	Temperature
	Nitrate	pH
	Flouride	
	Sulfate	
Sediment	TCL volatile organics	EH
	TCL BNA extractables	Color
	Total organic carbon	pH
	TAL metals	Temperature
	Grain size	Specific conductivity
	Total organic halogens	
Soil	TCL volatile organics	
	TCL BNA extractables	
	TAL (metals and cyanide)	
	Flouride	
	Nitrate	
	Permeability	
	Porosity	
	Moisture	
	Cation exchange capacity	
	Bacteria count	
Sludge	TCL volatile organics	
	TCL BNA extractables	
	TAL (metals and cyanide)	
	Flouride	
	Nitrate	
	Sulfate	

Table 5-2

Contract Required Quantitation Limits for CLP Organic Compounds

	Quantitation Limits[a]	
Compounds	Water (ug/l)	Low Soil/Sediment[b,c] (ug/kg)
Volatiles		
Chloromethane	10	10
Bromomethane	10	10
Vinyl chloride	10	10
Chloroethane	10	10
Methylene chloride	5	5
Acetone	10	10
Carbon disulfide	5	5
1,1-Dichloroethylene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethylene (total)	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon tetrachloride	5	5
Vinyl acetate	10	10
Bromodichloromethane	5	5
1,1-Dichloropropane	5	5
cis-1,3-Dichloropropylene	5	5
Trichloroethylene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene 5	5	
trans-1,3-Dichloropropylene	5	5
Bromoform	5	5
4-Methyl-2-pentanone	10	10
2-Hexanone	10	10
Tetrachloroethylene	5	5
Toluene 5	5	
1,1,2,2-Tetrachloroethane	5	5
Chlorobenzene	5	5
Ethyl benzene	5	5
Styrene	5	5
Xylenes (total)	5	5

	Quantitation Limits[a]	
Compounds	Water (ug/1)	Low Soil/Sediment[b,c] (ug/kg)
Semi-Volatiles		
Phenol	10	330
bis(2-Chloroethyl) ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
Benzyl alcohol	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl) ether	10	330
4-Methylphenol	10	330
N-Nitroso-dipropylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
Benzoic acid	10	330
bis(2-Chloroethyoxy) methane	50	1,600
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1,600
2-Chloronaphthalene	10	330
2-Nitroaniline	50	1,600
Dimethylphthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	50	1,600
Acenaphthene	10	330
2,4-Dinitrophenol	50	1,600
4-Nitrophenol	50	1,600
Dibenzofuran	10	330
2,6-Dinitrotoluene	10	330
Diethylphthalate	10	330

Compounds	Quantitation Limits[a] Water (ug/l)	Low Soil/Sediment[b,c] (ug/kg)
4-Chlorophenyl phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	50	1,600
4,6-Dinitro-2-methylphenol	50	1,600
N-Nitrosodiphenylamine	10	330
4-Bromophenyl phenyl ether	10	330
Hexachlorobenzene	10	330
Pentachorophenol	50	1,600
Phenanthrene	10	330
Anthracene	10	330
Di-n-butylphthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butylbenzylphthalate	10	330
3,3'-Dichlorobenzidine	20	660
Benzo(a)anthracene	10	330
Chrysene	10	330
bis(2-Ethylhexyl)phthalate	10	330
Di-n-octyl phthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330
Pesticides/PCBs		
alpha-BHC	0.05	8.0
beta-BHC	0.05	8.0
delta-BHC	0.05	8.0
gamma-BHC(Lindane)	0.05	8.0
Heptachlor	0.05	8.0
Aldrin	0.05	8.0
Heptachlor epoxide	0.05	8.0
Endosulfan I	0.05	8.0
Dieldrin	0.10	16.0
4,4'-DDE	0.10	16.0

Compounds	Quantitation Limits[a] Water (ug/1)	Low Soil/Sediment[b,c] (ug/kg)
Endrin	0.10	16.0
Endosulfan II	0.10	16.0
4,4'-DDD	0.10	16.0
Endosulfan sulfate	0.10	16.0
4,4'-DDT	0.10	16.0
Methoxychlor	0.5	80.0
Endrin ketone	0.10	16.0
alpha-Chlordane	0.5	80.0
gamma-Chlordane		
Toxaphene	1.0	160.0
Aroclor-1016	0.5	80.0
Aroclor-1221	0.5	80.0
Aroclor-1232	0.5	80.0
Aroclor-1242	0.5	80.0
Aroclor-1248	0.5	80.0
Aroclor-1254	1.0	160.0
Aroclor-1260	1.0	160.0

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a/ Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRQL. For semivolatile compounds, they are 60 times the individual Low Soil/ Sediment CRQL. For pesticide/PCB compounds, they are 15 times the individual Low Soil/Sediment CRQL.

b/ Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

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

Table 5-3

CRDLs for the Inorganic Target Analytes

Analyte	Contract Required Detection Limit (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5,000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	5
Magnesium	5,000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5,000
Selenium	5
Silver	10
Sodium	5,000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

Table 5-4

EPA Methods for Non-CLP Parameters

Parameter	Method
Total organic carbon	415.1, 415.2[a]
Total dissolved solids	160.1[a]
Total suspended solids	160.2[a]
Hardness ($CaCO_3$)	130.2[a]
Total alkalinity	310.1[a]
Grain size	ASTM D422-63[b]
Total organic halides	9020[c]
Cation exchange capacity	9080[c]
Flouride (soil samples)	340.2[a]
Flouride (aqueous samples)	300.0[a]
Nitrate	352.1[a]
Sulfate (soil samples)	375.4[a]
Sulfate (aqueous samples)	300.0[a]
Permeability	EM-110-2-1906[d]
Porosity	ASTM D854-58[e]
Moisture	CLP Modified 624/625[f]
Bacteria count	(g)

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a/ U.S. EPA. 1979. Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020 (Revised March 1983).

b/ 1981 Annual Book of ASTM Standards, Part 1g Soil and Rock; Building Stones. pp. 113-123.

c/ Test Methods for Evaluating Solid Waste Physical/Chemical Methods. Third Edition. November 1986. (SW-846).

d/ The Department of the Army, November 1970.

e/ 1981 Annual Book of ASTM Standards, Part 1g Soil and Rock; Building Stones. pp. 213-215.

f/ CLP Statement of Work.

g/ To be determined by EPA.

matrices, ESC (with EPA assistance, if required) will provide professional guidance on how to continue without excessive cost increases or compromise of data quality.

For purposes of quality control, a minimum of 5% of all samples collected in the field for laboratory analyses will be replicated, i.e., there will be 1 duplicate sample for every 20 samples collected. These replicates are blind to the laboratory. Internal laboratory replicates are also analyzed at the rate of 1 per every 20 samples for analyses.

The accuracy of analytical techniques and instrument calibration is monitored through the use of calibration standards (see Section 8.0). Quality control checks, such as the analysis of one field blank and one trip or travel blank provided with each batch of sample containers shipped to the laboratory, will provide guidance and ascertain the integrity of analyses.

Matrix spike samples will be prepared and analyzed by the laboratory at the rate of 1 per 20 samples of the same matrix. Sample matrices will thus be examined to evaluate their effect on the analytical protocols.

Laboratory QC reference samples will be integrated into the analytical scheme to assess accuracy. All field and laboratory QC samples will be analyzed according to the method protocols as regular samples, including all spikes, dilutions and processing. All QC samples will be evaluated based on the CLP or other EPA acceptance criteria of the relevant analytical method.

Field blanks will be analyzed with each run to detect possible sampling equipment contamination. Laboratory blanks will be analyzed with each run to detect container, sample preparation, reagent or system contamination.

5.3 Data QA Assessment

All data will be reported completely. No data will be omitted unless an error occurred in the analyses or the run was invalidated because of QC sample recovery or poor precision.

EPA has established requirements for accuracy and precision for the analyses in CLP Protocol and for other EPA approved analytical methods. Data precision is routinely evaluated based on the results of the samples analyzed in duplicate. The range is calculated and then divided by the average of the two analyses. When multiplied by 100, this value equals the relative percent difference. The relative percent differences of duplicates in each data set are compared with values previously found in the lab.

5.4 Data Representativeness

All proposed field testing and measurement procedures are designed to maximize the goal that the field data will represent the conditions found at the site. All sampling efforts will be conducted using procedures designed to maximize the goal that the sample be representative of the matrix from which it was taken.

The use of variable diameter hand augers or a hollow stem auger and split barrel sampler will allow undisturbed soil samples to be collected from discrete depth intervals. These procedures (see SAP, Appendix A of the Work Plan) will also prevent cross-contamination by drag down from upper to lower depths. Inlet and river sediment samples will be sampled using a gravity driven marine or lacustrine corer, which will also prevent cross-contamination by drag down. In the Sampling Plan element of the RI/FS Work Plan, ESC has addressed representative sampling of soils and sediments.

All well water samples will be collected after purging of the stagnant water in the open interval of the well bore to allow collection of groundwater that is representative of the aquifer flow. Where possible, discrete phases noted above or below the groundwater will be sampled.

All analytical activities are designed to produce data representative of the samples submitted for analysis. The main tool for ensuring data representativeness is that described in Section 12 and the proper execution of field activities.

5.5 Data Comparability

All data collection mechanisms proposed in the Work Plan are designed to produce comparable data. Procedures for field measurements are provided in Section 9.0 to ensure that tests performed at various locations across the site are conducted using accepted procedures, in a consistent manner between locations and over time, and include appropriate QA/QC procedures (i.e., instrument calibration) to ensure the validity of the data. Any limitations on the comparability of test data will be noted, and test results will be evaluated on that basis.

Sampling procedures for environmental matrices are provided in Section 6.0 to ensure that samples are collected using accepted field techniques, in a consistent manner between locations and over time, and include appropriate QA/QC procedures to ensure the validity of the data.

All soil, groundwater, and sediment samples will be analyzed by CAA and its subcontractors using consistent protocols for sample preservation, holding times, sample preparation, analytical methodology, and quality control as described in approved EPA methods and in CLP Procedures. Relevant parameters, such as holding times, and sample containers have been included in the SAP (Appendix A of the Work Plan).

The data will be reduced, reported, and documented in a consistent manner throughout the study. For example, water and sediment quality data will be reported using a consistent set of units throughout the study. Any deviations from established protocols will be noted in the data base so that data comparability can be maintained.

5.6 Data Completeness

The data generated by the investigations are intended to be complete. Analytical and field data completeness will be addressed by applying data quality checks and assessments described in Section 5.2.1 and 5.3 to ensure that the data collected are valid and significant.

The analytical laboratory will be required to supply CLP protocol deliverables; as specified in the latest statement of work (SOW): 7/87 for inorganics and 7/88 for organics (with the exception of the requirement in both of these SOWs for diskette deliverables). Both CLP format summary reporting forms and supporting new data will be provided by the laboratory. ESC will use EPA functional guidelines for data review to define and assess the completeness and validity of data deliverables. The completeness of an analysis must be documented by including in the report sufficient information to allow ESC to assess the quality of the results. The information delivered will include such items as chromatograms, spectra, QC data, and summaries of results. Additional information, such as the laboratory worksheets and notes, will be stored with the sample results in the laboratory. The raw data (prior to data reduction) will be archived indefinitely on magnetic tape by the laboratory. All analytical information, per sample, is retained by the laboratory whether or not ESC requests results substantiation.

6.0 Sampling Procedures

The Sampling and Analysis Plan addresses sampling in all environmental media. The design and justification for the sampling proposed is discussed in general throughout the RI/FS Work Plan and is discussed in detail in the Sampling Plan element of the RI/FS Work Plan.

[Cambridge Analytical Associates, Inc. (CAA), has agreed to provide ESC with analytical services in support of the (RI/FS) at Hellertown. CAA will provide sample analysis, sample containers (prepreserved), CLP data deliverables, and a diskette deliverable. Sample analysis will be performed using Contract Laboratory Program (CLP) protocols, EPA-approved protocols for conventional pollutants, and EPA method 524.2 for volatile organics in drinking water samples. Sections 3 and 4 of CAA's Quality Assurance Project Plan (Appendix A) detail the services to be provided, including project organization and management.]

6.1 Groundwater Sampling Procedures

Groundwater samples from selected wells will be collected in accordance with the procedures described in the SAP (Appendix A of the Work Plan). The procedures describe sampling order, labeling, and other requirements. Domestic well samples will be collected in accordance with the procedures described in the [Sampling and Analysis] Plan.

6.1.1 Monitoring Wells

Sampling of monitoring wells will be done (as described in SAP) after the wells have been properly developed and purged. Because drilling and well construction disturb the natural groundwater system for the new wells, 24 hours will be allowed for the groundwater system to return to chemical and physical equilibrium. All measuring devices and equipment used during sampling will be decontaminated and thoroughly rinsed with distilled water before being used as described in the SAP (Appendix A of the Work Plan). Before sampling, a quantity of water will be removed equal at a minimum to three to five times the estimated volume of water in the well, if it cannot be pumped or bailed dry. If the well goes dry during bailing, it will be allowed to recover and then be reemptied before sampling. To avoid cross-contamination, dedicated bailers will be used for some wells and nondedicated bailers will be used in other wells for sampling. The same bailer rope will not be used in more than one well. Other materials incidental to sampling will be cleaned and decontaminated as described in the SAP. The sample container requirements, preservatives to be used, minimum sample quantities required, and maximum holding times are outlined in Appendix A of the Work Plan.

6.2 Surface Water Sampling Procedures

Surface water sampling procedures are described in the SAP (Appendix A of the Work Plan). Sampling equipment will be cleaned and decontaminated before and after each sample is collected as described in the SAP. Surface water grab samples will be collected in precleaned sample containers supplied by laboratory.

6.3 Sediment Sampling Procedures

Solid samples will be collected as described in the SAP (Appendix A of the Work Plan). Grab sediment samples will be collected by scooping the sediments into the jar until it is full. The sample jars will be filled as full as possible to eliminate head space and to minimize the loss of volatiles.

The sampling information, along with sample condition, will be recorded on a field sampling tracking record and inserted into the field log by the field sampler.

The samples will be stored and shipped in the same manner as water samples. The maximum storage time will be equivalent to that for water samples.

6.4 Soil Sampling Procedure

Soil will be sampled as indicated in the Sampling and Analysis Plan (SAP).

6.5 Post Sampling Procedure

All aqueous samples will be field tested for temperature, pH and conductivity. All solid samples will be scanned with a field HNu meter. At the end of sampling, the exterior of all containers will be rinsed with distilled or organic free water, wiped clean, and dried, marked with a waterproof marker, and labeled and stored in ice chests for shipment (SAP). Identifying information on the label will include the time, date, location, depth, sample type, and sample identification number. Samples collected for metals analyses will be filtered in the field (SAP). Samples for metals analyses will be appropriately preserved, stored in temperature-controlled conditions, and shipped to the laboratory in a timely manner, as described in the SAP. All preservatives will originate from the candidate laboratory.

Field observations and data from the measurement of temperature, HNu readings, pH, and conductivity will be recorded on the surface water sampling records. These records will be kept in a field log. Other pertinent field information, such as air monitoring data, will be recorded in the field log. Field blanks will be prepared as indicated in Appendix A of the Work Plan.

7.0 Sample Custody

Sample custody is controlled and maintained through the chain-of-custody procedures. Chain-of-custody is the means by which the possession and handling of samples will be tracked from the source (field) to their final disposition, the laboratory. A sample is considered to be in a person's custody if it is in the person's possession or it is in the person's view after being in his or her possession or it was in that person's possession and that person has locked it to prevent tampering.

[Sample containers will be cleaned and preserved at the laboratory before shipment to the site. Other chain-of-custody supplies, such as shipping containers (coolers), sample labels, custody seals, and ice packs, will also be provided by the laboratory. Section 7 of CAA's QAPP outlines chain-of-custody procedures to be followed.]

7.1 Sample Container Preparation

Sample containers for the investigations under this project will be prepared and supplied by CAA and its subcontractors. Chain-of-custody will begin with the source of the sample container. The procedures and associated protocols for container cleaning are documented in the Quality Assurance and Quality Control manuals for the laboratory.

7.2 Field Sampling Operations

ESC personnel are responsible for the custody of samples from the time they are collected until they are transferred to the sample shipper or the laboratory. The chain-of-custody procedures for the project are given below.

Each sample will be assigned a unique ESC sample identification number by affixing a self sticking, prenumbered labeled on the sample number, and sampling information will be recorded in a field log.

The sample will be placed on ice in a thermal shipping container and otherwise preserved as required. The container will remain within the sampler's view or locked in the sampling vehicle for temporary storage and transport to the sampling staging area.

Upon arrival at the sampling staging area, the sampler will fill out chain-of-custody form(s) to account for each sample (Figure 7-1). Blanks and QC samples will be sent with each group of samples as described in Sections 5.0 and 6.0. Field duplicate samples will be sent as "blind duplicates," that is the laboratory will be unable to distinguish a field duplicate from any other sample. The identity of the field duplicate sample will be recorded in the ESC field notebook. The ESC copy of the chain-of-custody form will be retained as a permanent record in the project files.

The location of sampling points in the field will be documented in accordance with the procedures described in the SAP (Appendix A of the Work Plan). These procedures are designed to ensure that

No. 1001

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME AND LOCATION:
SAMPLERS: *(Signature)*	PRINT NAME:

LINE	SAMPLE NO.	DATE	TIME	COMP.	GRAB	SAMPLE LOCATION	MATRIX	NO. OF CONTAINERS							REMARKS
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	LAB NAME: CITY:
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	COURIER: AIRBILL NO.:
Received for Laboratory by: *(Signature)*	PRINT NAME:	Date / Time	CUSTODY SEAL NOS: COOLER NO:

ATTENTION LAB: SEND ANALYTICAL RESULTS TO THE FOLLOWING ESC STAFF MEMBER:

ENVIRONMENTAL STRATEGIES CORPORATION
8521 LEESBURG PIKE, SUITE 650
VIENNA, VIRGINIA 22182
703-821-3700

ESC

ESC

ENVIRONMENTAL STRATEGIES CORPORATION
8521 LEESBURG PIKE • SUITE 650
VIENNA, VIRGINIA 22180
(703) 821-3700

Figure 7-1

Chain-of-Custody Record

sampling points used during the investigations can be relocated in the future and are accurately represented in subsequent reports. The record of the location of sampling points will be retained as a permanent record in the project files.

Following sample collection, the sampler will record the date and time and sign in the appropriate block of the form to relinquish custody. The sampler carrier will then sign and record the date and time in the appropriate box to accept custody. The original chain-of-custody (COC) record will be placed inside the shipping package. The shipping container will then be sealed with a custody seal. The seal will serve to document that samples have not been tampered with. The sample shipping receipt will be retained as part of the permanent COC document.

CAA will assume custody of the samples upon receipt. A designated laboratory sample coordinator will record the date and time and sign the COC form upon receipt. The sample coordinator will immediately inspect the shipment for damage and completeness and report any problems to the ESC QAO. The laboratory sample coordinator will then complete the appropriate lab tracking forms and logs.

7.3 Laboratory Operations

The laboratory sample coordinator is Alison Darrow of Cambridge Analytical Associates and is responsible for the custody of samples from the time of sample receipt to the time of discard. CAA has established standard operating procedures for sample handling and tracking. These are detailed in the laboratory's Quality Assurance Project Plan (Appendix A).

Most of the organic parameters (BNA and Volatiles) to be analyzed for under this project do not require special chemical preservatives. They do require holding samples at cool temperatures (4° C). Holding conditions of the samples are checked and recorded. Preservation of the samples is verified by the lab sample coordinator when the samples are logged. The field crew will follow the SAP for the appropriate preservative and holding time for other TCL constituents or other indicator parameters (such as TSS, TOC, TDS, and hardness).

8.0 Calibration Procedures and Frequency

The calibration and schedules established for the accuracy of instruments and measuring equipment apply to all test and measuring equipment. Specific calibration procedures for each instrument to be used in the field are detailed in the SAP.

8.1 Field Instruments

Field meters to be used during sampling include pH, HNu, wind gauge, and conductivity. The calibration procedures for these instruments are discussed in the Sampling and Analysis Plan (Appendix A of the Work Plan). All calibration, maintenance, repair and equipment usage will be recorded in sampling and equipment logs maintained by ESC. Field instrument and equipment calibration and maintenance schedules are summarized in Table 8-1.

8.2 Laboratory Instruments

The calibration and maintenance schedule for laboratory analytical instruments are described in the Laboratory's Quality Assurance Project Plan (Appendix A).

Table 8-1

Field Instrument Calibration and Maintenance Schedule

Instrument	Reference	Schedule Calibration	Scheduled Maintenance
HNU photoionization detector-organic vapors (or equivalent	HNU Systems Inc. 1975. Instruction Manual for Model P101 Photoionization Analyzer	Daily	Daily
Conductivity meter	Omega	Daily	Daily
pH meter	Omega	Daily	Daily
Wind gauge	Windial™	Daily	Daily
Stream gauge	Teledyne Gurley	Daily	Daily

9.0 Analytical Procedures

Field measurements will be obtained in accordance with the standard operating procedures described for the HNu meter, the pH meter, the conductivity meter, and the wind meter in the SAP (Appendix A of the Work Plan).

Laboratory analytical procedures will follow the USEPA Contract Laboratory Program (CLP) protocols and additional EPA approved methods (Table 9-1). The frequency with which CLP procedures will be used is indicated in the Sampling and Analysis Plan. Non-CLP method SOPs, including the SOPs for TSS, TDS, hardness, flouride and nitrate methodologies, have been included in Appendix A.

Table 9-1

Analytical Methods

Parameter	Method
TCL volatiles	CLP-Modified 624
TCL BNA extractables	CLP-Modified 625
TAL metals	CLP
Total cyanide	CLP
Hardness	130.2
Total dissolved solids	160.1
Total suspended solids	160.2
Total organic carbon	415.1
Total organic halogens	9020
Total alkalinity	310.1
Flouride (soil/water)	340.2/300.0
Nitrate	352.1
Sulfate (soil/water)	375.4/300.0
Permeability	EM-110-2-1906
Grain size	ASTM 0422-63
Porosity	ASTM D854-58
Moisture	CLP Modified 624
Cation exchange capacity	9080
Bacteria count	(a)

---

a/ To be determined pending clarification from EPA.

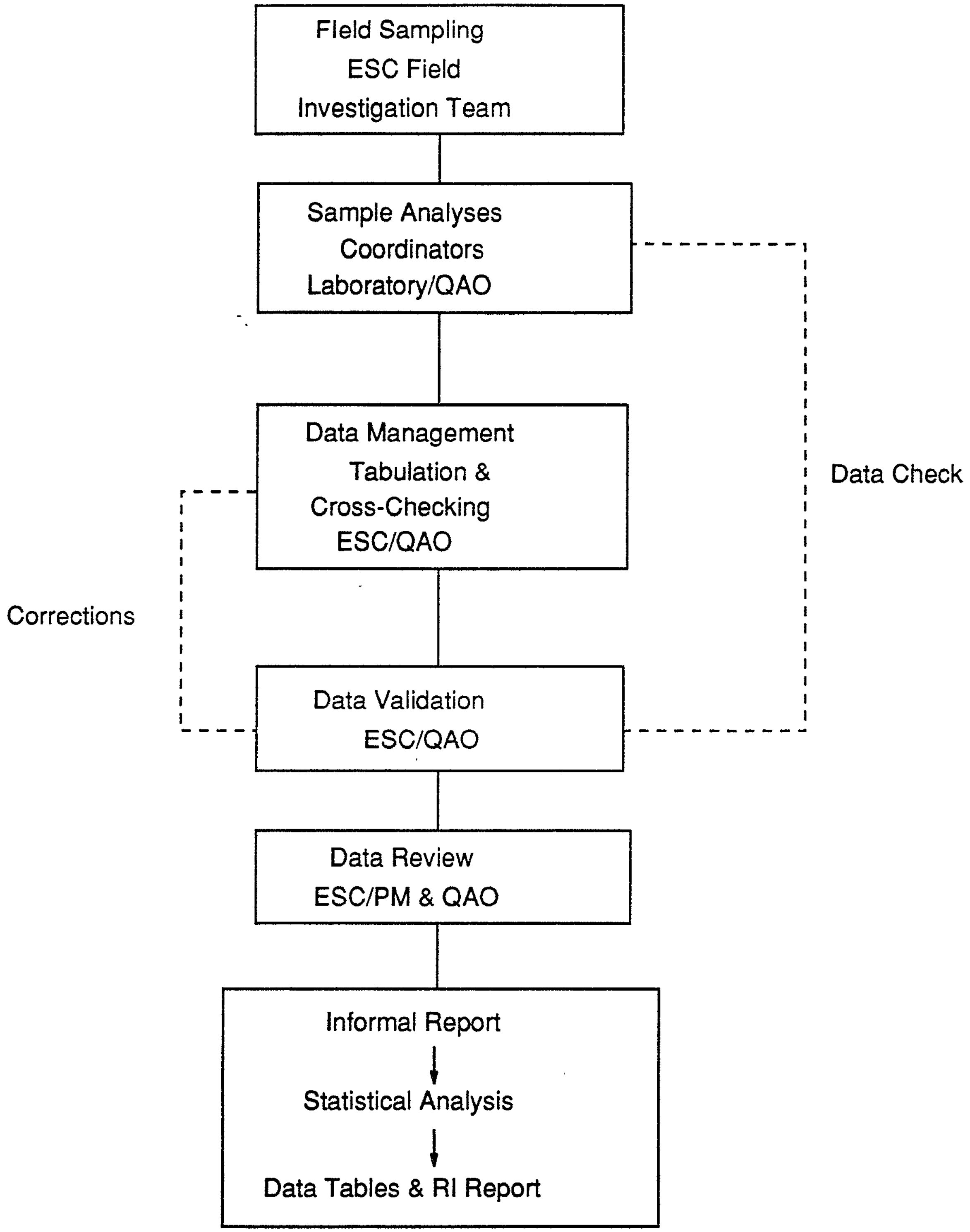
10.0 Data Reduction, Validation and Reporting

The reporting scheme from sample collection to the use of validated data is shown in Figure 10-1. Samples will be collected by ESC personnel and sent by carrier with the proper COC documents to the laboratory.

10.1 Data Reduction

ESC and the laboratory will attempt to minimize manual data entry through the use of personal computers and software packages. CAA and its subcontractors will supply packages of all raw data to ESC. Also, analytical data may be supplied on diskettes. ESC will review all data supplied by the laboratories and perform data validation as required by the ACO. Laboratory data will be checked for errors in mathematical computation and to ensure that the analytical values for blanks are not subtracted from those of samples.

All data produced during the project investigations will be organized as tables of analytical results and may be stored in a computerized data base system at ESC. Hard copies of all analytical data on the project will be stored in ESC's filing system. It is anticipated that ESC's data reduction for this investigation will consist primarily of tabulating analytical results from the laboratory's report forms into summary forms through the use of



ESC
ENVIRONMENTAL STRATEGIES CORP.
8521 Leesburg Pike Suite 650
Vienna, Virginia 22180
703-821-3700

Figure 10-1
Data Flow & Reporting Scheme
Initial Response Measures & RI\FS

computerized spreadsheet software. All reduced numbers will be assigned document control identification numbers.

Data will be reported in micrograms per liter (ug/l) for water samples and micrograms per kilogram (ug/kg) for sediment samples. The procedures used to calculate concentrations will be the same as those specified in the specific analytical methodology used.

10.2 Data Validation

Data validation will be accomplished by the QA/QC managers for CAA and its subcontractors and the Quality Assurance Officer of ESC. All data will be validated by ESC's Quality Assurance Officers using the original laboratory reports. The laboratories will produce data reports that allow for validation by including all CLP deliverables or QA/QC deliverables for the relevant analytical method. Appropriate equations for precision, accuracy (bias), and completeness will be used for all analyses. The data reporting packages will be reviewed thoroughly by ESC's QA officer.

The data validation process will involve a review of instrument calibration procedures, instrument tuning and performance, holding times, blanks, matrix spike, matrix spike duplicate, interference in analytical determinations, compound identification, system performance, verifying calculations, and data assessment. Criteria for accepting and rejecting data will be based on EPA's Functional Guidelines for the Evaluation of Organic and Inorganic Analysis.

A preliminary review will be performed to verify all necessary paperwork (chain-of-custodies, traffic reports, analytical reports, laboratory personnel signatures) and deliverables are present.

A detailed quality assurance review will be performed by the ESC Officer (or a staff reviewer) to verify the qualitative and quantitative reliability of the data as they are presented. This review will include a detailed review and interpretation of all data generated by the laboratories. The primary tools which will be used will be guidance documents, established (contractual) criteria, and professional judgment. Table 10-1 presents the items examined during the quality assurance review.

Based on the review of the analytical data, an organic and inorganic quality assurance report will be prepared. The report will consist of a general introduction section, followed by qualifying statements that should be taken into consideration for the analytical results to be best utilized. Based on the quality assurance review, qualifier codes will be placed next to specific sample results on the sample data table. These qualifier codes will serve as an indication of the qualitative and quantitative reliability.

During the course of the data review, an organic and inorganic support documentation package will be prepared which will provide the backup information that will accompany all qualifying statements presented in the quality assurance review.

Once the review has been completed, the Quality Assurance Manager will then submit these data to the Project Manager.

Table 10-1

Items Reviewed During the ESC Data Validation

Areas Examined	Application (organic, inorganic, both)
ESC and laboratory chain-of-custodies	Both
(traffic reports, field notes)	
Laboratory narrative and QC summaries	
Holding times	Both
Extraction/digestion logs	Both
Blanks - field and laboratory (accuracy)	Both
Instrument tune	Organic
Standards	Both
Linearity	Both
Sensitivity/stability	Both
Selectivity/specificity	Both
EPA criteria (SPCC & LCS)	Both
Variability of technique (internal standards)	Organic
Analyte breakdown	Organic
Analytical sequence	Organic
ICP interference	Inorganic
Control standards	Inorganic
Samples	
Detection limits	Both
Instrument printouts	Both
ICP data	Inorganic
AA data	Inorganic
GC data	Organic
GG/MS data	Organic
Autoanalyzer data	Inorganic
Qualitative identification	Both
Mass spectra	
Pesticide/PCB results	
Tentatively identified compounds	
Quantitative reliability	Both
Calculations/equations	Both
Matrix spikes (accuracy)	Both
Bias	
Accuracy & precision	
Surrogate spikes	Organic
Bias	
Duplicates (field and laboratory)	Both
Precision	
Representativeness	
Post-digestion spikes	Inorganic
Matrix effects	

10.3 Data Reporting

Analytical data will be summarized in tabular form with information elements to include sample number, sample matrix description, parameters analyzed and their corresponding detected concentrations, CLP "flags" where appropriate, and the detection limit. The laboratory will be required to use CLP Standard Reporting Forms for data reporting. EPA Functional Guidelines for Data Review will be used for data review. The use of these protocols defines the forms that will be used; examples of the forms are not duplicated in the QAPP. The data reporting scheme is summarized in the flow chart in Figure 10-1.

Results from the Phase II sampling plans will be incorporated into reports as data tables, maps showing sampling locations and contamination and supporting text. Results will be provided to EPA Region III according to the schedule required in the ACO.

ESC will require a rigorous data control program that will ensure that all documents for the investigations are accounted for when they are completed. Accountable documents include items such as log books, field data records, data packages, photographs, computer disks, and reports. The Project Manager is responsible for maintaining a central file in which all accountable documents will be inventoried.

To maintain control in the transfer of data, all copies of raw data from the field notebooks, and the data as received from the laboratory, will be entered into a data file and assigned an appropriate document control identification number. The data file will serve as the ultimate archive for all information and data generated during this investigation.

The documentation of sample collection will include the use of bound field log books in which all information on sample collection will be entered in indelible ink. Appropriate information will be entered to reconstruct the sampling event, including site name (top of each page), sample identification, brief description of sample, date and time of collection, sampling methodology, field measurements and observations, and sampler's initials (bottom of each page), and dated.

11.0 Internal Quality Control Checks

The internal quality control checks for laboratory analyses of groundwater, surface water, and soil and sediment samples collected during the Phase II investigation are covered in the Quality Assurance Project Plan of the laboratory (Appendix A). The checks include internal quality control methods covering spikes, duplicates, preparation blanks, calibration, and reagent checks.

One field blank will be collected for each daily sampling activity. These samples will be used as a QC check of the decontamination procedures for sampling devices.

The surface water, groundwater and soil and sediment sample containers will be filled with organic free water for organic analysis and distilled water for inorganic analysis. The samples will be labeled, documented, and handled in the same manner as other field samples. A field blank and trip blank will be sent to the laboratory for each batch of shipping containers.

Duplicate samples will be collected to allow determination of analytical precision. One duplicate sample will be collected for every 20 samples collected of the same matrix (i.e., groundwater, surface water, soil, sediment, or sludge) and submitted for analysis. These samples may be run as matrix spike/ matrix spike duplicate samples.

A laboratory matrix spike sample will also be analyzed as a further QC check. The matrix spike samples will be analyzed at the same frequency as stated above for the duplicate samples. The matrix spike samples will allow accuracy to be determined by using the percent recovery of the spiked compounds (see Appendix A). The purpose of the laboratory spike samples is to monitor any possible matrix effects specific to samples collected from the subject site.

Duplicate or replicate sample aliquots for ground and surface waters will be collected sequentially as grab samples after collection of the initial sample aliquot. The specific sample location which will be used for matrix spikes may be chosen by the QAO. Soil or sediment sample duplicates will be collected by splitting the sample between the sample container and the duplicate container. Homogenizing is discouraged for volatile field duplicate samples to avoid the loss of aromatic hydrocarbons.

12.0 Performance System Audits

Performance and system audits will be conducted by ESC's QA officer or his designated representative to ensure that the procedures used to conduct field operations and laboratory analyses are properly followed. The QA officer will formulate corrective action acceptance reports, audit reports, and coordinate the recommended actions with the laboratory QA officers. **[All audit reports will be retained by the QA Officer.]**

12.1 Field Audits

A minimum of one field audit per investigation is planned by the ESC QA Officer or his designated representative. System and performance audits will be conducted during the investigations to monitor adherence to the standard operating procedures for sample collection techniques and field decontamination procedures. Also, the use of QA/QC samples, chain-of-custody procedures, and documentation on all QA/QC requirements will be monitored. All nonconformance items will be documented and addressed. A written report will be prepared for each audit and retained by the QA Officer. The report will address adherence to the standard operating procedures for sample collection, preparation, preservation, storage, and field decontamination.

12.2 Laboratory Audits

Cambridge Analytical Associates participates in EPA's Contract Laboratory Program (CLP) and as a result will not have to be audited as indicated in the ACO. CAA conducts routine in-house performance and systems audits to monitor all procedures. The laboratory has developed standard operating procedures covering laboratory practices.

Blind duplicate samples will be sent to the laboratory for analysis to determine the data accuracy, precision, and completeness. In addition, split samples may be sent to another CLP lab for an additional check on data accuracy, precision and completeness. The candidate laboratory is still under consideration by ESC. ESC's QAO will conduct a system audit of the CAA laboratory at least once during the project to ensure that proper quality control measures are being incorporated into the sample handling and analysis. Table 12-1 lists the checklist that will be used for the system audit.

Results of both the field and laboratory audits will be submitted to ESC's project manager for review and incorporation into the status reports prepared by ESC. If the results of the audit necessitate further action, the Project Manager will be notified and will be apprised of any action taken.

Table 12-1

ESC's System Audit Checklist

Chain-of-Custody

- Log-In procedures evaluated
- Sample custodian is assigned and oversees sample transfers
- Sample routing and pickup are documented and accounted for
- Separate area for sample storage is maintained and locked

Sample Preparation

- Correct sample preparation procedures are followed
- Areas designated for sample preparation (organic and inorganic)
- Holding times maintained

QA/QC Procedures

- Procedures are being followed according to methods specified
- Data validation and reduction processes reviewed by group leaders
- Proper documentation of QA procedures
- Internal QC maintained
- Data transfers and reporting checked by group leaders
- Awareness by personnel of QA requirements

Equipment Maintenance

- Maintenance logs are up-to-date
- Instrumentation is in repair
- Reasonable spare parts are on hand

Miscellaneous

- Overall housekeeping in order
- Certifications up-to-date

Table 12-1 (continued)

ESC Quality Assurance Audit

Project________________________ W.O.________________

Date________________ Audit Conducted From __ Hr. to __ Hr.

Auditor(s): ________________________

____

Onsite Personnel: __________________________

____

Audit Conducted on the Following:

_____ Soil Sampling
_____ Surface Water/Sediment
_____ Groundwater
_____ Decontamination
_____ Health & Safety

Sample Collection:

Do sampling locations agree with those specified in the Work Plan? _____

Is the location of the sampling location documented sufficiently to allow it to be found and sampled again in the future? _____

Are sampling times, ESC Traffic Report Numbers and sample descriptions noted? _____

Is sampling proceeding from the suspected least contaminated area to the most contaminated area? _____

Have sample bottles been labeled properly? _____

Have proper containers and preservatives been used? _____

Are samples being refrigerated or iced immediately after collection? _____

Does a travel blank exist for each matrix present? _____

Does the potential for sample cross-contamination exist based on procedures observed? _____

Table 12-1 (continued)

ESC Quality Assurance Audit

Soil Sampling (Check if not applicable _____):
Type: ______ Hand ______ Auger or Rig

Are samples being collected at proper depths? ______

Are samples being screened with an OVA (if specified in Work Plan and applicable)? ______

Is a description of soils/materials being logged? ______

Have soils been homogenized where applicable (specified by the Sampling Plan)? ______

Surface Water/Sediment Sampling (Check if not applicable _____):

Have stream flow and velocity parameters been noted? ______
Estimated ____ or Measured ____

Has sampling proceeded from downstream to upstream locations? ______

Has the sampler acquired the water sample upstream of his position to minimize suspended sediment from entering the sample? ______

Have sediments been characterized as to type and size distribution? ______

Has the proper sediment fraction (fine, depth) been sampled for the analyses of interest? ______

Are the selected locations effectively monitoring effects of the potential source? ______

Groundwater Sampling (Check if not applicable _____):

Have the well specifications been noted properly (i.e., total depth, casing diameter, depth-to-water)? ______

Has the purge volume been calculated properly? ______

What evacuation method has been used?
_____ Bailer _____ Submersible _____ Bladder Pump
______ Other (___________________________)

If metals are being analyzed, have the samples been field filtered?

Table 12-1 (continued)

ESC Quality Assurance Audit

Are field pH, conductivity, and temperature being measured? ______ Is there documentation of calibrating the instruments? ______

Is bailer line and bailer dedicated to each well and line disposed of after use? ______
Bailer type ____________ Line type ____________

Have appropriate measures been taken to dispose of contaminated purge water? ______

For Domestic Wells: Has as much information on the well and distribution system been obtained, i.e., depth, casing type, diameter, treatment present, etc.? ______

Has the sample been collected prior to treatment and as close to the well head as possible? ______

Has the domestic well been purged sufficiently to reach temperature stabilization? ______

Decontamination:

Has sampling equipment been decontaminated properly for the given analytes? ______

Have the proper decontamination solutions been used? ______

For large equipment (backhoes, drill rigs), has decontamination taken place in an appropriate area? ______

Has decontaminated water/solution been collected for proper disposal? ______ Where disposed? ______________

Safety:

Is the proper level of protective clothing being worn for the tasks? ______ Level A __ B __ C __ D __

Is the site Health and Safety Plan present with proper emergency contacts included? ______

Is monitoring equipment present? ______ OVA ______
H_2, O_2 meter ______ Explosimeter ______ Other ________

Is the vehicle equipped with a First Aid Kit? ______

Is contaminated protective clothing being disposed of properly? ______

Table 12-1 (continued)

ESC Quality Assurance Audit

Are personnel aware of the contaminants present at the site? ______

General:

Are employees conducting the investigation in a professional manner? ______

Are the objectives of the sampling activities understood by the field personnel? ______

Are weather conditions affecting sample quality or representativeness? ______

Audit Summary and Comments:

Signed by: ______________________ Print: ______________________

Date: ______________________

13.0 Preventive Maintenance

Minimal maintenance is required for the field testing equipment. Spare parts can easily be obtained from suppliers. All well pumps, meters, and electronic water level indicators will be thoroughly checked before set-up of field tests. Battery checks will be made for all instruments before sampling begins and periodically during the day. Replacement parts for damaged instruments will only require one day for delivery from ESC's Vienna office or the supplier. Field maintenance will mainly consist of keeping the instruments clean and dry. A preventive maintenance program of field equipment is presented in Table 13-1. The field monitoring equipment and measuring devices are maintained under a routine schedule. This maintenance reduces the potential for unscheduled downtime. Knowledge of part failure rates permits the replacement of components during scheduled maintenance checks.

Table 13-1

Preventive Maintenance Checklist for Field Equipment

Equipment	Task	Check Frequency
Electronic water	Check battery	Daily
Level Indicator	Rinse probe	After each well
Bailer	Detergent and water wash Potable water rinse Organic-free water rinse Air dry	After each sampling
Pump and pump wire	Steam clean	After each well
pH/conductivity	Rinse probe	After each well
Meters	Check battery	Daily
HNU meter	Check battery	Daily
	Check photoionization detector	Daily

14.0 Assessment of Data Precision, Accuracy, and Completeness

The precision, accuracy, and completeness of groundwater, surface, and soils, and sediment data will be determined from the data of QC samples (replicates, field blanks, and trip blanks). Precision will be based on one or more replicate samples. Accuracy will be evaluated based on results of the spiked samples and blanks. The analytical detection limits and QA protocols for laboratory analyses are discussed in Section 5.0 and summarized in Table 5-1. All field and laboratory data will be checked for completeness, proper documentation, and reported results.

Data completeness will be evaluated by comparing the objectives of the Phase II efforts with the data obtained and determining whether there are any shortcomings in needed information. A series of protocols, described below, will be used to evaluate data completeness. The purpose is to:

- Rigorously assess the quality and adequacy of data collected during the Phase II investigation.
- Review data collected during the Phase II field investigation to evaluate if the study's objectives are being addressed and met.
- Ensure that the data collected are valid by applying the quality checks described in this and other sections of the QA plan.

The data quality requirements and assessments applicable for groundwater, surface water, and sediment and soil are based on the CLP and additional approved EPA methods. Although CLP data quality requirements will not be required for all analyses, the CLP data quality requirements will be adhered to. Data quality requirements and assessments for field measurements are described in the SAP (Appendix A of the Work Plan).

Field blanks are analyzed with each laboratory run to detect contamination by sampling equipment. Laboratory blanks are analyzed with each run to detect container, sample, reagent or system contamination.

Sample matrices will be evaluated to assess their effect on the analytical protocol. However, minimal interference is expected on the samples analyzed in the investigations. A series of sample spikes, dilution spikes and dilution will be examined to determine interference.

15.0 Corrective Action

Corrective action procedures for deficiencies in the laboratory are covered in the Quality Assurance Project Plan. If the analyses and data do not conform to the objectives identified by the Quality Assurance Plan identified in Section 5.0, errors that necessitate corrective action will be identified by ESC's QA Officer based on knowledge of the analytical procedures or predetermined limits under CLP protocol. If data are rejected as a result of the data validation procedures or QC checks, the sample matrix will be reanalyzed.

If errors in field procedures are found during the observation or review of field activities by ESC's QA Officer or his designee, corrective action will be initiated. Nonconformance to the QA/QC requirements of the field SOPs will be identified by system and performance audits or by project staff who know or suspect that a procedure is not being performed in accordance with the requirements. The ESC QA Officer or his designee will be informed of all deficiencies. Timely action will be taken if corrective action is necessary. The following protocol will be used to ensure that the identified deficiencies will meet the specified QA/QC requirements:

- Nonconformance reports will be completed for activities that are not performed in accordance with the work plan and QA plan requirements.
- The QA Officer and Project Manager will review the identified deficiencies to determine the source of the

problem and develop a corrective action plan. Corrective actions for field sampling and testing deficiencies will be developed with assistance from the field team.

- The deficiency will be corrected before further field activities are conducted. The Project Manager will have ultimate responsibility for ensuring that corrective actions are fully implemented.
- The QA officer or his designee will be notified when corrective actions are completed. A follow-up audit will be conducted and a written report on the acceptability of the corrective action will be filed with the Project Manager.

16.0 Quality Assurance Reports

A QA report on the Field Performance Audit will be submitted to the EPA Region III. The report will include discussions on status of the project, results of performance and system audits, QA problems encountered, and the corrective actions taken to remedy the deficiencies and any changes made in the project operations plan.

Appendix A

Cambridge Analytical Associates (CAA) QAPP

Environmental Strategies Corporation
8521 Leesburg Pike, Suite 650
Vienna, Virginia 22180

Quality Assurance Project Plan

for the

Hellertown, Pennsylvania
Remedial Investigation/Feasibility Study
(RI/FS)

Prepared By:

Cambridge Analytical Associates, Inc.
1106 Commonwealth Avenue
Boston, Massachusetts 02215

January 13, 1989

Approved: ______________________ Date: ______________
CAA Project Manager
Nancy Kilar

Approved: ______________________ Date: ______________
CAA QA Coordinator
Clare Killough

Approved: ______________________ Date: ______________
ESC Project Manager

Approved: ______________________ Date: ______________
ESC QA Coordinator

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3. PROJECT DESCRIPTION

3.1 Introduction

This Quality Assurance Project Plan (QAPP) is submitted to Environmental Strategies Corporation (ESC) by Cambridge Analytical Associates, Inc. (CAA) for laboratory analysis services consisting of sample analysis for volatile organics, semivolatile organics, pesticides/PCBs, metals, and cyanide, by Contract Laboratory Program (CLP) protocols and EPA approved protocols for conventional pollutants. These analysis are made in support of the Hellertown, Pennsylvania Remedial Investigation/Feasibility Study (RI/FS).

CAA is prepared to provide a wide variety of technical consulting services. If a project's requirements exceed, or vary from, the level of QA/QC measures outlined in this QAPP, a revision to this QAPP will be provided to ESC by CAA's Quality Assurance Department. This QAPP will ensure that the data generated by the Analytical Laboratory is useful to ESC, and meets all of ESC's QA requirements.

Table 3.1 Target Compound List (TCL)

VOLATILES	CAS Number	CRDL Water ug/L	CRDL Low Soil/Sediment^a ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-34-3	5	5
10. 1.2-Dichloroethene (total)	540-59-0	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,2-Dichloropropane	78-87-5	5	5
19. cis-1,3-Dichloropropene	10061-01-5	5	5
20. Trichlorethene	79-01-6	5	5
21. Dibromochloromethane	124-48-1	5	5
22. 1,1,2-Trichloethane	79-00-5	5	5
23. Benzene	71-43-2	5	5
24. trans-1,3-Dichloropropene	10061-02-6	5	5
25. Bromoform	75-25-2	5	5
26. 4-Methyl-2-pentanone	108-10-1	10	10
27. 2-Hexanone	591-78-6	10	10
28. Tetrachloroethene	127-18-4	5	5
29. Toluene	108-88-3	5	5
30. 1,1,2,2-Tetrachloroethane	79-34-5	5	5

CRDL - contract required detection limit

Table 3.1 (cont'd.) Target Compound List (TCL)

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

CRDL - contract required detection limit

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[a] Medium/Sediment CRDLs for Volatile Compounds are 125 times the individual Low Soil/Sediment CRDL.

Specific detection limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be acheivable.

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

Table 3.1 (cont'd.) Target Compound List (TCL)

SEMIVOLATILES	CAS Number	CRDL Water ug/L	CRDL Low Soil/Sediment[b] ug/Kg
35. Phenol	108-95-2	10	330
36. bis(2-chloroethyl)ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-Dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl Alcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. bis(2-chloroisopropyl)ether	108-60-1	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-nitroso-di-n-dipropylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic acid	65-85-0	50	1600
52. bis(2-chloroethoxy)methane	111-91-1	10	330
53. 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330
55. Naphthalene	91-20-3	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330
60. Hexachlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330
64. 2-Nitroaniline	88-74-4	50	1600

CRDL - contract required detection limit

Table 3.1 (cont'd.) Target Compound List (TCL)

SEMIVOLATILES		CAS Number	CRDL Water ug/L	CRDL Low Soil/Sediment[b] ug/Kg
65.	Dimethylphthalate	131-11-3	10	330
66.	Acenaphthylene	208-96-8	10	330
67.	2,6-Dinitrotoluene	606-20-2	10	330
68.	3-Nitroaniline	99-09-2	50	1600
69.	Acenaphthene	83-32-9	10	330
70.	2,4-Dinitrophenol	51-28-5	50	1600
71.	4-Nitrophenol	100-02-7	50	1600
72.	Dibenzofuran	132-64-9	10	330
73.	2,4-Dinitrotoluene	121-14-2	10	330
74.	Diethylphthalate	84-66-2	10	330
75.	4-Chlorophenyl-phenyl ether	7005-72-3	10	330
76.	Fluorene	86-73-7	10	330
77.	4-Nitroaniline	100-01-6	50	1600
78.	4,6-Dinitro-2-methylphenol	534-52-1	50	1600
79.	N-nitrosodiphenylamine	6-30-6	10	330
80.	4-Bromophenyl-phenyl ether	101-55-3	10	330
81.	Hexachlorobenzene	118-74-1	10	330
82.	Pentachlorophenol	87-86-5	50	1600
83.	Phenanthrene	85-01-8	10	330
84.	Anthracene	120-12-7	10	330
85.	Di-n-butylphthalate	84-74-2	10	330
86.	Fluoranthene	206-44-0	10	330
87.	Pyrene	129-00-0	10	330
88.	Butylbenzylphthalate	85-68-7	10	330
89.	3,3'-Dichlorobenzidine	91-94-1	20	660
90.	Benzo(a)anthracene	56-55-3	10	330
91.	Chrysene	218-01-9	10	330
92.	bis(2-Ethylhexyl)phthalate	117-81-7	10	330
93.	Di-n-octylphthalate	117-84-0	10	330
94.	Benzo(b)fluoranthene	205-99-2	10	330

CRDL - contract required detection limit

Table 3.1 (cont'd.) Target Compound List (TCL)

SEMIVOLATILES	CAS Number	CRDL Water ug/L	CRDL Soil/Sediment[b] ug/Kg
95. Benzo(k)fluoranthene	207-08-9	10	330
96. Benzo(a)pyrene	50-32-8	10	330
97. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98. Dibenz(a,h)anthracene	53-70-3	10	330
99. Benzo(g,h,i)perylene	191-24-2	10	330

CRDL - contract required detection limit

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[b] Medium Soil/Sediment CRDLs for Semivolatile TCL Compounds are 60 times the individual Low Soil/Sediment CRDL.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

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

Table 3.1 (cont'd.) Target Compound List (TCL)

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

CRDL - contract required detection limit

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[c] Medium Soil/Sediment CRDLs for Pesticide/PCB TCL compounds are 15 times the individual Low Soil/Sediment CRDL.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

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

Table 3.1 (cont'd.) Target Compound List (TCL)

Analyte	CRDL[d] ug/L
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	5
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

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[d] The CRDL are the instrument detection limits obtained in pure water. The detection limits for samples may be considerably higher depending on the sample matrix.

4. PROJECT ORGANIZATION AND RESPONSIBILITIES

4.1 Description of Responsibilities

The responsibilities of the individuals associated with this Quality Assurance/Quality Control (QA/QC) program are described below and illustrated in Figure 4.1:

- The Quality Assurance Officer is responsible for reviewing and advising on all aspects of QA/QC. The duties and responsibilities of the QA Officer are to:
    1. assist the project/task manager in specifying QA/QC procedures to be used during the project;
    2. implement quality control procedures and techniques to assure that the laboratory achieves established standards of quality;
    3. evaluate data quality and maintain records on related QC charts and other pertinent information;
    4. monitor laboratory activities to determine conformance with authorized quality assurance policy, and to implement appropriate steps to ensure adherence to quality assurance programs;
    5. coordinate internal audits with the Project Manager;
    6. review performance evaluation results;
    7. administer intralaboratory and interlaboratory QA efforts; and
    8. prepare quality assurance reports to management.

- The Project Manager has overall responsibility for management of the analytical tasks of the project. The duties and responsibilities of the project manager are to:
    1. administer and supervise all requirements of the analytical tasks to ensure meeting project objectives within budget and on schedule;

2. direct formulation of the work plan and initiate work plan revisions in accordance with the project officer's directions;
3. work with task managers in planning and conducting project progress meetings;
4. review work plans, progress reports, analytical reports, project reports, and financial reports prior to issue; and
5. take part in corrective actions.

- The <u>Task Managers</u> (the CLP Task Managers, the Director of Analytical Services, the Laboratory Managers, and the Laboratory Supervisors) have the day-to-day responsibilities for the analytical tasks of the project. Their areas of responsibilities are to:
    1. organize the personnel, equipment, and materials in a manner required to meet the objectives of the analytical tasks of the project;
    2. implement analytical procedures for use in data evaluation;
    3. provide technical directions in conduct of laboratory analyses, and resolve day-to-day problems;
    4. direct the task activities and monitor performance of task members to ensure that they are adhering to high technical standards and to the budget and task schedules;
    5. review analytical data for validity and clarity ; and
    6. maintain contact with the project manager in areas of technical concern, and advise him of progress, needs, and potential problems of the various tasks.

- The <u>Project Analysts</u> are responsible for each task identified in the scope of work. They are responsible for performing the laboratory technical activities within their tasks. In execution of their duties, the analysts are expected to:
    1. assist in planning for each phase of their tasks and in defining objectives and activities;
    2. respond to work plan revisions related to their tasks;
    3. advise the task manager of progress, needs, and potential

problems of their tasks;

4. train and qualify alternate analysts in specified laboratory QC and analytical procedures;

5. verify that laboratory QC and analytical procedures are being followed as specified;

6. review sample QC data at least daily. This will include examination of raw data such as chromatograms (and checking of calculations for a minimum of 10% for the samples analyzed) as well as an inspection of reduced data, calibration curves, and laboratory notebooks; and

7. inform task managers if the daily review indicates a decline in data quality and implement corrective actions.

- Sample Coordinator - The sample coordinator acts as sample custodian for the laboratory. The duties and responsibilities of the sample coordinator are to:

  1. Sign for the incoming field samples and verify the data entered on the chain-of-custody forms;

  2. Enter sample information into computerized Sample and Analysis Management System (SAM) for tracking and reporting;

  3. Generate computerized sample tracking and laboratory data entry forms;

  4. Transfer samples and tracking forms to laboratory project analysts.

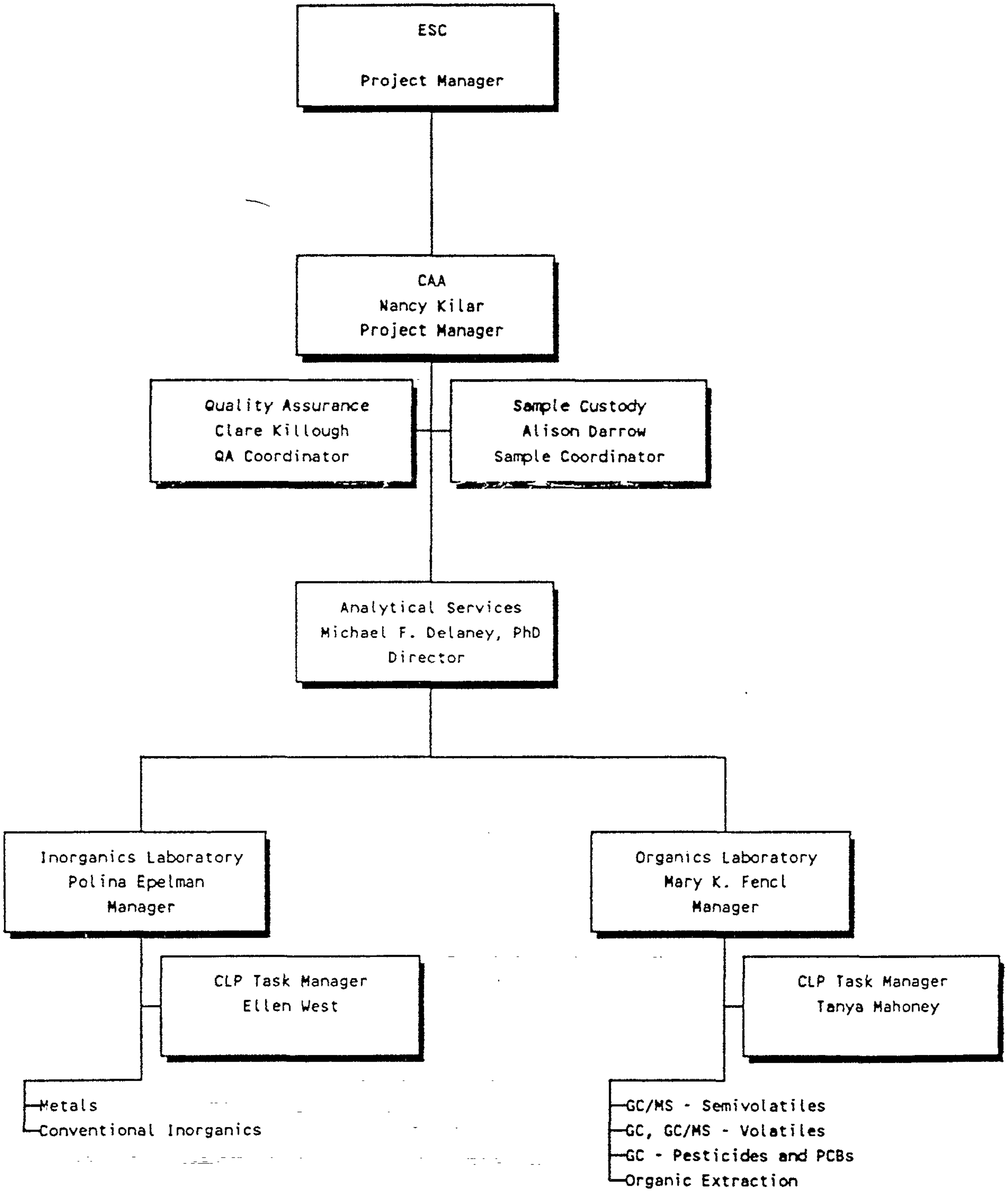

Figure 4.1 Project Organization

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

5.1 Introduction

The analytical quality assurance objectives for this project are to provide analytical data of known quality and to be able to defend the quality of that data. Data quality is assessed for precision, accuracy, completeness, representativeness, and comparability.

The routine analysis of replicate and spiked samples will provide precision and accuracy data for assessing the validity of analytical results. These Quality Control measures and their control limits are summarized in Table 5.1. The control limits listed in Table 5.1 are established CLP and experimentally determined CAA criteria. The frequency of the quality control measures employed by the laboratory are described in Table 5.2.

5.2 Level of QA Efforts

Every attempt will be made to have all data generated be valid data. The precision of laboratory analysis will be evaluated using sample duplicates. Analytical accuracy will be monitored using recovery of analytes from surrogate spikes, matrix spikes, EPA reference check standards and Performance Evaluation (PE) samples. These quality control measures and their frequency are summarized in Table 5.2. These QA efforts will assist in determining the reliability of the analytical data.

5.3 Accuracy and Precision

Accuracy is a measure of the degree of agreement between an analyzed value and the true or accepted reference value where it is known. Accuracy is usually expressed as percent recovery. Precision is a measure of the mutual agreement among individual measurements of the same parameter under similar conditions, usually expressed as standard deviation. Accuracy and precision in the laboratory is assessed by the regular analysis of known standards and duplicate samples.

5.4 Completeness

Completeness is a measure of the amount of valid data obtained from the analytical measurement system, expressed as a percentage of the number of valid measurements that should have been or were planned to be collected. CAA will make every attempt to generate valid data from all samples received. However, realistically, some samples may be lost in laboratory accidents or some results may be deemed questionable based on internal QC procedures. Due to the variable nature of the completeness value, the objective will be to have data completeness for all samples received for analysis as high as possible to meet completeness objectives as described by the client.

5.5 Representativeness

Representativeness is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the sample. Sampling will be performed by the client. Sample handling protocols (e.g., storage, preservation and transportation) have been developed to preserve the representativeness of the collected samples. Proper documentation will establish that protocols have been followed and that sample identification and integrity have been assured.

5.6 Comparability

Comparability is a QA objective wherein all sample data is comparable with other representative measurements made by CAA or another organization. CAA will achieve comparability by operating within the instrument linear range and by strict adherence to analytical protocols. The use of published analytical methods, standard reporting units and thorough documentation will ensure meeting this objective.

Table 5.1

Quality Control Objectives

Volatile Organics - CLP Protocols

Audit	Parameter	Control Limit*	
		aqueous	soils
Holding Blank	Any project analyte	≤ 5 x CRQL	
Method Blank	methylene chloride	≤ 5 x CRQL	
	acetone	≤ 5 x CRQL	
	toluene	≤ 5 x CRQL	
	2-butanone	≤ 5 x CRQL	
	any other project analyte	≤ CRQL	
Continuing Calibration	CCC Compounds	RF<25% from initial calibration	
Surrogate Spiking Compounds	d_4-1,2-dichloroethane	76-114%	70-121%
	d_8-toluene	86-110%	81-117%
	4-bromofluorobenzene	86-115%	74-121%
Matrix Spike/ Matrix Spike	1,1-dichloroethylene	61-145% ≤14 RPD	59-172% ≤22 RPD
	trichloroethylene	71-120% ≤14 RPD	62-137% ≤24 RPD
	benzene	76-127% ≤11 RPD	66-142% ≤21 RPD
	toluene	76-125% ≤13 RPD	59-139% ≤21 RPD
	chlorobenzene	75-130% ≤13 RPD	60-133% ≤21 RPD

CRQL - Contract Required Quantitation Limit
CCC - Calibration Check Compounds specified in test method
RF - Response Factor
RPD - Relative Percent Difference

*<u>US EPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, Revision 7/87</u>

Table 5.1 (cont'd.)

Quality Control Objectives

Semivolatile Organics - CLP Protocols

Audit	Parameter	Control Limit*	
		Aqueous	Soils
Method Blank	phthalate esters of TCL any other target compounds	≤ 5 x CRQL ≤ CRQL	
Continuing Calibration	CCC Compounds	RF <25% RSD from initial calibration	
Surrogate Standard	d_5-nitrobenzene	35-114%	23-120%
	2-fluorobiphenyl	43-116%	30-115%
	p-terphenyl	33-141%	18-137%
	d_5-phenol	10-90%	24-113%
	2-fluorophenol	21-100%	25-121%
	2,4,6-tribromophenol	10-123%	19-122%
Matrix Spike/ Matrix Spike Duplicate	1,2,4-trichlorobenzene	39-98% ≤28 RPD	38-107% ≤23 RPD
	acenapthene	46-118% ≤31 RPD	31-137% ≤19 RPD
	2,4-dinitrotoluene	24-96% ≤38 RPD	28-89% ≤47 RPD
	pyrene	26-127% ≤31 RPD	35-142% ≤36 RPD
	N-nitroso-di-n-propylamine	41-116% ≤38 RPD	41-126% ≤38 RPD
	1,4-dichlorobenzene	36-97% ≤28 RPD	28-104% ≤27 RPD
	pentachlorophenol	9-103% ≤50 RPD	17-109% ≤47 RPD
	phenol	12-89% ≤42 RPD	26-90% ≤35 RPD
	2-chlorophenol	27-123% ≤40 RPD	25-102% ≤50 RPD
	4-chloro-3-methyl phenol	23-97% ≤42 RPD	26-103% ≤33 RPD
	4-nitrophenol	10-80% ≤50 RPD	11-114% ≤50 RPD

CRQL - Contract Required Quantitation Limit
CCC - Calibration Check Compounds specified in test method
RF - Response Factor
RPD - Relative Percent Difference

*US EPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, Revision 7/87

Table 5.1 (cont'd.)

Quality Control Objectives

Pesticides/PCBs - CLP Protocols

Audit	Parameter	Control Limit*	
		Aqueous	Soil
Method Blank	Any target compound	≤ CRQL	
Analytical Standard	Aldrin, Endrin, 4,4'-DDT, and DBC	RF<20% RSD from initial calibration	
Surrogate Standard Compound	Dibutylchlorendate (DBC)	24-154%**	20-150%**
Matrix Spike/Matrix Spike Duplicate	Lindane	56-123% ≤15 RPD	46-127% ≤50 RPD
	Heptachlor	40-131% ≤20 RPD	35-130% ≤31 RPD
	Aldrin	40-120% ≤22 RPD	34-132% ≤43 RPD
	Dieldrin	52-126% ≤18 RPD	31-134% ≤38 RPD
	Endrin	56-121% ≤21 RPD	42-139% ≤45 RPD
	4,4'-DDT	38-127% ≤27 RPD	23-134% ≤50 RPD

CRQL - Contract Required Quantitation Limit
RF - Response Factor
RSD - Relative Standard Deviation
RPD - Relative Percent Difference

[*] US EPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, Revision 7/87

[**] These limits are advisory only

Table 5.1 (cont'd.)

Quality Control Objectives

Metals and Mercury - CLP Protocols

Audit	Element	Control Limit**
Preparation Blank	All	≤ 5 x CRDL
Analytical Spike	All	75-125%
Initial Calibration Verification	Hg All others	80-120% 90-110%
Continuing Calibration	Hg All others	80-120% 90-110%
LCS	All	80-120%
Duplicate Samples	All	≤ 20% RPD

CRDL - Contract Required Detection Limit

** US EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, Revision 7/87

Table 5.1 (cont'd.)

Quality Control Objectives

Cyanide - CLP Protocols

Audit	Control Limits*
Calibration Blank	$\leq$ 5 x CRDL
Digestion Blank	$\leq$ 5 x CRDL
Initial Calibration Verification	85-115%
Continuing Calibration Verification	85-115%
Spike Recovery	75-125%

CRDL - contract required detection limit

*US EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, Revision 7/87

Table 5.1 Quality Control Objectives

Conventional Pollutants

Quality Control Measure	Parameter	Control Limits
Calibration Blank	Conventional Pollutant	≤5xMDL
Digestion Blank	Conventional Pollutant	≤5xMDL
Spike Recovery	Conventional Pollutant	80-120%
Initial Calibration Verification (an independent reference)	Conventional Pollutant	90-110%
Continuing Calibration Verification	Conventional Pollutant	90-110%
Laboratory Control Sample (LCS)	Conventional Pollutant	80-120%

IDL - instrument detection limit
LCS - Laboratory Control Sample

Table 5.2

Quality Control Measures and Frequency

Volatile Organics - CLP Protocols

Sample Type	Frequency*
Holding Blank	One per case
laboratory Method Blank	One per 12 hour time period
Continuing Calibration	One per 12 hour time period
Surrogate Spike	Added to each sample, matrix spike, matrix spike duplicate, blank and standard
Matrix Spike/Matrix Spike Duplicate	One per: each case of field samples received; each 20 field samples in a case; each group of samples of a similar concentration level (soils only); or each 14 calendar day period during which samples were received. Whichever is more frequent
GC/MS Tune	Once per day or per 12 hour period, whichever is more frequent
Performance Evaluation Samples	As required for State certifications and CLP

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*US EPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, Revision 7/87

Table 5.2 (cont'd.)

Quality Control Measures and Frequency

Semivolatile Organics - CLP Protocols

Sample Type	Frequency*
Method Blank	One per batch of samples extracted
Continuing Calibration	Once per 12 hour time period
GC/MS Tune	Once per 12 hour time period
Surrogate Standard	Added to each sample, blank and standard
Matrix Spike/Matrix Spike	One set per batch, per similar concentration level or per 20 samples analyzed, whichever is more frequent
Performance Evaluation Samples	As required for state certifications and CLP

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*US EPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, Revision 7/87

Table 5.2 (cont'd.)

Quality Control Measures and Frequency

Pesticides/PCBs - CLP Protocols

Sample Type	Frequency*
Laboratory Method Blank	One per case; per batch of samples of similar matrix or concentration extracted, or per 20 analyses, whichever is more frequent
Analytical Standards	One standard run after every 5 samples
Surrogate Standard	Added to each sample, matrix spike, matrix spike duplicate, blank and standard
Matrix Spike/ Matrix Spike Duplicate	For samples of similar matrix, one per case, per 20 samples, or per similar concentration level, whichever is more frequent
Performance Evaluation Samples	As required for state certifications and CLP

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*US EPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, Revision 7/87

Table 5.2 (cont'd.)

Quality Control Measures and Frequency

Metals and Mercury - CLP Protocols

Sample Type	Frequency*
Preparation Blank	One per matrix, batch, or one for every 20 samples, whichever is more frequent
Analytical Spike Recovery	One per matrix, batch, or one for every 20 samples, whichever is more frequent
Duplicate Precision	One per matrix, or per batch (if sample quantity allows)
Initial Calibration Verification	Once for each time instrument is calibrated
Continuing Calibration Verification	One per every 10 analyses
Performance Evaluation	As required for State certifications and CLP

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*US EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration, Revision 7/87

Table 5.2 (cont'd.)

Quality Control Measures and Frequency

Cyanide - CLP Protocols

Type	Frequency
Preparation Blank	One per matrix, batch, or one for every 20 samples, whichever is more frequent
Digestion Spike Recovery	One per matrix, batch, or one for every 20 samples, whichever is more frequent
Duplicate Precision	One per matrix, batch, or one for every 20 samples, whichever is more frequent
Initial Calibration Verification	One for each time the instrument is calibrated
Continuing Calibration Verification	One per every 10 analyses
Performance Evaluation Samples	As required for State Cerfifications and for CLP

*US EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, Revision 7/87

Table 5.2 Quality Control Measures and Frequency

Conventional Pollutants

Sample Type	Frequency
Preparation Blank	One per twenty (20) samples of similar matrix
Spike	One per twenty (20) samples of similar matrix
Duplicate	One per twenty (20) samples of similar matrix
Initial Calibration Verification	One for each time instrument is calibrated
Continuing Calibration Verification	One per every ten (10) analyses
Laboratory Control Sample	One per twenty (20) samples of similar matrix
Performance Evaluation Samples	As required for State certifications and CLP

6. SAMPLING PROCEDURES

CAA does not expect to perform any sampling for this project. If sample collection should be required, quality control procedures will be provided as a revision to this QA plan.

7. SAMPLE CUSTODY

7.1 Chain-of-Custody Procedures

The purpose of the chain-of-custody procedure is to document in a legally defensible manner, the transfer of custody for each sample from collection through analysis to analytical data reports. The sample custody procedures to be used conform to the guidelines of the U.S. EPA Contract Laboratory Program, and are performed under the supervision of the sample coordinator. The sample coordinator will have primary responsibility for ensuring chain-of-custody procedures are followed and all documentation is properly executed.

When samples arrive at CAA, the sample coordinator documents the condition of the locked or sealed shipping box on the custody form. She then checks the sample label information (Figure 7.1) against the custody record, (Figure 7.2) and notes the conditions of the samples and verifies proper container and preservative procedures as noted in Table 7.1. Samples are then logged in by assigning laboratory identification numbers in serialized ascending sequence. The sample log-in record will include the sample number, date of receipt, condition of sample when received, the assigned laboratory number, sample preparation, sample distribution and other pertinent information. A sample distribution sheet will be generated. Samples will then be secured in a refrigerator maintained at approximately 4°C prior to preparation and analysis. Analysts will sign for the receipt of all samples to be processed and maintain the samples in their possession or in view at all times when the samples are outside of the storage area. At all times when custody is transferred, both the issuing and receiving parties will verify that information in the sample label is properly recorded.

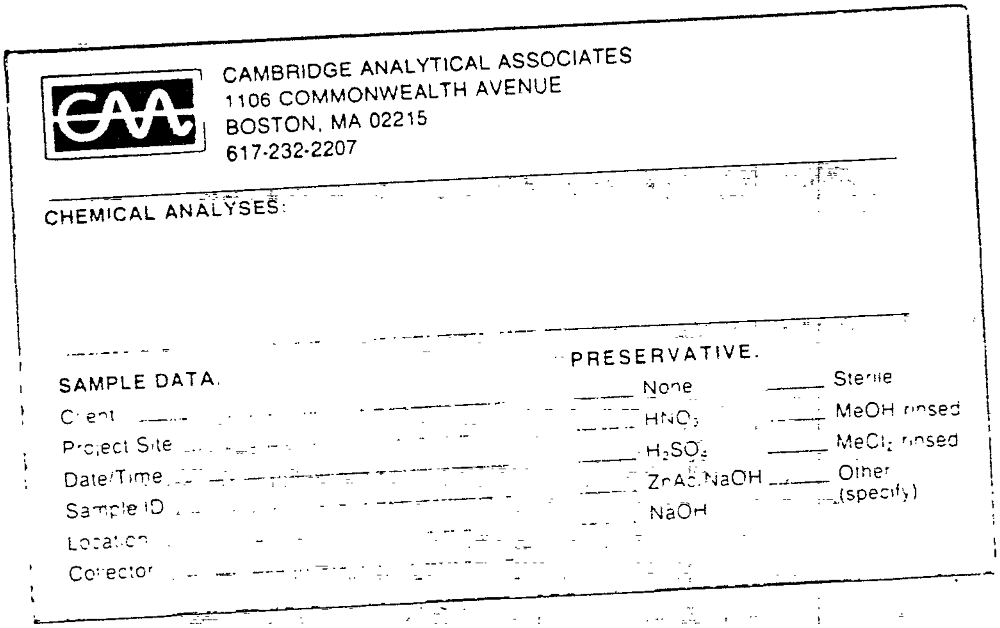
7.2 Laboratory Document Control

The goal of the Document Control Program is to assure that all documents for a group of samples will be accounted for when the project is completed.

All observations and results recorded by CAA, are entered into pre-printed data sheets or into permanent laboratory logbooks. Data recorded are referenced with the project number, date and analyst's signature at the top of the page. All pertinent data are maintained in the project file.

All documentation in logbooks and other documents are entered in ink. If an error is made in a logbook assigned to one individual, that person will make corrections simply by crossing a line through the error and entering the correct information. Changes made subsequently are dated and initialed. Corrections made to other data records or logbooks are made by crossing a single line through the error, entering the correct information and initialing and dating the correction.

Before releasing analytical results, the laboratory assembles and cross checks the information of custody records, lab bench sheets, analyst and instrument logs and other relevant data to ensure that data pertaining to each particular sample is consistent throughout the record.



CAMBRIDGE ANALYTICAL ASSOCIATES
1106 COMMONWEALTH AVENUE
BOSTON, MA 02215
617-232-2207

CHEMICAL ANALYSES:

SAMPLE DATA:

Client ______
Project Site ______
Date/Time ______
Sample ID ______
Location ______
Collector ______

PRESERVATIVE:

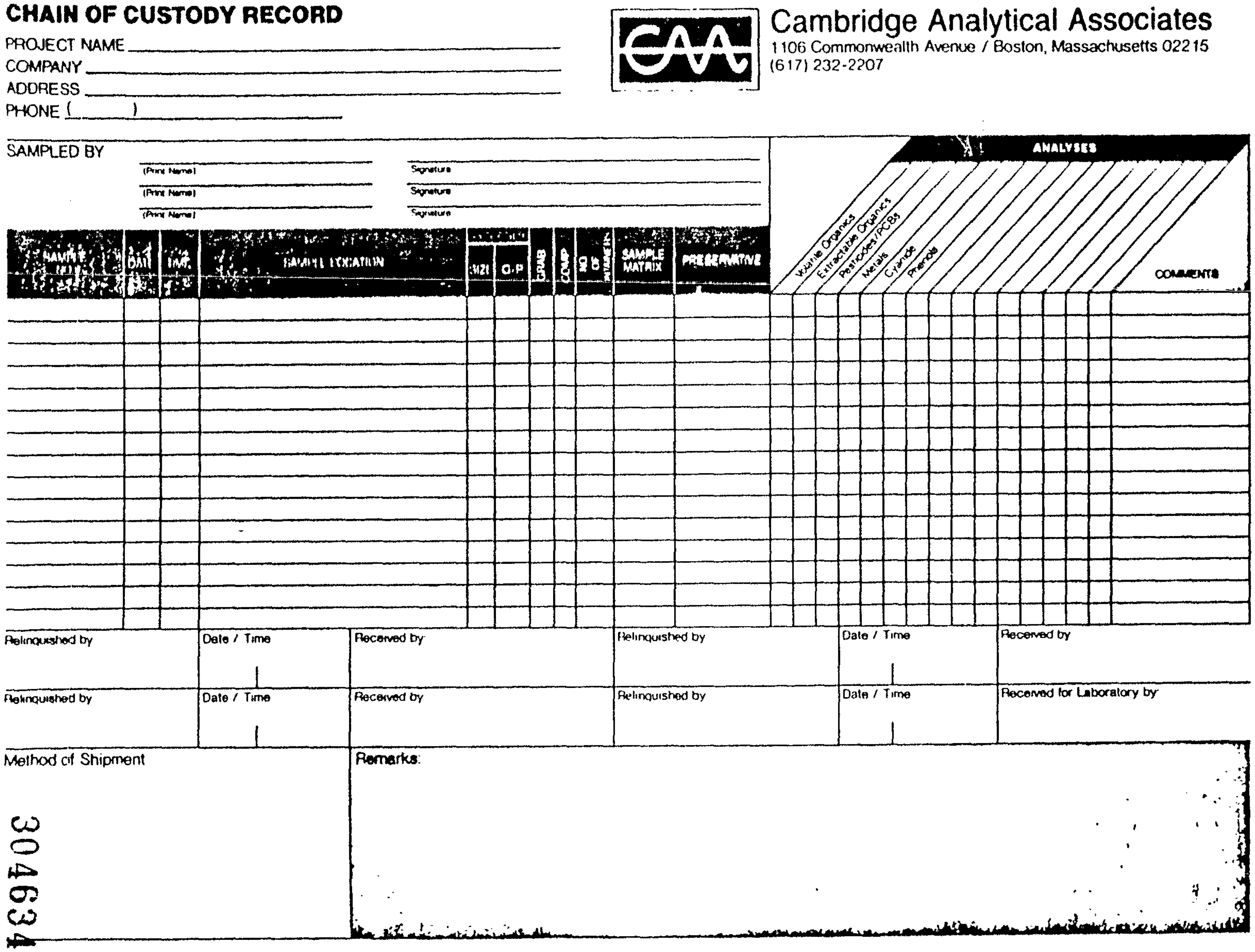
______ None
______ HNO_3
______ H_2SO_4
______ ZnAc.NaOH
______ NaOH
______ Sterile
______ MeOH rinsed
______ $MeCl_2$ rinsed
______ Other (specify)

Figure 7.1

Example Sample Label

Figure 7.2

Example Chain-of-Custody



CHAIN OF CUSTODY RECORD

PROJECT NAME ______
COMPANY ______
ADDRESS ______
PHONE (   ) ______

Cambridge Analytical Associates
1106 Commonwealth Avenue / Boston, Massachusetts 02215
(617) 232-2207

SAMPLED BY
(Print Name) ______ Signature ______
(Print Name) ______ Signature ______
(Print Name) ______ Signature ______

SAMPLE [illegible]	DATE	TIME	SAMPLE LOCATION	SIZE	G-P	GRAB	COMP	NO OF CONTAINERS	SAMPLE MATRIX	PRESERVATIVE	ANALYSES Volatile Organics	Extractable Organics	Pesticides/PCBs	Metals	Cyanide	Phenols										COMMENTS

Relinquished by	Date / Time	Received by	Relinquished by	Date / Time	Received by
Relinquished by	Date / Time	Received by	Relinquished by	Date / Time	Received for Laboratory by
Method of Shipment	Remarks:				

Table 7.1

Recommendations for Sampling and Preservation of Samples[1]

Parameter	Volume Required (ml)	Container[2]	Preservative[3]	Minimum[4] Holding Time
Physical Properties				
Hardness	100	P,G	HNO_3 pH<2	6 months.
Residue				
Filterable (TDS)	500	P,G	Cool, 4°C	7 days
Non-Filterable(TSS)	500	P,G	Cool, 4°C	7 days
Metals				
CLP (aqueous)	1000	P,G	HNO_3 to pH<2	180 days from date of sample receipt
CLP (soil)	100 g	P	cool, 4°C	180 days from date of sample receipt
Mercury CLP	1000	P,G	HNO_3 to pH<2	28 days from date of sample receipt
Conventional Parameters				
Alkalinity	100	P,G	Cool, 4°C ascorbic acid	14 days
Cyanides, CLP	1000	P,G	Cool, 4°C; NaOH to pH>12; 0.6 g ascorbic acid	14 days[5]
Fluoride	300	P,G	None required	28 days
Nitrogen Nitrate[6]	100	P,G	Cool, 4°C H_2SO_4 to pH<2	48 hrs.
Organic Carbon	25	G	Cool, 4°C; H_2SO_4 to pH<2	28 days
Organic Halides	250	G, amber	Protect from light; Cool, 4°C	14 days
Sulfate	50	P,G	Cool, 4°C	28 days

Parameter	Minimum Volume Required (ml)	Container[2]	Preservative[3]	Holding[4] Time
Organics				
Base/Neutrals, Acids				
(CLP 7/87 - aqueous)	3000 ml	G, teflon lined cap	Cool, 4°C	5 days until extraction, 40 days after extraction
(CLP 7/87 - solid)	250 g	G, teflon lined cap	Cool, 4°C	10 days until extraction, 40 days after
Purgeables, Halocarbons and Aromatics				
(CLP 7/87 - aqueous)	6x40 ml	G, teflon lined septum	Cool, 4°C	10 days
(CLP 7/87 - solid)	6x40 ml	G, teflon lined septum	Cool, 4°C	10 days

NOTES:

[1] More specific instructions are contained in each method.

[2] Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

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

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

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

[6] For samples from non-chlorinated drinking water supplies conc. H_2SO_4 should be added to lower sample pH to less than 2. The sample should be analyzed before 14 days.

8. CALIBRATION PROCEDURES AND FREQUENCY

This section describes the calibration procedures and frequency for the instrumentation which will be used in the determination of the parameters of interest. All materials used for instrument calibration, internal standards and surrogate standards will be of the highest purity available and will be obtained through the U.S. Environmental Protection Agency Pesticide and Industrial Chemicals Repository or a suitable commercial source. The calibration procedures presented here are those routinely used in the laboratory. Calibration frequencies are described in Table 5.2.

8.1 Inductively Coupled Argon Plasma Emission Spectrometer

8.1.1 Calibration Standards

1. Prepare calibration standards by dilution of the stock standard at the time of analysis.
2. The calibration standards are prepared using the same type of acid or combination of acids as the sample will have after preparation.

8.1.2 Calibration Procedure

1. Calibrate the instrument using a blank and standards.
2. After the system is calibrated, verify and document the initial calibration for each element of interest using an EPA Quality Control concentrate or other independent standard at a concentration other than that used for calibration but within the linear range.
3. If the reported values for the calibration check sample exceed the control limits, the analysis is terminated and the problem corrected.
4. To assure calibration accuracy throughout each analysis run, the calibration check standard must be analyzed at a frequency of 10% or every 2 hours during an analysis run, whichever is more frequent. The calibration check sample is also analyzed after the last analytical sample. If the calibration check sample is outside the control limits, the analysis must be terminated and the instrument recalibrated. All samples analyzed since the last time the calibration check was in control must be reanalyzed.

5. Record all values for the initial and subsequent calibration verifications.

8.2 Atomic Absorption Spectrophotometer

8.2.1 Calibration Standards

1. Prepare calibration standards by dilution of the stock standard.

2. The calibration standards are prepared using the same type of acid or combination of acids as the sample will have after preparation.

8.2.2 Calibration Procedure

1. Calibrate the instrument beginning with a blank and three standards, working toward the highest standard.

2. After the system is calibrated, verify and document the initial calibration for each element of interest using an EPA Quality Control concentrate or other independent standard at a concentration other than that used for calibration but within the calibration range.

3. If the reported values for the calibration check sample exceed the control limits, the analysis is terminated and the problem corrected.

4. To assure calibration accuracy throughout each analysis run, the calibration check standard must be analyzed at a frequency of 10% or every 2 hours during an analysis run, whichever is more frequent. . The calibration check sample is also analyzed after the last analytical sample. If the calibration check sample is outside the control limits, the analysis must be terminated and the instrument recalibrated. All samples analyzed since the last time the calibration check was in control must be reanalyzed.

5. Record all values for the initial and subsequent calibration verifications.

8.3 Technicon AutoAnalyzer II

8.3.1 Calibration Standards

1. Prepare working standards by dilution of the stock standard. A minimum of a blank and three to five standards are required.
2. Prepare a calibration check standard using an EPA quality control concentrate or other independent standard.

8.3.2 Calibration Procedure

1. Calibrate the instrument beginning with the blank and working toward the highest standard.
2. After the instrument is calibrated verify and document the initial calibration using an EPA quality control concentrate or other independent standard at a concentration other than that used for calibration but within the calibration range.
3. If the reported values for the calibration check sample exceed the control limits, the analysis is terminated and the problem corrected.
4. To assure calibration accuracy throughout each analysis run, the calibration check standard must be analyzed at a frequency of 10%. The calibration check sample is also analyzed after the last analytical sample. If the calibration check sample is outside the control limits, the analysis must be terminated and the instrument recalibrated. All samples analyzed since the last time the calibration check was in control must be reanalyzed.

8.4 Total Organic Carbon Analyzer

8.4.1 Calibration Standards

1. Prepare a 1000 ug/ml carbon stock solution using primary standard grade potassium hydrogen phthalate in water.
2. Prepare working standards daily by dilution of the above stock standard.
3. Prepare a laboratory control sample from an EPA concentrate or other appropriate reference material.

8.4.2 Calibration Procedure

1. Calibrate the instrument according to the appropriate procedures given in the manufacturer's operating manual.
2. Use these working standards at the start of each analysis day to verify that the instrument is functioning properly.
3. Analyze an EPA QC sample or other appropriate laboratory control sample. If the results are within established control limits, the analysis may proceed.
4. Document all standard preparations and insturment operating parameters.

8.5 Ion Chromatograph

8.5.1 Calibration Standards

1. Prepare calibration standards by dilution of the stock standard at the time of analysis. The instrument must be calibrated using a blank and a minimum of three standards.

8.5.2 Calibration Procedure

1. Calibrate the instrument beginning with the blank and working toward the highest standard.

2. After the system is calibrated, verify and document the initial calibration for each analyte of interest using an EPA Quality Control concentrate or other independent standard at a concentration other than that used for calibration but within the calibration range.

3. If the reported values for the calibration check sample exceed the control limits, the analysis is terminated and the problem corrected.

4. To assure calibration accuracy throughout each analysis run, the calibration check standard must be analyzed at a frequency of every 20 samples.

   The calibration check sample is also analyzed after the last analytical sample. If the calibration check sample is outside the control limits, the analysis must be terminated and the instrument recalibrated. All samples analyzed since the last time the calibration check was in control must be reanalyzed.

5. Records all values for the initial and subsequent calibration verifications.

8.6 Spectroproducts Hg-3 Mercury Analyzer

8.6.1 Calibration Standards

1. Prepare the calibration standards by dilution of the stock standard at the time of analysis. Calibrate the instrument using a blank and a minimum of three standards.

2. Prepare the standards in the same manner as samples using the same combination of reagents at the same concentration as that which the sample will have after preparation.

8.6.2 Calibration Procedure

1. Calibrate the instrument beginning with the blank and working toward the highest standard.

2. After the system is calibrated, verify and document the initial calibration using an EPA Quality control concentrate or other independent standard at a concentration other than that used for calibration but within the calibration range.

3. If the reported values for the calibration check sample exceed the control limits, the analysis is terminated and the problem corrected.

4. To assure calibration accuracy throughout each analysis run, the calibration check must be analyzed at a frequency of 10% or every 2 hours during an analysis run, whichever is more frequent. The calibration check sample is also analyzed after the last analytical sample. If the calibration check sample is outside the control limits, the analysis must be terminated and the instrument recalibrated. All samples analyzed since the last time the calibration check was outside the control limit must be reanalyzed.

8.7 Volatile and Semi-volatile Organics by Gas Chromatograph/Mass Spectrometry - CLP Protocols

8.7.1 Calibration Standards

1. Prepare stock solutions using materials available from the EPA Reference Standards Repository.

2. Prepare working standards by dilution of the stock standards.

3. Verify the working standards by analysis of a calibration check standard prepared using either EPA QC concentrates or other independent standard.

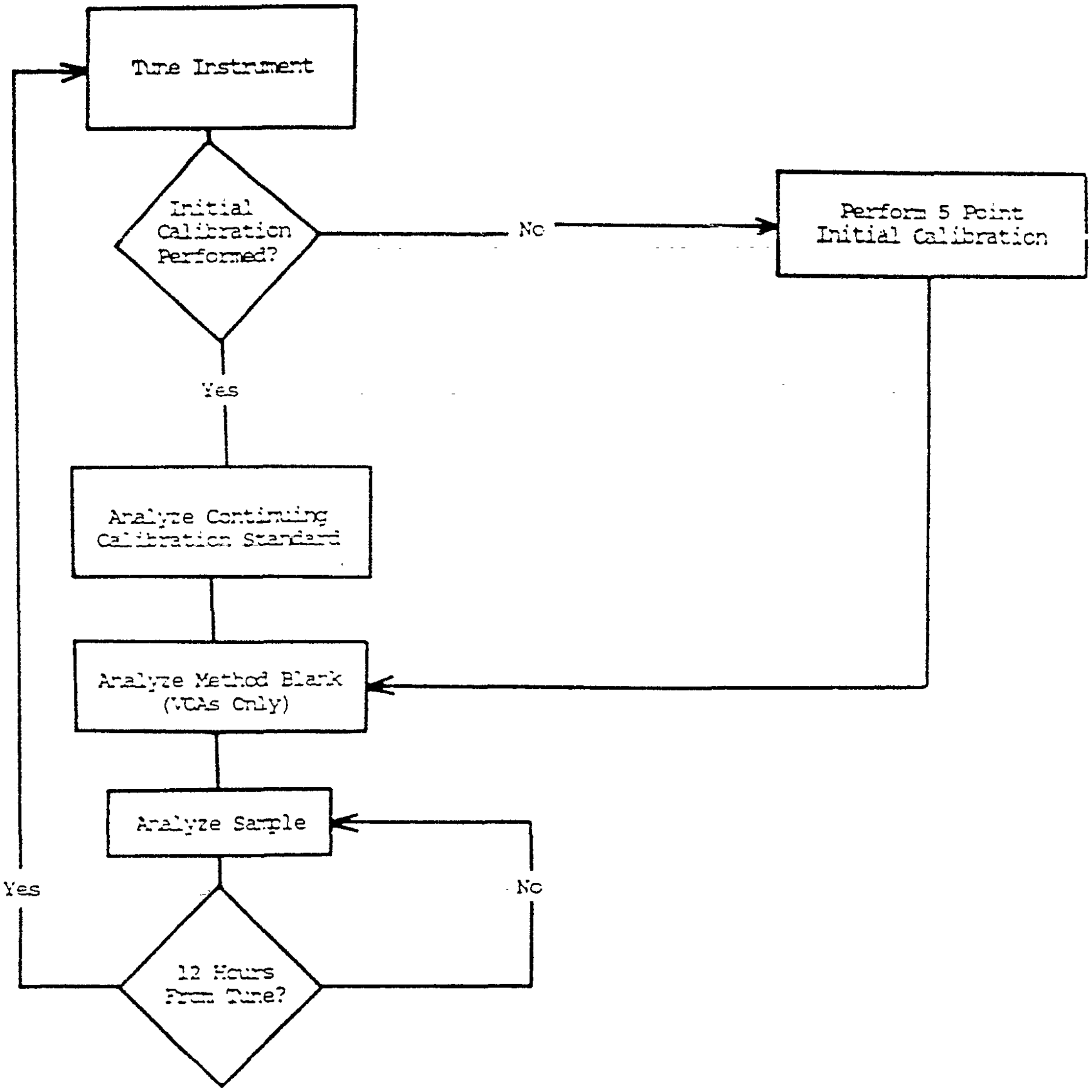
8.7.2 Calibration Procedure

1. At the beginning of each 12 hour shift that volatile organics analyses are performed, the GC/MS system must be checked to verify that acceptable performance criteria are obtained for bromofluorobenzene (BFB). The performance test must be passed before analyzing any samples, blanks or standards.

2. At the beginning of each 12 hour shift that semi-volatile organics analyses are performed, the GC/MS system must be checked to see if acceptable performance criteria are achieved for decafluorotriphenyl phosphine (DFTPP). The performance criteria must be achieved before any samples, blanks or standards are analyzed.

Figure 8.1

GC/MS Calibration and Sample Analysis Sequence



3. Analyze a five point initial calibration sequence using standards prepared following EPA protocols. Calibration check compound (CCC) criteria must be met before sample analysis may begin. If the instrument has had a five point initial calibration performed, this step may be skipped, provided that all criteria in Step 4 are met.

4. Analyze a continuing calibration check standard prepared following EPA procedures. If the CCC and System Performance Check Compounds (SPCC) compounds do not meet the criteria stated in the analytical method, the source of the problem must be located and the problem corrected before sample analysis can proceed. If SPCC and CCC criteria cannot be met, the instrument must have a new initial calibration performed following any necessary maintainance.

5. Record all values for the initial and subsequent calibration verifications. See Figure 8.1 for flow-chart of GC/MS calibration and sample analysis sequence.

8.8 Pesticides/PCB Analysis by Gas Chromatography - CLP Protocols

8.8.1 Calibration Standards

1. Prepare stock solutions using materials available from the EPA Reference Standards Repository.

2. Prepare working standards by dilution of the stock standards.

3. Verify the working standards by analysis of a calibration check standard prepared using either EPA QC concentrates or other independent standard.

8.8.2 Calibration Procedure

1. Analyze initial Evaluation standard mixtures at three concentration levels (A,B,C). Determine linearity of each compound and breakdown of Endrin and 4,4'-DDT according to the procedures in the EPA CLP protocol.

2. Analyze initial Individual standard mixture(s) to determine response factors (RFs) for each compound by the external standard method.

3. Analyze Toxaphene and PCB standards.

4. Analyze samples in groups of five.

5. Periodically throughout the 72 hour analysis sequence (Figure 8.2) analyze continuing Evaluation standards to determine compound breakdown; and continuing Individual standards to

determine % difference between current RFs and the RFs from the initial Individual standard analyses.

Figure 8.2

Pesticide Analysis 72 Hour Sequence

1. Evaluation Standard Mix A
2. Evaluation Standard Mix B
3. Evaluation Standard Mix C
4. Individual Standard Mix A*
5. Individual Standard Mix B*
6. Toxaphene
7. Aroclors 1016/1260
8. Aroclor 1221**
9. Aroclor 1232**
10. Aroclor 1242
11. Aroclor 1248
12. Aroclor 1254
13. 5 samples
14. Evaluation Standard Mix B
15. 5 samples
16. Individual Standard Mix A or B
17. 5 samples
18. Evaluation Standard Mix B
19. 5 samples
20. Individual Standard Mix A or B (whichever not run in step 16)
21. 5 samples
22. Repeat the above sequence starting with Evaluation Standard Mix B (step 14 above).
23. Pesticide/PCB analysis sequence must end with Individual Standard Mix A and B regardless of number of samples analyzed.

*These may be combined into one mixture.

**Aroclors 1221 and 1232 must be analyzed on each instrument and each column at a minimum of once per month. Copies of these chromatograms must be submitted for sample analyses performed during the applicable month.

9. ANALYTICAL PROCEDURES

The analytical procedures to be used in this project are contained in the EPA Manuals Methods for Chemical Analysis of Water and Wastes, Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, Test Methods for Evaluating Solid Wastes (SW-846), Contract Laboratory Program Statement of Work for Inorganic Analysis, Multimedia, Multi-Concentration, Revision No. 7/87, and Contract Laboratory Program Statement of Work for Organic Analysis, Multi-media, Multi-concentration, Revision No. 7/87. Other methods may be taken from APHA-Standard Methods for the Examination of Water and Wastewater. These methods are summarized in Table 9.1 for organic parameters and Table 9.2 for inorganic parameters.

CAA is prepared to use test methods other than those listed below should ESC request it. If additional methods should be required, quality control procedures will be provided as a revision to this QA plan.

Table 9.1 Summary of Organic Analytical Methods

Constituent	Method Reference	Method Description
CLP Organic Compounds	SOW 7/87 (1)	VOC, BNA, Pest/PCB

(1)U.S. EPA. 1987. Organic Analysis for Multi-Media, Multi-Concentration, Statement of Work, Revision 7/87. U.S. Contract Laboratory Program. EPA/CLP, Washington, DC.

Table 9.2. Summary of Inorganic Analytical Methods

Constituent	Method Reference	Method Description
Aqueous Samples		
CLP Metals	SOW 787 (3)	ICP/GFAAS
Hardness	130.2(1); 314A (2)	ICP; by calculation
Alkalinity	310.1 (1)	Titrimetric
Cyanide (CLP)	SOW 787 (3)	Distillation, colorimetric/ automated
Fluoride	300 (1)	Ion Chromatography
Nitrate/Nitrite	353.2 (1)	automated colorimetric
Solids		
- dissolved (TDS)	160.1 (1)	Gravimetric, dried at 180°C
- suspended (TSS)	160.2 (1)	Gravimetric, dried at 103-105°C
Sulfate	300 (1)	Ion Chromatography
Soils		
CLP Metals	SOW 787 (3)	ICP/GFAAS
Cyanide (CLP)	SOW 787 (3)	Distillation, colorimetric/ automated
Fluoride	340.1; 340.2	Ion Selective Electrode
Nitrate/Nitrite	353.2 (1)	automated colorimetric
Sulfate	375.2;375.4 (1),9038	Colorimetric; Turbidimetric
Total Organic Carbon (TOC)	415.1; 415.2 (1)	Persulfate oxidation, UV promoted

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

(2)APHA, 1985. Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition, American Public Health Assocaiates, Washington, D.C. U.S. EPA. 1985.

(3)Inorganic Analysis for Multi-Media, Multi-Concentration, Statement of Work, 785. U.S. EPA Contract Laboratory Program. EPA/CLP, Washington, DC.

10. DATA REDUCTION, VALIDATION, AND REPORTING

10.1 Data Reduction

Analysis results will be reduced to the concentration units specified in the analytical procedures using the equations provided in the analytical references listed in Section 9. Blank corrections will be applied where required by the method for the parameter of interest. All calculations will be independently checked by senior laboratory staff.

10.2 Data Validation

Data validation is the process by which analytical data are filtered and accepted or rejected based on a set of criteria. CAA personnel use the following criteria in the validation of laboratory data:

- use of published or approved analytical procedures
- use of properly operating and calibrated instrumentation
- precision and accuracy achieved comparable to that achieved in similar analytical programs
- precision, accuracy and blank contamination meeting project specific criteria outlined in Table 5.1 and 5.2
- completeness of data set.

Records of all data will be maintained, even those judged to be "outlying" values. Where applicable, outliers will be identified using Dixon's test[1,2] for extreme observations or the one-tailed t-test for difference. All data will be validated by laboratory supervisors prior to being released for reporting purposes to the CAA project manager. The persons validating the data will have sufficient knowledge of the technical work to identify questionable values. All analyses requiring CLP protocols will be validated in accordance with the requirements of those protocols.

10.3 Data Reporting

Figure 10.1 depicts the analytical data reduction, validation and reporting process. Key personnel who will handle data gathering and evaluation are shown in the Project Organization Chart (Figure 4.1). CAA uses a computerized Sample and Analysis Management System (SAM) for routine tracking and reporting of analysis data.

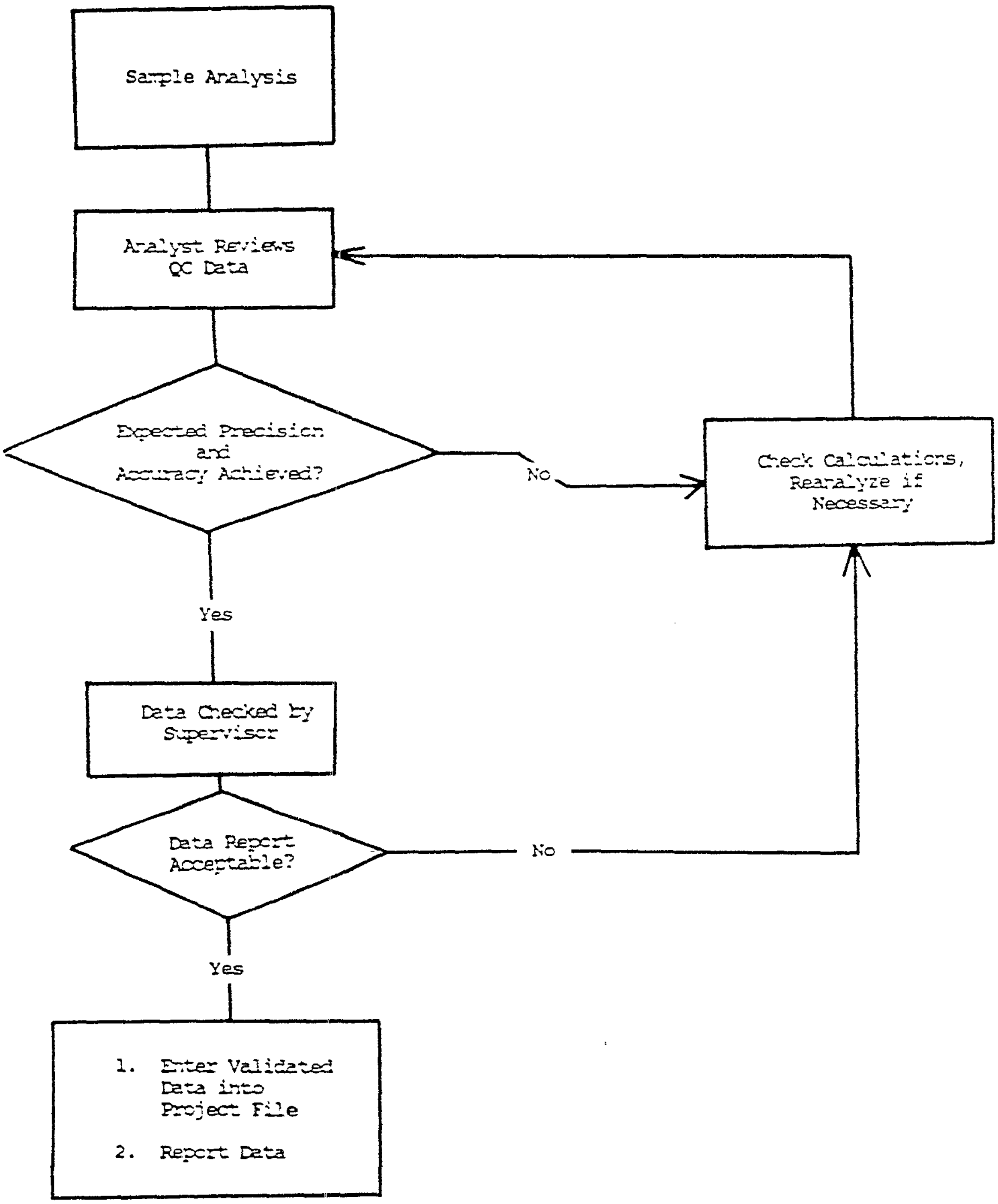
Reports will include:

- sample results
- statement of methods for each parameter
- date of sample receipts
- initialed chain of custody
- minimum detection limits for each method
- sample extraction and analysis dates
- lab duplicate results
- blank results
- matrix and surrogate spike % recoveries and CAA or EPA limits

The reports issued will include a cover page/case narrative which will outline the case specifics, and any problems or corrective actions.

CLP data are reported using CLP specified forms and in CLP protocol format. CAA uses a custom designed data management system for reporting CLP inorganics data. This system transfers reduced data from dedicated microprocessors on each instrument to a central computer for storage and processing. The data are screened for compliance with QC limits and reported in CLP format. Organics CLP data are compiled and reduced by Finnigan's Q/A-Formaster II system which produces reports in CLP organics format.

Figure 10.1 CAA Analytical Data Reporting Scheme



11. INTERNAL QUALITY CONTROL AND QUALITY ASSURANCE

11.1 Internal Quality Control

Quality control is the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process. Quality control checks are the application of CAA's Quality Control program for laboratory analysis in order to ensure the generation of valid analytical results on project samples. These checks are performed by project participants throughout the program under the guidance of the Director of Quality Assurance.

CAA makes use of a number of different types of QC samples to document the validity of the generated data. The following types of QC samples are used routinely:

1. Blank Samples - Blanks are used to assess contamination introduced in transit, storage or in the laboratory.

    a. Preparation Blanks - For inorganic analyses, these deionized water blanks are prepared using the same reagents and analytical procedures as the samples, in order to assess possible laboratory contamination.

    b. Laboratory Method Blanks - For organic analyses, these blanks are "clean" samples, prepared in the laboratory to include surrogates, and analyzed according to a prescribed method in order to assess possible laboratory contamination.

    c. Laboratory Holding Blank - For organic analyses, these blanks are placed in cold storage with the volatile organics samples during the holding time to assess contamination which may be introduced in storage.

d. Calibration Blanks - For all analyses, these blanks are used in instrument calibration and contain all the reagents used in preparing instrument calibration standards except the parameters of interest.

2. Initial and Continuing Calibration Verification - Verification samples are analyzed during each analysis run to assure calibration accuracy for each analyte. For inorganic analysis, these are prepared from a source other than that used for calibration.

3. Surrogate Spikes - For organic analyses, all samples are spiked with surrogate compounds prior to sample preparation in order to assess the behavior of actual components in individual samples during the entire preparative and analysis scheme. Surrogate standard compounds are chemically similar to compounds of interest (target compounds).

4. Matrix Spikes/Analytical Spikes - For all analyses at frequencies particular to each method, samples are spiked with spiking solutions in order to evaluate any matrix effect of the samples on the analytical method. Matrix spikes and analytical spikes are performed using actual elements of interest or target compounds.

5. Duplicate Samples - For all analyses, a second aliquot of a sample carried through all sample preparation and analysis procedures to verify the precision of the analytical method. At least one sample in each analysis batch of 20 or fewer samples is analyzed in duplicate.

6. Laboratory Control Samples - For inorganic analyses, at least one sample in each preparation batch of 20 or fewer samples is prepared and analyzed for each analyte of interest, in order to verify the preparation and analytical methods.

Reagents used in the laboratory are normally of analytical reagent grade or higher purity. Each lot of acid or solvent received is checked for acceptability prior to lab use. All reagents are labeled with the date received and date opened. The quality of the laboratory deionized water is continuously monitored through the use of an in-line conductivity meter.

11.2 Internal Quality Assurance

To monitor quality, CAA's QA Department conducts internal quality assurance audits including:

1. QC Blind Samples - Blind samples prepared by CAA's QA Department are sent to the laboratory for analysis. These duplicate and/or spiked samples or standards are submitted as "blind" QC samples, those which are not recognizable to the analyst. These blind samples are inserted into the sample flow at the time the samples are logged in. Each section receives blind QC samples at least once per quarter. Lab and/or Project Managers may request that samples be submitted more frequently.

2. Internal Data Audit - Once per month a representative set of data is chosen randomly from work completed the previous month for one or more of CAA's commercial clients. This data review includes each laboratory section.

3. Internal laboratory Audits - The QA Director will perform laboratory audits quarterly or as needed. This involves evaluation of:

    - sample storage
    - chain-of-custody
    - instrument maintanence
    - documentation
    - precision, and
    - accuracy

The results of the above procedures are distributed to laboratory and project personnel as well as corporate management. In addition the QA coordinators will meet periodically with the project manager and task managers to review QA/QC data summaries and other pertinent information. Further, the Director of Quality Assurance prepares quarterly reports summarizing the performance of measurement systems and data quality.

12. SYSTEM AND PERFORMANCE AUDITS

12.1 System Audits

A system audit is an evaluation of the various components of a laboratory's measurement system to assess proper selection and use. This audit will consist of an on-site review of a laboratory's quality assurance systems and physical facilities for sampling, calibration and measurements. System audits are performed on a regular basis by the U.S. EPA as well as various state agencies. CAA will cooperate on all on-site external systems audits performed by the client. The audit may include several or all of the components listed below:

- Personnel, facilities and equipment
- Chain-of-custody procedures
- Instrument calibration and maintenance
- Standards preparation and verification
- Analytical procedures
- Quality control procedures
- Data handling procedures
- Documentation control procedures

12.2 Performance Audits

Performance audits provide a systematic check of laboratory operations and measurement systems by comparing independently obtained data with routinely obtained data. CAA routinely participates in laboratory performance evaluations for the U.S. EPA as part of the Water Supply (WS) and Water Pollution (WP) programs. The laboratory also undergoes quarterly audits by EPA as required by the Contract Laboratory Program which supports Superfund investigations and activities. In addition, CAA participates in numerous on-going state performance evaluations. A schedule for CAA's participation in these performance evaluations is detailed in Table 12.1. The reports from these audits will be made available if requested by the client.

Table 12.1 Laboratory Performance Evaluation Schedule (1 yr)

Source	1st quarter	2nd quarter	3rd quarter	4th quarter
EPA WS		X		X
EPA WP	X		X	
NYSDOH (New York State Dep't of Health)	Non-Potables	Potables	Non-Potables	Potables
CLP-organic	X	X	X	X
-inorganic	X	X	X	X

12.3 State Certifications

The following is a list of the States in which Cambridge Analytical Associates holds laboratory certification to perform environmental analysis.

State of Connecticut - full certification.

Commonwealth of Massachusetts - full certification.

State of New Hampshire - full certification.

State of New York - interim certification.

State of New Jersey - full certification.

State of Florida - full certification.

State of Rhode Island - full reciprocal certification.

Commonwealth of Virginia - full reciprocal certification.

12. 4 Contract Laboratory Program

Cambridge Analytical Associates currently holds contracts for organic (CLP SOW 787) analyses under U.S. EPA Superfund Contract Laboratory Program. Our contract for inorganic analyses has recently expired and has not been renewed, pending bids for the new contract, which will begin shortly. CAA has been a participating laboratory in the program since 1983.

13. PREVENTIVE MAINTENANCE

CAA follows a well-defined program to prevent the failure of laboratory equipment or instrumentation during use. This preventive maintenance and careful calibration help to assure accurate measurements from laboratory instruments. CAA also avoids any time delays during analyses due to unscheduled downtime by maintaining more than one instrument of each type in full working order.

Preventive maintenance procedures such as lubrication, source cleaning, detector cleaning and the frequency of such maintenance are performed according to the procedures delineated in the manufacturer's instrument manual. Chromatographic carrier gas purification traps, injector liners, and injector septa are cleaned or replaced on a regular basis. Precision and accuracy data are examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance must be performed when the instrument begins to degrade as evidenced by the degradation of peak resolution, shift in calibration curves, decreased sensitivity, or failure to meet one or another of the quality control criteria. The preventive maintenance performed on the major instrumentation which will be used is summarized in Table 13.1.

Instrument logbooks are maintained in the laboratories at all times. They contain records of usage, calibration, maintenance and repairs. Adequate supplies of spare parts such as GC columns, syringes, septa, injection port liners, and electronic parts are maintained in the laboratories so that they are available when needed.

Table 13.1 Maintenance Procedures and Schedule For Major Instrumentation

Instrument	Maintenance Procedure/Schedule	Spare Parts
Gas Chromatography/ Mass Spectrometry (GC/MS)	1. Replace pump oils as needed 2. Change septa as needed 3. Change gas line dryers as needed 4. Replace electron multiplier as needed	1. Syringes 2. Septa 3. Various electronic components 4. Plumbing supplies-tube fittings
Gas Chromatograph (GC)	1. Change septa as needed 2. Change gas line dryers as needed 3. Leak check when installing new analytical column 4. Periodically check inlet system for residue buildup	1. Syringes 2. Septa 3. Various electronic components 4. Plumbing supplies-tube fittings
Inductively Coupled Argon Plasma Spectrometer (ICP)	1. Clean torch assembly and mixing chamber when discolored or after 8 hours of running hish dissolved solids samples	1. Spare torch and mixing chamber 2. Spare coil
Purge and Trap Sample Concentrator	1. Replace trap as needed 2. Decontaminate system as required by blank analysis 3. Leak check system	1. Spare traps 2. Various electronic components and circuit boards 3. Plumbing supplies-tube fittings
Graphite Furnace Atomic Absorption Spectrophotometer	1. Change graphite contact rings as necessary 2. Change D_2 background connection lamp as necessary 3. Clean quartz windows as necessary	1. Contact rings 2. D_2 arc lamp
Spectroproducts Hg Analyzer	1. Clean tubing and quartz cell as necessary 2. Clean aspirator as necessary	1. Quartz cells 2. Aspirator
Technicon Autoanalyzer II	1. Inspect pump tubes after each 8-hr urn; replace if discolored or distorted	1. Pump tubes, glass coil, flow cells

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

14.1 Precision

Precision is a measure of the degree of agreement between repeated measurements of the same parameter under prescribed, similar conditions. Analytical precision will be monitored using results from duplicate analyses. The program analytical precision goals, expressed as relative percent difference (RPD), are presented in Table 5.1, Section 5. The RPD is expressed as follows:

$$\text{RPD} = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100$$

where RPD = Relative Percent Difference

D_1 = First Duplicate Value (percent recovery)

D_2 = Second Duplicate Value (percent recovery)

14.2 Accuracy

Accuracy is the degree of agreement between the true value of the parameter being measured and the observations made according to the test method. Accuracy will be evaluated by comparing the recovery of the parameters of interest against the goals established in Section 5 through the use of EPA Quality Control Samples or NBS Standard Reference Materials. The recovery of a compound will be defined as:

$$\text{Percent Recovery} = \frac{Q_d}{Q_a} \times 100\%$$

where Q_d = quantity determined by analysis

Q_a = true value

Accuracy criteria for this project are included in Table 5.1.

14.3 Completeness

Completeness is a measure of the amount of valid data obtained from the analytical measurement system. It is defined as the total amount of acceptable data divided by the total number of samples received multiplied by 100. The QA objective for this study is to obtain acceptable data for all of the samples received. The procedures in Section 10 of this QA Plan for validating data will be used to determine which data are acceptable. Completeness also implies the ability of the final report to answer the client's questions. CAA's scientists and engineers will be available to interpret the analytical reports and consult with the client to recommend future courses of action.

Completeness is expressed as follows:

$$C = 100 \frac{V}{T}$$

where:

C = Percent completeness

V = Number of measurements judged valid

T = Total number of measurements

15. CORRECTIVE ACTION

An important part of any quality assurance program is a well-defined effective policy for correcting quality problems. CAA maintains a closed-loop corrective action system which operates under the direction of the QA Director. While the entire quality assurance program is designed to avoid problems, it also serves to identify and correct those that may exist. Usually these quality problems fall into two categories, immediate corrective action or long-term corrective action.

Specific quality control procedures are designed to help analysts detect the need for corrective action. Often an analyst's experience will be most valuable in identifying suspicious data or malfunctioning equipment; immediate corrective action may then be taken. The actions should be noted in laboratory notebooks but no other formal documentation is required unless further corrective action is necessary.

The need for long-term action may be identified by standard QC procedures, control charts, performance or system audits. Any quality problem which cannot be solved by immediate corrective action falls into this long-term category. CAA uses a system to insure that the condition is reported to a person who is part of the closed-loop action and follow up plan.

The essential steps in the closed-loop corrective action system are:

a. The problem will be identified.
b. Responsibility for investigating the problem will be assigned.
c. The cause of the problem will be investigated and determined.
d. A corrective action to eliminate the problem will be determined.
e. Responsibility for implementing the corrective action will be assigned and accepted.
f. The effectiveness of the corrective action will be established and the corrective action implemented.

g. The fact that the corrective action has eliminated the problem will be verified.

h. The complete process of establishing and implementing corrective action will be documented. The Corrective Action Request Form (Figure 15.1) serves to summarize all such documentation.

This process of corrective action will be used to make all corrections deemed necessary by the CAA Project Manager or QA Department, the client QA Coordinator, or the client Project Officer. CAA's QA Coordinator assigned to the project will coordinate correspondence and ensure compliance with their request.

Figure 15-1

Corrective Action Request Form No. ____________________

Originator ____________________ Date ____________________

Person responsible for replying ____________________ Laboratory ____________________

Nature of Problem:

____

____

____

Cause of Problem:

____

____

____

Corrective Action Planned:

____

____

____

Temporary Action

Permanent Action

Acceptance of Corrective Action

Approved By: ____________________

Record Distribution

Original: QC Coordinator
2nd copy: Originator
3rd copy: CAA file

16. QUALITY ASSURANCE REPORT TO MANAGEMENT

In order to provide information to CAA's Project Manager on the performance of the quality assurance program for this project, the laboratory Quality Assurance Coordinator will meet with the Project Manager, and Task Managers on a periodic basis to review quality control data summary documentation, and other pertinent information.

On a quarterly basis the Quality Assurance Director prepares reports to CAA's corporate management summarizing the performance of measurement systems and data quality. These reports will include:

- results of interlaboratory precision and accuracy studies;
- results of performance evaluation studies for ongoing or new contracts;
- summary results of blind internal QC test samples;
- an assessment of measurement data accuracy, precision and completeness;
- significant quality assurance problems and recommended solutions.

17. PERSONNEL QUALIFICATIONS

CAA ENVIRONMENTAL DIVISION RESUME

NANCY I.KILAR

PROJECT MANAGER

EXPERIENCE SUMMARY: Ms.Kilar is a Project Manager for the Environmental Services Division of CAA. She has overall responsibility for the management of many projects. This includes the administration and supervision of analytical tasks, ensuring that the project objectives are within the budget designated, and ensuring the timeliness of a project. As a Project Manager, she must coordinate a work plan with the task managers, review these work plans, review progress reports, analytical reports, project reports and financial reports to ensure that client requirements are met.

Prior to joining CAA, Ms. Kilar was a Chemist IV at Enseco, Inc.(ERCO) in Cambridge,Massachusetts. She was solely responsible for the coordination and analysis of Oceanographic monitoring for a large chemical company. This included sampling on a Research vessel, extraction of the samples and analysis on Atomic Absorption Furnace(AA),Atomic Absorption Flame, cold vapor mercury analysis, and Hydride analysis by Flame. In addition, Ms.Kilar was active in an Interlaboratory Method Validation Study of Atomic Absorption Flame of 23 Elements. She was the Lead Instrument operator for commercial projects, as well as CLP projects, on both Furnace and Flame AA.

EDUCATION: B.A.,Biology, Merrimack College, N.Andover,MA,1986
A.S.,Medical Assistant,Becker Jr.College,1977

Cornell University/University of New Hampshire
Underwater Research,Isle of Shoals, 1986

EMPLOYMENT HISTORY:

1988-present:	Cambridge Analytical Associates,Inc.,Boston,MA. Project Manager.
1987-1988:	Enseco,Inc.(ERCO),Cambridge,MA. Chemist IV.
1986-1987:	Enseco,Inc.(ERCO),Cambridge,MA. Analytical Chemist.

PROFESSIONAL AFFILIATIONS:

Sigma Xi Research Society

LINDA P. LEONARD

DIRECTOR, QUALITY ASSURANCE

EXPERIENCE SUMMARY: Ms. Leonard currently directs the Quality Assurance Department at CAA. She is responsible for the development, application and evaluation of quality control and quality assurance procedures for environmental analytical programs. Her background includes development of methods for sample preparation and instrumental analysis, as well as direction of laboratory projects and personnel.

EDUCATION: B.S., Biology, Southeastern Massachusetts University, 1972

Operation Principles and Applications for 2000/2400 AtomScan, Jarrell-Ash Corporation, Waltham, MA. 1984

Principles and Application of Mark II Plasma AtomComp Spectrometer, Jarrell- Ash Corporation, Waltham, MA. 1980

EMPLOYMENT HISTORY:

1986 to present:	Cambridge Analytical Associates, Inc., Boston, MA. Director, Quality Assurance.
1984 - 1986:	Cambridge Analytical Associates, Inc., Boston, MA. Manager, Inorganic Chemistry Laboratory.
1983 - 1984:	Cambridge Analytical Associates, Inc., Boston, MA. Senior Scientist.
1979 - 1983:	Energy Resources Company, (ERCO), Cambridge, MA. Senior Scientist.
1976 - 1979:	Jarrell-Ash Division, Fisher Scientific, Waltham, MA. Chemist.
1972 - 1975:	Tibbetts Engineering Corporation, New Bedford, MA. Chemist.

PUBLICATIONS: Author/co-author of a number of publications and presentations on environmental chemistry, analytical methodology and data management.

PROJECT EXPERIENCE:

Inorganic Analysis of Multi-Media, Multi-Concentration Samples from EPA Superfund Sites. (U.S. EPA Contract Laboratory Program). Project manager for multi-year contract requiring analyses for metals and cyanide in support of Superfund site investigations.

Evaluation of Chemical Data from Modena, NY Site. (New York State Department of Law). Scientist involved in study evaluating the extent of trace metals contamination at industrial site in New York.

Analysis of Water, Sediment, and Organisms Collected in the Vicinity of COE and EPA Oceanic Disposal Sites. (Interstate Electronics Corporation). Scientist involved in multi-year study to perform baseline study of chemistry, biology, and sedimentology at designated ocean disposal sites for EPA.

Evaluation of Chemical Contamination of Groundwater and Soil at the Baird-McGuire Site in Holbrook, MA. (Goldberg-Zoino Associates & EPA Region I). Scientist responsible for characterization of trace metals contamination at Superfund site.

Demonstration of Compliance of Acid-Waste Disposal at the 106-mile Ocean Waste Disposal with Subparts B, D, and E of the Ocean Dumping Regulations. (Gulf and Western Industries). Scientist involved in chemical analyses in support of study to demonstrate compliance of acid waste disposal practices with requirements of Ocean Dumping Regulations.

Ecological Evaluation of Proposed Oceanic Discharge of Dredged Material in the New England Region. (U.S. Army Corps of Engineers, New England Division). Project scientist for multi-year investigation evaluating effects of dredged material disposal in the ocean and compliance with Ocean Dumping Regulations.

Extraction Method Development Study for Trace Metals in Leachate. (U.S. EPA). Scientist involved in an investigation examining effectiveness of RCRA methods for the analysis of metals in EP toxicity leachates.

Interlaboratory Method Study of Trace Metals by Atomic Absorption (AA) Furnace Procedures. (U.S. EPA). Scientist involved in 10-laboratory round-robin study evaluating precision and accuracy of graphite furnace atomic absorption methods for the analysis of metals in laboratory, surface, and drinking water, as well as industrial effluents.

LEONARD RESUME
(CONTINUED)

PUBLICATIONS:

Hausknecht, K.A., A. Schkuta, L.P. Leonard, D. Farnsworth and A. Atlas. **Implementation of a Data Management System in an Environmental Laboratory using an IBM PC Network.** Presented before the 25th Eastern Analytical Symposium New York City, New York, October, 1986.

Studer, M., L. Leonard, and K. Hausknecht. **Comparison of Background Correction Methods for the Furnace Atomic Absorption Spectrometry Determination of Arsenic and Selenium in Environmental Samples.** Presented before the Inorganic Caucus EPA/CLP. Oakland, CA. October, 1985.

Studer, M., L. Leonard, and K. Hausknecht. **Comparison of Background Correction Methods for Furnace Atomic Absorption Determination of Selenium in Environmental Samples.** Presented before the 12th Annual Meeting of the Federation of Analytical Chemistry and Spectroscopy Societies. Philadelphia, PA. October, 1985.

Leonard, L., M. Studer, K. O'Leary, and K. Hausknecht. **Comparison of Methods for Determination of Silver in Wastewater.** Presented before the Inorganic Caucus EPA/CLP. Las Vegas, NV. March, 1985.

Young, C.P., G. Slusarczuk, N. Brandt, K. Hausknecht, and L. Leonard. **Comparison of Methods for the Analysis of Alkali and Alkaline Earth Metals in Black Liquors.** Presented before the Ninth National Conference on Spectrochemical Excitation and Analysis. Edgartown, MA. September 6-9, 1984.

Hausknecht, K.A., W.P. Kays and L.P. Leonard. **A Comparison of Methods for Multi-Element Analysis of Drilling Muds.** Presented before the Eighth National Conference on Spectrochemical Excitation and Analysis, Edgartown, MA. September 6-9, 1983.

Hausknecht, K.A., L.P. Leonard, A.E. O'Hara, and L.A. Stoddard. **Multi-Element Analysis of Fish Tissue and Standard Reference Material Using Inductively Coupled Argon Plasma Emission Spectrocopy.** Jarrell-Ash Plasma Newsletter 6(1):7-9. 1983.

Hausknecht, K.A., L.P. Leonard and L.A. Stoddard. **Multi-Element Analysis of Biological Tissues Using Atomic Absorption and Plasma Emission Spectroscopy.** Presented before the Seventh National Conference on Spectrochemical Excitation and Analysis, Edgartown, MA. September, 1982.

Hausknecht, K.A., L.P. Leonard, and E.A. Ryan. **Determination of Lead in Paint Chips Using a Modified Ashing Procedure and Atomic Absorption Spectrophotometry.** Atomic Spectroscopy 3(2):53-55. 1982.

CLARE KILLOUGH

QUALITY ASSURANCE COORDINATOR

EXPERIENCE SUMMARY: Ms. Killough serves as a Quality Assurance Coordinator at CAA. She is actively involved in seeking and maintaining certification from a number of states. This includes correspondence, tracking/reviewing and submitting Performance Evaluation samples from the EPA or state organizations and assisting in laboratory audits conducted by these or any external groups.

Ms. Killough prepares Quality Assurance Project Plans, works with the QA Director to develop, implement and document Standard Operating Procedures in the laboratory for commercial and government work and she provides "refresher seminars" in good laboratory practice to ensure that the laboratory is producing quality data she conducts internal audits. These include random data audits of CAA's commercial work, laboratory audits as needed and a program of blind performance samples to the laboratory, which are not know to the analysts. Along those lines, she also maintains updated Quality Control Charts for the laboratory.

Previously Ms. Killough was a Quality Control Technician for a large chemical company. Her laboratory experience included in-house effluent testing and effluent sampling for outside contract laboratories. While there, she helped to edit and update standard operating procedures for the laboratory including IC, GC and LISM computer work. Her day-to-day work consisted of a variety of tests on production samples, final packaged products, incoming raw materials and outgoing truck and tank car samples. Tests included various titrations, physical properties, GC, IC and UV spectrophotometry.

EDUCATION: B.S., Chemistry, St. John University, New York, NY, 1986

EMPLOYMENT HISTORY:

1987 - present:	Cambridge Analytical Associates, Inc., Boston, MA. Quality Assurance Coordinator.
1986 - 1987:	Monsanto Chemical Company, Everett, MA. Quality Control Technician.
1985 - 1986:	St. John's University, New York, NY. Laboratory Teaching Assistant.

PROFESSIONAL AFFILIATIONS:

American Chemical Society

CAA ENVIRONMENTAL DIVISION RESUME

MICHAEL F. DELANEY, Ph.D.

DIRECTOR OF ANALYTICAL SERVICES

EXPERIENCE SUMMARY: Dr. Delaney performs a variety of technical functions largely focused in the areas of Chemometrics. He has worked on methods for determining Method Detection Limits for analyses conducted at a major environmental monitoring site. This location is currently being resampled in an effort to determine whether the site is habitable. This project has necessitated the extensive examination of laboratory data analyzed by GC/MS in order to quantify the sources of variability and bias. Dr. Delaney has also had extensive hands-on experience with instrumentation used in environmental analyses.

Dr. Delaney has performed research in the areas of selective chromatographic detectors, evaluation of spectral library searching systems, mathematical resolution of overlapping chromatographic peaks, and chemical applications of pattern recognition. Other projects have included developing statistical sampling designs for environmental monitoring studies and providing analytical chemistry expertise to hazardous waste site sampling and remediation projects.

EDUCATION: Ph.D., Analytical Chemistry, University of Massachusetts/Amherst, 1979
B.S., Chemistry, Massachusetts Institute of Technology, 1975

EMPLOYMENT HISTORY:

1986 to present:	Cambridge Analytical Associates, Inc., Boston, MA. Co-Director, Consulting Services Department.
1987 to present:	Boston University, Boston, MA. Adjunct Associate Professor of Chemistry.
1980 - 1987:	Boston University, Boston, MA. Assistant Professor of Chemistry.
1978 - 1980:	Tufts University, Medford, MA. Assistant Professor of Chemistry.
1979 - present:	U.S. Food and Drug Administration, Winchester Engineering and Analytical Center, Winchester, MA. Science Advisor.

PROFESSIONAL AFFILIATIONS:

American Chemical Society
The Chemometrics Society

Reviews proposals and publications for Analytical Chemistry, Analytica Chimica Acta, Canadian Journal of Chemistry, National Science Foundation, American Chemical Society Petroleum Research Foundation, Environmental Protection Agency, LC/GC Magazine.

PUBLICATIONS: Author/co-author of over forty publications in scientific journals in the areas of chemometrics, computerized compound identification, chromatographic curve resolution, and chromatographic detectors.

PROJECT EXPERIENCE:

Love Canal Habitability Study (CH2M Hill & U.S. EPA Region II). Project manager and senior scientist for a multi-year study involving tasks on methods for estimating detections limits, chemometric analysis of data quality, real-time quality control using electronic communication with seven laboratories, multi-laboratory logistics, statistical data interpretation, and report writing.

Statistical Sampling and Chemical Analysis for a Private Client. Statistical sampling design and data interpretation for a multi-site study involving low-level PCB spills. A three dimensional grid sampling design was used to support post-cleanup decision making.

Chemometrics Workshop for a Pharmaceutical Manufacturer. (Berlex Laboratories). Developed and presented a two-day workshop on Chemometrics for pharmaceutical scientists and analytical chemists.

Analytical Chemistry and Quality Control Support for Investigation of the S-Area Landfill. (Gannett-Fleming & U.S. EPA Region II) Scientist responsible for providing expertise on analytical chemistry and QA/QC aspects of the sampling and analysis plan for the S-Area Landfill in Niagara Falls, New York.

Statistical Sampling, Analysis, and Data Interpretation for the Boston Shipyard. (Massachusetts Port Authority). Devised and implemented a statistically valid sampling program for classifying for disposal purposes large amounts of shipyard sandblasting material.

Sampling, Analysis, and Data Interpretation for the Schiavone Scrap Metal Site. (Massachusetts Port Authority). Developed a sampling plan, collected samples, and analysis resulting data to classify for disposal purposes excavated material from a former scrap metal site.

Sampling, Analysis, and Data Interpretation for a Boston and Maine Railyard. (Massachusetts Port Authority). Developed a sampling plan, collected samples, and analysis resulting data to classify for disposal purposes excavated material from a former railroad yard.

Statistical Sampling Design, Analysis, and Data Interpretation for Soil Samples Near the Tobin Bridge (Mystic River Bridge). (Massachusetts Port Authority). Based on the results of previous chemical analyses a statistically valid sampling plan was developed to monitor the concentration of lead in soil samples from areas near the Tobin Bridge. Using the sampling plan samples were collected, analyzed, and the results were studied for recommendations on soil replacement and continued periodic monitoring.

PUBLICATIONS:

Michael F. Delaney, Review of the book, **Environmental Application of Chemometrics,** J. J. Breen and P. E. Robinson, editors, to appear in Chemometrics and Intelligent Laboratory Systems, 1988.

Michael F. Delaney, **Multivariate Detection Limits for Selected Ion Monitoring Gas Chromatography - Mass Spectrometry**, submitted to Chemometrics and Intelligent Laboratory Systems, 3: 45-51, 1988.

Michael F. Delaney, Review of the book, **Computer Applications in Chemistry**, P. C. Jurs Analytical Chemistry 59: 852A, 1987.

Michael F. Delaney, **Using "Electronic Laboratory Notebook" Software in the Instrumental Analysis Course**, Journal of Chemical Education, 1987.

John R. Hallowell Jr., Michael F. Delaney, and F. Vincent Warren Jr., **Effect of Noise on Spectral Library Searching Performance**, Analytical Chemistry 59: 1544-1549, 1987.

F. Vincent Warren Jr., Brian A. Bidlingmeyer, and Michael F. Delaney, **Selection of Representative Wavelength Sets for Monitoring in Liquid Chromatography with Multichannel UV-VIS Detection**, Analytical Chemistry 59: 1890-1986, 1987.

F. Vincent Warren Jr., Brian A. Bidlingmeyer, and Michael F. Delaney, **Selection of Wavelengths for Absorbence Ratio Monitoring in Liquid Chromatography**, Analytical Chemistry 59: 1897-1907, 1987.

Michael F. Delaney, Andrew N. Papas, and Milda Walters, **Selection of Equivalent High Performance Liquid Chromatography Columns Using Cluster Analysis**, Journal of Chromatography 410: 31-41, 1987.

Andrew N. Papas and Michael F. Delaney, **Evaluation of Chromatographic Integrators and Data Systems**, Analytical Chemistry 59: 54A-59A, 1987.

Michael F. Delaney, and A.N. Papas, **Evaluation of Chromatographic Integrators and Data Systems**, invited for the A/C Interface column in Analytical Chemistry, to appear January, 1987.

Michael F. Delaney, and M.M. Mauro, **Resolution of Infrared Spectra of Mixtures by Self-Modeling Curve Resolution Using a Library of Reference Spectra with Simplex Assisted Searching**, Analytical Chemistry, 58: 2622, 1986.

Michael F. Delaney, **Scientific Literature Management Using "Electronic Laboratory Notebook" Software**, American Laboratory 18(7): 51-57, 1986.

DELANEY RESUME
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MARY FENCL

ORGANIC CHEMISTRY SECTION MANAGER

EXPERIENCE SUMMARY: Ms. Fencl's responsibilities as Organic Chemistry laboratory manager have included overseeing rapid expansion of the laboratory and facilities and the training of new personnel, while maintaining rigorous quality control standards. She is also involved in the application of new computerized procedures for data reduction and report preparation.

As CAA's organic CLP contract project manager, Ms. Fencl is responsible for sample scheduling, data reporting, and communications with EPA's project officer and the EPA Sample Management Office. In addition, Ms. Fencl has extensive knowledge in computerized analytical and laboratory management applications. She has participated in the development and modification of laboratory management software and CLP data forms software packages.

Prior to joining CAA, Ms. Fencl was Organic Chemistry Operations Manager and CLP Project Manager at ThermoAnalytical, Inc. in Richmond, California from December, 1985 through 1987. Responsibilities included administrative, budget and operations for GC/MS, GC, organic sample preparation and data reduction. She supervised a staff of seventeen people involved in all aspects of organic sample analysis for commercial and governmental clients.

From 1981 to 1985 Ms. Fencl served as Project Manager for Spectrix Corporation, Houston, Texas. There she managed the EPA-Contract Laboratory Program organic chemical analyses, scheduling data reporting, and client interactions. Other responsibilities included sample analysis by GC and GC/MS and modification of laboratory management systems computer software.

EDUCATION: 1980, Chemistry, B.S., Indiana University

EMPLOYMENT HISTORY:

1987 to present:	Cambridge Analytical Associates, Inc., Boston, MA. Organic Chemistry Section Manager.
1985 - 1987:	ThermoAnalytical Inc., Richmond, CA. CLP Project Manager / Organic Chemistry Operations Manager.
1985:	Analytical Technologies, Inc., San Diego, CA. Senior Project Manager / Director, Data Management Systems.
1981 - 1985:	Spectrix Corporation, Houston, TX. CLP Project Manager / Supervisor, GC/MS Laboratory.

PROJECT EXPERIENCE:

Organic Analysis of Multi-Media, Multi-Concentration Samples from EPA Super Fund Sites. (U.S. EPA Contract Laboratory Program). Project Manager for multi-year contract requiring analyses for semi-volatile and volatile organics and pesticide/PCBs in support of Superfund site investigations.

Analyses and Evaluation of Incineration Test Samples. Project manager for study evaluating different burn conditions and effects on various contaminants.

POLINA EPELMAN

INORGANIC LABORATORY MANAGER

EXPERIENCE SUMMARY: Ms. Epelman is responsible for Metals and Inorganic Laboratory operations at CAA. She is CAA's Inorganic CLP Project Manager and responsible for sample scheduling, data reporting, and communications with the Environmental Protection Agency office. Her background includes over 20 years of managerial experience and the practical applications of a variety of instrumental techniques.

Prior to joining CAA, Ms. Epelman was Senior Chemist and Laboratory Supervisor for eight years at ESA Laboratories in Bedford, Massachusetts. She worked on method development and applications for the analysis of metals using electrochemical techniques of anodic stripping voltammetry, and controlled potential coulometry. Her expertise includes: Atomic absorption Spectrometry, Anodic Stripping Voltammetry, GC, HPLC, UV, Ion Chromatography of environmental, industrial hygiene and biological samples.

EDUCATION: M.S., B.S., Pharmaceutics and Chemistry, Leningrad Institute, 1966
A.S., Analytical Chemistry, Leningrad Institute, 1960

EMPLOYMENT HISTORY:

1986 - present: Cambridge Analytical Associates, Inc., Boston, MA.
Inorganic Laboratory Manager.

1981 - 1986: Environmental Sciences Associates Lab., Inc. Bedford, MA.
Supervisor, Analytical Services Laboratory.

1979 - 1981: Environmental Sciences Associates Lab., Inc. Bedford, MA.
Senior Chemist.

1974 - 1976: Negev Regrow Pharmacy, Ber-Sheva, Israel.
Pharmaceutical Chemist.

1970 - 1974: First City Hospital, Leningrad, U.S.S.R.
Director, Pharmacy Department.

1966 - 1970: First City Hospital, Leningrad, U.S.S.R.
Analytical Chemist, Pharmacy Department.

PROFESSIONAL AFFILIATIONS:

Pharmaceutical License, U.S.S.R. Ministry of Health
Pharmaceutical License, Israeli Ministry of Health
American Industrial Hygienist Association

EPELMAN RESUME
(CONTINUED)

PROJECT EXPERIENCE:

Evaluated Blood Level Screening Program. Was directly involved in the screening programs for children in 45 cities of the United States with elevated blood lead level. The work resolved measure of lead in blood samples using Anodic Stripping Voltammetry Technique.

Livestock Study of Trace Metals. Conducted livestock study of trace metals under U.S. Environmental Protection Agency Contract Laboratory Program (special analytical services).

Experimental Studies of Pipe Leachate. Conducted an experiment on leachate of pipes to determine amount of lead in water using different extract solutions followed by G.F.A. technique.

Method Validation in Speciation of As III and As V. Involved in method validation using speciation of As III and As V from nature waters and waste waters using extraction techniques.

Method Development of Uranium using Controlled Potential Coulometry. Involved in method development of uranium in urine using controlled potential coulometry.

Bi-Study of Animal Tissue as a Drug Side Effect. Participated in Bi-study on animal tissue as a drug side effect using Anodic Stripping Voltammetry technique.

Attachment 1

Facilities and Equipment for the Hellertown, PA RI/FS Project

Prepared By:

Cambridge Analytical Associates, Inc.
1106 Commonwealth Avenue
Boston, Massachusetts 02215

January 13, 1989

Attachment 1

Facilities and Equipment

Cambridge Analytical Associates maintains primary offices and laboratories in Boston, Massachusetts with satelite offices in Princeton, New Jersey and Simi Valley, California. Computer capabilities include an in-house local area network of IBM PCs, as well as time-sharing access to IBM 3033 and 3083 mainframes.

The analytical chemistry laboratories at CAA are designed to provide rapid turnaround of high quality environmental and analytical data. Laboratory facilities are divided into eight laboratory areas, each with a defined function. These areas are: 1) organic preparation laboratory for sample extraction, glassware preparation, and gas chromatography (GC) analysis, 2) trace metals preparation laboratory; 3) gas chromatography/mass spectrometry (GC/MS) laboratory; 4) volatile organics analysis laboratory; 5) trace metals analysis laboratory; 6) pesticide (FIFRA) chemistry laboratory; 7) bioremediations Research and Development laboratory and 8) general chemistry laboratory. Separate areas are designated for sample log-in, solvent and equipment log-in, solvent and equipment storage, staff offices, and administrative functions.

Each laboratory is fully equipped with fume hoods, benches, ovens, balances, furnaces, mills, shakers, clean benches, glassware and other apparatus for sample preparation and analysis. Distilled, deionized water is provided by a high capacity Continental deionizing system and a Barnstead Nanopure system.

The organic preparation laboratory contains five 6-ft. fume hoods for sample extraction and a separate area equipped with an automatic dishwasher for glassware cleaning. The Gas Chromatography laboratory is located adjacent to the main preparation laboratory. The organic sample preparation laboratory is equipped with analytical balances, drying oven, muffle furnace, shakers, refrigerators, freezers, ultrasonic baths and other glassware and equipment for rapid and efficient sample preparation.

The metals preparation laboratory is equipped with a 5-ft. LFI Class-100 laminar flow clean bench to control atmospheric contamination and provide a controlled area for preparation of low-level samples. Two 5-ft. conventional fume hoods and five-foot perchloric acid hood are available for sample digestion and handling of hazardous samples. The inorganic sample preparation area is equipped with analytical balances, top-loading balances, mills, shakers, incubating shakers, ultrasonic baths, refrigerators, freezers, muffle furnace, vented drying oven, and other glassware and equipment necessary for sample preparation.

The metals instrument laboratory, volatile organics laboratory, and GC/MS laboratory each contain fume hoods for sample and standard preparation. A separate air-handling system for the volatile organics facility minimizes cross-contamination from other laboratory operations. The pesticide chemistry laboratory contains four six-foot fume hoods, ovens, environmental chambers and a complete collection of sample preparation equipment. The general chemistry laboratory contains two four-foot fume hoods and a complement of glassware and equipment for analysis of conventional pollutants.

Laboratories at CAA are fully equipped with state-of-the-art instrumentation. This equipment includes an array of sample preparation apparatus, analytical instruments, and computers. Major pieces of analytical equipment are listed below.

Gas Chromatography/Mass Spectrometry

- Hewlett Packard 5993 GC/MS including: EI Source, 4-800 amu quadrupole mass analyzer with open-split and direct capillary, and packed column interfaces, HP 5700 series gas chromatograph with split/splitless and packed column injectors, Hewlett-Packard "Quicksilver" data system. Software includes isotope dilution, the NBS mass spectral database and direct data transfer to RTE-6 GC/MS data system. The system is equipped with a Tekmar LSC-2/ALS purge and trap concentration system for volatile organics analysis.

- Hewlett Packard 5987 GC/MS core including: EI/CI source, 4-1000 amu quadrupole mass analyzer, with capillary and packed column interface, direct insertion probe, HP 5840 gas chromatograph with split/splitless capillary and packed column injectors. The GC/MS is interfaced to an HP RTE-6 data system. Sample introduction accessories dedicated to this instrument are direct insertion probe, HP 7672 automatic liquid sampler for semi-volatile organic analysis.

- Hewlett-Packard 5995 GC/MS core including: EI source, 4-800 amu quadrupole mass analyzer with open-split and direct capillary, and packed column interface, HP 5700 series gas chromatograph with split/splitless capillary and packed column injectors. The GC/MS is interfaced to a HP RTE-6 data system. The system is equipped with a HP7671 automatic liquid sampler for semi-volatile organic analysis, and a Tekmar LSC-2/ALS purge and trap system for volatile organics analyses.

- Two (2) Hewlett-Packard 5890 GC/5970 MS System including: EI source, 4-800 amu quadrupole mass analyzer with open/split and direct capillary interfaces and split/splitless capillary injection ports. HP-7673 robotics autosampler for the analysis of semi-volatile organics. The GC/MS is interfaced to a HP RTE-6 data system.

- Two (2) Hewlett-Packard 5890 GC/5970 MS System including: EI source, 4-800 Amu quadrupole mass analyzer with open/split and direct capillary and packed column interfaces and split/splitless capillary injection ports. The GC/MS is interfaced to a HP RTE-6 data system. The systems are equipped with Tekmar LSC-2/ALS purge and trap systems for volatile organic analysis.

- Hewlett-Packard 5890 GC/5970 MS System including: EI source, 4-800 amu quadrupole mass analyzer with open/split and direct capillary interfaces and split/splitless capillary packed column injectors. Hewlett-Packard "Quicksilver" data system. Software includes isotope dilution, the NBS mass spectral database and direct data transfer to RTE-6 GC/MS data system. The system is equipped with a Tekmar 16 port LSC 2000/ALS 2016 purge and trap concentration system with heater for volatile organics analysis.

- Three (3) Hewlett Packard RTE-6 mass spectral data systems including: a total of 3.5 megabytes of main memory, 280 megabytes of disk storage, two 9-track tape drives and 8 computer terminals. System output devices include 2 HP "thinkjet" terminal printers, HP 2934A high speed printer, HP 9678A graphics printer, HP 2608 system line printer and Hayes modem for data transfer to, or direct system access from remote locations. Software includes NBS/Wiley mass spectral database and Aquarius package for automated batch analysis and quantitation of priority pollutants.

Gas Chromatography

- Five (5) Hewlett-Packard 5880 GCs, with split/splitless capillary injection ports, flame ionization detectors, Ni-63 electron capture detectors, flame photometric detector, level 4 data reduction systems and 7673A, 7672A or 7671A automatic liquid samplers.

- Hewlett-Packard 5890 GC, with split/splitless capillary injection ports, Ni-63 electron capture detector, nitrogen-phosphorus detector, 7672A automatic liquid sampler, and a 3392A integrator.

- Hewlett-Packard 5890 GC, with packed and split/splitless capillary injection ports, H-Nu Model PI 52 photoionization detector, Oceanography International Model 4420 electrolytic conductivity detector (halogen, sulfur, and nitrogen modes), Tekmar LSC-2/ALS purge and trap concentration systems for volatile organics analysis, and Nelson Analytical multi-instrument chromatography data system.

- Hewlett-Packard 5890 GC, with packed and split/splitless capillary injection ports, thermal conductivity detector, flame ionization detector, 7673A robotics autosampler and Nelson Analytical data system.

- Hewlett-Packard 5840A GC, with flame ionization detector, 7671A automatic liquid sampler, and 18850A GC data system for the screening of semi-volatile sample extracts.

- Perkin Elmer 3920 GC, with flame ionization detector, Nelson Analytical data system, and Hewlett Packard 19395A headspace autosampler system for the screening of samples requiring volatile organics analysis.

Atomic Spectroscopy

- Jarrell-Ash AtomScan 2000 sequential inductively coupled argon plasma emission spectrometer. Equipped with Apple IIE computer for data acquisition, reduction and transfer to atomic spectroscopy data system, printer, high solids nebulizer, sapphire torch for use with hydrofluoric acid matrices and 114-position autosampler.

- Jarrell-Ash AtomComp 975 simultaneous inductively coupled argon plasma emission spectrometer. Equipped with Digital Equipment PDP-8 computer for data acquisition, reduction and transfer to main data system, printer and 114 position autosampler.

- Two (2) Perkin Elmer 5000 Atomic Absorption Spectrophotometers with Zeeman effect deuterium arc/tungsten halide background correction systems. Equipped for use with hollow cathode or EDL sources, HGA-500 microprocessor-controlled graphite furnace, AS-40 autosampler, microcomputer data station allowing transfer to CAA atomic spectroscopy main data system, and printer.

- Two (2) Perkin Elmer 2380 Atomic Absorption Spectrophotometers with deuterium arc background correction. Equipped for use with hollow cathode or EDL sources, HGA-400 microprocessor-controlled graphite furnace and AS-40 autosampler. Dedicated microcomputers for data reduction and transfer to CAA atomic spectroscopy data system.

- Nippon Jarrell-Ash HYD-1 hydride generator.

- SpectroProducts Hg-3 mercury analyzer.

- CAA Designed Atomic Spectroscopy Data Management System operating on an IBM PC-AT computer. Data is transferred from microcomputers dedicated to each instrument, to the PC-AT where it is stored and processed. Data is screened for compliance with QC limits and reported in a number of formats including EPA Contract Laboratory Program (CLP) format, or direct transfer to CAA's main laboratory automation system (SAM).

Optical Spectroscopy

- Beckman Model 25 UV-Visible spectrophotometer.
- Sequioa-Turner Model 340 UV-Visible spectrophotometer.
- Varian 635D Ultraviolet/Visible Scanning Spectrophotometer.

High Performance Liquid Chromatography

- Two (2) Beckman Model 336 Gradient HPLC systems with variable wavelength UV and fluorescence detectors, Model 504 Autosampler and Model 427 data systems.
- Three (3) Spectra Physics 740 pumps, three (3) 714 pressure monitors, 744 solvent programmer, and two (2) Rheodyne 7125 injectors.
- Spectra Physics Model 770 variable wavelength UV detector.
- Spectra Physics Model 230 dual wavelength UV detector.
- Waters HPLC system including two Model 510 pumps, Model 45 pump, WISP autosampler, automated gradient controller, Model 490 programmable multi-wavelength detector, system interface module and Waters data system.

Other Instruments

- Perkin Elmer Corporation Model 1310 Infrared Spectrophotometer.
- Xertex-Dohrmann DC-80 Total Organic Carbon analyzer using the UV-Peroxide/IR method.
- Dionex QIC ion chromatograph.
- Technicon AutoAnalyzer II with autosampler and automated distillation apparatus.
- Berthoid Tracemaster 20 automatic thin layer chromatography analyzer.
- Oceanography International Corporation Model 254 total organic carbon analyzer with both direct injection and sealed ampule sample introduction system.
- Pensky-Martens Flashpoint tester.
- Wheaton Dissolved Oxygen/BOD System.
- Selected Ion Electrodes and Meters.

Laboratory Management System

- Radian Sample and Analysis Management (SAM) system running on a local area network of IBM PCs using IBM's PC network. The system is currently configured with 25 network terminals, 300 MB of on-line storage, 2 HP "laserjet" batch printers, 5 terminal printers and Hayes modem for data transfer and remote system access. Analytical data may be input directly from the Atomic Spectroscopy Data System and GC/MS data systems.

Attachment 2

Standard Operating Procedures
for the
Hellertown, PA RI/FS Project

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January 13, 1989