Remedial Investigation Work Plan
For:
Van Raalte Knitting Mill
Saratoga, New York 12866
NYS-DEC Site No. 54036

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Remedial Investigation
Work Plan

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1. INTRODUCTION

In March 1993, an Order on Consent (Index No A5-0310-93-11) between FFF Liquidation Trust and the New York Department of Environmental Conservation was executed, stipulating the preparation of a Work Plan for Remedial Investigation (RI) Study at the Van Raalte Knitting Mill site in Saratoga, NY.

This Remedial Investigation (RI) was developed in accordance with those technical requirements setforth within the NYDEC Consent Order (Index # A5-0310-93-11). A RI is a process to characterize the nature and extent of risks posed by a specific inactive hazardous waste site.

The subject site that this RI Work Plan addresses is the "Van Raalte Knitting Mill", that is classified as an "Inactive Hazardous Waste Disposal Site", as that term is defined in ECL 27-1301.2.

In September of 1992, the site owner entered into an Order on Consent with the NYSDEC for the performance of an Preliminary Site Assessment (PSA) whereby the site owner agreed to gather data to allow the NYSDEC to characterize hazardous wastes which may now be present at the Site and to enable the NYDEC to determine whether such wastes constitute a significant threat to public health or the environment.

Based upon a wide range of information presented, excluding the PCB problem of building interior surfaces (which is being addressed through Consent Order A5-0299-93-03 dated March 31, 1993), the conclusions of the PSA found that there were, as site conditions were known at that time and as of today, three (3) additional environmental concerns associated with the property, namely:

1. The existence of an underground storage tank outside the building which was supposedly identified and sampled by a previous survey, but could not be confirmed during the following-up site visits.

2. The existence of hazardous sludge material (due to RCRA reactivity criteria) located in a water filled subgrade vault within the building's Jet Dry Room.

3. The potential migration routes of PCB contaminated materials from within the building to areas outside the building, including the surface soils outside building's waste oil room and a suspected subgrade conduit that may have been contaminated via a connection to the building's transformer room "pit".

Based upon all the information presented within the PSA, it is important to note that the environmental concerns noted above are the only remaining environmental concerns associated with the property, and in addition, the presence of identified contamination within these areas is fairly well defined and isolated to those specific areas identified. In respect to the sludge material located within the building Jet Dry Room's vault cavity, the material was observed in only one (1) localized area within the cavity and is presumed to be isolated from other areas of the site (i.e. groundwater, site soils) due to the fact the sludge lies within a concrete floor surface which thereby prevents direct contact with the groundwater or site soils. In respect to the contaminated surface soils located outside the building's Waste Oil room, preliminary sampling results (as included within this RI Workplan) indicate the extent of contamination is defined vertically to the upper six inches of soil.

This RI Workplan addresses the three (3) additional environmental concerns concluded by the PSA; environmental concerns as they relate to PCB contamination of building interior surfaces is addressed through a separate NYSDEC Consent Order, and therefore is not addressed within this RI Workplan.

1.1 Property Description

The Van Raalte Knitting Mill site is located at the east corner parcel of High Rock and Excelsior Avenues (Section 166.37, Block 1, Lot #28) in Village of Saratoga, County of Saratoga, New York 12866.

Site Topography, Environmental Setting and Hydrogeology have been thoroughly documented by previous work plans pertaining to the site and are not reintroduced here. Beneath the mill site are Deerfield soils that characteristically display a high permeability (surface drainage K=0.6 to 20 in./hr). This permeability and the near stream-level condition assure water abundance at shallow elevations.

Loughberry Lake (from which Saratoga Springs receives drinking water) is located 2500 feet northeast. This is the only aboveground drinking source for Saratoga Springs except Old Red Spring (an artesian spring), 300 feet east of Van Raalte. Another spring, High Rock Spring, is 500 feet south of the site.

Figure 1 shows the location of the site within the Village of Saratoga. Figure 2 shows the property and vicinity. Figure 3 depicts the various areas of concerned to be addressed by this RI.

1.2 Site History

In 1987, the Van Raalte Knitting Mill liquidated all its assets into F.F.F. Industries, Inc., Common Shareholders Liquidation Trust. Contamination of the site with Polychlorinated Biphenols (PCBs) was suspected when the site was being considered for condominium development during 1986 and contemplated by the owner. The New York State Department of Environmental Conservation (NYC DEC) and Department of Health (DOH) inspected the site during January of 1987 and subsequently recommended a number of actions be conducted to address potential contamination at the site. Items identified by the Department needing attention included 1) removal of electrical equipment and cleaning and testing the underlying building floor for PCBs, 2) the sludge and concrete floor in the tunnel under the building's Transformer Room, 3) cleaning of the floor in the building's Waste Oil Room and Compressor Room, 4) testing of oils in the knitting machines in order to properly salvage the machines, 5) cleaning of the floor underlying the knitting machines, and 6) removal and proper disposal of drums of oil and wastes with concentration levels of PCBs in excess of 50 parts per million.

During May of 1987 the site owner arranged for samples to be taken from a number of areas throughout the mill for PCBs as discussed with NYS-DEC and DOH. 107 Samples were taken, 65% of which contained detected levels of PCBs. Several of the PCB levels from the oil drums were high enough to meet the definition of hazardous wastes, and several areas within the building contained PCB contaminated oil and sludges spilled upon structure surfaces.

On October 21, 1991, DEC initiated a response action to address hazardous materials contained inside the facility. Seventy-five 55 gallons drums and nineteen other smaller containers were inventoried and sampled to determine whether or not their contents were hazardous. By November 1992, the site owner arranged for the remaining hazardous and non-hazardous (including oil products) drummed waste materials identified in the building were effectively removed, transported and disposed of in a safe and legal manner.

By December 1993, the NYS-DEC approved an Interim Remedial Measures (IRM) Work Plan that addressed the direct mitigation of PCB contamination within the building's interior surface areas.

Starting in December, 1993 and continuing through June , 1994, building interior surfaces (previously characterized to be PCB contaminated) were remediated via gross removal sweeping and fine cleaning power washing methods. As part of this work building interior wipe samples collected from the areas of remediation showed an substantial lowering of residual PCB contamination within the work and, in addition, based upon samples collected from the entire facility, the PCB contamination was limited to those rooms previously identified. Based upon these test, the site owner will be petitioning the NYSDEC that the site has met the established cleanup objective.

By August, 1995, all generated wastes (PCB contaminated floor/wall sweeping, floor wood strips and floor/wall washwater) were removed from the site, transported and disposed of in a safe and legal manner.

1.3 RI Workplan Approach

The field investigation proposed in this RI Workplan will attempt to delineate and characterize the contamination completely to ensure each area of concern is properly investigated. In association with these field investigation objectives, specific remediation work activities (i.e., sludge removal, soils removal) will be done to effectively manage the remediation of known contaminated materials. At this time, it is not anticipated that any new contaminated areas will be identified during RI activities. If new contaminated areas are found, there may be a need for a RI second phase.

2. TASK PLAN FOR REMEDIAL INVESTIGATION

The task plan elements for the RI correspond to Task 1 through 10 as described in the USEPA Guidance for RI / FS Under CERCLA (USEPA, 1988). The need for Task 7 (Treatability Study/Pilot Testing), as well as, Tasks 12, 13, 14, and 15 (e.g., Response Action Planning) are not applicable or anticipated at this time and therefore are not included. As the remedial alternatives associated with the RI are limited, the need for a feasibility study will not be necessary. The remediation activities that are planned to proceed concurrently with the RI include building cavity sludge removal and exterior surface soil removal which will be done through simple hand tool methods.

The following tasks are considered to be part of the RI:

- Task 1 - Project Planning
- Task 2 - Community Relations
- Task 3 - Field Investigations
- Task 4 - Sample Analyses/Validation
- Task 5 - Data Evaluation
- Task 6 - Risk Assessment
- Task 7 - Remedial Investigation Report

2.1 Task 1 - Project Planning

This task involves several subtasks which are performed in order to produce the project planning documents and project schedule necessary to execute the RI.

The Sampling and Analyses Plan (Section 3) includes information on the site background, sampling objectives, sample locations and frequency with maps, sample designation, sampling equipment and procedures and sampling handling and analysis.

The Quality Assurance and Quality Control (QA/QC) Plan (Section 4) was prepared with guidance with the following EPA publications:

- Test Methods for Evaluating Solid Waste (SW-846) (most recent version)
- Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, (USEPA QAMS-005-80)
- Guidance for Preparation of Combined Work/Quality Assurance Project Plans for Environmental Monitoring (USEPA Office of Water Regulations and Standards, May 1984)

Chain-of-Custody procedures are detailed in the QA/QC Plan in accordance with:

- National Enforcement Investigations Center Policies and Procedures Manual (revised November, 1984)
- National Enforcement Investigation Center Manual for the Evidence Audit (September 1981 and in SW-846)

Accredited Laboratories Inc. (NYS Certification No. 11109) has been proposed as the laboratory to perform all analytical services. Accredited is NYSDOH ELAP certified for CLP (or equivalent QA/QC program) and the method being proposed for analyses. Accredited shall maintain certification throughout the project. Accredited will follow EPA Methods, specifically those listed in:

- Contract Lab Program Statement of Work for Inorganic Analysis
- Contract Lab Program Statement of Work for Organic Analysis (dated February 1988 or updated)

In addition, all analyses will be done in accordance with the NYSDEC Analytical Service Protocols (ASP).

The HASP (Attachment 1) will include site specific information, a hazard assessment, training requirements, monitoring procedures for site operations, safety and disposal procedures for field activities and other requirements in accordance with 29 CFR Section 1910.120, OSHA Hazardous Waste Operations Standards and the EPA Guidance Document, Standard Operating Safety Guides (OSWER, 1988).

2.2 Task 2- Community Relations - Citizen Participation

Personnel, services, materials, and equipment will be provided to assist the New York State DEC and the New York State Department of Health in undertaking a community relations program. This program will be integrated closely with all remedial investigation activities to ensure community understanding of actions being taken and to obtain community input on RI progress.

A Citizens Participation Plan was prepared (Attachment 2) that prescribes how Citizens can be involved in the process based on interviews with community representatives and leaders. The Citizens Participation Plan describes the types of information to be provided to the public and outlines the opportunities for community comment and input during RI.

2.3 Task 3 - Field Investigation

2.3.1 Objectives

The primary objective of the RI is to define and characterize the nature and extent of site-related contamination. At this time, it is not anticipated that any new contaminated areas will be identified during RI activities. If new contaminated areas are found, there may be a need for a RI second phase.

2.3.2 Approach

The RI field investigation has been initiated through the development of this Work Plan. Available site information has been collected and reviewed. This information review has formed the basis for the preliminary evaluation of risk and discussion of the preliminary remedial alternatives.

2.4 Task 4 - Sample Analyses/Validation

A data management system was developed to include sample management and tracking procedures, and document control and inventory procedures for both laboratory data and field measurements to ensure that the data collected during the investigation is of adequate quality and quantity to support the objectives of the field investigation. Data collected shall be validated at the appropriate laboratory QC level to determine if it is appropriate for its intended use. The information obtained from this task will be incorporated into the RI report. In addition to the laboratory QC checks, a 3rd party data validator shall be contracted to provide an additional independent level of QC check. The proposed data validator is B.V. Rao of Groundwater Science and Environmental Technology, Inc. of Saddle River, New Jersey (see Appendix B for his qualifications).

2.5 Task 5 - Data Evaluation

All site investigation data will be analyzed and results of analyses, will be presented in logical manner so that an adequate interpretation of each media is apparent. A summary will be provided to include (1) the quantities and concentration of specific chemicals at the site; (2) the number, locations, and types of nearby populations and activities; and (3) the potential transport mechanism and the expected fate of the contaminant in the environment.

The assigned Quality Assurance Officer (see Appendix B) is responsible for developing a data usability report.

2.6 Task 6 - Risk Assessment

A Risk Assessment will be conducted to assess the potential human health and environmental risks posed by the site in the absence of any remedial action. This will involve three components:

1. Contaminant Identification
2. Exposure Assessment
3. Risk Characterization

A risk assessment will not be required if the site model proves to be correct. Specifically, it is anticipated that no new contaminated areas will be found during RI activities addressed under this consent order. A risk assessment will be required only if new contaminated areas are found.

2.7 Task 7 - Remedial Investigation Report

Monthly reports will be generated describing the progress at the site. Each month the following items will be reported:

- Status of work and progress to date
- Percentage of the work completed and the status of the schedule
- Difficulties encountered and corrective actions to be taken
- The activities in progress
- Activities planned for the next reporting period
- Any changes in project personnel

Monthly reports will be submitted to the New York State DEC as specified in the Order of Consent. In addition, activities conducted as well as conclusions drawn during the Remedial Investigation will be documented in the RI Report. The RI report shall be a stand along document that pulls all information collected during the RI together and resolves all issues.

3. SAMPLING AND ANALYSES PLAN

As stated previously, each area of concern has been already characterized, this SAP uses this information to evaluate each.

3.1 Field Sampling Plan

3.1.1 Site Reconnaissance Survey/Unidentified Underground Storage Tank

In June, 1994, P.T.&L. performed a magnetometer survey (with a representative of NYDEC) to locate the previously unidentified UST. The only observable possible subsurface metal detection was found east of the concrete loading dock, beyond the fence line.

It is proposed that test pits be conducted in the area. If a UST is found, work will cease and the proper notifications shall be made. However, if no underground storage tank is found, no further action is warranted.

If the exploratory excavation indicate the presence of subsurface soil contamination, such materials will be excavated and staged for proper classification pursuant to NYSDEC Guidelines. It is possible that the installation of deep boring and a groundwater monitoring well shall be considered as part of a second phase of the RI.

3.1.2 Jet Dry Room Water and Sludge

Currently there is approximately 30,000 to 40,000 gallons of water and a small quantity of sludge material present within a totally enclosed subfloor cavity located within the Jet Dry Room. The site diagram provided in Figure 4 depicts these cavities. According to information provided by the site owner, the water was used as coolant for vicinity process machinery. The origin of the sludge material cannot be confirmed; the sludge is most likely to be the dye material that was formerly used in this room, however, the dye applying machine was reported to be self containing when in use. Since only a very localized area was observed to contain the sludge material, it is likely the material was accidentally deposited when the machinery was decommissioned and taken out of the facility.

Previous Surveys

Most recent sampling of the waste water and sludge material have been done and are provided in Attachment 3. As noted samples of water (Aqueous sample #9313043 and #9313044) were analyzed for PCB's and Volatile Organics. Samples of sludge material (sample #9313042) was analyzed for PCB's, Volatile Organics, TCLP complete and RCRA characteristic. Sampling locations are illustrated on the accompanied site diagram (Figure 4).

3.1.2.1 *Sludge*

The sludge materials exhibit PCB and Volatile Organic contamination at levels of 15,100 parts per billion (ppb) and 1866 ppb respectively.

Sampling suggests that this material, in accordance with 6 NY CRR 371, is a hazardous waste due to reactivity.

To the extent possible, bulk materials shall be removed (through the use of hand tools), placed into a drum, and then profiled appropriately for proper disposal.

3.1.2.2 *Water*

Aqueous samples illustrated non detectable levels of PCB's and Volatile Organics.

As the provided sampling data reports, the water is considered "non-contaminated" and as such will not require an NYSDEC approval for discharge excepting that a local approval will be required for discharge to a sanitary or stormwater outlet. The quantification limit of PCB for the purpose of discharge to surface water is low enough to verify a discharge limit of 0.65 ug/L.

3.1.3 Potential PCB Migration Routes

Background Information

The most predominant source of the PCB contamination seems to be originating from the Transformer Room, Waste Oil Room and Compressor Room where PCB-contaminated fluids leaked unknown quantities from capacitors, transformers, drums and machinery onto building interior structure and surfaces. Within the Waste Oil Room and Transformer Room areas, the following aspects for potential routes for contaminant migration were observed.

The Transformer Room Tunnel Pit Space has been observed to fill with water and empty through intake and outlet pipes. No water was reported flowing through the pit, but evidence exists to suggest flushing occurred. There is no information to document where the water that might have flushed the pit went, but it is suspected that groundwater or the bricklined subsurface sewer line that transverses the property may have been the final deposition area.

In respect to the bricklined sewer, P.T.&L. was able to obtain representative sampling data (collected July, 1991), provided by Atlantic Environmental Services of Colchester, Connecticut, of liquid material found within the subject sewer located downgradient of the Van Raalte Knitting Mill. This sampling was conducted in association with the environmental site investigation project for the adjacent Niagara Mohawk property (an EPA classified potential Superfund site). [1] The sampling included low as well as high flows conditions. The results of this sampling indicate no presence of PCBs, nor the vast majority of other Target Compound list compounds (See Appendix C). By these results, it can be interpreted that the Van Raalte Knitting Mill Property is not a source of contamination of liquid materials found within the brick lined sewer. Based upon the results, PCB contaminated oils/sludges that were introduced to the Mill's Transformer's Room Pit are likely not to have entered the bricklined sewer.

The Waste Oil room contains a small gutter which runs near the sides and into a sump near the northeast corner of the room. There is an inactive pump in the sump, with pipes leading through the wall and outside. An

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[1] **The Niagara Mohawk site, according to a EPA written Consent Order, has identified soil and groundwater contamination. The contamination includes volatile organic compounds, PCBs, polycyclic aromatic hydrocarbons and metals.**

outlet pipe originating from the sump may have deposited PCB contaminated materials to soils immediately beneath the outlet pipe (exterior of the building).

Previous Survey

Transformer Room Pit

In June 1994, a video inspection and tracer dye test was made within the area. The video inspection was not successful due to the inaccessibility of even the smallest of cameras; the passage was determined to be less than 4 inches in diameter and changed directions approximately once per every 2 foot vertical. The results of the tracer dye tests did not indicate flow into any of the municipal sewer systems (including the brick lined sewer which runs underneath the building) or storm water runoff systems surrounding the facility. The check points observed are shown in Figure 5.

Building Exterior Surface Soil

In June 1994, two (2) surface soil samples (0-6" depth) were collected from the area. Two (2) additional samples were collected from the 6"-12" interval.

Chemical analyses included PCB's, Total Petroleum Hydrocarbon (TPHC), Priority Pollutant Volatile (VOA+10), and Priority Pollutant Semi-Volatile (BN+15). The results of the chemical analysis is provided within Attachment 4.

Volatile Organics were detected in the analyses, however at levels that do not present a concern, Semi-Volatile Organics and PCBs were also detected and are elevated to where concern would arise with respect to contamination in the soil. A summary table of the results is presented in Table 1.

3.1.3.1 Proposed Further Investigation/Remedial Actions

Building Exterior Surface Soil

It is proposed that hand excavation be performed in the area immediately in the vicinity of the building's waste oil room outlet pipe (to a 1 foot depth). The excavated soils shall then be placed into a drum(s) and then sampled for waste classification and final off-site disposal.

In order to verify that all contaminated soils will be removed, horizontal and vertical soil sampling shall be conducted within the excavation area. One soil sample shall be collected for every 25 square feet of the bottom of the excavation; two (2) surface soil samples (0-6") shall be collected from each excavation side wall. All samples shall be tested for PCBs and Semi-Volatile Organic compounds.

If subsurface soil sampling indicates the presence of contamination, deep borings and groundwater monitoring well installation shall be considered as part of an second phase to the remedial investigation.

Transformer Room Pit

Given that the pit's outlet pipe is inaccessible and that dye tests conducted within the brick sewer ("down gradient") from the outlet pipe do not show a connection to the sewer, no further action is proposed.

4.0 QUALITY ASSURANCE / QUALITY CONTROL OBJECTIVES

The overall QA objective is to develop and implement procedures for field measurements, sampling and analytical testing that will provide data of known quality that is consistent with the intended use of the information. This section defines the Data Quality Objectives by (1) describing the use of the data; (2) specifying the applicable QC effort (field checks and analytical levels), and (3) defining the QC objectives (data quality acceptance criteria).

4.1 Data Usage and Requirements

The field measurements and laboratory analyses will be used to fulfill the objectives of the investigation detailed in the Work Plan. The types and means of data collection have been tailored to the intended uses of the data. These range from qualitative information (based on field observations) to highly sensitive laboratory analyses.

Data quality is measured by how well the data meet the quality goals of the project. Quality control elements include accuracy, precision, sensitivity, representatives, and completeness. For this project, data are required to be sensitive enough to achieve detection levels low enough for meaningful use of the data.

4.2 Level of Quality Control Effort

The field team will make use of a number of different types of QC check samples to ensure and document the integrity of the sampling and sample laboratory handling procedures and the validity of the measurement data.

The laboratory will utilize standard levels of QC effort to provide data of known and defensible quality. The data quality elements which will be checked and documented include precision, accuracy, representativeness, comparability and completeness.

The USEPA has developed a standard series of analytical support levels to denote types of analysis and the associated level of QC effort. These are:

Level 1: Field screening or analysis using portable instruments.
Level 2: Field analyses using more sophisticated instruments.
Level 3: Standard USEPA methodology.

The analytical support levels which will be used to generate the project data are detailed below and fall within Levels 1, 2, and 3.

Table 1

Objective	Sample Type	Method	Support Level
Soil Investigation	Bulk	SW846-8080[1]	3
		EPA Method 625/8270	3
		EPA Method 625/8240	3
Waste Classification	-	As Applicable	1, 2, 3

[1] All samples shall be delivered to the laboratory within 24 to 48 hours from the time of collection and the holding time is 5 days for extraction, 40 days for analysis for PCB analysis. Method can be modified for PCB analysis only with Decachlorophenyl as the surrogate compound.

All analyses will be done in accordance with the NYSDEC Analytical Service Protocols (ASPs).

4.3 Data Quality Acceptance Criteria

All data shall be reported in a clear, concise and comprehensive manner. Instrument calibration, field data, holding times, preservation and sample transport are other QA elements that are important to the project. Within this manual, analytical parameters, methods/protocols are discussed in detail. All applicable methods, parameters and maximum detection limits as well as the required sample containers, sample preservation methods, shipping means and sample holding times shall be summarized.

4.4 Sampling Procedures

Bulk samples and waste classification samples will be collected in accordance with the standard project SOPs as detailed in the Work Plan.

The SOPs specify detailed step by step protocols for sampling collection and address as appropriate:

- Selection of sampling locations.
- Use of sampling equipment.
- Pre-sampling requirements (if applicable)
- Field screening procedures.
- Performance of field analyses.

4.4.1 Chain of Custody Forms

A chain of custody will be maintained for each sample collected. The chain of custody will provide an accurate written record which can be used to trace the possession and holding of samples from collection through analysis and reporting. The procedures will be followed to provide the chain of custody in the field from sample collection through shipment to the laboratory (including sample preservation) are specified in the work plan. The procedures which will be followed to provide the chain of custody in the field from sample collection through shipment to the laboratory (including sample preservation) are specified in the work plan. The procedures will be used to continue the chain of custody for each sample from its arrival in the laboratory through analysis and reporting will be specified in the laboratory QAPP. The project samples will be retained by the laboratory until the holding times are exceeded, or until permission to discard is received.

4.5 Data Reduction, Validation and Reporting

Data reduction, validation and reporting are basic steps in the control and processing of the project data generated in the field and by the laboratory. The data validation process will consist of a systematic review of the analytical results and QC documentation.

On the basis of this review, the data validator will make judgments and express concerns and comments on the quality and limitations of specific data, as well as on the validity of the overall data package. The data validator will prepare documentation of his or her review and conclusions to summarize the overall deficiencies requiring attention, as well as a general laboratory performance.

The data validator will inform the project manager of data quality and limitations, and assist the project manager in interacting with the laboratory to correct data omissions and deficiencies. The laboratory may be required to rerun or resubmit data depending on the extent of the deficiencies, and their importance in meeting the data quality objectives within the overall context of the project.

The validated laboratory data will be reduced into a computerized tabulation, and will be designed to facilitate comparison and evaluation of the data. The data tabulations will be sorted by classes of constituents and by sample matrix. Each individual table will present the following information.

- Sample Matrix, designations, and locations.
- Sample data.
- Constituents for which positive results were obtained.
- Reported constituent concentrations in the field and/or trip blanks associated with the samples.
- constituent concentration units.
- Name and location of laboratory which performed the analyses.
- Data Qualifiers provided by the laboratory.
- Data qualifiers and comments provided by the data validator, if any.

The laboratory-provided data qualifiers will include such items as (1) estimated concentration which is below the required detection limit, (2) estimated concentration due to poor spike recovery, and (3) concentration of constituent was also found in method blank. Additional comments by the data validator will be addressed if the data is (1) useable as a quantitative concentration, (2) useable with caution as an estimated concentration. or (3) unusable due to poor QC.

The analytical data tables will be used as the basis for data interpretation, and will be checked for completeness and accuracy of translation against the original laboratory data packages prior to use by and independent reviewer. The analytical data tables will be incorporated into the main body of the report, and the full laboratory data packages including the chain of custody record will be bound and appended.

Note: The reporting (site specific reporting) and deliverables from the analytical lab for method 8080 should conform to Category B from NYS DEC ASP 91-3.

4.6 Internal Quality Control

Field QC checks will be performed by the field supervisor under the project manager. The field supervisor will make use of a number of different types of QC samples to ensure and document the integrity of the sampling and sampling handling procedures and the validity of the measurement data.

For Quality Control purposes, field blank samples shall be collected at an rate of 10% of the total number of soil samples collected.

Internal laboratory QC checks will be performed by the analytical laboratory subcontractor. The laboratory will make use of a number of different types of QC samples to ensure and document the generation of valid analytical results for the project samples. These are:

- Blank Samples

    Preparation
    Method
    Holding
    Calibration

- Initial and continuing Calibrations
- Surrogate spikes
- Matrix spikes/analytical spikes
- Control samples
- Reagent check samples
- Sample Duplicates

4.7 Data Assessment Procedures

The laboratory generated data will be assessed for the previously identified parameters. Both quantitative and qualitative procedures will be used for these assessments.

The laboratory will calculate and report the precision, accuracy, and completeness of the analytical data. Precision will be expressed as the relative percent difference between values for duplicate samples. Accuracy will be expressed as percent recoveries for surrogate standards and matrix spike compounds. The precision and accuracy results will be compared to the prescribed QC acceptance criteria.

Completeness is expressed as the percentage of valid data, based on the total amount of data intended to be collected. The laboratory will make every effort to generate completely valid data.

The assessment of data representativeness with respect to laboratory performance will be based on the criteria that the samples were properly handled and analyzed within holding times and on the method blank results. Data comparability will be assessed based on the criterion that analyses were performed in strict adherence with NYS-DEC ASP and other standard USEPA analytical protocols.

4.8 Corrective Action

The investigation will be performed in accordance with the approved work plan, the contents of the approved Quality Control/Assurance Plan, and with the provisions of the Administrative Order. The QA program will enable problems to be identified, controlled, and corrected. Potential problems may involve non-conformance with the SOPs and/or analytical procedures established for the project, or other unforeseen difficulties. Any persons identifying an unacceptable conditions will notify the field supervisor, where applicable, and/or the project manager. The project manager will be responsible for developing and initiating appropriate corrective action and verifying that the corrective action has been effective.

Corrective actions may include repeating measurements, re-sampling and/or re-analysis of samples, and amending or adjusting project procedures. Additional work which is dependent upon an unacceptable activity will not be performed until the problem has been eliminated.

The laboratory shall maintain an internal closed-loop corrective action system.

4.9 Key Personnel

The following are the definitions of responsibilities of the key personnel involved in the project:

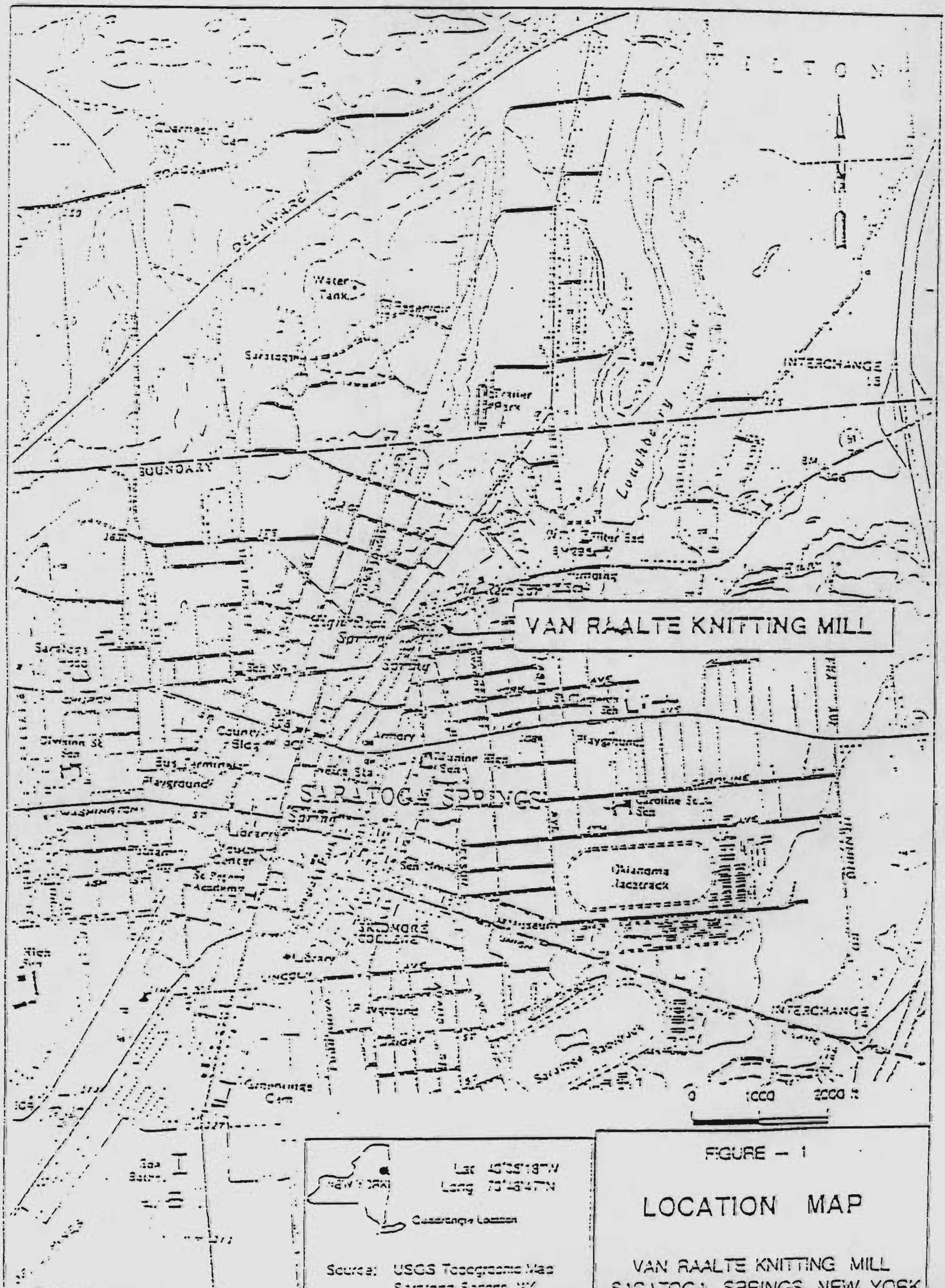
- *Project Coordinator* is responsible for overseeing the implementation of the Work Plan. To the maximum extent possible, all documents, including reports, approvals and other correspondence concerning the activities performed be directed through the project coordinator.

- *Project Manager* is responsible for adherence to the project schedules; directing, reviewing and assessing the adequacy of the performance of the technical staff assigned to the project and the subcontractors; implementing corrective action, if warranted; interaction with the project coordinator; and maintaining full and orderly project documentation. He/She is responsible for the overall technical adequacy of the investigation activities and reports, and conformance to the scope of work.
- *Project QA Manager* is responsible for providing independent review of project documents and reports. He/She is also responsible for developing the data usability report.

- *Data Validator* is responsible for review of laboratory data for compliance with the QA objectives; and notifications to the project manager of any QC deficiencies.

The names, firms, addresses and telephone numbers of the key personnel as well as the resumes of the project QA officer and the data validator for DEC review and approval are listed in Appendix B. Tasks which will be performed by subcontractors include analytical (laboratory) testing.

FIGURE 1



Lat 43°05'18"W
Long 73°48'47"N

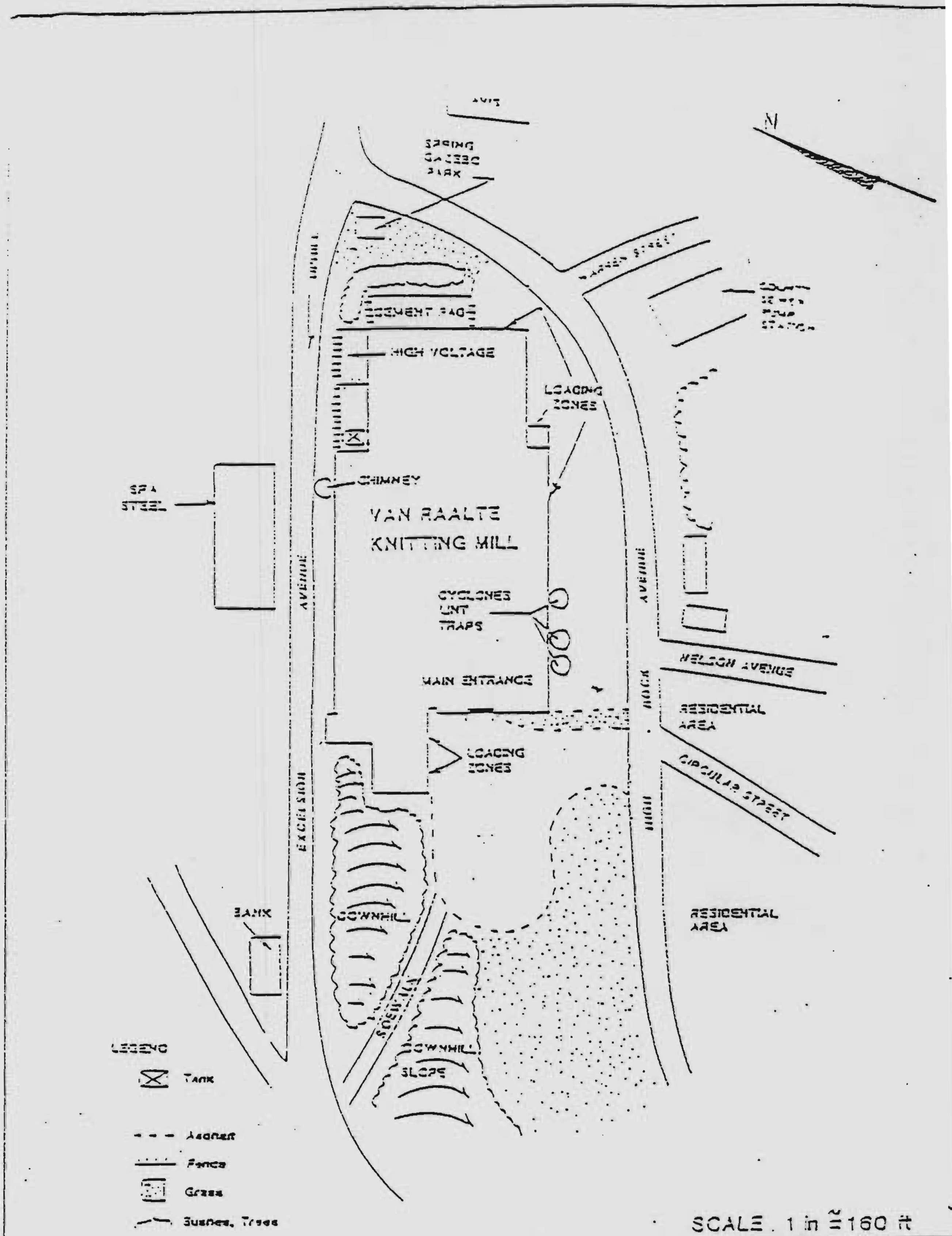
Source: USGS Topographic Map
Saratoga Springs, NY

FIGURE — 1

LOCATION MAP

VAN RAALTE KNITTING MILL
SARATOGA SPRINGS, NEW YORK

FIGURE 2



SCALE . 1 in ≅ 160 ft

FIGURE — 2

SITE PLAN

VAN RAALTE KNITTING MILL
SARATOGA SPRINGS, NEW YOR

FIGURE 3

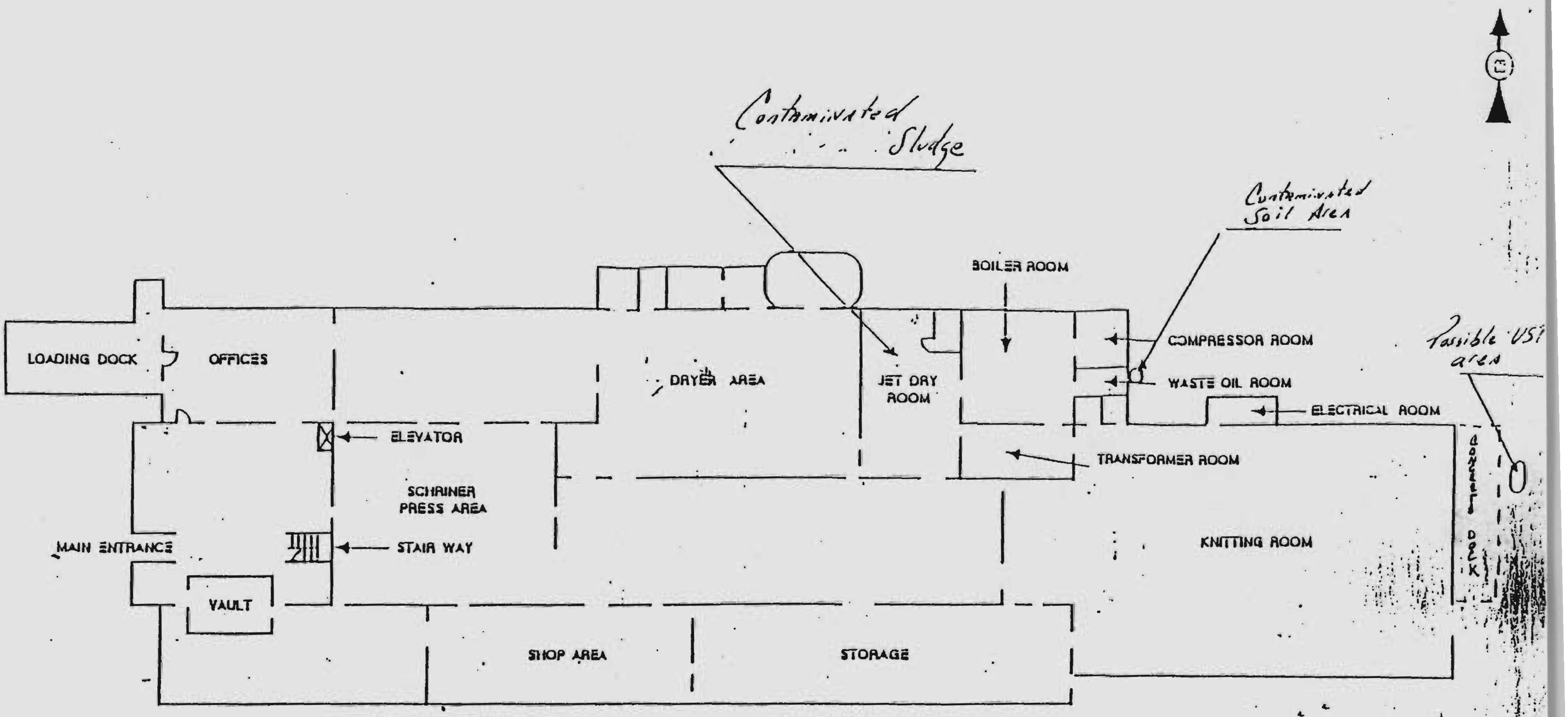


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Figure 3

BUILDING PLAN - FIRST FLOOR

VAN RAALTE KNITTING MILL
SARATOGA SPRINGS, NEW YORK

APPROX. SCALE: 1 INCH ~~= [illegible] FEET~~ | 8/4/93 | P.T.&L PROJECT # 525

NOT TO SCALE

FIGURE 4

VAN RAALTE KNITTING MILL

1ST FLOOR JET DRY ROOM AND VICINITY SUB FLOOR CAVITIES

NOT TO SCALE

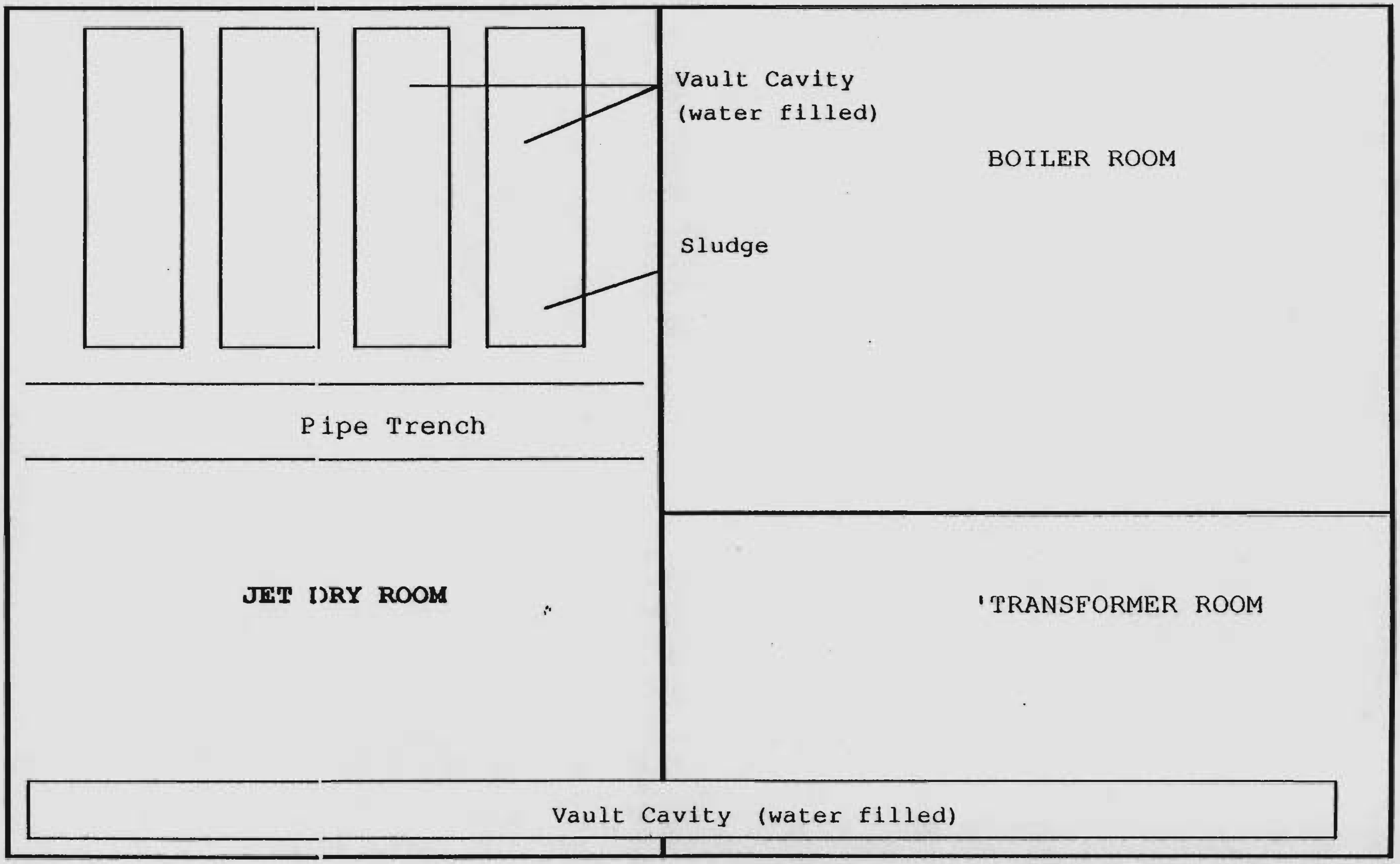

FIGURE 5

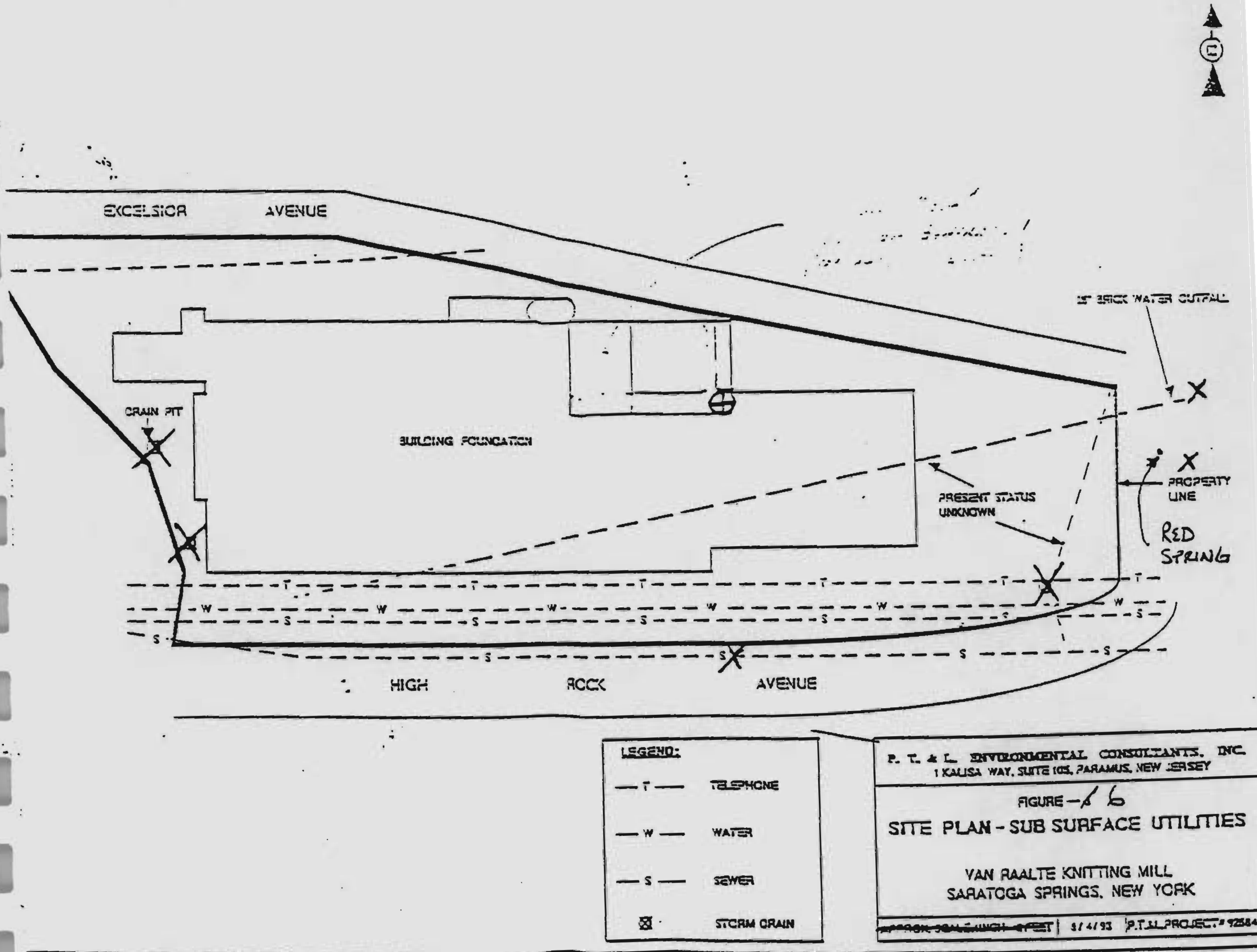

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FIGURE – 6

SITE PLAN - SUB SURFACE UTILITIES

VAN RAALTE KNITTING MILL
SARATOGA SPRINGS, NEW YORK

3/4/93 | P.T.&L. PROJECT # 9258

⊕ - TRANSFORMER ROOM PIT

X - Dye Test Check Point

TABLE 1

P.T.&L. Environmental Services

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SOIL SEMI-VOLATILE ORGANIC ANALYSIS DATA

	Field Sample ID:	29840	29841	29842	29843					New York State*
	Sample Depth (ft.):	0"	0"	6"	6"					DEC Allowable
	Sample Date:	6/24/94	6/24/94	6/24/94	6/24/94					Soil Concentration
CAS #	Compound	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)
111444	BIS (2-Chloroethyl) Ether	U	U	U	U					50,000
541731	1,3 - Dichlorobenzene	U	U	U	U					50,000
106467	1,4 - Dichlorobenzene	U	U	U	U					50,000
100516	Benzidine	U	U	U	U					50,000
95501	1,2 - Dichlorobenzene	U	U	U	U					50,000
108601	BIS (2 - Chloroisopropylether)	U	U	U	U					50,000
621647	N-Nitroso Di-n-Propylamine	U	U	U	U					50,000
67721	Hexachloroethane	U	U	U	U					50,000
98953	Nitrobenzene	U	U	U	U					2
78591	Isophorone	U	U	U	U					50,000
111911	BIS (2-Chloroethoxy) methane	U	U	U	U					50,000
120821	1,2,4 - Trichlorobenzene	U	U	U	U					50,000
91203	Naphthalene	**2900**	**6500**	**2900**	**1800**					130
106478	4-Chloroaniline	U	U	U	U					50,000
87683	Hexachlorobutadiene	U	U	U	U					50,000
91576	2-Methylnaphthalene	**750**	**1900**	**810**	**420(J)**					364
77474	Hexachlorocyclopentadiene	U	U	U	U					50,000
91587	2 - Chloronaphthalene	U	U	U	U					50,000
88744	2-Nitroaniline	U	U	U	U					4
131113	Dimethyl Phthalate	U	U	U	U					20
208968	Acenaphthylene	U	U	U	U					410
99092	3-Nitroaniline	U	U	U	U					5
606202	2,6 - Dinitrotoluene	U	U	U	U					50,000
83329	Acenaphthene	**1800**	**4300**	**2100**	**1000**					900
132649	Dibenzofuran	**2000**	**4800**	**2200**	**1100**					62
121142	2,4 - Dinitrotoluene	U	U	U	U					50,000
84662	Diethylphthalate	U	U	U	U					71

Key:	(J):	Indicates detected below MDL
	(U):	Indicates compound analyzed for but not detected
	(B):	Indicates analyte found in both the blank and sample
	(Ug/Kg):	Micrograms per Kilogram = parts per billion (ppb)
	(NSA):	No Standard Applicable

Method: EPA Method 625/8270 with a library search

*Source: Obtained from Technical and Administrative Gudance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels #4046.

Bold type denotes sample exceeds allowable soil concentration.

Client Name: FFF Common Shareholders

Project Location: Van Raalte Mill
Saratoga, New York

Project Number: 92684

P.T.&L. Environmental Services

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SOIL SEMI-VOLATILE ORGANIC ANALYSIS DATA

	Field Sample ID: Sample Depth (ft.): Sample Date:	29840 0" 6/24/94	29841 0" 6/24/94	29842 6" 6/24/94	29843 6" 6/24/94					New York State* DEC Allowable Soil Concentration
CAS #	Compound	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)
7005723	4-Chlorophenyl-Phenylether	U	U	U	U					50,000
86737	Fluorene	1900	**4200**	2100	940					3,500
100016	1,2 - diphenylhydrazine	U	U	U	U					50,000
86306	N-Nitrosodiphenylamine	U	U	U	U					50,000
101553	4-Bromophenyl-Phenylether	U	U	U	U					50,000
118741	Hexachlorobenzene	U	U	U	U					14
85018	Phenanthrene	**16000**	**17000**	**37000**	**21000**					2,200
120127	Anthracene	**990**	**5700**	**2600**	360(J)					700
84742	Di-n-Butylphthalate	U	U	U	U					81
206440	Fluoranthene	**20000**	**22000**	**43000**	5800					19,000
129000	Pyrene	16000	22000	43000	24000					66,500
85687	Butylbenzylphthalate	U	U	U	U					1,215
91941	3,3-Dichlorobenzidine	U	U	U	U					na
56553	Benzo(a) Anthracene	5600	7000	14000	**67000**					50,000
218019	Chrysene	**7400**	**10000**	**20000**	**11000**					4
117817	BIS (2-Ethylhexyl) Phthalate	U	U	680	950					4,350
117840	Di-n-Octyl Phthalate	U	U	U	U					1,200
205992	Benzo(b) Flouranthene	**8300**	**15000**	**31000**	**13000**					11
207089	Benzo(k) Flouranthene	**6800**	**8300**	**14000**	**5000**					11
50328	Benzo(a)Pyrene	**7000**	**8800**	**19000**	**10000**					110
193395	Indeno (1,2,3-cd) Pyrene	**5500**	**8700**	**17000**	**7600**					32
53703	Dibenz(a,h) Anthrcene	U	U	U	U					50,000
191242	Benzo(g,h,i) Perylene	U	U	U	U					8,000
62759	N-Nitrosodimethylamine	U	U	U	U					50,000
	Total Targeted B/N	102940	146200	251390	110670					NA
	Total Non-Targeted B/N	35980	914100	118630	73500					NA
	Total B/N+15	138920	**1060300**	370020	184170					500000

Key:	(J):	Indicates detected below MDL
	(U):	Indicates compound analyzed for but not detected
	(B):	Indicates analyte found in both the blank and sample
	(Ug/Kg):	Micrograms per Kilogram = parts per billion (ppb)
	(NSA):	No Standard Applicable

Method: EPA Method 625/8270 with a library search

*Source: Obtained from Technical and Administrative Gudance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels #4046.

Bold type denotes sample exceeds allowable soil concentration.

Client Name: FFF Common Shareholders

Project Location: Van Raalte Mill
Saratoga, New York

Project Number: 92684

P.T.&L. Environmental Services

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SOIL VOLATILE ORGANIC ANALYSIS DATA

	Field Sample ID:	29840	29841	29842	29843					New York State*
	Sample Depth (ft.):	0"	0"	6"	6"					DEC Allowable
	Sample Date:	6/24/94	6/24/94	6/24/94	6/24/94					Soil Concentration
CAS #	Compound	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)
107028	Acrolein	U	U	U	U					NSSA
107131	Acrylonitrile	U	U	U	U					NSA
74873	Chloromethane	U	U	U	U					NSA
74839	Bromomethane	U	U	U	U					NSA
75014	Vinyl Chloride	U	U	U	U					1
75003	Chloroethane	U	U	U	U					19
75092	Methylene Chloride	18	25	23	21					1
67641	Acetone	U	U	8(J)	64					1
75150	Carbon Disulfide	U	U	U	U					27
75694	Trichlorofluoromethane	U	U	U	U					NSA
75354	1,1 - Dichloroethene	U	U	U	U					4
75343	1,1 - Dichloroethane	U	U	U	U					1
156605	Trans - 1,2 - Dichloroethene	U	U	U	U					NSA
67663	Chloroform	U	U	U	U					3
107062	1,2 - Dichloroethane	U	U	U	U					1
78933	2 - Butanone	U	U	U	U					3
71556	1,1,1, - Trichloroethane	U	U	U	U					8
56235	Carbon Tetrachloride	U	U	U	U					6
108054	Vinyl Acetate	U	U	U	U					NSA
75274	Bromodichloromethane	U	U	U	U					NSA
78875	1,2 - Dichloropropane	U	U	U	U					NSA
10061015	CIS - 1,3 - Dichloropropene	U	U	U	U					NSA

Key:	(J):	Indicates detected below MDL
	(U):	Indicates compound analyzed for but not detected
	(B):	Indicates analyte found in both the blank and sample
	(Ug/Kg):	Micrograms per Kilogram = parts per billion (ppb)
	(NSA):	No Standard Applicable

Method: EPA Method 625/8270 with a library search

*Source: Obtained from Technical and Administrative Gudance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels #4046.

Client Name:	FFF Common Shareholders
Project Location:	Van Raalte Mill Saratoga, New York
Project Number:	92684

Bold type denotes sample exceeds allowable soil concentration.

P.T.&L. Environmental Services

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SOIL VOLATILE ORGANIC ANALYSIS DATA

	Field Sample ID: Sample Depth (ft.): Sample Date:	29840 0" 6/24/94	29841 0" 6/24/94	29842 6" 6/24/94	29843 6" 6/24/94					New York State* DEC Allowable Soil Concentration
CAS #	Compound	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)	(Ug/Kg)
79016	Trichloroethene	U	U	U	U					7
71432	Benzene	U	U	U	U					0.6
124481	Dibromochloromethane	U	U	U	U					NSA
79005	1,1,2 - Trichloroethane	U	U	U	U					7.6
10061026	Trans-1,3-Dichloropropene	U	U	U	U					NSA
110758	2 - Cchloroethylvinylether	U	U	U	U					NSA
75252	Bromoform	U	U	U	U					NSA
591786	2-Hexanone	U	U	U	U					NSA
108101	4 - Methyl - 2 - Pentanone	U	U	U	U					10
127184	Tetrachloroethene	U	U	U	U					14
79345	1,1,2,2 - Tetrachloroethane	U	U	U	U					6
108883	Toluene	U	U	U	U					15
108907	Chlorobenzene	U	U	U	U					17
100414	Ethylbenzene	U	U	U	U					55
100425	Styrene	U	U	U	U					NSA
1330207	M,P - Xylene	U	U	U	U					
95476	O-Xylene	U	U	U	U					12
156592	CIS - 1,2 - Dichloroethene	U	U	U	U					NSA
	Total VOA (targeted)	18	25	31	85					NA
	Total VOA (non-targeted)	38	U	U	25					NA
	Total VOA+15	56	25	31	110					10000

Key:
(J): Indicates detected below MDL
(U): Indicates compound analyzed for but not detected
(B): Indicates analyte found in both the blank and sample
(Ug/Kg): Micrograms per Kilogram = parts per billion (ppb)
(NSA): No Standard Applicable

Method: EPA Method 625/8270 with a library search

*Source: Obtained from Technical and Administrative Gudance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels #4046.

Client Name: FFF Common Shareholders

Project Location: Van Raalte Mill
Saratoga, New York

Project Number: 92684

Bold type denotes sample exceeds allowable soil concentration.

P.T.&L. Environmental Services

411 Sette Drive, Paramus, New Jersey 07652

SOIL SAMPLE ANALYSIS DATA

Field Sample ID#: **Sample Depth:** **Sample Date:**		**29840** **0"** **6/24/94**	**29841** **0"** **6/24/94**	**29842** **6"** **6/24/94**	**29843** **6"** **6/24/94**	[redacted]	**New York State** **DEC Allowable** **Soil Concentration**
POLYCHLORINATED BIPHENYS (PCBs)							
CAS#	**Compound**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	[redacted]	**ug/kg**
12674112	Aroclor 1016	U	U	U	U	[redacted]	NA
11104282	Aroclor 1221	U	U	U	U	[redacted]	NA
11141165	Aroclor 1232	U	U	U	U	[redacted]	NA
53469219	Aroclor 1242	U	U	U	U	[redacted]	NA
12672296	Aroclor 1248	U	U	U	U	[redacted]	NA
11097691	Aroclor 1254	9490	6080	6280	12900	[redacted]	NA
11096825	Aroclor 1260	2340	3630	1710	5130	[redacted]	NA
	TOTAL	11830	9710	[redacted]	[redacted]	[redacted]	1000
		[redacted]	[redacted]	7990	18030	[redacted]	10,000
TOTAL PETROLEUM HYDROCARBONS		12700	41400	9990	33300		NSA

KEY:	U:	Compound Not Detected
	NA:	Not Applicable
METHOD:	PCB:	EPA Method 8080
	TPHC:	EPA Method 418
SOURCE:	Obtained from Technical and Adminstrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels #4046.	

Client Name: FFF Common Shareholder

Project Location: Van Raalte Mill
Saratoga, New York

Project Number: 92684

SSIADSB/4-8-94

APPENDIX A

Department of Environmental Conservation

Division of Water

Sampling Guidelines & Protocols

Technological Background and Quality Control
Quality Assurance for NYSDEC Spill Response Program

September 1992

New York State Department of Environmental Conservation
MARIO M. CUOMO, Governor THOMAS C. JORLING, Commissioner

SAMPLING
GUIDELINES & PROTOCOLS

Technological Background and Quality Control/Quality Assurance For NYS DEC Spill Response Program

BUREAU OF SPILL PREVENTION AND RESPONSE

DIVISION OF WATER

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

MARCH 1991

SAMPLING GUIDELINES AND PROTOCOLS

Technological Background and Quality Control/Quality Assurance
For NYS DEC Spill Response Program

Preparer : Simon Wu
Project Manager : Tom McClane
Section Chief : Tom Plesnarski
Bureau Director : Tom Quinn

BUREAU OF SPILL PREVENTION AND RESPONSE

DIVISION OF WATER

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

MARCH 1991

3.0 SAMPLING EQUIPMENT

3.1 INTRODUCTION

This section is prepared to acquaint the spill responder with equipments which are used in soil or solid material sampling, water, slurry or liquid sampling, and air or vapor sampling. Their functions and factors which can lead to uncertainty in data quality are reviewed. The selection of proper sampling mechanisms, including equipment and material, is essential to the success of an environmental investigation and remediation. Minimally disturbed samples must be carefully collected and analyzed if the results are to have any meaning.

The ideal sampling equipment should be completely inert; economical to manufacture; easy to clean, sterilize and reuse; operable at remote sites without external power sources; and capable of delivering continuous and variable flow rates for well purging and sampling.

With few exceptions, most of the equipments discussed below may be used in the activities of spill response. The equipment is categorized according to the sample type. Selection of appropriate sampling equipments depends upon the sample type, sample reactivity, and site conditions. There is no one universal sampling equipment that can be used to adequately sample everything found in the environment.

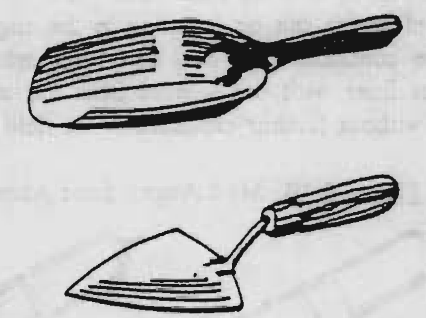
3.2 EQUIPMENT FOR SOIL, SLUDGE, SEDIMENT OR SOLID MATERIAL SAMPLING

The soil or the material to be investigated can be powder, granule, sludge or mud, or it can be clumped or aggregate, or solid and hard. To meet these conditions, different sampling equipments have been developed and used as described below.

3.2.1 Scoop/Spade/Trowel for Soil, or Powdered or Granular Solids Sampling

For surface or near surface sampling, a scoop (Figure 3-1) or spade will suffice in most applications. Care should be exercised concerning compatibility of the material to be sampled and the tool to be used such as those plated with chrome or other materials. Mason or garden trowels may be used in this sampling if they are made of the proper material, such as stainless steel. Sometimes a flat, pointed mason trowel will be helpful in cutting a block of the desired soil when undisturbed profiles are required. Polypropylene, polyethylene, and teflon may also be used to make scoops and spades.

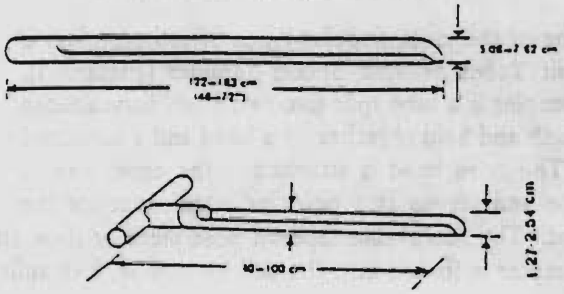
<u>Figure 3-1</u> Scoop & Trowel



3.2.2 Trier for Soil and Materials in Powder, Granule, or Sludge Forms

A typical sampling trier (Figure 3-2A) is a long tube cut in half lengthwise, extending almost the entire length of the tube. The tip and edges of the tube slot are sharpened so that the trier can be inserted into the material to be sampled and rotated to cut a core of the material. Similar in shape to the trier is a grain, powder, or thief sampler (3.2.3). It tends to have a smaller, less tapered slot, with a converged sharp point at its tip. A trier is preferred over the grain sampler when the

<u>Figure 3-2A</u> Sampling Triers



powdered or granular material to be sampled is moist or sticky.

Another modified sampler of this sort is the footstep soil sampler or Hankinson soil sampling tube (Figure 3-2B). They have been made for sub-soil probe. These modified samplers have been claimed to reach depths exceeding 15 feet.

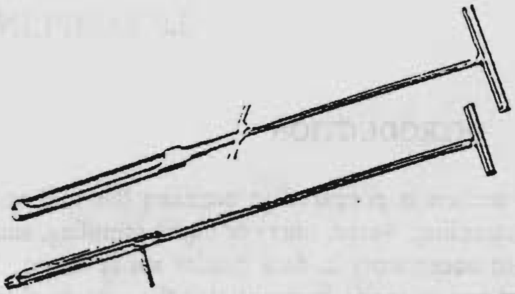
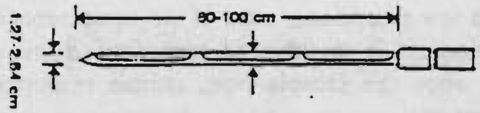


Figure 3-2B Hankinson & Footstep Soil Samplers

3.2.3 Thief Sampler for Dry Granules or Powdered Sample

A thief sampler (Figure 3-3) consists of two slotted concentric tubes, usually made of stainless steel or brass. The outer tube has a conical pointed tip that permits the sampler to penetrate the material being sampled. The inner tube is rotated to open and close the sampler. A thief sampler is useful for sampling drying granules, pellets, powdered material.

Figure 3-3 Thief Samplers



3.2.4 Hand Auger for Soil Sample

A hand auger system (Figure 3-4A) consists of an auger bit connected with a bucket type cylinder. A T-shaped handle with various lengths of extension is employed to obtain samples from different depths. Also, various designs of hand augers have been made for different soils, soft or hard. There are four different hand augers shown in Figure 3-4B, and their appropriate usages are indicated in Table 3-1. A removable liner of rigid acetate or stainless steel which can be installed in the auger to protect the sample from contamination has also been made available. By removing the liner with the sample from the auger and capping the ends of the liner, the sample can be transported without further exposure to the field environment.

Figure 3-4A Regular Hand Auger

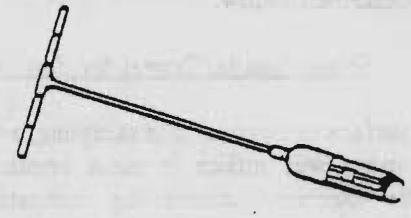
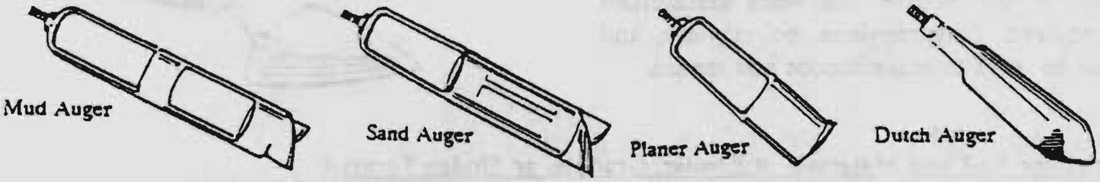


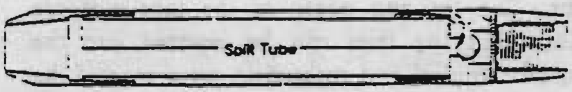
Figure 3-4B Mud Auger, Sand Auger,Planer Auger, and Dutch Auger.



3.2.5 Split-Spoon Sampler for Soil Sample

One of the most popular types of soil samplers is the Split Tubes or Split Spoon Sampler (Figure3-5). This sampler is a tube split into two equal halves along the length and held together by a head and a hardened shoe. The drive head is attached to the upper end of the tube and serves as a point or attachment for the drill rod. The removable tapered nose piece or shoe attaches to the lower end of the tube, facilitating cutting. The sampler is forced into the soil by jacking, hydraulic driving or sledge hammering.

Figure 3-5 Split Spoon Sampler



The sampler can be equipped with a ball check valve in the head which prevents the washing out of the sample as it is being hoisted from the hole. A basket-like sample retainer can also be fitted to the lower end of the tube to hold the loose, dry soil sample in the tube as it is being lifted from the hole. After being withdrawn from the hole, the sampler head and shoe are unscrewed and the sampler can be split open.

This sampler can also be designed to accommodate optional liners for collecting and delivering samples from the field to the laboratory without disturbing them.

3.2.6 Thin Wall Tube Sampler (Shelby), Hand Corer or Hand Sediment Sampler for Cohesive Type Soils and Clays, Sludges, and Sediments

3.2.6.1 Thin Wall Tube Sampler (Shelby tube) Figure 3-6A shows a piece of hard-drawn, seamless, thin wall steel tubing. One end can be attached to a drilling head and the other end to a sharpened cutting edge. The thin wall construction is for minimum disturbance to soil during sampling. It can be used to profile strata in the sample. The thin steel tube containing the sample may be removed from the sampler and used as a container for transportation to the laboratory. Similar to a split-spoon sampler, this thin wall sampler can also be equipped with a ball check valve assembly in the head to prevent the loss of the sample when it is being removed from the hole.

Figure 3-6A Thin Wall(Shelby) Tube Sampler

3.2.6.2 Hand Corer or Hand Sediment Sampler Figure 3-6B shows essentially a thin wall tube corer, which is modified by adding a handle and a check valve on top to prevent sample washout during retrieval through an overlying water layer. This sampler is for sampling sediment or sludge. Operation may be performed by hand and by use of optional extension handles. It also has the advantage of collecting a minimally disturbed sample which can profile any strata in the sample. Various liners, plastic or stainless steel, are available for minimizing sample disturbance and cross-contamination.

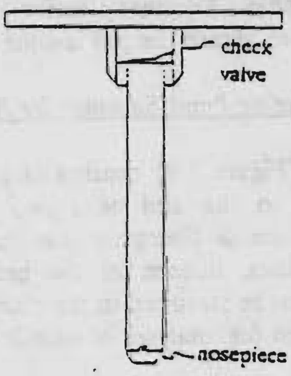
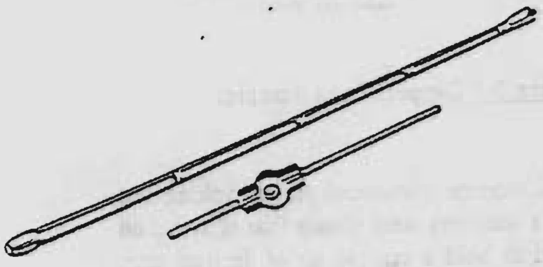


Figure 3-6B Hand Corer/Sediment Sampler

Figure 3-6C Veihmeyer Soil Sampling Tube



The Veihmeyer soil sampler(Figure 3-6C) is another tool for taking core samples. It is a tube with a larger outside diameter at the cutting end than the rest of the tube and with tube depth reference markings.

3.2.7 Sludge Getter for Sludges

This Sludge Getter (Figure 3-7) is a stainless steel grab sampler with a conical bottom cup which allows penetration into viscous or sludge type materials. In use, the six feet unit is pushed into the sludge to the desired depth. The top handle is lifted about one half inch (½") and rotated to the side, allowing the sludge material to move into the sample cup. The handle is then turned to secure the lid over the cup, the lid is locked into position, and the unit is removed from the sample spot.

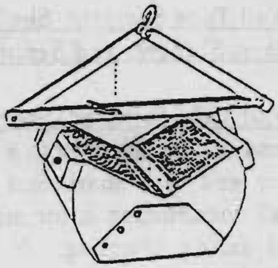
Figure 3-7 Sludge Getter

The sample can be trowled out of the cup, or a plastic cup liner can be used for allowing the sample to fall directly into the the cup liner and be removed. The unit may be washed with a solvent or cleaned with steam to decontaminate it.

3.2.8 Bottom Sampling Dredge or Ponar Grab for Sludges or Sediments

This device (Figure 3-8) is a clamshell type scoop activated by a counter lever system. The shell is opened, latched in place and slowly lowered to the bottom. When tension is released on the lowering cable, the latch releases and the lifting action of the cable on the lever system closes the clamshell. This grab type dredge is capable of sampling most types of sludges and sediments from silts to granular materials. The drawbacks for the system are that it cannot penetrate more than several centimeters and can not collect undisturbed samples.

Figure 3-8 Ponar Grab for Sludges



3.3 EQUIPMENT FOR LIQUID MATERIAL AND WATER SAMPLING

Liquids include both aqueous and nonaqueous solutions, and are subdivided as surface waters, containerized liquids, and groundwaters. Containerized liquids can be any size of sealed and unsealed containers varying from drums to large tanks. To meet a variety of situations, one should be familiar with the available tools to make a job easier and to assure the job is done properly.

3.3.1 Dipper or Pond Sampler for Surface Water

The dipper (Figure 3-9) consists of a glass or plastic beaker clamped to the end of a two or three piece telescopic aluminum or fiberglass pole that serves as the handle. Sometimes, instead of the beaker, a sample container itself can be strapped to the clamp directly. This is particularly good for analyses of volatile organics.

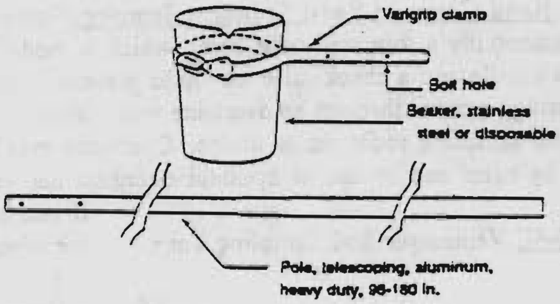
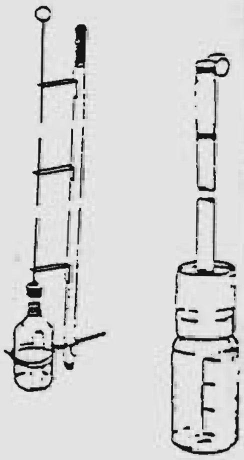


Figure 3-9 Dipper/Pond Sampler

3.3.2 Extended Bottle Sampler for Surface Water

Figure 3-10 Bottle Sampler



These bottle samplers (Figure 3-10) consist of a 6 foot long metal tube or reinforced plastic holder and a sample container. One of the designs is a stainless steel clamp that is attached to the end of the tube and can be adjusted to hold a sample jar of desired size. The jar cap can be remotely removed and replaced while the bottle is submerged by turning the handle grip rod, which is attached to the cap by means of a screw clamp or a suction cup. In the second design, the sample bottle is screwed onto the sampling head, and the sampler lowered to the desired sampling location and depth. The ring at the top is then pulled, opening the spring-loaded plunger in the head assembly and allowing liquid to flow in. When the bottle is observed to be full, the ring is released to stop liquid flow.

Since the sampler is exposed to the sampled medium, it must be decontaminated before shipment or reuse.

3.3.3 Weighted Bottle or Bacon Bomb Sampler for Surface or Well Water

The weighted Bottle Sampler (Fig.3-11, Right) consists of a glass or plastic bottle, sinker, stopper, and a line that is used to lower, raise, and open the bottle to sample liquid or free-flowing slurries. The bomb sampler (Figure 3-11 left) uses the same principle as the weighted bottle sampler. It consists of a cylindrical chamber, a line, and a removable cover. The cylindrical chamber has an internal tapered plunger that acts as a valve to admit the sample. The line attached to the top of the plunger is used to open and close the valve. The removable cover provides a point of attachment for the sample line and has a locking mechanism to keep the plunger closed after sampling. These samplers are suited for collecting viscous materials or water in storage tanks, tank cars, ponds, lagoons and wells at different depths. The material used to construct these samplers are brass, bronze, and stainless steel.

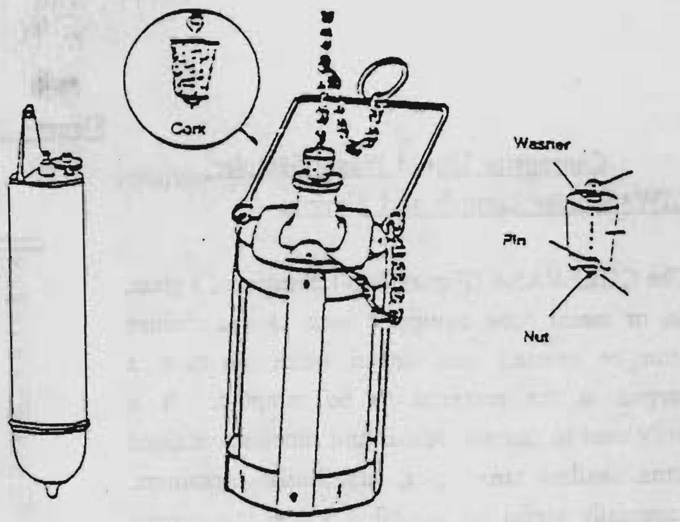


Figure 3-11 Weighted Bottle(right)/Bacon Bomb(left)Sampler

3.3.4 Suspended-Sediment Sampler for Surface Water in River or Stream

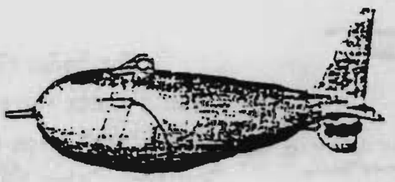


Figure 3-12 Suspended-Sediment Sampler

This sampler (Figure 3-12) contains glass or plastic sample bottle sealed in the sampler head, an intake nozzle oriented upstream for filling, and a rear port for air to escape. It samples at the vertical points of river or stream cross-sections and can continue to take its sample throughout the time of submergence, or start and stop the sampling process by an electrically operated valve in the sampler head.

3.3.5 Kemmerer Sampler for Surface and Subsurface Water

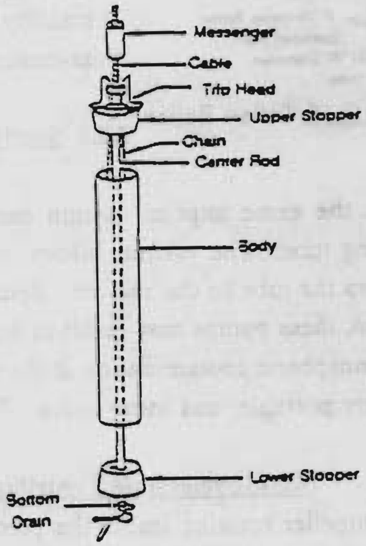


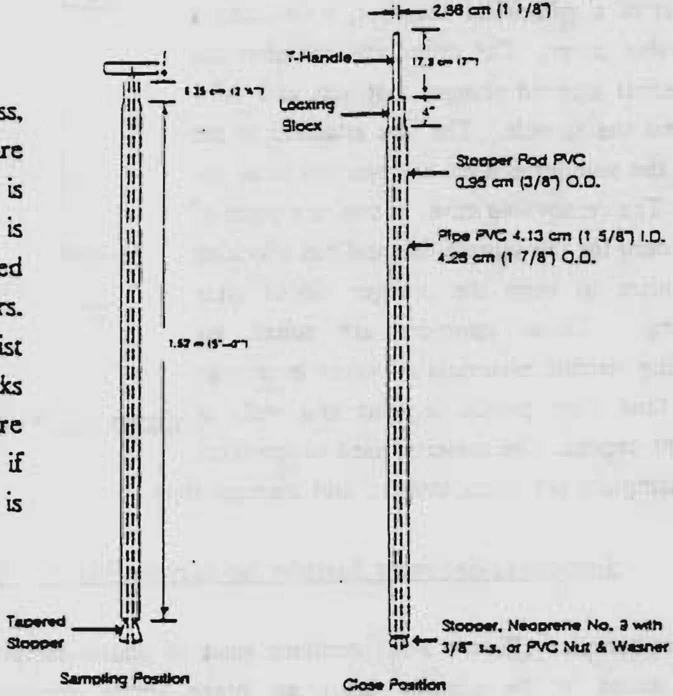
Figure 3-13 Kemmerer Sampler

The Kemmerer sampler (Figure 3-13) is a mechanically operated depth-specific sampler. It consists of a short length of tubing and each end is fitted with a spring activated rubber stopper. End stoppers are locked open before lowering the unit into the water. When the sampler reaches the desired depth, the operator activates the spring mechanism by dropping down the messenger, and the rubber stoppers are pushed against each end of the tube, thereby entrapping the liquid sample. This sampler is very practical for collecting discrete, at-depth samples from surface water or vessels where the collection depth exceeds the lifting capacity of pumps. Samples may be obtained by using the Kemmerer sampler for depths up to 300 feet. Use of the rubber stopper and spring assembly could cause bias in the analysis of trace organics and metal constituents of the sample. Selection of other assemblies, i.e. all metal for organic analysis or all plastic for trace element analysis, will avoid this problem.

3.3.6 Composite Liquid Waste Sampler (COLIWASA) for Liquids and Slurries

The COLIWASA (Figure 3-14) consists of a glass, plastic, or metal tube equipped with an end closure that can be opened and closed while the tube is submerged in the material to be sampled. It is primarily used to sample liquids and slurries contained in drums, shallow tanks, pits, and similar containers. It is especially useful for sampling wastes that consist of several immiscible liquid phases. The drawbacks associated with using a COLIWASA are decontamination and cost. The sampler is difficult, if not impossible, to decontaminate in the field, and it is a high cost apparatus.

Figure 3-14 Composite Liquid Waste Sampler (COLIWASA)



3.3.7 Bailers for Surface Water and Groundwater

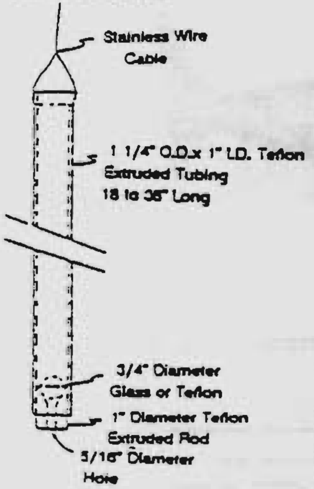


Figure 3-15 Teflon Bailer

The bailer (Figure 3-15) consists of a length of tube fitted at the bottom end with a check valve that allows liquid to flow into the tube as it is lowered into the liquid, and keeps the liquid from flowing out as the tube is brought back to the surface. Other bailers, referred to as "point source" bailers, also have a check valve at the top, which reduces the possibility of mixing the liquid sample with the liquid contained in the installation while the bailer is withdrawn. The advantages of the bailer are: 1) simple construction and economical; 2) available in a wide variety of structural materials; and 3) with minimal sample disturbance if handled carefully. Their disadvantages are: 1) aeration during transferring from bailer to sample bottle; 2) inability to collect discrete samples; 3) inefficiency with deep water table; and 4) cross-contamination from an inadequately cleaned bailer and its rope or cable.

3.3.8 Suction Lift Pumps for Liquids or Water

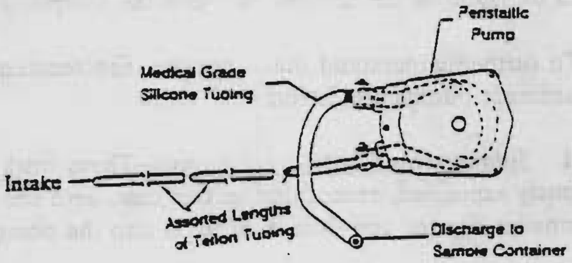
As the name implies, suction pumps are operated, generally in a low volume, by a partial vacuum in a sampling tube. The vacuum allows the pressure exerted by the atmosphere on the water in the well to force water up the tube to the surface. Because of this, the practical limit of suction lift is approximately 25 feet. In addition, these pumps may result in degassing and volatilization caused by the negative pressure that is applied, and atmospheric contamination at the surface. In spite of these drawbacks, suction pumps are readily available, relatively portable, and inexpensive. Two types of suction lift pumps are introduced below.

3.3.8.1 Non-Submersible Centrifugal Pumps--In the centrifugal pump, the fluid is displaced by the action of an impeller rotating inside the pump chamber. This discharges water by centrifugal force. The resulting pressure drop in the chamber creates a suction and causes water to enter the intake pipe or tube in the well.

These pumps can provide substantial yields, and are readily available and inexpensive.

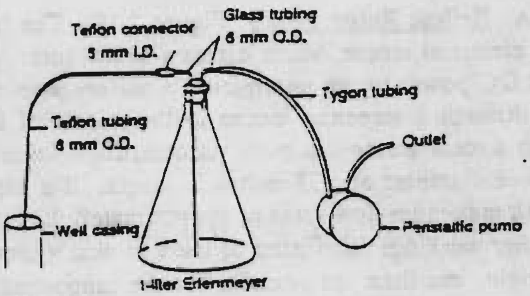
The disadvantages are that they require a foot or check valve on the end of the suction pipe to aid in maintaining a prime and may be difficult to clean between sampling events. In addition, the materials with which these pumps are constructed may frequently be incompatible with certain sample constituents.

<u>Figure 3-16</u> Peristaltic Pump



3.3.8.2 <u>Peristaltic Pumps</u> (Figure 3-16)--The major components of this apparatus are the peristaltic pump, which consists of a rotor and several ball bearing rollers within a pump head, and a flexible tubing. The peristaltic pump can be battery operated and portable for a wide range of applications in the field. Since it works by squeezing the flexible tubing which creates a vacuum and draws the water sample through the intake line, the only contact between the pump and sample is the tubing. The tubing can be easily changed to avoid cross-contamination. In addition, these pumps sample with little agitation.

<u>Figure 3-17</u> System for Grab Sampling for organics from a monitoring well



The disadvantages are: 1) low pumping rates make it difficult to evacuate the well bore in a reasonable amount of time, 2) the choice of appropriate materials for flexible tubing is restrictive. Also the commonly used silicone tubing has a propensity for absorbing many organic compounds and inert flexible tubing is not flexible enough to be used in these pumps. An alternative sampling arrangement, suggested by Scalf et al. (1981) as a method for sampling for organic contaminants, utilizes a peristaltic pump and a two-way stoppered bottle with Teflon tubing as shown in Figure 3-17.

Hand operated diaphram pumps are also available and can be used over a wide range of pumping rates, which facilitates rapid evacuation of a well bore initially and lowers the controlled pumping rate for subsequent sampling.

3.3.9 Positive Displacement Pumps for Water

Positive displacement pumps use positive pressure, generated from a pumping mechanism which is placed in the well, to drive the water from the sampling installation to ground surface. This minimizes the potential for aerating or stripping volatile organic from the sample during removal from the well. Positive displacement pumps include submersible centrifugal pumps, gear-drive pumps, gas operated submersible piston pumps, gas-squeeze pumps, and gas drive pumps. Other pumping systems such as air lift and jet pumps use positive pressure as well, but only to drive a carrier gas or fluid.

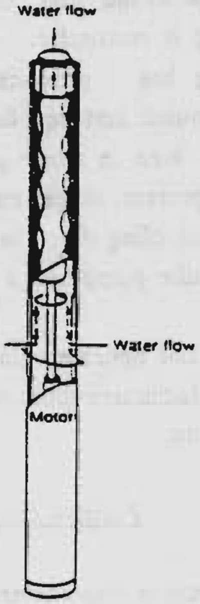
The chemical alteration produced in the water as a result of positive pressure are small compared to the alterations from negative pressure; for this reason, positive displacement pumps are commonly preferred over suction-lift pumps. In addition, positive displacement pumps can lift a sample from a depth which far exceeds the limits of suction-lift pumps and a depth at which bailers become laborious or impractical. It should also be noted that degassing occurs as a result of a decrease in pressure. Raising a sample from its natural position at a depth of a hundred or a few hundred feet and subjecting it to atmospheric pressure can mean a change in pressure of several atmospheres in a sample. Thus, although the application of positive pressure pump does not cause degassing directly, a sample would undergo a decreasing pressure as it moves up the well column and degassing could occur. Therefore, even with positive displacement techniques, for gas sensitive parameters, care should be taken in the manner in which the sample is taken from the outflow.

To further understand these positive displacement sample collection techniques, several types of positive displacement pumps are introduced below.

3.3.9.1 Submersible Centrifugal Pumps--These work in a manner similar to the centrifugal suction-lift pump previously explained, except that in this case, both the pump and electric motor are lowered into the well. As the impeller rotates and fluid is brought into the pump chamber, fluid is displaced up the well.

Until recently, most submersible centrifugal pumps were developed for or by the water well industry, and were designed for wells having a diameter of four inches or bigger. They were frequently constructed with materials and used lubricants which interfered with sample analysis, particularly of organics. At present, there are two small diameter submersible centrifugal pumps available: the helical rotar pump and the Johnson-Keck Pump.

Figure 3-18 Helical Rotor Pump



3.3.9.1A Helical Rotor Pump (Figure 3-18)--The helical rotor pump consists of a sealed electrical motor, which drives a helical rotor. An electric power cord provides 12-volt DC power to the pump from a battery pack at the surface. Water enters the pump through a screened intake in the middle of the pump and is drawn upward through a rotor-stator assembly via centrifugal force. The pump itself is 1.75 inches in outside diameter and 33 inches in length. It is capable of pumping lifts up to 125 feet with maximum flow rates of approximately 0.3 gpm. The housing is stainless steel with inner workings fabricated of inert or nearly inert materials. The pump itself is lightweight, less than ten pounds, but the supporting battery pack and hose reel are typically in excess of 50 pounds. Other disadvantages are that the pump must be cycled on and off approximately every 20 minutes to avoid overheating of the motor. It is somewhat difficult to clean between sampling events because it is moderately difficult to disassemble.

3.3.9.1B Johnson-Keck Pump--As the name implies, this pump was designed by Johnson-Keck and is for groundwater quality monitoring. It can be used in two inch diameter wells or greater, and is constructed of stainless steel and teflon. Experience with this pump is little reported; however, it appears to be a reasonably efficient means of obtaining water from depths below the limit of suction lift and with minimal disturbance to the chemical integrity of the sample. The pumping rate is such that at least for small diameter installation, it would be an adequate means of removing the standing water from the well. In some instances, degassing within the pump unit or in the outflow line may be of concern.

3.3.9.2 Submersible Gear-Drive Electric Pumps--This type of pump is made with a stainless steel body, a highly efficient electric motor, and a set of two teflon gears. The motor drives the set of teflon gears, which draws water through a fine mesh intake screen at the top of the pump. Water is drawn through the gear and pushed in a continuous stream through the discharge line to the surface for sampling. There are several different power sources for these pumps. The basic unit is factory equipped with a series of four six-volt DC rechargeable batteries. These batteries may provide power for approximately four hours of continuous operation and may be recharged overnight by using a 120-volt trickle-charger unit. For a longer duration and an increased pumping rate, these batteries may be supplemented or replaced by one of the following sources: 1) an auxiliary DC generator; 2) an auxiliary battery pack; 3) two vehicle batteries wired in parallel to provide 24-volts; or 4) an adapter unit to facilitate the use of a 120-volt AC power supply.

The only parts that should require replacement under normal field use are the teflon gears. With prolonged purging and/or sampling of water with high suspended solids, these gears may wear, which diminishes pump output. The gears are inexpensive and simple to replace. The weight of the entire system is less than 50 pounds, so it is highly portable. Reasonably high pumping rates can be achieved to depths of 150 feet, and the depth range can be extended through the use of an auxiliary power source. The disadvantages are:

1) there is no control of flow rates;
2) sampling in wells with high levels of suspended solids may require frequent replacement of gears; and
3) the potential for pressure changes produced at the drive mechanism.

3.3.9.3 Submersible Gas-Operated Piston Pumps--Pumps of this type consist of a plunger (piston) or set of plungers moving inside a stationery submerged cylinder (barrel). Another type, a reverse one, of piston pump is the traveling barrel type, in which the piston is held stationery inside a moving cylinder. Although the operating principle for both is identical, the latter type is fairly uncommon.

The cylinder, and sometimes the piston, is fitted with one-way check valves in such a way as to direct the water moved by the piston toward the surface. The pumping capacity depends on the inside diameter of the cylinder, the stroke rate of the moving piston, and the length of the stroke. Once these three parameters are fixed, the output of the pump will have little variation. The piston can be operated by means of a mechanical device or by a gas driven mechanism. Pumps driven by the mechanical device are often referred to as "rod pumps", and those powered by a gas-driven mechanism are referred to simply as "gas-operated" or gas-driven piston pumps.

Like centrifugal pumps, piston pumps, which were initially developed for water and petroleum production, and in terms of water quality monitoring, the rod pumps possess the same disadvantages as the large diameter centrifugal pumps and do not have much value that would require further elaboration here.

Two gas-operated piston pumps reviewed below are single acting and double acting piston pumps.

3.3.9.3A Single-Acting Gas Driven Piston Pumps

An example from Hillerich (1977) is given in Figure 3-19. This pump consists of a gas chamber in the bottom of the pump housing in line with a water chamber in the top, sharing the same piston rod. A gas pressure alternately applied to the air chamber from the end of the chamber drives both pistons up and down. On the upstroke, water is drawn through a check valve into the water chamber on one side of the piston. At the same time the water is expelled from the chamber on the other side of the piston, through the check valve, and into the water discharge line. On the downstroke, water is moved from one side of the piston to the other through a check valve on the piston itself.

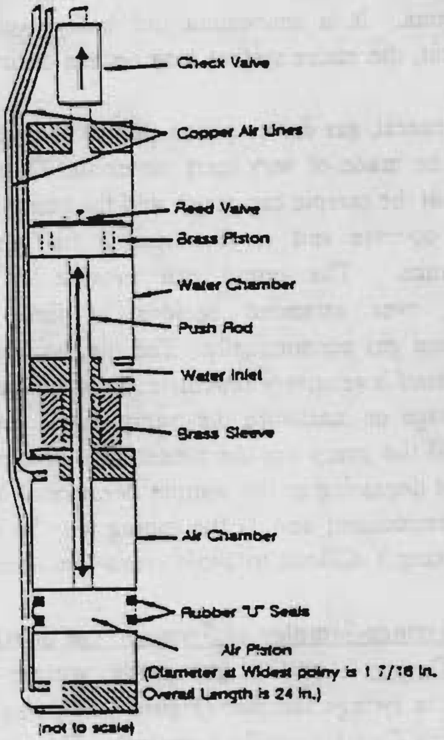


Figure 3-19 Single-Acting Gas Driven Piston Pump

3.3.9.3B Double-Acting Gas Driven Piston Pump--This double acting gas driven piston pump (Figure 3-20) uses two water chambers on either side of a gas chamber and a switching unit through which a common connecting rod passes to a piston in each cylinder. Through an arrangement of O-ring seals, button bleed valves, and needle-valve restrictions in the switching unit, the driving gas both enters and exhausts from the intermediate chamber as it alternately drives the two-piston assembly up and down. Two check valves in each water chamber operate so that on the upstroke, water is expelled from the upper chamber as water is drawn into the lower chamber from well; on the downstroke, water is expelled from the lower chamber and water from the well is drawn into the upper chamber.

The flow rate of the pump may be varied over a limited range by increasing or decreasing the driving gas pressure to the pump. Rates of from 0.25 to 0.50 gpm are achievable at pumping lifts up to 500 feet with these pumps. The design of this double acting piston pump offers a better driving gas consumption than the previous single acting pump, but it may also be prone to more frequent malfunction because of more mechanical components. It is convenient but bulky, weighing several hundred pounds. Adding the compressed gas equipment, the entire system may be less desirable for moving from place to place.

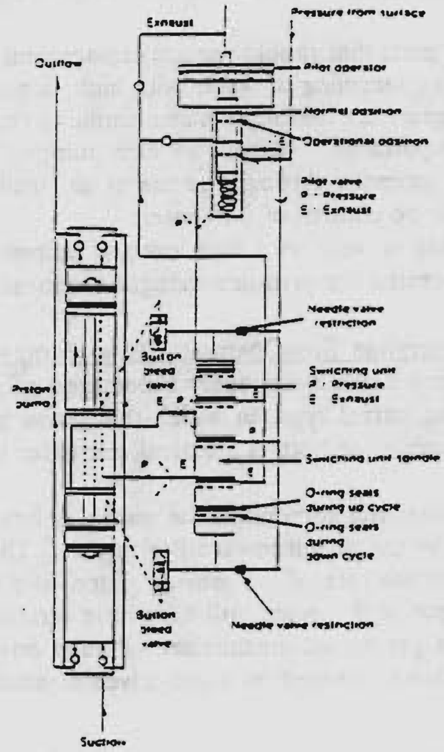
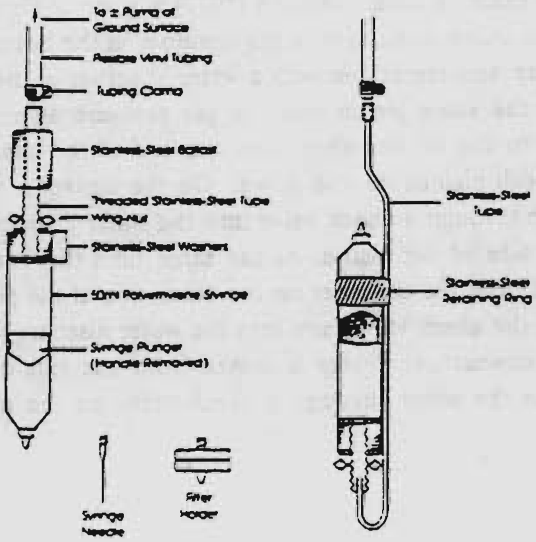


Figure 3-20 Double-Acting Gas Driven Piston Pump

In general, gas driven piston pumps are well suited for groundwater monitoring because they are portable and can be made of very inert materials. Thus, there is a reduced possibility for sample contamination. No aeration of the sample can occur, and the pump is relatively easy to operate and to disassemble for cleaning and maintenance. The pump can provide a continuous sampling over extended periods of time and uses compressed gas economically. The disadvantages are: 1) the unit itself is relatively expensive; 2) particulate material may damage or inactivate the pump unless the intake is filtered; 3) the pump has the potential of causing pressure drops and degassing in the sample because of its intricate valving mechanism; and 4) the tubing may be difficult to clean making it difficult to avoid cross-contamination.

Figure 3-21 Syringe-Type/Syringe Sampler



3.3.9.4 Syringe-Sampler or Syringe-Type Sampling Devices--Another pneumatic sample collection device is the syringe sampler (Figure 3-21), also called the " Pneumatic Depth-Specific Sampler". The simplest and most inexpensive syringe sampler is composed of a disposable 50 ml plastic syringe modified by cutting off the plunger and the finger grips, and a flexible tubing which is used not only to sustain the syringe but also to provide compressed air or gas for actuating the syringe. To collect a discrete sample, one lowers the syringe to the desired depth in the well and then actuates the syringe, applying positive or negative pressure via the tubing. If water is to be collected from depths of greater than 10-15 feet below the level of standing water in the well, positive pressure must be applied to the syringe while it is being lowered to the sampling depth to keep the plunger from moving. When the desired depth is reached, the pressure in the tubing is released and reduced to atmospheric pressure (or slightly less), and the sampled water enters the syringe. After the syringe is filled, it is withdrawn from the well.

Significant advantages of this method of taking samples are: 1) it can be rinsed down a hole with the water to be sampled; 2) aeration is eliminated and the possibility of degassing is reduced; 3) discrete sampling can be done at any depth; 4) the syringe can be used to sample slowly recharging wells or as a sample container and for wells as small as 1½" inside diameter; 5) the syringes can be made of inert materials, and are inexpensive and highly portable. The disadvantages are: 1) the syringe is inefficient for large volume sampling and can not be used to evacuate a well; and 2) the use of syringes is limited to water with a low suspended solid concentration, and some leakage has been found to be caused from high suspended solid content.

3.3.9.5 Gas-Operated Squeeze or Gas Squeeze Pumps--There are several different designs of gas-squeeze (Bladder (Figure 3-22) and Diaphrams) pumps, but all have several common features and are operated with the same principle. These pumps consist of a flexible membrane enclosed inside a long and rigid housing, a screened intake check valve, a perforated tube inside the bladder (membrane), a discharge check valve, and two tubing lines. One of the two tubings is to allow pressurization of the annular space between the bladder and the housing, and the other one is to allow sample discharge to the surface. When the pump is submerged, water sample enters the bladder through the intake check valve. After the bladder is filled, gas pressure is applied to the annular space between the bladder and the rigid housing, forcing the water upward through the discharge tubing. When the pressure is released, the discharge check valve closes, preventing the water sample from flowing back down into the bladder, and water from the well again refills the bladder through the intake check valve and the cycle is repeated.

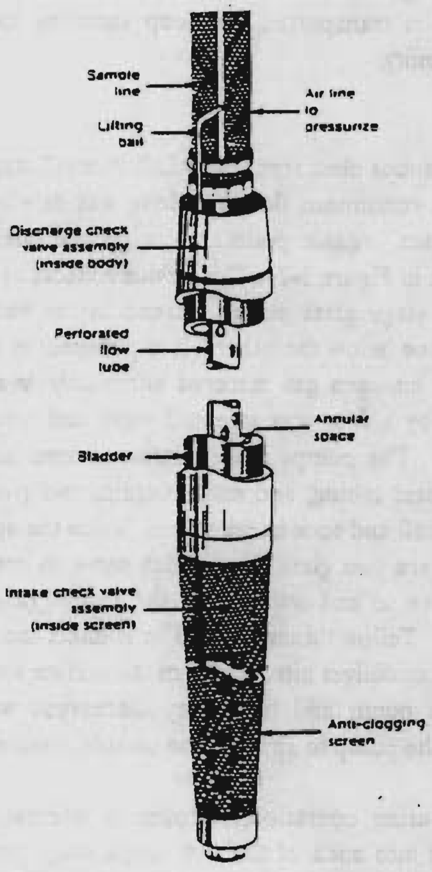


Figure 3-22 Gas-Operated Bladder Pump

The advantages of this pump are: 1) it has a fair range of pumping rates; 2) it has a wide variety of materials that can be used to meet the needs of the parameters of interest; 3) it is relatively portable, though the accessory equipments may be cumbersome; 4) there is no contact between driving gas and the samples, thus eliminating possible contamination or gas stripping; 5) the pump can be as small as one inch, and is easy to disassemble for cleaning and repair; and 6) these pumps are capable of pumping and lifting in excess of 200 feet.

Their disadvantages are: 1) deep sampling requires large gas volume and longer cycles; 2) pumping rates can not match the rate of other submersible pumps; and 3) these pumps can be relatively expensive.

3.3.9.6 Gas Drive Pumps--A wide variety of gas-driven sampling devices are available. In principle, the gas-driven pumps (Figure 3-23) use a positive gas pressure to force water from the well to the ground surface. Water enters the pumps through a screened intake and a check valve at the bottom end when the pressure is released. When the pressure is applied, it closes the check valve at the bottom and opens the check valve in the discharge line and forces the water into the sample line extending from the bottom of the chamber to ground surface.

The advantages of this pump are: 1) the pumps are highly portable and inexpensive; 2) pumps can be used in wells of 1½" inside diameter and in boreholes without casing; 3) discrete depth sampling and delivery of a sample at a controlled, nearly continuous rate are possible; and 4) pumps can be constructed entirely of inert materials. The disadvantages are: 1) oxidation may occur, causing precipitation of metals if air is used as the compressed gas; 2) stripping of volatiles and CO_2 can occur; and 3) an air compressor must be transported for deep sampling locations, thus reducing portability.

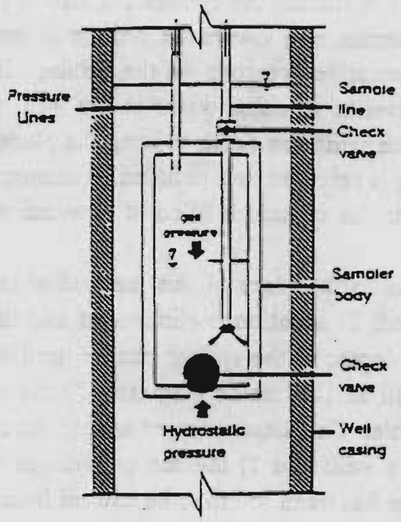
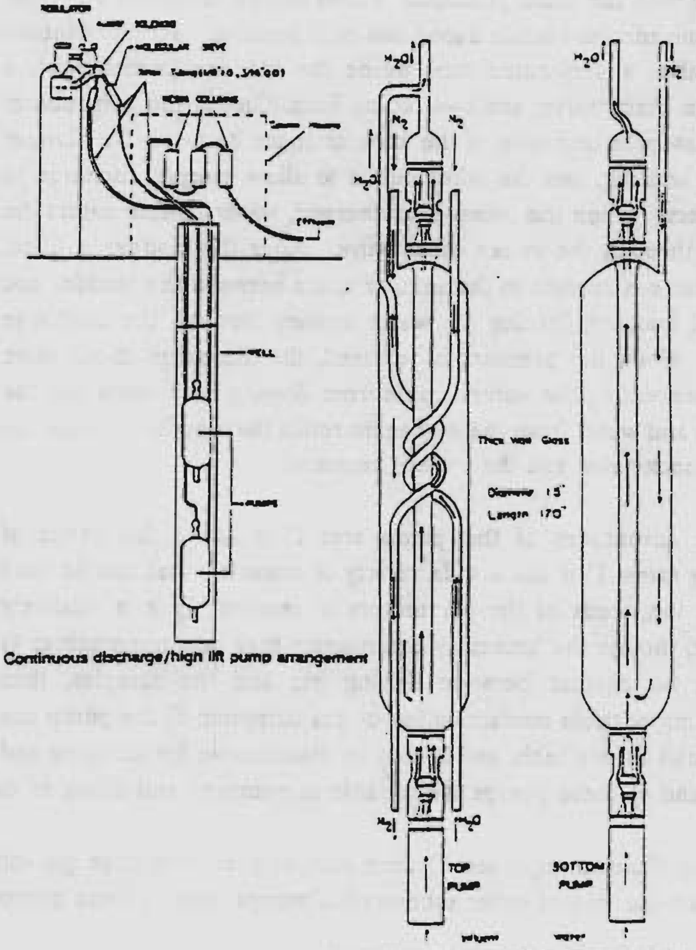


Figure 3-23 Operating Principles of gas Drive Sampling Devices

Figure 3-24



Continuous discharge/high lift pump arrangement

The continuous discharge/high lift pump consists of two stages

Continuous discharge/High Lift Pump(2 stages)

A continuous flow gas drive was developed for trace organic pollutants in groundwater as shown in Figure 3-24. This device consists of two single-stage glass pumps, placed in the well in line, one below the other. It is powered by high purity nitrogen gas metered alternately to each stage by a four-way solenoid valve and electric timer. The pumps are constructed from heavy wall glass tubing, and each contains two ground glass ball and sock check valves. Inside the upper stage are two glass lines which serve to convey nitrogen to and water from the second (lower) stage. Teflon tubing is used to connect the two stages to deliver nitrogen from the surface supply to the pump and to convey discharged water from the pump to appropriate sample containers.

During operation, nitrogen is alternatively forced into each of the two single-stage pumps by timed operation of the four-way solenoid valve to obtain sequential filling and emptying of the pump chambers. The air in the pump, which is in the state of being filled, is vented to the atmosphere via the nitrogen inlet line in order to allow water to flow through the lower check valve. Once the filling is completed for that stage (pump), the nitrogen pressure is diverted back into it, forcing the water through the upper check valve into the discharge line. During this pumping cycle, the other pump is operating in the fill mode. The net result is a continuous stream entering the discharge line.

The advantages of this pump are: 1) the pump can be constructed of non-contaminating, non-adsorbing materials; 2) variable flow rates up to 45 gph are obtainable; and 3) the pump can be used in well casings with a diameter of about two inches. The disadvantages are that the pump requires high purity nitrogen gas, in addition to the problems mentioned earlier in this sub-section with the single step gas drive pump.

3.3.9.7 Other Pump Systems--Gas-Lifts and Jet Pumps--Gas (or air)-lift jet pumps use positive pressure and may be good for well purging, but they are not very helpful for sampling, particularly for volatile organics.

Gas (or air)-Lift Pumps consist of a gas or air line extending into the sampled water and a gas or air at high pressure being used to blow the water out of the well. The gas or air acts as a carrier fluid, or reduces the effective specific gravity of the water column, causing the water column to rise to ground surface. The advantages of these systems are that the devices are highly portable and can be permanently installed and used for well development or purging. The method is considered unsuitable for sampling because it can strip volatile compounds, contaminate the sample by the gas or air, affect pH sensitive parameters such as metals, and cause oxidation by air or oxygen-containing gas.

Jet Pumps basically are composed of a circulating pump at the surface and two tubes extending down the well from the pump to an ejector-venturi assembly at the submerged end of the tubes. As the circulating water passes the ejector-venturi assembly, the pressure is reduced as a result of the increased velocity, causing water to be drawn from the well and mixed with the circulating water.

Jet pumps are relatively simple devices and are easily transported. It can be used for pumping at great depths and is useful for purging monitoring wells. Its disadvantages are: 1) a large amount of water needs to be pumped before the circulating water has a composition that is close to the water in the well; 2) the water entering the venturi assembly is subjected to a pressure drop, and can therefore undergo degassing and/or vaporization; and 3) the circulating pump at the surface can contaminate the pumped water because of its materials and lubricants. Because of these multiple deficiencies with regard to sampling, jet pumps are unpopular.

3.4 SUMMARIES AND CHARACTERISTICS OF SOME SAMPLING EQUIPMENT FOR LIQUIDS AND SOLIDS

No one sampling method is applicable to all situations; however, for nearly all situations there may be at least one appropriate sampling device available. The most representative samples are obtained with one of these devices if the appropriate sampling device is chosen for a particular sampling situation.

This section describes examples of sampling equipment and suggests potential uses for the equipment. Because each sampling situation is unique, the cited equipment and applications may have to be modified to ensure that a representative sample is collected and its physical and chemical integrity is maintained. The information in this section is general in nature and therefore limited. It is the responsibility of those who conduct the sampling programs to evaluate the situation and make appropriate modifications.

Table 3-1 provides a review of, and criteria for selecting soil sampling equipment.

Table 3-2 contains examples of sampling equipment and potential applications. Again, these sampling devices may not be applicable to a user's situation due to sample - or site-specific factors.

Table 3-3 summarizes the characteristics of some sampling pumps available for small diameter monitoring wells. Based on these and other considerations of site-specific factors and targeted compounds, appropriate sampling devices may be found. For a brief direction on bigger diameters of monitoring well, see Table 3-4.

Table 3-5, prepared by Pohlman and Hess with EPA support, illustrates the general relation of groudwater

TABLE 3-1. REVIEW AND CRITERIA FOR SELECTING SOIL SAMPLING EQUIPMENT

	Obtain Core Sample		Most Suitable Core Types			Operations in Stony Soils		Most Suitable Soil Moisture Conditions			Access to Sampling Sites During Poor Soil Conditions		Relative Sample Size		Labor Requirements	
Type of Sample	Yes	No	Clay	Sand	Inter	Fav.	Unfav.	Wet	Dry	Inter	Yes	No	Sm.	Lg.	Single	2/more
A. Hand Auger																
1. Screw-Type Augers		X			X		X	X			X		X		X	
2. Barrell Augers a. Post-Hole Auger (IWAN)		X	X			X		X			X			X	X	
b. Dutch Auger		X	X			X		X								
c. Regular Barrel Auger		X	X			X				X	X		X		X	
d. Sand Augers		X		X		X				X	X			X	X	
e. Mud Augers		X	X			X		X			X			X	X	
Tube-Type Samplers a. Soil Probes																
(1) Wet Tips	X				X		X	X			X					
(2) Dry Tips	X				X		X	X			X		X		X	X
b. Veihmeyer Tubes	X				X					X			X		X	
c. Thin-Walled Tube Samplers	X		X				X			X	X			X		X
d. Peat-Samplers	X		X				X	X			X			X		X
B. Power Auger 1. Hand-Held Screw Type Power Auger		X			X	X				X	X			X		X
2. Truck Mounted Auger					X											
a. Screw Type		X			X	X		X				X		X		X
b. Drive Sampler	X		X			X				X		X		X		X
3. Tripod Mounted ive Sampler	X		X							X		X		X		

TABLE 3-2 EXAMPLES OF SAMPLING EQUIPMENT FOR PARTICULAR SAMPLE OR WASTE TYPES

	Sample (Waste) Location or Container								
Sample (Waste) Type	Drum	Sacks and bags	Open-bed truck	Closed-bed truck	Storage tanks or bins	Waste Piles	Ponds, Lagoons, & Pits	Conveyor Belt	Pipe
Free-flowing liquids & slurries	Coliwasa	N/A	N/A	Coliwasa	Weighted Bottle	N/A	Dipper	N/A	Dipper
Sludges	Trier	N/A	Trier	Trier	Trier	a	a		
Moist powders or granules	Trier	Trier	Trier	Trier	Trier	Trier	Trier	Shovel	Dipper
Dry powders or granules	Thief	Thief	Thief	Thief	a	Thief	Thief	Shovel	Dipper
Sand or Packed Powders & granules	Auger	Auger	Auger	Auger	Thief	Thief	a	Dipper	Dipper
Large-Grained Solids	Large Trier	Large Trier	Large Trier	Large Trier	Large Trier	Large Trier	Large Trier	Trier	Dipper

[a] This type of sampling situation can present significant logistical sampling problems, and sampling equipment must be specifically selected or designed based on site and waste conditions. No general statement about appropriate sampling equipment can be made.

TABLE 3-3 CHARACTERISTICS OF SAMPLING DEVICES AVAILABLE FOR SMALL DIAMETER MONITORING WELLS

Device	Minimum Well Diameter	Approximate Maximum Sampling Depth	Typical Sample Delivery@ Maximum Depth	Flow Control Ability	Materials* (Sampling Device Only)	Potential For Chemical Alteration	Ease Of Operating Cleaning & Maintenance
Bailers	½"	Unlimited	Variable	Not Applicable.	Any	Slight-Moderate	Easy
Syringe Samplers	1½"	Unlimited	0.2 gal.	Not Applicable	Stainless 316, Teflon or poly-Ethylene/glass	Minimum-Slight	Easy
Suction-Lift (Vacuum) Pumps	½"	23-25 ft.	Highly Variable	Good	Highly Variable	High-Moderate	Easy
Gas-Drive Samples	1"	300 ft.	0.2 gpm	Fair	Teflon, PVC, polyethylene	Moderate-High	Easy
Bladder Pumps	1½"	400 ft.	0.5 gpm	Good	Stainless 316 Teflon/Viton, PVC, Silicone	Minimum-Slight	Easy
Gear Drive Submersible Pumps	2"	200 ft.	0.5 gpm	Poor	Stainless 304 Teflon/Viton	Minimum-Slight	Easy
Helical Rotor Submersible Pumps	2"	125 ft.	0.3 gpm	Poor	Stainless 304 EPDM, Teflon	Slight-Moderate	Moderately Difficult
Gas-Driven Piston Pumps	1½"	500 ft.	0.25 gpm	Good	Stainless 304 Teflon, Delrin	Slight-Moderate	Easy to Moderately Difficult

Notes: * Materials dependent on manufacturer and specification of optional materials.
** Costs highly dependent on materials specified for devices and selection of accessory equipment.

TABLE 3-4 PURGING EQUIPMENT SELECTION & SAMPLE WITHDRAWAL EQUIPMENT

Diameter Casing	Bailer	Peristaltic Pump	Vacuum Pump	Airlift	Diaphram "Trash" Pump	Submersible Diaphram Pump	Submersible Electric Pump	Submersible Electric Pump w/Packer
1.25-inch Water level								
< 25 ft.		X	X	X	X			
> 25 ft.				X				
2-inch Water level								
< 25 ft.	X	X	X	X	X	X		
> 25 ft.	X			X		X		
4-inch Water level								
< 25 ft.	X	X	X	X	X	X	X	X
> 25 ft.	X			X		X	X	X
6-inch Water level								
< 25 ft.				X	X		X	X
> 25 ft.				X			X	X
8-inch Water level								
< 25 ft.				X	X		X	X
> 25 ft.				X			X	X

TABLE 3-5 Evaluation and Selection of Groundwater Sampling Equipment

						GROUND-WATER PARAMETERS													
						INORGANIC							ORGANIC				RADIO-ACTIVE		BIOL.
		Device	Approximate Maximum Sample Depth	Maximum Well Diameter	Sample † Delivery Rate or Volume	EC	pH	Redox	Major ions	Trace Metals	Nitrate Fluoride	Dis-solved Gases	Non-volatile	Volatile	TOC	TOX	Radium	Gross Alpha & Beta	Coliform Bacteria
PORTABLE SAMPLING DEVICES*	GRAB	Open bailer	no limit	1/2 in.	variable	•			•	•	•		•				•		•
		Point-source bailer	no limit	1/2 in.	variable	•	•	•	•	•	•		•	•	•	•	•		•
		Syringe sampler	no limit	1/2 in.	0.01-0.2 gal	•	•	•	•	•	•		•				•	•	•
	POSITIVE DISPLACEMENT (submersible)	Gear-drive	200 ft.	2 in.	0-0.5 gpm									•					
		Bladder pump	400 ft.	1 1/2 in.	0-2 gpm	•	•	•	•	•	•	•	•	•	•	•	•	•	•
		Helical rotor	160 ft.	2 in.	0-1.2 gpm	•	•	•	•	•	•	•	•	•	•	•	•	•	
		Piston Pump (gas-drive)	500 ft.	1 1/2 in.	0-0.5 gpm	•			•	•	•		•				•	•	
		Centrifugal	variable	3 in.	variable	•			•		•						•	•	
	Suction lift	Peristaltic	26 ft.	1/2 in.	0.01-0.3 gpm	•			•		•		•				•		•
	Gas Contact	Gas-lift	variable	1 in.	variable														
		Gas-drive	150 ft.	1 in.	0.2 gpm	•			•		•		•				•		
In Situ Sampling Devices*		Pneumatic	no limit	not applicable	0.01-0.13 gal	•	•	•	•	•	•		•				•	•	•

* Sampling devices in this table are divided into: 1) portable devices for sampling existing monitoring wells; 2) in-situ monitoring devices (often multi-level) that are permanently installed. Sampling dev construction materials (including tubing, haul lines, etc.) should be evaluated for suitability in analyzing specific groundwater parameters.

† Sample delivery rates and volumes are average ranges based on typical field conditions.

• Indicates device is generally suitable for application (assuming device is cleaned, operated properly, and is constructed of suitable materials).

EC--Electrical Conductivity; TOC--Total Organic Carbon; TOX--Total Organic Halogen.

parameters to sampling devices. There are 12 types of sampling devices and 14 groundwater parameters (including inorganic, organic, radioactive, and biological) considered, and notes regarding sampling depths, well diameters, sampling delivery rates, and construction materials are included.

3.5 EQUIPMENT FOR AIR, GAS OR VAPOR SAMPLING

Pollutants in air can be in the form of gases, vapors, particulates, or a mixture of any of the three. Gases and vapors consist of substances dispersed as molecules in the atmosphere, while particulates consist of aggregates of molecules sufficiently large that they are said to behave like particles. Further more, any dispersed and suspended matter, whether solid or liquid, in which the individual aggregates are larger than single small molecules, about 0.0002 micron in diameter, but smaller than about 500 micron, is referred to as a particulate. Additional terms used to further describe particulate matter include dust, fly ash, smoke, soot, aerosols, droplets, mist, fog and fumes.

Devices which are suitable for collecting one form of pollutant are not usually suitable for collecting others and, hence, an incorrect selection of sampling methods may lead to erroneous results. If sampling is to be appropriately conducted, prior knowledge of the physical state in which a substance exists must be available or else a judgement must be made.

For gas and vapor sampling, there are five categories of devices: 1) collection in bags or containers; 2) absorption devices; 3) adsorption devices; 4) impingers, and 5) freezing-out sampling. For particulate matter sampling, there are also five categories of apparatus: 1) filtration; 2) impingers; 3) impactors; 4) electrostatic precipitation; and 5) thermal precipitators.

3.5.1 Collection In Collapsible Bags or Rigid Containers

These devices are used to obtain only instantaneous or grab samples. Grab samples are usually collected when analysis is to be performed on gross amounts of gases in air (e.g., mine gases, sewage gases, methane, carbon monoxide, oxygen, carbon dioxide). The devices should not be used for collecting reactive gases such as hydrogen sulfide, oxides of nitrogen, and sulfur dioxide unless the analysis can be made directly in the field. Such gases may react with dust particles, moisture, wax sealing compound, or glass, altering the composition of the sample.

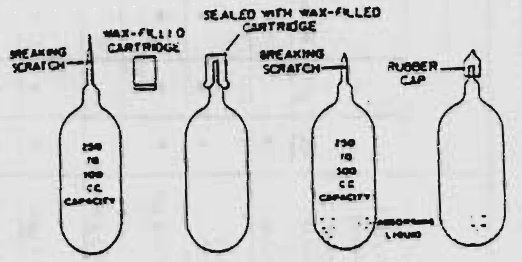


Figure 3-25 Evacuated & sealed Bottles

In areas where the atmospheric composition stays constant, the grab sample may be representative of the average as well as the momentary concentration of the components; thus, it may truly represent an integrated equivalent. Where the atmospheric composition varies, numerous samples must be taken to determine the average concentration of a specific component.

Rigid containers include vacuum flasks or bottles, glass bottles (Figure 3-25), gas or liquid-displacement collectors (Figure 3-26), metallic collectors,and plastic syringes. Samples are collected by: 1) breaking the heat-sealed end to let the sampled air in and then resealing with a wax-filled cartridge if a pre-evacuated flask or bottle is used; 2) draining the pre-filled liquid, mostly water, at the site and allowing the sampled air in and then sealing the passage if a liquid displacement collector is used. A third method is to allow a sufficient amount of air through the container at the site by a pumping device until the original gas or air in the container is completely displaced by the air being sampled.

Figure 3-26 Gas or Liquid displacement collector

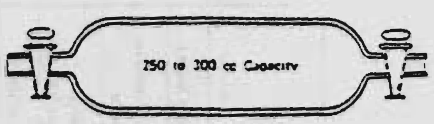
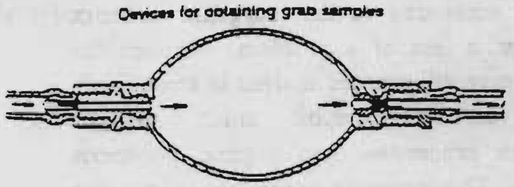


Figure 3-27 Double-acting Rubber Bulb Aspirator



Flexible or collapsible bags are another device for collecting air or gas samples. Filling a bag usually can be done by using hand operated squeeze bulbs(Figure 3-27) with check valves on each end. In most cases, this procedure is satisfactory, but care should be taken to avoid contamination from the sampling bulb or possible losses of the constituents on the walls of the sampling bulb. Proper selection of bag materials is also important, for some will permit losses of contaminants by diffusion through the walls, and others may contribute contaminants to the air being sampled. Other chemical reactions can occur in the bag too, depending upon what is in the air and the storage temperature. It is generally advisable to perform analysis as soon as possible after collecting the sample.

A good practice is that the bags should be leak tested and pre-conditioned for 24 hours before they are used for sampling. Pre-conditioning consists of flushing the bags 3 to 6 times with the test gas, the number of times depending on the nature of the bag material and the gas. In some cases, it is recommended that the final refill remains in the bag overnight before the bag is used for sampling. Such pre-conditioning usually is helpful in minimizing the rate of decay of a collected gas.

3.5.2 Collection In Sorbent Vessel Tubes or Canisters

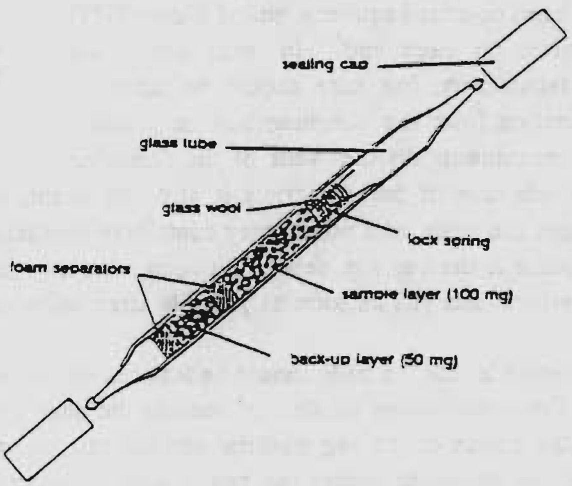
Most air sampling for gases and vapors are performed by absorbing or adsorbing the contaminants of interest in a suitable sampling medium. Ordinarily, the absorbing medium is a reactive liquid of some kind, but solid absorbents may also be used. By contrast with absorption, adsorption consists of retention of gaseous substances by solid adsorbents which, in most cases, do not chemically combine with gases or vapors. Solid adsorbents require less manipulative care than do liquid absorbents; they can provide high collection efficiencies, and with improved adsorption tube design and a better definition of desorption requirements, they are becoming increasingly popular.

Solid sorbent media can be divided into three categories: organic polymeric sorbents, inorganic sorbents, and carbon sorbents. Organic polymeric sorbents include materials such as a porous polymeric resin of 2,4-diphenyl-p-pheylene oxide (Tenax) and styrene-divinylbenzene copolymer (XAD) resins. These materials have the important feature that minimal amounts of water are collected in the sampling process; thus, large volumes of air can be sampled. A major disadvantage is the inability of the polymeric sorbents to capture highly volatile organic compounds (e.g. vinyl chloride) as well as certain polar materials (e.g. low molecular weight alcohols and ketones).

Inorganic sorbents are silica gel, alumina, a magnesium aluminum silicate (Florisil), and molecular seives. These sorbents are considerably more polar than the organic polymeric sorbents and efficiently collect polar organic compounds. Unfortunately, water is also efficiently captured, and this, in turn, causes a rapid deactivation of the sorbent. For this reason, inorganic sorbents are not often used for sampling volatile organic compounds.

Silica gel has been used widely as an adsorbent for polar or readily polarized contaminants in air samples. The general order of decreasing polarization or attraction is: water, alcohols, aldehydes, ketones, esters, aromatic compounds, olefins, and paraffins.

Figure 3-28 Activated Charcoal Sampling Tube



Carbon sorbents (Figure 3-28) are relatively nonpolar compared to the inorganic sorbents, and water is less of a problem, although the problem may still prevent analysis in some cases. Carbon sorbents exhibit much stronger adsorption properties than organic polymeric sorbents. This superior adsorption allows the efficient collection of volatile organic compounds such as vinyl chloride. But this strong adsorption of organic compounds, unfortunately, is also a disadvantage because it is difficult to remove most of the collected chemicals and it requires using a solvent. The sampler needs to consider both the capturing ability and the ease of recovering the compound when choosing the sorbent material for sampling organic compounds. Between the two processes of desorptions, thermal desorption is most useful for compounds having boiling points less than 300° C; solvent extraction is most useful for compounds boiling above 150° C and is used extensively for semi-volatile organic compounds.

The most popular sorbent for capturing semi-volatile organic compounds is polyurethane foam. The advantages of the polyurethane foam are its efficiency in collecting many semi-volatile organic compounds and its low resistance to air flow; thus, large volumes of air can be sampled. Other sorbents for sampling semi-volatile organic compounds such as styrene-divinylbenzene copolymer resin in granular form (Amberlite XAD-2); porous, cross-linked styrene-divinylbenzene polymeric resin (Chromosorb 102); porous styrene-divinylbenzene resin (Poropak R); Florisil; and silica gel have also been used, but not as widely as polyurethane foam because of their higher resistance to air flow.

Generally, an adsorbent collection system (Figure 3-28) consists of a vessel packed with charcoal or synthetic resin specifically selected for targeted contaminants and a calibrated sampling device to draw ambient air through the vessel. Air contaminants are retained as a thin layer of molecules on the surface of the packed sorbent material in the vessel. Analysis is then done by chromatography after desorbing the contaminants by either thermal desorption or solvent extraction. The selection of the proper sorbent material for the concerned compounds and the determination of total sample flow through the vessel are critical. Table 3-6 shows some sorbent materials and their use.

3.5.3 Direct Reading Equipment

Various direct reading equipments, portable and fixed site monitors that can be used to evaluate airborne concentrations of gases and vapors, are available today. Table 3-7 summarizes the types of direct reading equipment available, along with typical operating characteristics and examples of gases and vapors for which the equipments have been used successfully. Table A-4 of Section 1.5.5, Screening Techniques for Organics in Air, also lists some typical commercially available equipment for organic compounds in ambient air. As references, Table 3-8A shows another summary of sampling and analytical methods for organic compounds in ambient air and Table 3-8B for selected toxic organic compounds.

TABLE 3-6

SORBENT PROPERTIES AND APPLICATIONS

SORBENT	GENERALLY SUITBALE FOR	EXISTING METHODS		REMARKS
		CHEMICALS	LIMIT	
Florisil	Highly chlorinated Compounds, PCBs, Pesticides, Phthalates	PCBs BHCs Phthalates	1 ng/m^3 1 ng/m^3 5-20 ng/m^3	Phthaiate Contamination
Silica Gel	High Molecular Wt. Organic Compounds	Dioxins Furans	10^{-13} gm/m^3 10^{-12} gm/m^3	Special GC/MS analysis for dioxin and furans is very expensive
P.U.F. (Polyurethane Foam)	PCBs, Pesticides Dioxins, Furans	EPA Methods		Special sampler needed
PORAPAK-N	Volatile organic solvents, degreasers and volatile halogenated atomatics	Benzene Chloroform Perchloroethylene Chlorotoluene	10 ug/m^3 1 ug/m^3 1 ug/m^3 1 ug/m^3	NYS DOH analysis
Tenax	Same as PORAPAK	EPA Methods		Breakdown of polymer and resulting contamination limits shelf life of cleansed adsorbant to 30 days max.
Carbon	Almost universal adsorbant	At low concentrations chemicals do not desorb efficiently		Researchers are tyring to coat particles to increase desorption efficiencies

Combinations of different adsorbants lead to a combination of characteristics to sample for a wide range of chemicals at great sensitivity.

from "Quality Assurance Manual for Speical Ambeint Air Studies, Bureau of Toxic Air Sampling, Division of Air Resources, NYSDEC".

Table 3-7 Direct Reading Physical Instruments

Principle of Operation	Applications and Remarks	Code*	Range	Repeatability (precision)	Sensitivity	Response Time
Aerosol photometry	Measures records and controls particulates continuously in areas requiring sensitive detection of aerosol levels; detection of 0.05 to 40 μm diameter particles. Computer interface equipment is available.	A and B	10^{-3} to 10^{2} ug/liter	Not given	10^{-3} ug/liter (for 0.3 μm DOP)	Not given
Chemiluminescence	Measurement of NO in ambient air selectively and NO_2 after conversion to NO by hot catalyst. Specific measurement of O_3. No atmospheric interferences.	B	0-10,000 ppm	± 0.5 - ± 3%	Varies: 0.1 ppb to 0.1 ppm	ca 0.7 sec. NO mode and 1 sec. NO_x mode: longer period when switching ranges
Colorimetry	Measurement and separate recording of NO_2, NO_x, SO_2, total oxidants, H_2S, HF, NH_3, Cl_2 and aldehydes in ambient air.	A and B	ppb and ppm	± 1 - ± 5%	0.01 ppm (NO_2, SO_2)	30 sec to 90% of full scale
Combustion	Detects and analyzes combustible gases in terms of percent LEL on graduated scale. Available with alarm set at 1/3 LEL.	A	ppm to 100%	–	ppm	<30 sec.
Conductivity, electrical	Records SO_2 concentrations in ambient air. Some operate off a 12-V car battery. Operate unattended for periods up to 30 days.	A and B	0-2 ppm	< ± 1 - ± 10%	0.01 ppm	1-15 sec. (lag)
Coulometry	Continuous monitoring of NO, NO_2, O_3, and SO_2 in ambient air. Provided with strip-chart recorders. Some require attention only once a month.	A and B	Selective: 0-1.0 ppm overall, or to 100 ppm (optional)	± 4% of full scale	varies: 4-100 ppb dependent on instrument range setting	< 20 min. to 90% of full scale
Flame ionization (with gas chromatograph)	Continuous determination and recording of methane, total hydrocarbons, and carbon monoxide in air. Catalytic conversion of CO to CH_4. Operates up to 3 days unattended.	B	Selective: 0-1 ppm; 0-100 ppm	± 1% of full scale	Not given	5 min. (cycle time)
	Separate model for continuous monitoring of SO_2, H_2S, and total sulfur in air. Unattended operation up to 3 days.	B	0 - 20 ppm	± 4% of full scale	0.005 ppm (H_2S); 0.01 ppm (SO_2)	5 min. (cycle time)
Flame ionization (hydrocarbon analyzer)	Continuous monitoring of total hydrocarbons in ambient air; potentiometric or optional current outputs compatible with any recorder. Electronic stability from 32 to 110°F.	B	0-1 ppm as CH_4 x 1 x 10 x 100 x 1,000 with continuous span adjustment	± 1% of full scale	1 ppm to 2% full scale as CH_4; 4 ppm to 10% as mixed fuel	< 0.5 sec. to 90% of full scale

Table 3-7 Direct Reading Physical Instruments (Cont'd)

Principle of Operation	Applications and Remarks	Code*	Range	Repeatability (precision)	Sensitivity	Response Time
Gas chromatograph, portable	On-site determination of fixed gases, solvent vapors, nitro and halogenated compounds, and light hydrocarbons. Instruments available with choice of flame ionization, electron capture, or thermal conductivity detectors and appropriate columns for desired analyses. Rechargeable batteries.	A	Depends on detector	Not given	< 1 ppb (SF_6) with electron capture detector; < 1 ppm (HCs)	–
Infrared analyzer (photometry)	Continuous determination of a given component in a gaseous or liquid stream by measuring amount of infrared energy absorbed by component of interest using pressure sensor technique. Wide variety of applications include CO, CO_2, Freons, hydrocarbons, nitrous oxide, NH_3, SO_2 and water vapor.	B	From ppm to 100% depending on application	± 1% of full scale	0.5% of full scale	0.5 sec. to 90% of full scale
Photometry ultraviolet (tuned to 253.7 mμ)	Direct readout of mercury vapor; calibration filter is built into the meter. Other gases or vapors that interfere include acetone, aniline, benzene, ozone, and others that absorb radiation at 253.7 mμ.	A	0.005 - 0.1 and 0.03-1 mg/m^3	± 10% of meter reading or ± minimum scale division, whichever is larger	0.005 mg/m^3	Not given
Photometry, visible (narrow-centered 394 mμ band pass)	Continuous monitoring of SO_2, SO_3, H_2S, mercaptans, and total sulfur compounds and ambient air. Operates more than 3 days unattended.	B	1-3,000 ppm (with airflow dilution)	± 2 %	0.01 - 10 ppm	< 30 sec. to 90% of full scale
Particle counting (near forward scattering)	Reads and prints directly particle concentrations at 1 of 3 preset time intervals of 100, 1,000 or 10,000 seconds, corresponding to 0.01, 0.1 and 1 cubic foot of sampled air.	B	Preset (by selector switch); particle size ranges: 0.3, 0.5, 1.0, 2.0, 3.0, 5.0 and 10.0 μm; counts up to 10^7 particles per ft^3 (35×10^3/liter)	± 0.05% (probability of coincidence)	—	Not given
Polarography	Monitor gaseous oxygen in flue gases, auto exhausts, hazardous environments, and in food storage atmospheres and dissolved oxygen in wastewater samples. Battery operated, portable, sample temperature 32 to 110° up to 95% relative humidity. Potentiometric recorder output. Maximum distance between sensor and amplifier is 1,000 feet.	A	0-5 and 0-25%	± 1% of reading at constant sample temperature	Not given	20 sec to 90% of full scale

Table 3-7 **Direct Reading Physical Instruments** (Cont'd)

Principle of Operation	Applications and Remarks	Code*	Range	Repeatability (precision)	Sensitivity	Response Time
Radioactivity	Continuous monitoring of ambient gamma and X-radiation by measurement of ion chamber currents, averaging or integrating over a constant recycling time interval, sample temperature limits 32 to 120°F; 0 to 95% relative humidity (weatherproof detector); up to 1,000 feet remote sensing capability. Recorder and computer outputs. Complete with alert, scram, and failure alarm systems. All solid state circuitry.	B	0.1-10^7 mR/hr	± 10% (decade accuracy)	–	< 1 sec.
Radioactivity	Continuous monitoring of beta or gamma emitting radioactive materials within gaseous or liquid effluents; either a thin wall Geiger-Muller tube or a gamma scintillation crystal detector is selected depending on the isotope of interest; gaseous effluent flow, 4 cfm; effluent sample temperature limits 32 to 120°F using scintillation detector and 65 to 165°F using G-M detector. Complete with high radiation, alert and failure alarms.	B	10-10^6 counts/min.	± 2% full scale (rate meter accuracy)	< 10^7 µCi of ^{131}I per cc of air and 10^{-7} µCi of ^{137}Cs per cc of water using a scintillation detector	0.2 sec. at 10^6 counts/min. (rate meter)
Radioactivity	Continuous monitoring of radioactive airborne particulates collected on a filter tape transport system; rate of airflow, 10 scfm; scintillation and G-M detectors, optional but a beta-sensitive plastic scintillator is provided to reduce shielding requirements and offer greater sensitivity. Air sample temperature limits 32 to 120°F; weight 550 pounds. Complete with high and low flow alarm and a filter failure alarm.	B	10 to 10^6 counts/min.	± 2% of full-scale (rate meter accuracy)	10^{-12} µCi of ^{137}Cs per cc of air using a scintillation detector	0.2 sec. at 10^6 counts/min (rate meter)

* Codes: A, portable instruments; B, fixed monitor or "transportable" instruments.

Table 3-8A
SUMMARY OF SAMPLING AND ANALYTICAL METHODS FOR ORGANIC COMPOUNDS IN AMBIENT AIR

Method Designation	Compounds Determined	Sampling and Analysis Approach	Detection Limit	Accuracy	Precision	Relative Cost		References	Limitations	Comments
						Instrument	Time/Materials			
Hydrocarbons										
A. ASTM D2820	C_1-C_3 Hydrocarbons	Direct gas injection onto GC/FID	0.01 ppmv	–	±10%	Low	Low	3, 52	Losses due to surface adsorption may occur in some cases, especially for less volatile compounds	GC/MS can be used for component identification. GC/PID is useful for aromatics.
B. –	C_2-C_{10} Hydrocarbons and other nonpolar organics with B.P. -100 to 175°C	Whole air collection in canister cryogenic concentration; GC/FID analysis	0.1 ppbv (100 ml. sample)	–	±10%	Moderate	Moderate	17, 58	Storage times greater than a week are not recommended. Reactive and water soluable compounds are not readily analyzed.	GC/MS can be used for component identification. If possible, a field GC/FID should be used to avoid sample storage problems.
C. –	C_6-C_{12} hydrocarbons and other nonpolar organics with B.P. 80-200°C	Adsorption on Tenax; thermal desorption GC/MS analysis	1-200 pptv (20 liter sample)	70-95%	±10-40%	High	Moderate	27	Blank levels usually limit sensitivity. Artifacts due to reactive components (e.g., O_3, No_x) can be a problem. Sample can be analyzed only once.	GC/FID can be used to reduce analysis cost. If component identification is not required.
D. –	C_6-C_{12} hydrocarbons and other nonpolar organics with B.P. 80-200°C	Adsorption on Tenax; thermal description into canisters; GC/FID or GC/MS analysis	0.01-1 ppbv (20 liter sample)	80-100%	±20%	Moderate to high, depending on GC detector	Moderate	14	Carbon tetrachloride gives poor recovery precision due to adsorption onto metal surface. Blanks and artifact problems same as above.	Sample can be analyzed 3-4 times, thus allowing GC/FID quantification and GC/MS identification.
E. ASTM D3686/ D3687 or NIOSH P&CAM 127	Nonpolar volatiles (B.P. 0-150°C)	Adsorption on charcoal; desorption with CS_2; analysis by GC/FID	0.01-1 ppmv (10 liter sample)	–	±10%	Low	Low	2, 3	Sensitivity much poorer than for thermal desorption approaches.	Charcoal absorbs highly volatile compounds more efficiently than Tenax.

Table 3-8A (continued)

ethod ignation	Compounds Determined	Sampling and Analysis Approach	Detection Limit	Accuracy	Precision	Relative Cost		References	Limitations	Comments
						Instrument	Time/Materials			
	Nonpolar volatiles (B.P. 0-100°C)	Adsorption on carbon molecular sieves; thermal desorption into canister; analysis by GC/FID or GC/MS	0.01-1 ppbv (20 liter sample)	80-100%	±20%	Moderate to high, depending on GC detector	Moderate	14	High temperature (350°C) required for desorption may decompose labile compounds.	See Method D.
NIOSH P&CAM 206	PAH	Collection of particulate matter on high volume filter; ultrasonic extraction with cyclohexane/silica powder; analysis by normal phase HPLC	3 ng/m^3 (1500 m^3 sample)	95%	±5%	Moderate	Moderate	2	PAH is more volatile than benzo(a)pyrene may be lost by volatilization during the sampling period. Approaches similar to reference 40 may be required for such compounds.	PAH and other particle bound components may be determined using GC/MS.

ogenated Hydrocarbons

Methods A-F can be used for volatile halogenated hydrocarbons as well, except that GC/ECD should be used in place of GC/FID in most cases.

ethod ignation	Compounds Determined	Sampling and Analysis Approach	Detection Limit	Accuracy	Precision	Relative Cost		References	Limitations	Comments
						Instrument	Time/Materials			
	PCBs, PCNs organochlorine pesticides, and other semivolatile organics (B.P. 140-450°C)	Adsorption on solid adsorbent such as polyurethane foam (PUF), XAD 2, or Chromosorb 102); solvent desorption; GC/ECD, GC/MS, or CG/FID analysis.	3 ng/m^3 (1500 m^3 sample)	80-100%	±20%	Moderate to high depending on GC detector	Moderate	40 Lower volume approaches (41, 42, 50)	--	Similar approaches using low volume sampling trains may be more useful for detecting higher levels (1-10 µg/m^3). Hydrocarbons with boiling points > 140°C (> C_8) can be determined.
	Tetrachloro-dibenzodioxines	Collection on high volume filter; extraction (Soxhlet) with methylene chloride; column chromatographic cleanup; high resolution GC/MS analysis	~1 pg/m^3 (1500 m^3 sample)	–	±10-20%	Very High	High	48	TCDDs occur primarily in the particle bound state, but backup adsorption approaches such as reference 40 may be required to ensure no loss occurs through volatilization.	TCDD is highly toxic, hence the need for high sensitivity. These analyses are generally conducted in a special laboratory equipped to handle such materials.

Table 3-8A (continued)

ethod signation	Compounds Determined	Sampling and Analysis Approach	Detection Limit	Accuracy	Precision	Relative Cost		References	Limitations	Comments
						Instrument	Time/Materials			
ygenated Neutral Compounds										
–	Aldehydes	Collection in dinitrophenyl hydrazine (DNPH); solvent extraction of DNPH derivatives; reversed phase HPLC analysis	1-5 ppbv (40 liter sample)	80-100%	±20%	Low	Moderate	10	Blank levels of aldehydes (particularly formaldehyde) will usually determine the detection limit. Reagents must be carefully prepared to avoid significant contamination.	Analysis within 24 hours is recommended.
--	Aldehydes (C_1-C_3)	Collection in 1% sodium bisulfate impinger; determine formaldehyde using chromotropic acid, acrolein using mercuric chloride-hexylresorcinol and C_2-C_3 aliphatic aldehyde by GC/FID	10-30 ppbv (assume 120 liter sample)	–	±10-20%	Low	Moderate	4	High levels of phenols, ethylene, and propylene cause negative interference with formaldehyde determination.	--
NIOSH P&CAM 556, 558, 559, 560, 562-566	Alcohols (C_1-C_3)	Adsorption on charcoal; desorption with CS_2 with 1 % dissimilar alcohol; GC/FID analysis	100-1000 ppmv	–	±5-10%	Low	Low	2, 58	Humidity level must not be sufficient to allow condensation in tube. Sensitivity is inadequate for most ambient air monitoring purposes.	Direct analysis in the field using GC/FID (as in Method A) should provide 1-10 ppm sensitivity.
cellaneous Neutral Compounds										
–	Nitrosamines	Adsorption on Thermosorb N; desorption with acetone; GC/thermal energy or GC/MS analysis	25 ng/m³ (200 liter sample)	85-100%	±10%	High	Moderate	49	Thermal energy analyzer is a nitrosamine specific detector and is rather expensive ($30-40K). GC/NPD may be a less expensive alternative in many situations.	Thermosorb N is a special adsorbent from Thermo-Electron Corporation.

Table 3-8A (continued)

thod gnation	Compounds Determined	Sampling and Analysis Approach	Detection Limit	Accuracy	Precision	Relative Cost		References	Limitations	Comments
						Instrument	Time/Materials			
r, Phosphorus, and Nitrogen Compounds										
Most compounds in these classes can be determined using Methods A-F or H, depending on volatility characteristics, except that selective detectors may be used (e.g., GC/FPD for S or P compounds, GC/AFD for N or P compounds, etc.)										
c Compounds										
NIOSH P&CAM 221	Aliphatic Amines (C_1 to C_6)	Adsorption on silica gel; elution with acid; neutralization; GC/FID analysis	500 ppbv (10 liter sample)	–	±3-5%	Low	Low	2	Sensitivity may not be adequate for ambient air monitoring.	GC/NPD can be used to obtain better sensitivity (see method below).
–	Aliphatic Amines (C_1-C_4)	Adsorption of alkali treated Porasil A; thermal desorption GC/NPD analysis	1-5 ppbv (60 leter sample)	80-100%	±5-10%	Moderate	Moderate	44	Requires careful conditioning of GC system to obtain adequate performance	–
NIOSH P&CAM 168	Aromatic Amines	Adsorption on silica gel; elution with ethanol; GC/FID analysis	100 ppbv (100 liter sample)	–	±10%	Low	Low	2	High humidy levels reduce adsorption capacity	Sensitivity could be improved using GC/NPD. HPLC can also be used (46).
--	Aromatic Amines	Adsorption on Tenax GC; thermal desorption GC/FID or GC/NPD analysis	1 ppbv (100 liter sample)	–	–	Low	Moderate	45	Desorption of high boiling compounds is not complete.	Solvent desorption approaches may be more effective in some cases.
ogen Heterocycles										
These compounds can be determined by the methods described for hydrocarbons and halogenated hydrocarbons, depending on volatility, except GC/NPD or HPLC detection of these compounds may be required. Polar GC phases (e.g., Carbowax 20 M) should be used in most cases.										

Table 3-8B Summary of Sampling and Analysis Methods for Selected Toxic Organic Compounds

Compound	Most Appropriate Methods From Table 3-8A	Specific References	Comments
Acetaldehyde	J, K	4, 19	Compound very unstable, requires immediate analysis or derivatization.
Acrolein	J, K	4	Compound very unstable, required immediate analysis or derivatization.
Acrylonitrile	B, F	2	NIOSH Method S156 uses methanol as desorption solvent. GC/NPD will give improved sensitivity.
Allyl Chloride (3-Chloro-1-propene)	B, E, F	2	Compound is too volatile to allow use of Tenax/thermal desorption approach. NIOSH Method S116 uses benzene solvent desorption with GC/FID analysis.
Benzyl Chloride	B, C or D	27	Cryogenic trapping or Tenax adsorption appear to be the best approaches. Adsorption on XAD-2 may also be useful. GC/PID is a useful determinative method.
Carbon Tetrachloride	B, C or D	27	Cryogenic trapping or Tenax adsorption appear to be the best approaches. Storage of samples in contact with stainless steel surfaces can result in rapid loss of this compound. GC/ECD is a useful method.
Chlorobenzene	B, C or D	14, 27, 50	Cryogenic trapping or Tenax adsorption appear to be the best approaches. GC/PID is a useful method.
Chloroform	B, C or D	14, 27	Cryogenic trapping or Tenax adsorption appear to be the best approaches. GC/ECD is a useful determinative.
Chloroprene (2-Chloro-1,3-butadiene)	B, C or D	–	Cryogenic trapping or Tenax adsorption appear to be best approaches, although very little data is available. GC/PID is a useful determinative method.
o,m, or p-cresol (2,3, or 4-methyl phenol)	C, S, H (low volume)	4, 54	Either collection in sodium hydroxide impinger, Tenax adsorption, or resin adsorption/solvent extraction can be used. GC/PID is a useful determinative method.
1,4-dichlorobenzene	B, C or D	27, 50	Cryogenic trapping or Tenax adsorption appear to be the best approaches. Resin adsorption/solvent desorption approaches can be used. GC/ECD or PID are useful determinative methods.
Dimethylnitrosamine (N-nitrosodimethylamine)	M	49	Adsorption on Thermosorb N/thermal desorption appears to be the best approach. GC/NPD may provide sufficient selectivity in many cases.

Table 3-8B Summary of Sampling and Analysis Methods for Selected Toxic Organic Compounds (Cont'

Compound	Most Appropriate Methods From Table 3-8B	Specific References	Comments
Epichlorohydrin (1-Chloro-2,2-epoxypropane)	B, C or D	27	Relatively little ambient air data are available in the literature. Cryogenic trapping or Tenax adsorption appear to be viable approaches.
Ethylene dichloride (1,2-dichloroethane)	B, C or D	14, 27	Cryogenic trapping or Tenax adsorption appear to be the best approaches. GC/ECD is a useful determinative method.
Ethylene Oxide	A, B, E	2	Compound too volatile to use Tenax adsorption. Cryogenic trapping is probably the best approach.
Formaldehyde	J, K	4, 19	Compound very reactive. Requires immediate analysis or stabilization.
Hexachlorocyclopentadiene	C or D, H (low volume approach)	53	Very little data available for this compound in ambient air.
Maleic Anhydride	–	–	No suitable methods could be found.
Methyl Chloroform (1,1,1-trichloroethane)	B, C or D	27	Cryogenic trapping or Tenax adsorption appear to be the best approaches. GC/ECD is a useful determinative method.
Methylene Chloride	B, F	14	Cryogenic trapping, appears to be the most useful approach. This compound is not retained well by Tenax or other polymeric adsorbents. Adsorption on carbon molecular sieves in place of Tenax is a useful approach. Laboratory contamination with methylene chloride is a common problem.
Nitrobenzene	B, C or D	14	Tenax adsorption is probably the best approach. GC/ECD, PID or NPD are useful determinative methods.
Nitrosomorpholine	M	55	See Dimethylnitrosamine. HPLC may be useful in place of GC for this compound.
Perchloroethylene (Tetrachloroethylene)	B, C or D	14, 27	Cryogenic trapping or Tenax adsorption appear to be the most useful approaches. GC/ECD is a useful determinative method.
Phenol	C or S	4, 19	Trapping in basic impinger solution or Tenax adsorption appear to be the best approaches. GC/PID is a useful determinative method.

Table 3-8B Summary of Sampling and Analysis Methods for Selected Toxic Organic Compounds (Cont'd)

Compound	Most Appropriate Methods From Table 3-8A	Specific Methods	Comments
Phosgene	–	51	This compound is highly unstable and hence field determination is desirable. A manual colorimetric method using 4-nitrobenzylpridine appears to be the best approach for routine analysis (detection limit =0.05 ppm for 25 liter sample).
PCBs	H	40	Adsorption of XAD-2 or polyurethane foam followed by solvent extraction and GC/ECD analysis appear to be the best approaches. PCB formulations are composed of many individual compounds and the method of quantification required careful consideration.
Propylene Oxide	B, C or D	27	Cryogenic trapping or Tenax adsorption appear to be the best approaches, although the Tenax approach should be used with caution because of the low breakthrough volume for this compound.
Toluene	B, C or D	14, 17, 27, 41, 52	Cryogenic trapping or Tenax adsorption appear to be the best approaches. GC/PID is a useful determinative technique.
Trichloroethylene	B, C or D	14, 27	Cryogenic trapping or Tenax adsorption appear to be the best approaches. GC/ECD is a useful determinative technique.
Vinylidine Chloride (1,1-dichloroethane)	B, C or D	14, 27	Cryogenic trapping or Tenax adsorption appear to be the best approaches. GC/ECD is a useful determinative technique.
o,m,p-xylene (1,2; 1,3; or 1,4-dimethyl benzene)	B, C or D	14, 17, 27, 41, 52	Cryogenic trapping or Tenax adsorption appear to be the best approaches. Adsorption on XAD-2 and solvent extraction is also possible. GC/PID is a useful determinative method.

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4.0 EQUIPMENT AND CONTAINERS CLEANING PROCEDURES

4.1 GENERAL

4.1.1 Introduction

The cleaning procedures outlined here are to be used by DEC BUREAU OF SPILL PREVENTION AND RESPONSE (DEC BSPR) personnel to guide or evaluate laboratory contractor performance and to clean sampling and other field equipment, as well as sample containers, prior to and after field use. Sufficient clean equipment and sample containers should be transported to the field so that an entire inspection or investigation can be conducted without having to clean sample containers and equipment in the field. However, this will not always be possible when using specialized field equipment. Field cleaning procedures are included to cover these special problem areas. Emergency field sample container cleaning procedures are also included; however, they should not be used unless absolutely necessary. Specific cleaning procedures are presented in the following sections.

These procedures are the operating procedures for the DEC BSPR; any deviation from them should be documented in field records and investigative reports.

4.1.2 Cleaning Materials

The cleaning materials referred to in these procedures are defined in the following paragraphs.

The laboratory detergent shall be a standard brand of phosphate-free laboratory detergent such as Alquinox or Liquinox. The use of any other detergent must be justified and documented in the field logbooks and inspection or investigative reports.

The nitric acid solution (10 percent) shall be made from reagent-grade nitric acid and deionized water.

The standard cleaning solvent shall be pesticide-grade isopropanol. However, solvents may be substituted for a particular investigation if needed. Pesticide-grade acetone or methanol are both acceptable. However, it should be noted that if pesticide-grade acetone is used, the detection of acetone in samples collected with acetone rinsed equipment is suspect. Pesticide-grade methanol is much more hazardous to use than either pesticide-grade isopropanol or acetone, and its use is discouraged. Pesticide-grade hexane and petroleum ether are not miscible with water; therefore, these two solvents are not effective rinsing agents unless equipment is dry. The use of any solvent other than pesticide-grade isopropanol for equipment cleaning purposes must be justified and its use must be documented in field logbooks and inspection or investigative reports.

Tap water may be used from any municipal water treatment system. The use of an untreated potable water supply is not an acceptable substitute for tap water.

Deionized water is defined as tap water that has been treated by passing through a standard deionizing resin column. The deionized water should contain no heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard Analytical Method inductively coupled Argon Plasma Spectrophotometer (ICP) scan or any justified equivalent method. Organic-free water is defined as tap water that has been treated with activated carbon and deionizing units. A set up of a 5-micron pre-filter, activated carbon unit, two mixed bed deionizing units (in series), a 0.2 micron post filter, and a post-carbon filter can produce organic-free water. The Milli-Q system also produces organic-free water. Organic-free water should contain no pesticides, herbicides, extractable organic compounds, and less than 50 ug/l of purgeable organic compounds as measured by a low level GC/MS scan.

Sections which need special attention from DEC BSPR personnel are: 4.3, 4.4, 4.7.7, 4.7.10, 4.8.2

During cleaning operations, the substitution of a higher grade water (i.e., deionized or organic-free water for tap water) is permitted and need not be noted as a variation of these procedures. However, the deionized and organic-free water utilized must be subject to the specific quality control procedures as outlined in Section 4.2.2.

The brushes used to clean equipment as outlined in the various sections of this protocol shall not be of the wire-wrapped type.

The solvents, nitric acid solution, laboratory detergent, and rinse waters used to clean equipment shall not be reused, except as specifically permitted in the footnote for Step 3, Section 4.3.

4.1.3 Marking of Cleaned Sampling Equipment and Containers

All equipment and sample containers that are cleaned utilizing these procedures shall be tagged, labeled, or marked with the date that the equipment was cleaned. Also, if there was a deviation from the standard cleaning procedures outlined in this protocol, this fact should be noted on the label.

When sample containers are cleaned and prepared, they should be cleaned in standard sized lots of 100, if possible, to facilitate the quality control procedures outlined in Section 4.2.

4.1.4 Marking and Segregation of Used Field Equipment

Field or sampling equipment that needs to be repaired shall be identified with a red tag. Any problems encountered with the equipment and needed repairs shall be noted on this tag. Field equipment or reusable sample containers needing cleaning or repairs shall not be stored with clean equipment, sample tubing, or sample containers. Field equipment, reusable sample containers, disposable sample containers, and sample tubing that are not used during the course of an investigation may not be replaced in storage, without being recleaned, if these materials are transported to a facility or study site where herbicides, pesticides, organic compounds, or other toxic materials are present or suspected of being present, and/or, if, in the opinion of the field investigator, they may have become contaminated during the course of the field investigation.

4.1.5 Decontamination of Equipment Used to Collect Samples of Toxic or Hazardous Waste

Equipment that is used to collect samples of hazardous materials or toxic wastes or materials from hazardous waste sites, RCRA facilities, or in-process waste streams shall be decontaminated before it is returned from the field. At a minimum, this decontamination procedure shall consist of washing with laboratory detergent and rinsing with tap water. More stringent decontamination procedures may be required, depending on the waste sampled.

4.1.6 Proper Disposal of Cleaning Materials

The solvent used to rinse sampling equipment and containers shall be collected and disposed of by allowing it to evaporate under a fume hood or be containerized and disposed of through an approved hazardous waste disposal contract. Similarly, spent nitric acid shall be collected and disposed of through the same disposal contract. These procedures apply whether the cleaning operations take place in the equipment washroom or in the field.

4.1.7 Safety Procedures to be Utilized During Cleaning Operations

The materials used to implement the cleaning procedures outlined in this protocol can be dangerous if improperly handled. Due caution must be exercised by all operating personnel and all applicable safety procedures shall be followed. At a minimum, the following precautions shall be taken in the washroom and in the field during these cleaning operations:

1. Safety glasses with splash shields or goggles, neoprene gloves, and a neoprene laboratory apron will

be worn during all cleaning operations.

2. All solvent rinsing operations will be conducted under a fume hood or in the open (never in a closed room).

3. No eating, smoking, drinking, chewing, or any hand to mouth contact shall be permitted during cleaning operations.

4.1.8 Storage of Field Equipment and Sample Containers

All field equipment and sample containers shall be stored in a contaminant free environment after being cleaned using the procedures outlined in this protocol.

4.2 SPECIFIC QUALITY CONTROL PROCEDURES FOR CLEANING OPERATIONS

4.2.1 General

This section establishes guidelines for specific quality control procedures to monitor the effectiveness of the sampling equipment and sample container cleaning procedures outlined in this protocol. These procedures shall be carried out by appropriate personnel and the results monitored by the Quality Assurance Officer. All quality control procedures shall be recorded in a logbook maintained in the appropriate washroom(s). All quality control data shall be maintained in a separate quality assurance file. Upon receipt of quality control data, the Quality Assurance Officer shall review these data to identify any abnormalities or contamination of sampling equipment or sample containers. If problems are detected, the Quality Assurance Officer shall immediately initiate an investigation to determine the cause of the problem(s) and institute an immediate, corrective action.

4.2.2 Rinse Water

The quality of the deionized and organic-free water used shall be monitored by collecting samples once per quarter in standard precleaned, sample containers and submitting them to a certified laboratory for a standard ICP scan. Organic-free water will also be submitted for low level pesticide, herbicide, extractable and purgeable compounds analyses. When field deionizing and/or organic-free water units are utilized, more frequent quality control samples will be collected. An initial sample and samples at weekly intervals are the minimum number considered acceptable.

4.2.3. Sampling Equipment Cleaned in Washroom

The effectiveness of the equipment cleaning procedures used in the washroom shall be monitored by rinsing cleaned equipment (equipment used to collect samples for trace organics and metals analyses) with organic-free or Milli-Q water and submitting the rinse water to a certified laboratory for low level analysis of extractable organic compounds including pesticides and a standard ICP scan. At least one piece of field equipment shall be selected for this procedure each time equipment is washed. An attempt should be made to select different pieces of equipment for this procedure, each time equipment is washed, so that a representative sampling of all equipment is obtained over a 12-month period.

4.2.4 Sampling Equipment Cleaned in the Field

The effectiveness of field cleaning procedures shall be monitored by rinsing field cleaned equipment with organic-free water and submitting the rinse water in standard sample containers to a certified laboratory for analysis as outlined in Section 4.2.3. Any time equipment is cleaned in the field at least one such quality control sample shall be collected. No more than five percent of the equipment cleaned during large field studies shall be subjected to these procedures.

Additional samples may be required to document quality assurance of field cleaning procedures. Any time a source of cleaning materials or rinse water is used other than that specified in Section 4.1.2, a sample of that cleaning material or rinse water shall be submitted in standard sample containers as specified in Section 4.2.2.

4.2.5 Glass Disposable Sample Containers for Organic Compounds and Plastic Containers for Metals Analyses and Other Specified Organic Compounds

The sample containers will be submitted to a certified laboratory for analysis utilizing the same standard low level analytical techniques as outlined in Section 4.2.3. The sample containers will be supplied to the certified laboratory at the rate of one percent of each kind of container used.

4.2.6 Plastic Disposable Sample Containers for Oxygen Demand, Nutrients, and General Inorganics

These containers will be filled with deionized or organic-free water, preserved as required, and submitted to be checked up for the designated parameters for each sample container. These sample containers will be selected at random from the stock at the rate of approximately one percent of each kind of container of the total used.

4.2.7 Reusable Composite Sample and Organic-Free Water Containers

These containers will be rinsed with organic-free water and the rinse water will be submitted to the check up procedures as outlined in Section 4.2.3. Approximately one percent of all such containers cleaned will be subjected to this procedure.

4.3 CLEANING PROCEDURES FOR TEFLON OR GLASS FIELD SAMPLING EQUIPMENT USED FOR THE COLLECTION OF SAMPLES FOR TRACE ORGANIC COMPOUNDS AND/OR METALS ANALYSES*

1. Equipment will be washed thoroughly with laboratory detergent and hot water using a brush to remove any particulate matter or surface film.
2. The equipment will be rinsed thoroughly with hot tap water.
3. Rinse equipment with at least a 10 percent nitric acid solution.**
4. Rinse equipment thoroughly with tap water.
5. Rinse equipment thoroughly with deionized water.
6. Rinse equipment twice with solvent and allow to air dry for at least 24 hours.
7. Wrap equipment completely with aluminum foil or equivalent to prevent contamination during storage and/or transport to the field.

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* - When this sampling equipment is used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide-grade acetone or hexane to remove the materials before proceeding with Step 1. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with Step 1. If the field equipment cannot be cleaned utilizing these procedures, it should be discarded.

** - Small and awkward equipment such as vacuum bottle inserts and well bailers may be soaked in the nitric acid solution instead of being rinsed with it. Fresh nitric acid solution should be prepared for each cleaning session.

8. Rinse the Teflon or glass sampling equipment thoroughly with tap water in the field as soon as possible after use.

4.4 CLEANING PROCEDURES FOR STAINLESS STEEL OR METAL SAMPLING EQUIPMENT USED FOR THE COLLECTION OF SAMPLES FOR TRACE ORGANIC COMPOUNDS AND/OR METALS ANALYSIS*

1. Wash equipment thoroughly with laboratory detergent and hot water using a brush to remove any particulate matter or surface film.

2. Rinse equipment thoroughly with hot tap water.

3. Rinse equipment thoroughly with deionized water.

4. Rinse equipment twice with solvent and allow to air dry for at least 24 hours.

5. Wrap equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.

6. Rinse the stainless steel or metal sampling equipment thoroughly with tap water in the field as soon as possible after use.

4.5 CLEANING PROCEDURES FOR AUTOMATIC WATER SAMPLING EQUIPMENT

4.5.1 General

All ISCO and other automatic samplers will be cleaned as follows:

- The exterior and accessible interior (excluding the waterproof timing mechanism) portions of automatic samplers will be washed with laboratory detergent and rinsed with tap water.
- The face of the timing case mechanism will be cleaned with a clean damp cloth.
- All tubing (sample intake and pump tubing) will be discarded after use.
- New precleaned, silastic pump tubing (see Section 4.6.1) will be installed.
- When utilizing the samplers for collecting samples for metals and/or organic compounds analyses, the metal distributor tubes should not be used; only glass or silastic pump tubing should be used for this purpose.

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* - When this sample equipment is used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide grade acetone or hexane to remove the materials before proceeding with Step 1. In extreme cases, when equipment is painted, badly rusted, or coated with materials that are difficult to remove, it may be necessary to steam clean, wire brush, or sandblast equipment before proceeding with Step 1. Any stainless steel sampling equipment that cannot be cleaned using these procedures should be discarded.

- The ISCO 1680 automatic samplers should not be used for collecting samples for organic compounds analyses in the individual bottle mode because there is no way to properly clean the distributor plate to remove any residual organic compounds. The sample tubing headers may not be used to collect samples for organic compounds analyses for the same reason. The ISCO 2100 automatic samplers may be used to collect samples for organic compounds analyses in the individual bottle mode, if the specific cleaning procedures for the ISCO 2100 glass sequential bottles are followed as outlined in Section 4.5.8.

Specific cleaning procedures for components of the ISCO automatic samplers follow.

4.5.2 ISCO 1680 Automatic Sampler Rotary Funnel and Distributor

1. Use only for non-organic compounds sample collection using individual sequential bottles.
2. Clean with hot water, laboratory detergent and a brush.
3. Rinse thoroughly with deionized water.
4. Replace in sampler.

4.5.3 ISCO 1680 Automatic Sampler Metal Tube

Clean as outlined in 4.5.2.

4.5.4 All Automatic Sampler Heads

1. Disassemble header and using a bottle brush, wash with hot water and phosphate free laboratory detergent.
2. Rinse thoroughly with deionized water.
3. Reassemble header, let dry thoroughly and wrap with aluminum foil.

4.5.5 Reusable Glass Composite Sample Containers*

1. Wash containers thoroughly with hot tap water and laboratory detergent, using a bottle brush to remove particulate matter and surface film.
2. Rinse containers thoroughly with hot tap water.
3. Rinse containers with at least 10 percent nitric acid.
4. Rinse containers thoroughly with tap water.

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* - When these containers are used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the container several times with pesticide grade acetone before proceeding with Step 1. If these materials cannot be removed with acetone, the container should be discarded. Glass reusable composite containers used to collect samples at pesticide, herbicide, or other chemical manufacturing facilities that produce toxic or noxious compounds shall be disposed of "properly" (preferably at the facility) at the conclusion of sampling activities and shall not be returned for cleaning. Also, glass composite containers used to collect in-process wastewater samples at industrial facilities shall be discarded after sampling. Any bottles that have a visible film, scale, or discoloration remaining after this cleaning procedure shall also be discarded.

5. Rinse containers thoroughly with deionized water.

6. Rinse twice with solvent and allow to air dry for at least 24 hours.

7. Cap with aluminum foil or Teflon film.

8. After using, rinse with tap water in the field, seal with aluminum foil to keep the interior of the container wet, and return to the laboratory.

4.5.6 Plastic Reusable Composite Sample Containers*

Proceed with the cleaning procedures as outlined in 4.5.5 but omit the solvent rinse.

4.5.7 ISCO 1680 and 2100 Glass Sequential Sample Bottles Automatic Sampler Base for Sequential Mode**

1. Rinse with 10 percent nitric acid.

2. Rinse thoroughly with tap water.

3. Dishwasher, wash cycle, using laboratory detergent cycle, followed by tap and deionized water rinse cycles.

4. Replace bottles in covered, automatic sampler base, and cover with aluminum foil for storage.

5. Rinse bottles in the field as soon as possible after using tap water.

4.5.8 ISCO 2100 Glass Sequential Sample Bottles (Automatic Sampler Base for Sequential Mode) to be Used for Collecting Samples for Organic Compounds Analyses

1. Proceed as outlined in Steps 1-4 in Section 4.5.7.

2. Rinse twice with solvent and allow to air dry for at least 24 hours.

3. Replace in covered, automatic sampler base, cover with aluminum foil for storage, and mark the base as follows: "Cleaned for organic analyses."

4.5.9 Bottle Siphons Used to Transfer Sample From Composite Container

1. Use a new siphon for each sampling location.

2. Use 3/8-inch Teflon tubing for samples collected for organic compounds analyses. The tubing should be rinsed with solvent and dried in the contaminant-free drying oven overnight before use. The ends

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* - Plastic reusable sample containers used to collect samples from facilities that produce toxic or noxious compounds or are used to collect in-process waste stream samples at industrial facilities will be disposed of properly (preferably at the facility) at the conclusion of the sampling activities and will not be returned for cleaning. Any plastic composite sample containers that have a visible film, scale, or other discoloration remaining after this cleaning procedure will be discarded.

** - These ISCO 1680 glass sequential sample bottles are not to be used for collecting samples for organic compounds analyses. The ISCO 2100 bottles also are not to be used for collecting samples for organic compounds analyses unless the cleaning procedures outlined in 4.5.8 are used.

of the siphon should be capped with aluminum foil and/or Teflon film for storage. The siphon should be flushed with sample thoroughly before use.

3. The 3/8-inch PVC tubing utilized for samples, other than those collected for organic compounds analyses, should be thoroughly flushed with sample before use.

4.5.10 Reusable Teflon Composite Mixer Rods

1. Follow procedure outlined in Section 4.3.
2. Wrap rod in aluminum foil for storage.

4.6 CLEANING PROCEDURES FOR SAMPLE TUBING

4.6.1 Silastic Rubber Pump Tubing Used In Automatic Samplers and Other Peristaltic Pumps

New Precleaned tubing must be used for each automatic sampler set-up. The silastic rubber tubing need not be replaced in peristaltic pumps where the sample does not contact the tubing or where the pump is being used for purging purposes (i.e., not being used to collect samples).

The silastic tubing shall be precleaned as follows:

1. Flush tubing with hot tap water and phosphate-free laboratory detergent.
2. Rinse tubing thoroughly with hot tap water.
3. Rinse tubing with deionized water.
4. Install tubing in automatic sampler or peristaltic pump.
5. Cap both ends of tubing with aluminum foil.

4.6.2 Teflon Sample Tubing

Use only new Teflon tubing precleaned as follows for collection of samples for organic compound analyses:

1. Teflon tubing shall be precut in convenient lengths before cleaning.
2. Rinse outside of tubing with solvent.
3. Flush interior of tubing with solvent.
4. Dry overnight in the contaminant-free drying oven.
5. Wrap tubing and cap ends with aluminum foil to prevent contamination during storage.

4.6.3 Polyvinyl Chloride (PVC) Sample Tubing (1/8, 1/4, or 3/8 inch)

1. Use only new tubing.
2. The tubing will be flushed with sample immediately before use to remove any residues from the

manufacturing or extruding process.

3. Polyvinyl chloride tubing will be used selectively where organic compounds are not of concern.

4. Tubing should be stored in original container and not removed from this container until needed.

4.6.4 Stainless Steel Tubing

1. Wash with laboratory detergent and hot water using a long, narrow, bottle brush.

2. Proceed with Steps 2-6 as outlined in Section 4.4 (footnote applies).

4.6.5 Glass Tubing

Use new glass tubing, precleaned as follows:

1. Rinse thoroughly with solvent.

2. Air dry for at least 24 hours.

3. Wrap tubing completely with aluminum foil to prevent contamination during storage.

4. Discard tubing after use.

4.7 MISCELLANEOUS EQUIPMENT CLEANING PROCEDURES

4.7.1 Well Sounders or Tapes Used to Measure Ground Water Levels*

1. Wash with laboratory detergent and tap water.

2. Rinse with tap water.

3. Rinse with deionized water.

4. Equipment should be placed in a polyethylene bag or wrapped with polyethylene film to prevent contamination during storage or transport.

4.7.2 Submersible Pumps and Hoses Used to Purge Ground Water Wells*

Proceed as outlined in Section 4.7.1.

4.7.3 Portable Power Augers Such as the Little Beaver

1. The engine and power head should be cleaned with a power washer, steam jenny, or hand washed with a brush using detergent (does not have to be laboratory detergent but should not be a degreaser) to

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* - The same procedure applies whether this equipment is cleaned in the laboratory or equipment washroom or in the field.

remove oil, grease, and hydraulic fluid from the exterior of the unit. These units should be rinsed thoroughly with tap water.

2. All auger flights and bits shall be cleaned utilizing the procedures outlined in Section 4.4 (including footnotes) or Section 4.8.3 (including footnotes if appropriate).

4.7.4 Large Soil Boring and Drilling Rigs

1. The rig should be cleaned before being mobilized and brought on-site as outlined in Step 1 of Section 4.7.3.

2. All auger flights, auger bits, drilling rods, drill bits, hollow stem augers, Split Spoon Samplers, Shelby Tubes, or other parts of the drilling equipment that will contact the soil or ground water should be cleaned as outlined in Section 4.4 (including footnotes) or Section 4.8.3 (including footnotes if appropriate).

4.7.5 Miscellaneous Sampling and Flow Measuring Equipment

Miscellaneous flow measuring and sampling equipment shall be washed with laboratory detergent, rinsed with hot tap water, followed by a thorough deionized water rinse, and dried before being stored. This procedure is not used for any equipment utilized for the collection of samples for trace organic compounds or metals analyses.

4.7.6 ISCO Flow Meters, Field Analytical Equipment, and Other Field Instrumentation

The exterior of sealed, watertight equipment such as ISCO flow meters should be washed with a mild detergent (for example, liquid dish washing detergent) and rinsed with tap water before storage. The interior of such equipment may be wiped with a damp cloth if necessary.

Other field instrumentation should be wiped with a clean, damp cloth; pH meter probes, conductivity probes, DO meter probes, etc. should be rinsed with deionized water before storage.

The desiccant in flow meters and other equipment should be checked and replaced, if necessary, each time the equipment is cleaned.

4.7.7 Ice Chests and Shipping Containers

All ice chests and reusable containers will be washed with laboratory detergent (interior and exterior) and rinsed with tap water and air dried before storage. In the event that an ice chest becomes severely contaminated, in the opinion of the field investigator, with concentrated waste or other toxic material, it shall be cleaned as thoroughly as possible, rendered unusable, and disposed of properly.

4.7.8 Pressure Field Filtration Apparatus*

1. Proceed with steps 1 through 5 as outlined in Section 4.3, assembling and applying pressure to the apparatus after each rinse step (water and acid) to drive rinse material through the porous glass filter holder in the bottom of the apparatus.

2. Assemble the apparatus and cap both the pressure inlet and sample discharge lines with aluminum foil to prevent contamination during storage.

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* - The same procedure applies whether the pressure filtration apparatus is cleaned in the laboratory or equipments washroom or in the field.

4.7.9 Organic-Free Milli-Q Water Storage Containers

1. These containers will be used only for storing organic-free or Milli-Q water.

2. New containers shall be prepared as outlined in Section 4.5.5, Steps 1-5, then rinsed thoroughly with organic-free or Milli-Q water, filled with Milli-Q water and capped.

3. Used containers shall be capped with aluminum foil immediately after being used in the field.

4. The exterior of the container will be washed with laboratory detergent and rinsed with deionized water if necessary.

5. The interior of the container shall be rinsed twice with solvent.

6. The interior of the container will be thoroughly rinsed with organic-free or Milli-Q water. The container will be filled with organic-free or Milli-Q water and capped with aluminum foil for storage.

4.7.10 Vehicles

All vehicles utilized by sampling personnel should be washed when necessary at the conclusion of field trip. This routine maintenance should minimize any chance of contamination of equipment or samples due to contamination of vehicles. When vehicles are used in conjunction with hazardous waste site inspections, or on studies where pesticides, herbicides, organic compounds or other toxic materials are known or suspected to be present, a thorough interior and exterior cleaning is necessary at the conclusion of such investigations. It shall be the responsibility of the project leader and/or field investigators to judge its necessity and to see this procedure is followed.

All vehicles should be equipped with trash bags and/or trash containers to facilitate vehicle cleaning. All field personnel are responsible for keeping field vehicles clean by removing all trash and other debris before it accumulates. All contaminated trash and equipment must be kept separate from ordinary trash and must be disposed of properly on-site or upon return to appropriate facility for proper disposal.

4.8 FIELD EQUIPMENT CLEANING PROCEDURES

4.8.1 General

Sufficient clean equipment should be transported to the field so that an entire study can be conducted without the need for field cleaning. However, this is not possible for some specialized items of field equipment such as portable power augers (Little Beaver), well drilling rigs, soil coring rigs, and other large pieces of field equipment. In addition, during particularly large scale studies, it is not practical or possible to transport to the field all of the precleaned field equipment required. The following procedures are to be utilized when equipment must be cleaned in the field.

4.8.2 Equipment Used for Routine Sample Collection Activities

For routine operations involving classic parameter analyses, water quality sampling equipment such as Kemmerers, buckets, DO dunkers, dredges, bailers, etc. may be cleaned with sample or deionized water between sampling locations. Heavy duty disposable paper towel or cloth may also be used reciprocally with sample or deionized water to clean equipment when sample has any sticky product present. But the last step of cleaning should be rinsing with sample or deionized water. A brush may be used to remove deposits of material or sediment, if necessary. If deionized water is used, water samplers should be flushed with sample at the next sampling location before the sample is collected. It should be emphasized that these procedures cannot be used to clean equipment for the collection of samples for organic compounds or trace metals analyses.

Flow measuring equipment such as weirs, staff gages, velocity meters, and other stream gaging equipment may be cleaned with tap water after use between measuring locations, if necessary.

4.8.3 Teflon, Stainless Steel or Metal Equipment Used to Collect Sample for Organic Compounds and Trace Metals Analyses*

1. Clean with tap water and laboratory detergent using a brush if necessary to remove particulate matter and surface films.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with deionized water.
4. Rinse twice with solvent.
5. Rinse thoroughly with organic-free water and allow to air dry as long as possible.
6. If organic-free water is not available, allow equipment to air dry as long as possible. Do not rinse with deionized or distilled water.
7. Wrap with aluminum foil, if appropriate, to prevent contamination if equipment is going to be stored or transported.

4.9 PREPARATION OF DISPOSABLE SAMPLE CONTAINERS

4.9.1 General

No sample container (with the exception of the glass and plastic compositing containers) will ever be reused. All disposable sample containers will be stored in their original packing containers. When packages of uncapped sample containers are opened, they will be placed in new plastic garbage bags and sealed to prevent contamination during storage. Specific precleaning instructions for disposable sample containers are given in the following sections. These instructions apply to precleaned disposable sample containers whether they are purchased from a contractor or are precleaned by any appropriate personnel.

4.9.2 One-Pint Storemore, One-Quart Storemore, One-Half Gallon, and One-Gallon Plastic Containers for Oxygen Demand, Nutrients, Classic Inorganic, Sulfide, and Cyanide Analyses

Only new containers will be used.

4.9.3 One-Half and One-Gallon Amber Glass Bottles (Water Samples), 8-, 16-, and 32 -Ounce Clear Wide-mouth Jars (Soil, Sediment, Sludge, and Concentrated Waste) With Teflon Lined Caps for Organic Compounds (Excluding Purgeables) and Metals Analysis

1. Wash bottles and jars, Teflon liners, and caps in hot tap water and laboratory detergent.

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* - Portable power augers (such as the Little Beaver) or large soil boring or drill rigs should be cleaned as outlined in Step 1 of Section 4.7.3 before boring or drilling operations.

2. Rinse three times with tap water.
3. Rinse with nitric acid solution.*
4. Rinse three times with deionized water.
5. Rinse bottles, jars, and liners (not caps) with solvent.*
6. Oven dry bottles, jars, and liners at 125° C. Allow to cool.
7. Place liners in caps and cap containers.
8. Store containers in contaminant-free area.

4.9.4 40 ml Glass Vials for Water Samples (Purgeable Organic Compounds Analysis) and 250 ml Amber Glass Narrow Necked Bottles for Water Samples (TOX Analysis) with Teflon Lined Septa; and 4-Ounce (120 ml) Clear Wide-mouth Glass Jars with Teflon Liner for Soil Samples (Purgeable Organic Compounds Analysis)

1. Wash vials, bottles and jars, Teflon liners and septa, and caps in hot tap water and laboratory detergent (non-phosphate).
2. Rinse three times with hot tap water, and rinse three times with deionized water.
3. Oven dry at 125° C.
4. Allow all vials, bottles, jars, liners, and septa to cool in an enclosed contaminant-free environment.
5. Seal vials, bottles, and jars with liners or septa as appropriate and cap.
6. Store vials, bottles, and jars in a contaminant free area.

4.9.5 One Liter Polyethylene Bottle for Metals and General Inorganics

1. Wash polyethylene bottles and caps in hot water with laboratory detergent.
2. Rinse both with nitric acid solution.
3. Rinse three times with deionized water.
4. Invert bottles and dry in contaminant free environment.
5. Cap bottles.
6. Store in contaminant free area.

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* - Some bottle cleaning contractors use pesticide grade methylene chloride to solvent rinse sample containers. Also some of these contractors use 1:1 reagent grade nitric acid to rinse sample containers. For the purpose of cleaning sample containers as outlined in Section 4.9.3 and 4.9.5, both of these deviations from the information contained in Section 4.1.2 are permitted.

4.9.6 Containers for Conventionals, and Nitrogen and Phosphorous Series

1. Use new plastic or borosilicate glass bottles (1 liter minimum).
2. Wash containers and caps with hot water.
3. Rinse with 1:1 sulfuric acid.
4. Rinse three times with ASTM Type I reagent water.
5. Air dry.
6. Cap bottles when dry.

4.10 EMERGENCY DISPOSABLE SAMPLE CONTAINER CLEANING

New one-pint or one-quart mason jars may be used to collect samples for analyses of organic compounds and metals in waste and soil samples in an emergency. These containers would also be acceptable on an emergency basis for the collection of water samples for extractable and pesticide organic analyses, as well as metal analyses. These jars cannot be used for the collection of water samples for purgeable organic analyses.

The rubber sealing ring should not be in contact with the jar and aluminum foil should be used, if possible, between the jar and the sealing ring. If possible, the jar and aluminum foil should be rinsed with pesticides grade methanol* and allowed to air dry before use. Several empty bottles and lids should be submitted to the laboratory as blanks for quality control purposes.

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* - Pesticide-grade petroleum ether or hexane may also be used. The specific solvent used should be specified.

5.0 SAMPLING PROCEDURES

5.1 INTRODUCTION

This section discusses practices and procedures for use by DEC Bureau of Spill Prevention and Response (DEC BSPR) personnel or contractor during field operations to ensure the collection of representative samples. All sampling activities conducted by DEC BSPR personnel or contractor are conducted with the expectation that they will be used for enforcement purposes, unless specifically stated to the contrary in advance of the field investigation. Therefore, the use of proper sampling procedures cannot be over emphasized. The collection of representative samples depends upon:

- ensuring that the sample taken is truly representative of the material or medium being sampled;
- using proper sampling, sample handling, preservation, and quality control techniques;
- properly identifying the collected samples and documenting their collection in permanent field records;
- maintaining sample chain-of-custody; and
- protecting the collected samples by properly packing and transporting (shipping) them to a laboratory for analysis.

The objectives of this section are to present:

- general considerations that must be incorporated in all sampling operations conducted by the DEC BSPR personnel or contractor;
- specific sampling site selection and collection procedures for individual media; and
- specific sampling quality assurance procedures as well as equipment calibration and maintenance requirements for sampling equipment.

5.2 GENERAL CONSIDERATIONS

The following factors and procedures shall be considered and implemented in planning and conducting all sampling operations with the specific objectives and scope of individual site investigation. Representative sampling sites are dependent on the type of investigation being undertaken and are discussed under the sample procedures for each medium later in this section. The type of sampling equipment to be used is also discussed in Section 3.0 and the sampling procedure in this section. Section 4.0 describes the equipment cleaning procedures.

5.2.1 Sampling Equipment Construction Material

The material that sampling equipment is constructed of can affect sample analytical results. Materials must not contaminate the sample being collected and must be readily cleaned so that samples are not cross-contaminated. The standard materials for sampling equipment used for trace organic compounds or metals analyses are, in order of decreasing desirability; Teflon, glass, stainless steel and steel.

5.2.2 Selection of Parameters to be Measured

Parameters to be measured are usually dictated by the purpose of an investigation and should be based on required monitoring conditions (NPDES or RCRA permits for example) or on the field investigator's or requester's knowledge of the problem being investigated.

5.2.3 Dissolved and Particulate Sample Fractions

A water sample is generally composed of dissolved and particulate fraction. When it is necessary to analyze samples for each fraction, instead of the total sample, it may be necessary to filter the sample in the field. Field filtration should be conducted only for conventional analytical parameters or metals; samples that will be analyzed for organic compounds shall not be filtered in the field.

5.2.4 Required Sample Volumes

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

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

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

The sample volume required for each analysis is the volume of the standard container less ullage (empty space) required for sample mixing by laboratory personnel and safe shipment of samples to the laboratory. Sampling personnel shall allow a minimum of ten percent ullage in every sample container for this purpose. The only exceptions are samples collected for purgeable organic analysis (VOA) or dissolved gases such as sulfides for which sample containers must be completely filled.

5.2.5 Selection and Proper Preparation of Sample Containers

The type of sample container is dictated by the analyses required. Standard sample containers to be used by sampling personnel are presented in Appendix 5X.1. Special sample container preparation requirements are in Section 4.0.

5.2.6 Sample Preservation

Samples for some analyses must be preserved in order to maintain their integrity. Preservations required for routine analyses of samples are given in Appendix 5X.1. All samples should be preserved immediately upon collection in the field. The only samples that should not be immediately preserved in the field are:

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

- Samples that have extremely low or high pH or samples that may generate potentially dangerous gases if they were preserved using the procedures given in Appendix 5X.1.

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

- Samples for metals analysis which are to be shipped as soon as possible. They shall not be preserved with nitric acid in excess of the amount specified in Appendix 5X.3.

- Samples for purgeable organic compounds (VOA) analyses which are shipped by air shall not be preserved with hydrochloric acid in excess of the amount specified in Appendix 5X.3.

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

5.2.7 Sample Holding Times

The elapsed time between sample collection and initiation of laboratory analyses must be within a prescribed time frame for each individual analysis. Sample holding times for all routine samples are shown in Appendix 5X.1.

5.2.8 Sample Handling and Mixing

Once a sample has been collected, it may have to be split into separate containers for different analyses. The best way to split liquid samples is to continually stir the sample contents with a clean pipette or pre-cleaned Teflon rod and allow the contents to be alternately siphoned into respective sample containers using Teflon or PVC (Tygon type) tubing. Teflon must be used when analyses for organic compounds or trace metals are to be conducted. Any device used for stirring, or tubing used for siphoning, must be cleaned in the same manner as other equipment (Section 4.0).

A true split of soil, sediment, or sludge samples is almost impossible to accomplish under field conditions. The more moisture samples contain, the more difficult it is to split them. Procedures such as the one outlined in Section 5.7.4.5 should be used to obtain a homogenous sample. Even when such procedures are followed, the sample should be considered a duplicate and not a split sample.

After collection, all samples should be handled as few times as possible. Sample handling personnel should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, personnel should ensure that melted ice cannot cause sample containers to become submerged, as this may result in sample cross-contamination. Plastic bags, such as zip-lock bags, should be used to prevent cross-contamination when small sample containers (e.g., VOA's or bacterial samples) are placed in ice chests.

5.2.9 Special Precautions for Trace Contaminant Sampling

Some compounds can be detected in the parts per billion and/or parts per trillion range. Extreme care must be taken to prevent cross-contamination of these samples. The following precautions shall be taken when trace contaminants are of concern:

- A clean pair of new, disposable gloves will be worn each time a different point or location is sampled;

- Sample containers for source samples or samples suspected of containing high concentrations of contaminants shall be placed in separate plastic bags immediately after collecting, preserving, tagging, etc.;

- If possible, ambient samples and source samples should be collected by different field teams. If separate collection is not possible, all ambient samples shall be collected first and placed in separate ice chests or shipping containers. Samples of waste or highly contaminated samples shall never be placed in the same ice chest as environmental samples. It is good practice to enclose waste or highly contaminated samples in a plastic bag before placing them in ice chests. Ice chests or shipping containers for source samples or samples suspected of containing high concentrations of contaminants shall be lined with new, clean, plastic bags.

- If possible, one member of the field team should take all the notes, fill out tags, etc., while the other member does all of the sampling.

- When sampling surface waters, the water sample should always be collected before the sediment sample is collected.

- Sample collection activities should proceed progressively from the least contaminated area to the most contaminated area (if this fact is known).

- Sampling personnel should use equipment constructed of Teflon, stainless steel, or glass that has been properly precleaned (Section 4.0) for collecting samples for trace metals or organic compounds analyses. Teflon or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC shall not be used to collect samples for trace organic compounds analyses.

5.2.10 Sample Identification

All samples will be fully documented, as outlined in Appendix 5X.2, in the field records, on the field sample chain-of-custody record, and on the sample tags.

5.2.11 Procedures for Identifying Potentially Hazardous Samples

Any sample either known or thought to be hazardous should be so identified on both the sample tag and the field sample chain-of-custody sheet. Information explaining the hazard, i.e., corrosive, flammable, poison, etc., shall also be listed.

5.2.12 Collection of Auxiliary Data

All auxiliary data such as flow measurements, photographs of sampling sites, meteorogical conditions, and other observations shall be entered into field records when the auxiliary data are collected. Auxiliary data relative to a particular sampling location should be collected as close to the sample collection time as possible. Specific types of auxiliary data to collect for each medium sampled are discussed later in this section.

5.2.13 Time Records

All records of time shall be kept using local time in the 2400 hour time format and shall be recorded to the nearest five minutes.

5.2.14 Transporting and Shipping of Samples

Samples may be hand delivered to the laboratory using government owned (or private) vehicles or they may be shipped by common carrier. All sample handling personnel must be aware that certain samples are hazardous materials and, as such, are regulated by the U.S. Department of Transportation under the Transportation Safety Act of 1974. These regulations are contained in Title 49, CFR, Parts 110-119. All DEC BSPR employees shall be aware of and meet the regulations that have been set up by the Transportation Safety Act of 1974 when shipping samples by common carrier.

5.2.15 Sample Chain-of-Custody

DEC BSPR employees or all sample handling personnel shall maintain chain-of-custody during all field investigations for all samples collected. The recommended sample chain-of-custody procedures used by DEC BSPR employees or contractor are given in Appendix 5X.2.

5.3 DEFINITIONS

5.3.1 Grab Sample

A grab sample is an individual sample collected over a period of time generally not exceeding 15 minutes. A grab sample is normally associated with water or polluted water sampling. However, soil, sediment, liquid hazardous samples, etc., may also be considered grab samples. No particular time limit would apply for the collection of such samples.

1. Grab samples are:
   - Used to characterize the medium at a particular instant in time; and
   - Always associated with instantaneous water or polluted water flow data (where appropriate).
2. Grab sampling is conducted when:
   - The water or polluted water stream is not continuous (e.g., batch-discharges or intermittent flow);
   - The characteristic of the water or polluted stream are known to be constant or nearly so;
   - The sample is to be analyzed for parameters whose characteristics are likely to change significantly with time, i.e., dissolved gases, bacteria, etc.;
   - The sample is to be collected for analysis of a parameter such as oil and grease where the compositing process could significantly affect the actual concentration; and
   - Data on maximum/minimum concentrations are desired for a continuous water or polluted water stream.
3. Analyses for which samples of water should always be collected by the DEC BSPR personnel or contractor using the grab sample method or for which measurements shall be made in-situ include:

pH
temperature
dissolved oxygen
sulfide
chlorine residual
other dissolved gases
phenol
oil and grease
bacteria
volatile organic compounds
specific conductance
dissolved constituents in field filtered samples (total-P, ortho-P, metals, etc.)

5.3.2 Composite Sample

5.3.2.1 Timed Composite - A sample containing some discrete samples in equal volume collected at equal time intervals over the compositing period. (A timed composite may be collected continuously). Timed composites may be collected where water or polluted water flows vary widely and are not dampened by polluted water treatment units.

5.3.2.2 Flow Proportional Composites - A sample containing some discrete samples collected proportionally to the flow rate over the compositing period. Flow proportional samples may be collected where water or polluted water flows vary widely and are not dampened by polluted water treatment units.

5.3.2.3 Timed and Flow Proportional Composite Samples - The following guidance is given concerning the collection of composite samples:

1. Composite samples are:

   - collected when average concentrations are of interest; and are
   - always associated with average flow data (where appropriate).

2. Composite sampling is used when:

   - the water or polluted water stream is continuous;
   - it is necessary to calculate mass/unit time loadings; or when
   - analytical capabilities are limited.

3. A timed composite shall be collected as follows:

   - continuously; or
   - with constant sample volume at a constant time interval between samples.

4. A flow proportional composite shall be collected as follows:

   - continuously, proportional to stream flow;
   - with constant sample volume and with the time between samples proportional to stream flow; or
   - at a constant time interval between samples and with the sample volume proportional to flow at time of sampling.

5.3.2.4 Areal Composite - A sample composited from individual grab samples collected on an areal or cross-sectional basis. Areal composites shall be made up of equal volumes of grab samples. Each grab sample shall be collected in an identical manner. Examples include sediment composites made up of quarter-point grab samples from a stream, soil samples from grid points on a grid system, water samples collected at various depths at the same point or from quarter points in a stream, etc.

5.3.3 Split Sample

A split sample is a sample which has been portioned into two or more containers from a single sample container. Portioning assumes adequate mixing to assure the "split samples" are, for all practical purposes, identical.

5.3.4 Duplicate Samples

Duplicate samples are samples collected simultaneously from the same source under identical conditions into separate containers.

5.3.5 Reference or Control Sample

A sample collected upstream or upgradient from a source or site to isolate the effects of the source or site on the particular ambient medium being sampled.

5.3.6 Background Sample

A sample collected from an area, water body, or site similar to the one being studied, but located in an area known or thought to be free from pollutants of concern.

5.3.7 Sample Aliquot

A portion of a sample that is representative of the entire sample.

5.4 SPECIFIC SAMPLE COLLECTION QUALITY CONTROL PROCEDURES

5.4.1 General

This subsection provides guidelines for establishing quality control procedures for DEC BSPR sampling activities. Specific guidelines for sample site selection, selection of sampling equipment, types of samples to be collected, standard sample collection procedures, specific maintenance and calibration procedures for sampling equipment, and other considerations are presented for each medium later in this Section. Specific recommendations for all sampling activities are presented in Section 5.2. Adherence to the standard operating procedures outlined in this section form the basis for the DEC BSPR sampling quality assurance program.

5.4.2 Experience Requirements

There is no substitute for field experience. Therefore, all employees shall have field experience before they are permitted to select sampling sites. This field experience shall be gained by on-the-job training using the "buddy" system. Each new employee shall accompany an experienced employee on as many different types of field studies as possible. During this training period, the new employee will be permitted to perform all facets of field investigations, including sampling, under the direction and supervision of qualified technical staff.

5.4.3 Traceability Requirements

All sample collection activities shall be traceable through field records to the person collecting the sample and to the specific piece of sampling equipment (where appropriate) used to collect that sample. All maintenance and calibration records for sampling equipment (where appropriate) shall be kept so that they are similarly traceable.

5.4.4 Measurement of Relative Sampling Precision

The following duplicate sampling procedures shall be used during the collection of samples as a relative measure of the precision of the sample collection process. Duplicate grab and composite samples shall be collected during all major investigations and studies conducted by the DEC BSPR. No more than ten percent of all samples shall be collected in duplicate. These duplicates shall be collected at the same time, using the same procedures, the same equipment, and in the same types of containers as the required samples. They shall also be preserved in the same manner and submitted for the same analyses as the required samples. The collection of duplicate composite samples shall require the installation of duplicate automatic sampler setups if automatic samplers are used for sample collection. Duplicate sample data shall be reported to the quality assurance officer or his designee.

These data will be periodically examined to determine if any problems are evident with specific types of media samples or with the procedures used by specific sample handling personnel. The Quality Assurance Officer will advise the appropriate Section Chiefs of any problems encountered so that corrective action can be taken.

5.4.5 Measurement of Sample Handling Effectiveness

The effectiveness of sampling handling personnel's sample handling techniques will be monitored by utilizing preserved and unpreserved field blank samples. These blank samples will be prepared by DEC BSPR personnel or proper suppliers. These blank samples will be handled as follows:

- Water Sample Organic Trip Blank - Two sealed preserved (or unpreserved if appropriate) VOA vials and one sealed container each for other organic compounds will be transported to the field. These samples will be handled and treated by sampling personnel in the same manner as the other samples collected for organic compounds analysis on that particular study. These samples will be clearly identified on sample tags and Chain-of-Custody Records as trip blanks. These water sample trip blanks will also be used to monitor the effectiveness of sample handling techniques where samples other than water, i.e., sludge, soil, sediment, etc. are collected. At least one set of trip blanks will be used on every study where samples for organic compounds analyses will be conducted.

- Metals and General Inorganic Preservation Blanks - Metals and general inorganic sample containers filled with blank water will be transported to the field and treated in the same manner as other like samples. These blank samples will be preserved and submitted for the same analyses as the other samples collected. These samples will be clearly identified as preservatives blanks on sample tags and in the Chain-of-Custody Record(s). At least one preservative blank for each type of sample should be collected on non-routine field investigations. A minimum of one preservative blank should be prepared at the beginning and at the end of all major field investigations (20 samples or more). At least one preservative blank for each type of sample should be prepared once per quarter for routine inspections.

- Automatic Sampler Blanks - The procedure for collecting automatic sampler blanks is given separately at its own category of automatic sampling. In general, cleaning procedures outlined in Section 4.0 should be adequate to insure sample integrity. However, it is the standard practice of the DEC BSPR to submit automatic sampler blanks for analysis when automatic samplers are used to collect samples for organic compounds analyses. Automatic sampler blanks for other standard analyses shall be submitted at least once per quarter.

The DEC BSPR will advise the Quality Assurance Officer when trip blanks or preservative blanks are unacceptably contaminated. The Quality Assurance Officer will immediately initiate an investigation to determine the cause of the problem. The results of this investigation will be promptly reported to the appropriate Section Chiefs so that corrective action can be initiated.

5.4.6 Measurement of Sample Container, Sample Equipment, and Cleaning Procedure Integrity

Specific quality control procedures are outlined in Section 4.0.

5.4.7 Special Quality Control Procedures for Water Samples for Extractable, Pesticide, or Herbicide Organic Compounds Analyses

Sampling personnel shall submit duplicate water samples for extractable organic, pesticide, and/or herbicide organic compounds analyses from one sampling location per project. This sample should be collected from a location expected to be relatively free from contamination, since this sample will be used for laboratory quality control purposes. The duplicate sample should be clearly identified as "Duplicate Sample for Matrix Spike" on the sample tag, in the Chain-of-Custody Record, in the field logbook. This procedure shall be followed for all DEC BSPR projects where water samples are collected for the indicated organic compounds analyses, whether the samples are submitted to the contracted lab or other certified laboratory.

5.5 GROUNDWATER SAMPLING

5.5.1 General

Groundwater sampling may be required for a variety of reasons, such as examining potable or industrial water supplies, checking for and/or tracking contaminant plume movement in the vicinity of a land disposal or spill site, RCRA compliance monitoring , or examining a site where historical information is minimal or non-existent, but where it is thought groundwater contamination could have occurred.

Groundwater is usually sampled from a monitoring well, either temporarily or permanently installed. However, it can also be sampled anywhere groundwater is present, as in a pit or a dug or drilled hole.

Occasionally, a well will not be in the ideal location to obtain the sample needed. For example, a well may not be ideally located for tracking a contaminant plume. In that case, a well will have to be installed, and it may be either temporary or permanent. An experienced and knowledgeable person, preferably a hydrogeologist, will be needed to locate a place for the well and to supervise its installation so that the samples ultimately collected will be representative of the groundwater.

5.5.2 Site Selection

The relationship of the following factors to potential pollution sources shall be considered and evaluated when selecting groundwater sampling sites; the direction of groundwater flow; depth of groundwater; thickness of the aquifer (if applicable); type of stratigraphy; presence of perched water tables; types of soils; depth of bedrock; type of vegetation; surface drainage patterns; type of topography; and general land use. Surface features such as rock outcrops, seeps, springs, streams, rivers, and wet areas should also be considered (14). The area of interest should be located on an aerial photograph, a USGS 7.5 minute quadrangle map, a USDA soils map, and/or any other appropriate map that shows topography and general relationships between surface features. Aerial photographs can usually be obtained at the local Agricultural Stabilization Conservation Service Office or the local county tax office. USGS 7.5 minute quadrangle maps can be acquired from the State Department of Transportation or from the USGS, and soils maps from the USDA-SCS. A visual inspection of the area may be sufficient to evaluate and determine the surface conditions and their relationship to the subsurface conditions (14). In some cases, surface conditions and subsurface conditions cannot be correlated by site inspection or reconnaissance. When this occurs, a more detailed study, possibly involving test drilling, will have to be conducted.

It is extremely important to sample the unconfined or surficial aquifer downgradient of potential pollution sources or spills to determine if this aquifer has been affected. Generally the direction of groundwater flow can be estimated by two vectors - one in the direction of surface water flow (i.e., downstream) and another toward the surface water stream or river, if present. The relative magnitude of these vectors will vary according to site conditions and in some instances, both direction and magnitude may be changed by construction activities. If both shallow and deep aquifers are involved in the zone of interest, a screening study will reveal whether or not the deep aquifer needs to be sampled and/or if a more detailed study is required. To adequately assess subsurface conditions, a minimum of three wells are required, one in the upgradient portion of the area of interest, one in the middle portion, and one in the downgradient portion. In some cases, a more complex system of wells may be needed to define the subsurface conditions. Site conditions and the scope of the project will determine the total number of wells required. Existing wells should be used whenever possible. Where well installation is necessary, the wells should be installed according to the following procedures.

5.5.3 Monitoring Well Installation

Wells shall be dug, driven, drilled, or bored depending on the scope of work. Hand equipment such as augers, post hole diggers, picks, and shovels can be used to dig shallow wells in soft soils. Wells can be installed by driving a piece of casing connected to a well point into the ground with an axe, sledge hammer, or mechanical or power device. Power equipment such as drilling rigs can be used to drill or auger wells in all types of soils and to any depth.

Where feasible the following procedures shall be used for well installation:

5.5.3.1 Temporary Monitoring Wells - For very shallow wells (15 feet) in soft material, hand augers or small portable power augers shall be used for boring. A temporary well casing with a well screen attached shall be installed as soon as the hole is augured.

For deeper temporary wells, larger well drilling equipment should be used with a hollow stem auger wherever possible. The use of a hollow stem auger prevents cave-in of the hole during drilling, allows for the collection of soil samples at various depths during the drilling operation, and may serve as a temporary casing for the well. In some cases the bottom of the auger will become plugged and not allow water to flow into the casing. When this happens, the auger should be pulled and the hole allowed to fill with water. A well casing can be installed if caving occurs.

When the water table is 25 to 30 feet deep, permanent well installation procedures should be considered.

5.5.3.2 Permanent Monitoring Well - Permanent monitoring wells shall be installed using hollow stem augers or continuous flight augers in soil and by standard rock coring procedures when drilling in rock. Where site conditions do not warrant the use of augers, alternate drilling methods such as straight rotary by using mud as a drilling fluid, or air rotary can be used. When muds are used in the drilling, a sample of the mud shall be collected for appropriate analyses. Casings with well screens shall be installed in unconsolidated and semi-consolidated soils to prevent soil and other foreign material from entering the well during pumping. Screens may or may not be required for wells in rock. The space surrounding the screen should be back filled with sand and filter pack and the remainder of the space surrounding the casing above the screen should be backfilled with natural clay, bentonite and/or cement bentonite grout, depending on the conditions at the site. Stainless steel well casings are preferred if samples are to be collected for organic compounds analyses. PVC casings are not acceptable where organic contaminants are a concern or under extremely corrosive conditions (18).

5.5.3.3 Monitoring Well Security - Wells should be capped and locked at the conclusion of installation or sampling for future use, or if the well will not be used in the future, it should be properly abandoned by backfilling with suitable permanent fill materials such as concrete, bentonite, compatible soil, or a combination of these materials (15).

5.5.4 Monitoring Well Development

All permanently installed wells shall be adequately developed prior to initial sampling efforts (14). Adequate development should eliminate all fine material from the area of the well screen and allow for the collection of a sample which is free of suspended materials. Wells installed by "wet drilling" where drilling muds are used shall be developed so that residual drilling muds will not settle around the well screens or in the surrounding soil and contaminate future sampling.

Various methods may be used to develop wells. These methods consist of suction lift pumping (pitcher, centrifugal, roller, piston, peristaltic pumps), pressure ejection pumping, submersible pumping, surge blocks, bailing, and air lift pumping (15, 16, 17).

5.5.5 Purging Equipment and Techniques

5.5.5.1 General - Wells shall be purged before taking samples in order to clear the well of stagnant water which has been standing in the well casing and may not be representative of aquifer conditions. One method of purging is to pump the well until three to five times the volume of standing water in the well has been removed. A second method is to pump the well until the specific conductance, temperature and pH of the groundwater stabilizes. Normally, a combination of the two methods is employed (i.e., specific conductance, temperature, and pH are measured at intervals and a record of the volume purged is monitored). If a well is pumped dry, this constitutes an adequate purge and the well can be sampled following recovery (15, 17).

5.5.5.2 Equipment Available - Monitoring well purging is accomplished by using in-place plumbing/pumps or when in-place pumps are not available, by using a proper equipment, such as peristaltic, turbine, bladder, centrifugal, or other appropriate pump, depending on well depth. A Teflon, closed top bailer may be used for purging; however, bailing stirs up sediment in the well and tends to increase turbidity. Thus pumping is preferred.

Other monitoring equipment used during purging includes water level indicators, pH meters, thermometers, and conductivity bridges.

5.5.5.3 Purging Techniques (Wells Without Plumbing or in Place Pumps)

5.5.5.3.1 General - For permanently installed wells, the depth of water shall be determined (if possible) before purging. This can be accomplished by attaching a weight on the end of tape and lowering it into the well until it touches the water, or by use of a mechanical or electrical water level indicator. Operating personnel shall exercise extreme caution during this procedure to prevent contamination of the well. This is a critical concern when samples for trace organic compounds or metals analyses are collected.

5.5.5.3.2 Using Pumps to Purge - When suction lift or centrifugal pumps are used, only the intake line is placed into the water column. To minimize contamination, the line placed into the water is either standard cleaned Teflon (see Section 4.0), in the case of the suction lift pumps, or standard cleaned stainless steel pipe attached to a hose, when centrifugal pumps are used.

When submersible pumps (bladder, turbine, displacement, etc.) are used, the pump itself is lowered into the water column.

5.5.5.3.3 Using Bailers to Purge - Standard cleaned (Section 4.0) closed-top bailers with nylon rope are lowered into the top of the water column, allowed to fill and be removed, and the water is discarded.

Cleaning and decontamination materials are specifically mentioned as having to be collected and disposed of properly in Section 4.1.6. Purge water should be held in drums, labeled for each well, then disposed of properly in accordance with water quality laboratory results.

5.5.5.3.4 Field Care of Purging Equipment - Regardless of which method is used for purging, new aluminum foil or plastic sheeting shall be placed on the ground surface around the well casing. This is done to prevent contamination of the pumps, hoses, ropes, etc. in the event they need to be placed on the ground during the purging or accidentally come into contact with the ground surface.

It is preferable that hoses used in purging that come into contact with the groundwater be kept on a spool, both during transporting and during field use, to further minimize contamination from the transportation vehicle or ground surface.

5.5.5.3.5 Purging Entire Water Column - The pump/hose assembly or bailer used in purging should be lowered into the top of the standing water column and not deep into the column. This is done so that the purging will "pull" water from the formation into the screened area of the well and up through the casing so that the entire static volume can be removed. If the pump was placed deep into the water column, the water above the pump may not be removed, and the subsequent samples collected may not be representative of the groundwater.

To minimize cross contamination between wells, no more than three to five feet of hose should be lowered into the water column. If the recovery of the well is at least as fast as the pump rate, the pump may be left hanging at the initial level until an adequate volume has been purged. If the pump rate exceeds the recovery rate of the well, the pump will have to be lowered, as needed, to accommodate the draw-down.

After the pump is removed from the well, all wetted portions of the hose and the pump shall be cleaned as outlined in Section 4.0.

Careful consideration shall be given to using pumps to purge wells which are excessively contaminated with oily compounds, because it may be difficult to adequately decontaminate severely contaminated pumps under field conditions. When wells such as this are encountered, alternative purging methods, such as bailers, should be considered.

5.5.5.4 Purging Techniques - Wells With in-Place Plumbing

5.5.5.4.1 General - In-place plumbing is found at water treatment plants, industrial water supply wells, private residences, etc. The objective of purging is the same as with monitoring wells without in-place pumps -- to ultimately collect a sample representative of the groundwater.

The volume to be purged depends on several factors: whether the pumps are running continuously or intermittently, how close to the source the sample can be collected, and the presence of any storage/pressure tanks between the sampling point and the pump. If storage/pressure tanks are present, an adequate volume must be purged to totally exchange the volume of water in the tank.

5.5.5.4.2 Continuously Running Pumps - If the pump runs continuously, and the sample can be collected prior to a storage/pressure tank, no purge, other than opening a valve and allowing it to flush for a few minutes, is necessary.

If the pump runs continuously, and a storage/pressure tank is located ahead of the sample location, the purge must include the entire storage volume to be sure that a sample representative of the goundwater will be collected.

5.5.5.4.3 Intermittently Running Pumps - If the pump runs intermittently, it is necessary to determine the volume to be purged, including storage/pressure tanks that are located ahead of the sampling location.

The pump should then be run continuously until the required volume has been purged.

5.5.6 Sampling Equipment and Techniques

5.5.6.1 Equipment Available - Sampling equipment which can be used includes closed-top bailers and the peristaltic pump/vacuum jug assembly.

Other monitoring equipment used during sampling includes water level indicators, pH meters, thermometers, and conductivity brides.

5.5.6.2 Sampling Techniques - Wells With in Place Plumbing - Following purging, samples should be collected from a valve or cold water tap as near to the well as possible. Samples should be collected directly into the appropriate containers (see recommended Sample Containers, Appendix 5X.1). Also, refer to the Potable Water Supply discussion in Section 5.6.

5.5.6.3 Sampling Techniques - Wells Without Plumbing - Following purging, samples should be collected using a peristaltic pump - vacuum jug procedure, if possible, or with a closed top bailer. The pump used for purging generally should not be used for sampling. When the peristaltic pump is used, samples for purgeable organic compounds should be collected using a bailer or by allowing the Teflon tube to fill and then allowing the water to drain into the sample vials. All equipment shall be cleaned using the procedures described in Section 4.0. Also, refer to the Potable Water Supply discussion, Section 5.6, for additional information.

When bailing, new foil or plastic sheeting should be placed on the ground around each well to prevent contamination of sampling equipment in the event any equipment is dropped or otherwise comes in contact with the ground. Braided nylon cord may be used to haul the bailer if the nylon cord is used only one time and then discarded. Teflon coated wire, single strand stainless steel wire, or monofilament are acceptable for hauling bailers and may be decontaminated for reuse.

5.5.7 Special Sample Collection Procedures

5.5.7.1 Trace Organic Compounds and Metals - Special sample handling procedures shall be instituted when trace organic compounds and metals samples are being collected. All sampling equipment, including pumps, bailers, drilling equipment, water level measurement equipment, etc., which come into contact with the water in the well must be cleaned in accordance with the cleaning procedures described in Section 4.0. Synthetic drilling mud (i.e., Revert) should not be used when constructing wells which will be used for trace organic compounds and metals sampling. Pumps shall not be used for sampling, unless the interior and exterior portions of the pump and discharge hoses can be thoroughly cleaned. Blanks should be collected to determine the adequacy of cleaning prior to collection of any sample using a pump. Peristaltic pumps using Teflon tubing and a Teflon insert can be used to collect samples without the sample coming into contact with the pump. This is accomplished by placing the Teflon insert into the opening at a standard cleaned gallon glass container (Section 4.0). The Teflon tubing connects the container to the pump and sample source. The pump creates a vacuum in the container, thereby drawing the sample into the container without coming into contact with the pump tubing. Samples for purgeable organic compounds analyses shall be collected with well bailers or by allowing the Teflon tube to fill and then allowing the water to drain into sample collection vials. The procedures given in the General Considerations, Special Precautions for Trace Contaminant Sampling (Section 5.2) shall be followed.

5.5.7.2 Filtering - As a standard DEC BSPR policy, groundwater samples should not be filtered in the field. However, if required by RCRA regulations, then both filtered and non-filtered samples will be submitted for analyses. Proper well installation and development as well as proper well purging technique should minimize the turbidity of samples. Whenever extremely high concentrations of sediment are present in a well sample, the aliquot of the sample for metals analyses should not be preserved without first being filtered. Whenever samples for dissolved metals analyses are collected, an additional sample, unfiltered and acid preserved will also be collected for total metals analyses. Samples for analyses of organic compounds shall never be filtered. When samples are being filtered in the field, the filter apparatus must be cleaned (Section 4.0) and samples must be filtered properly.

5.5.7.3 Bacterial Sampling - Whenever wells (normally potable wells) are sampled for bacteriological parameters, care must be taken to ensure the sterility of all sampling equipment and all other equipment entering the well. Further information regarding bacteriological sampling is available in Sampling for Organic Chemicals and Microorganisms in the Subsurface (19) as well as References 4 and 5.

5.5.8 Specific Sampling Equipment Quality Assurance Techniques

All equipment used to collect groundwater samples shall be cleaned as outlined in Section 4.0 and repaired, if necessary, before being stored at the conclusion of field studies.

All equipment shall be tested before being issued for field studies.

Cleaning procedures conducted in the field (Section 4.0) or field repairs shall be thoroughly documented in field records.

5.5.9 Auxiliary Data Collection

Water table measurements from the top of the well casings (referenced to National Geodetic Vertical Datum) in permanent wells, and ground surface elevation in temporary wells should be made to determine the general direction of groundwater flow and gradient. Traced dyes and thermal detection methods can be used to determine direction and velocities of flow (14). Also, a study of the general topography and drainage patterns will generally indicate direction of groundwater flow.

Water table measurements shall not be taken until the water table has stabilized, preferably 24 hours after well installation for permanent wells (20). The ground surface elevation at the wells should be determined by standard engineering survey practices.

In addition to water level measurements, the pumping rate used to purge a well, the volume of water in wells, and drillers logs are examples of auxiliary data that should be collected during groundwater sampling activities. This information should be documented in field records. Methodology for obtaining these data are given in the following sections.

Temperature, specific conductance, and pH shall be measured each time a well is sampled. This information is generally obtained during the purging process to evaluate the adequacy of the purging procedure. In this situation, the final measurements for these parameters prior to sampling shall be considered the measurement of record for the well. If these parameters were not evaluated during purging, they shall be obtained prior to sampling.

5.5.9.1 Well Pumping Rate - Bucket/Stop Watch Method - The pumping rate of a pump can be determined by collecting the flow of water from the pump in a bucket of known volume and timing how long it takes to fill the bucket. The results should be flow rate in gallons per minute. This method shall be used only with pumps with a constant pump rate, such as gasoline powered or electric submersible pumps. It should not be used with battery powered pumps. As the batteries lose their charge, the pump rate decreases so that pumping time calculations using initial, high pump rates are erroneously short.

5.5.9.2 Volume of Water in Wells - In order to purge wells, the volume of water in the well should be known. To determine the volume, the following method should be used; measure the distance from the bottom of the well to the static water level, then measure the inside diameter of the well or casing. Obtain the volume of the well by the formula:

$V = 0.041\ d^2h$ Where:

h = depth of water in feet
d = diameter of well in inches
V = volume of water in gallons

If preferred, a quick reference nomograph or table may be used.

5.5.9.3 Driller's Log - It is imperative that drilling logs be concise, complete, and described in a manner that is easily understood to all who read them. The following items shall be included in the logging data:

- hole number and location;
- description of soils and subsurface conditions (if applicable);
- type of drilling equipment, driller, and drilling company (if applicable);
- method of drilling;
- type and size of casing;
- type and size of well screen;
- depth to well screen;
- type of pump and pumping rate;
- drilling and sampling times;

- depth to water table, and date and time measured;
- types of samples taken and depths at which the sample was taken;
- volume of water purged;
- type of well (permanent or temporary);
- type of sampling equipment and/or cleaning procedure; and
- depth of sampling and description (if applicable).

Additional groundwater related data can be obtained from most local, state, and federal agencies dealing with water resources. Some sites require well drillers to be licensed, and all work performed on wells must be reported to the state on prescribed forms. These forms are available to the public, so a study of wells installed in the area of interest will provide background information as to the subsurface conditions. State geological surveys, as well as the USGS, have various types of water related papers and reports on all phases of groundwater studies in each state. City and county governments usually have departments that deal with water related projects that may provide data for the local area. Federal agencies such as the U.S. Army Corps of Engineers, the Bureau of Reclamation, U.S. Forest Service, Science and Education Administration, and the U.S. Public Health Service have water programs and may provide data. Other sources include the Bureau of Mines, colleges, universities, and technical societies such as the American Association of Petroleum Geologists, American Institute of Mining and Metallurgical Engineers, National Water Well Association, Association of Engineering Geologists, and Geological Society of America (14,21).

5.6 SAMPLING OF POTABLE WATER SUPPLIES

5.6.1 General

When sampling potable water supplies, utmost care must be taken to insure that samples are representative of the water supply being sampled. This is important not only from a technical and public health perspective, but also from a public relations standpoint. Poor sampling techniques may result in incorrect results (either not detecting a compound which is present or by contaminating the sample and falsely indicating a compound which is not present). If incorrect results are disclosed to the public, it may be very difficult to change public opinion when correct results are reported.

5.6.2 Sampling Site Selection/Sampling Techniques

Even though the same care and techniques used in groundwater, etc., sampling (including thorough documentation of location, date, time, etc.) are used by sampling personnel in potable water supply sampling, there are certain additional special procedures which shall be used.

When water samples are collected from wells, either by mechanical or hand pumping, the wells must be purged before the sample is collected (see Section 5.5 for groundwater sampling methods). This procedure insures that water in the well field is sampled, not the standing water in the pump or holding tank. As a rule of thumb, at least one volume of water in the well casing and storage tank should be evacuated (see Section 5.5.5.4 for more details). This also insures that any contaminants that might have entered the area of the tap from external sources are flushed away (19).

Potable water samples shall be representative of the water quality within a given amount of the distribution network. Taps selected for sample collection should be supplied with water from a service pipe connected directly to a water main in the segment of interest and should not be separated from the segment of interest by a storage tank. The sampling tap must be protected from exterior contamination associated with being too close to the sink bottom or to the ground. Contaminated water or soil from the faucet exterior may enter the bottle during the collecting procedure since it is difficult to place a bottle under a low tap without grazing the neck interior against the outside faucet surface. Leaking taps that allow water to flow out from around the stem of the valve handle and down the outside of the faucet, or taps in which water tends to run up on the outside of the lip, are to be avoided as sampling locations. Aerator, strainer, and hose attachments on the tap must be removed before sampling. These devices can harbor a bacterial population if they are not cleaned routinely or replaced when worn or cracked. Whenever a steady stream of water cannot be obtained from taps, after such devices are removed, a more suitable tap shall be sought. Taps where the water flow is not steady should be avoided because temporary fluctuation in line pressure may cause sheets of microbial growth that are lodged in some pipe section or faucet connection to break loose and contaminate the sample. The cold water tap should be opened for two or three minutes or for sufficient time to permit clearing of the service line. A smooth-flowing water stream at moderate pressure without splashing should be obtained. Then, without changing the water flow which could dislodge some particles in the faucet, the samples can be collected (19).

Regardless of the type of sample bottle being used, the bottle cap should not be placed on the ground or in a pocket. Instead, hold the bottle in one hand and the cap in the other, keeping the bottle cap right side up (threads down) and using care not to touch the inside of the cap. Exercise care not to lose the Teflon liner in certain bottle caps. Avoid contaminating the sample bottle with fingers or permitting the faucet to touch the inside of the bottle. When sampling for bacterial content, the bottle should not be rinsed before use. This may not only contaminate the bottle, but also remove the thiosulfate dechlorinating agent (if used). When filling any container, care should be taken so splashed drops of water from the ground or sink do not enter into either the bottle or cap. In order to avoid dislodging particles in the pipe or valve, do not adjust the stream flow while sampling.

When sampling at a water treatment plant, samples should be collected both from the raw water supply and after chlorination.

Duplicate samples will always be collected for VOA and bacterial analyses. Single samples may be collected for extractable organic compounds, metals, phenol, cyanide, and conventional parameter analyses. The procedures given in Section 5.2.9 (Special Precautions for Trace Contamination Sampling) and in the Section 5.6.2.1 below (Purgeable Organic Compounds Sample Collection) shall always be followed when potable water supplies are sampled.

DEC BSPR or contractor shall always obtain the name(s) of the resident or water supply owner/operator and the resident's exact mailing address, as well as the resident's home and work telephone numbers. The information is required so that the residents or water supply owner/operators can be informed of the results of the sampling program.

5.6.2.1 Purgeable Organic Compounds Analyses (VOA) - Samples to be analyzed for purgeable organic compounds should be stored in 40 ml septum vials with screw caps that have a Teflon lined silicone disk in the cap to prevent contamination and loss of the sample through the cap. The disks should be placed in the caps (Teflon in contact with the sample) in the laboratory prior to the beginning of the sampling program.

When sampling for purgeable organic compounds, duplicate samples should always be collected from each location. The investigator should determine if the water to be sampled contains chlorine. If the water contains no chlorine, two 40-ml vials containing four drops of concentrated HCl should be filled with the sample and labeled PA (preserved acid). If the sample contains no chlorine and only if it will be analyzed within 24 hours, the HCl preservation is not necessary. If the water contains chlorine, the following sampling and preservation procedure should be followed:

- Fill a 4-ounce (120 ml) soil VOA sampling container containing 0.008 percent sodium thiosulfate with the water sample. Cap and mix thoroughly but gently by swirling to eliminate residual chlorine. Transfer the sample to two 40-ml VOA vials containing four drops of concentrated HCl*. Label 40-ml vials - PTA (preserved/sodium thiosulfate/acid).

* The sodium thiosulfate preservatives must be added in this order and in two separate steps because HCl reacts with sodium thiosulfate.

The purgeable organics vials (40-ml) should be completely filled to prevent volatilization, and extreme caution should be exercised when filling a vial to avoid any turbulence which could also produce volatilization. The sample should be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to gently pour the last few drops into the vial so that surface tension holds the water in a "convex meniscus". The cap is then applied and some overflow is lost, but air space in the bottle is eliminated. After capping, turn the bottle over and tap it to check for bubbles; if any are present, repeat the procedure.

Sampling and preservation containers should be prelabeled (i.e., PA, PT, or PTA) prior to any field activities. This will reduce the chances of confusion during sampling activities by the investigation team.

5.6.3 Sampling Equipment/Specific Sampling Equipment Quality Assurance Techniques

Sampling equipment and specific equipment quality assurance techniques are contained in Section 5.5 (Groundwater Sampling).

5.7 SOIL SAMPLING

5.7.1 General

The objective of this section is to give general guidance for the collection of soil samples during field investigations. Guidance for preparing soil sampling protocols, including statistical sampling methodology are included in the EPA publication "Preparation of Soil Sampling Protocol, Techniques and Strategies" (22).

5.7.2 Sampling Location/Site Selection

Any site selected for soil sampling shall be strategically located in order to collect a representative fraction of the soils with the minimum number of samples and amount of effort. A surface inspection of the subject area shall be made to locate pertinent features (e.g., rock outcrops, drainage patterns, surface runoff, ponds, lakes, wet areas, seeps, springs, permanent structures, fill areas, erosional areas, depositional areas, etc.) and to evaluate the relationship between these features and potential sources of pollution. The location of sediment depositional areas are good indicators of surface runoff direction. If the direction of surface runoff or drainage is difficult to detect, observation of new depositions or sediment movement following a rain may prove helpful in establishing this direction. The spreading or fanning of the sediment body will indicate direction of flow.

In most instances, the first investigation of a site will be a reconnaissance type survey. Soil sampling in these instances will generally be confined to surface or near-surface soils and/or sediments with hand equipment. For screening purposes, sampling of this type should be conducted in depositional areas on the periphery of the study area, primarily at the downstream or downgradient portion(s) of the area of interest; however, an upgradient location should also be selected for obtaining background and/or control samples. Investigators should be aware that sampling in depositional areas tends to bias the sampling toward elevated concentrations, which is useful as a screening tool, but should not be construed as representative of the area conditions.

More in-depth investigations are usually conducted after a preliminary study or reconnaissance survey has been completed. Review of previous investigations will aid in selection of suitable sampling locations, and these studies should be examined when the study plan for the more detailed study is prepared. The number of samples and the number of test pits and/or borings and the specific depth that samples are collected will vary according to the site conditions and the scope of the investigation. A determination of soil sample number and location based on statistical concept is discussed in Section 6B.1.

5.7.3 Equipment Available

The following equipment is available for field use in soil sampling: stainless steel spoons; stainless steel hand augers; stainless steel shovels; Shelby tubes; portable power augers (Little Beaver); stainless steel scoops; glass pans; and drill rigs and associated equipment (i.e., split spoon samplers), which may, on occasion, be rented or borrowed for special projects.

5.7.4 Sampling Techniques

5.7.4.1 General - Sampling is often conducted in areas where a vegetative turf has been established. In these cases a clean stainless steel shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. When the soil sample is obtained, it should be deposited into a glass pan for mixing (or compositing, if applicable) prior to filling in the sample containers. Mixing of the soil sample for non-volatile or non-semi volatile chemical analysis should be performed in accordance with the procedures outlined in Section 5.7.4.5. If an undisturbed sample is needed, the Shelby tube sampler may be used as described in Section 5.7.4.2.

If practical, and at the project leader's discretion, all trenches or holes that were excavated for sampling should be filled in and the turf replaced.

5.7.4.2 Surface Soil Sampling - Prior to sampling, leaves, grass, and surface debris should be removed from the area to be sampled using a clean stainless steel spoon or shovel. Surface soil samples shall then be collected using a precleaned, stainless steel scoop or spoon.

5.7.4.3 Shallow Subsurface Soil Sampling - Shallow subsurface soil samples may be collected by digging a hole or trench with a stainless steel shovel, then removing all of the loose soil and collecting a sample at the desired depth using a stainless steel spoon, a stainless steel hand auger, or a Shelby tube.

The stainless steel hand auger consists of three basic parts: (1) the bucket, (2) extension, and (3) handle. At the bottom end of the bucket are two cutting edges. The extensions are three feet long. When sampling deeper subsurface soil (Section 5.7.4.4), a number of extensions may be joined end to end to increase the depth from which soil may be sampled.

The Shelby tube is a stainless steel tube approximately 12 inches long and 2 inches in diameter. One end of the tube has the edges beveled into a cutting edge. The other end can be mounted on an adapter which allows attachment to the end of the hand auger. The Shelby tube is pushed into the soil to be sampled and then removed. The tube can then be removed from the adapter and the soil pushed out using a decontaminated piece of equipment such as the handle of a stainless steel spoon. If an undisturbed sample is required, the Shelby tube with its sample intact may be shipped directly to the laboratory for analyses.

5.7.4.4 Deeper Subsurface Soil Sampling - For deeper sampling using hand equipment, a stainless steel auger (see Section 5.7.4.3) is used to bore a sampling hole until the desired depth is reached. Another clean auger bucket or a Shelby tube is then used to collect the sample which is placed in a glass pan as described in Section 5.7.4.1. Surface debris should be removed from the location of the sampling hole using a clean, stainless steel shovel or spoon before auguring operations are initiated.

Often the depth which can be reached using a hand auger is limited due to the soil having low cohesion which leads to the hole collapsing or to the soil being very tightly packed, which can make turning and removing the auger difficult. In cases such as these, a portable power auger Little Beaver may be used to reach the desired depth. The sample can then be collected as described in the previous paragraph. The portable power auger consists of a powered drive unit (hand-held) used by sampling personnel to drive crew-like auger flights. The auger flights should be cleaned using the same procedures as for the other soil sampling equipment (Section 4.0). For safety reasons, the Little Beaver portable power auger should never be used with less than two sampling personnel present.

The split spoon sampler may be used for sampling at greater depths. Because of its weight, the split spoon sampler is generally used with power equipment, i.e., drilling rig. A hollow stem auger is used to advance the hole to the desired depth. The split spoon is added to the correct length of drill rod and forced into the undisturbed soil by means of a 140-pound weight or hammer. The split spoon is retrieved from the hole and opened to reveal the sample. The top two or three inches of the sample normally will be disturbed and should be discarded. The undisturbed portion should be placed in a glass pan by means of a clean, stainless steel spoon or spatula. The procedure is repeated until the desired amount of sample is collected. The sample should then be thoroughly mixed.

5.7.4.5 Mixing - Regardless of the method of collection, soil samples collected for non-volatile chemical analyses should be thoroughly mixed before being placed in the appropriate sample containers. The soil should be removed from the sampling device (dredge, core tube, scoop, etc.) and placed in a glass or Teflon coated stainless steel pan. The soil in the pan should be scraped from the sides, corners, and bottom of the pan, rolled to the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the container. Each quarter of the sample should be mixed individually. Each quarter is then rolled to the center of the container and the entire sample is mixed again.

This procedure should be continued to ensure that all parts of the sample are mixed and that the sample is as homogenous as possible before being placed in the sample containers.

5.7.5 Special Precautions for Trace Contaminant Soil Sampling

The procedures outlined in Section 5.2.11 shall be followed. All soil sampling equipment used for sampling of trace contaminants should be constructed of stainless steel whenever possible. In no case will chromium, cadmium, or galvanized plated or coated equipment be used for soil sampling operations. Similarly, no painted equipment shall be used. All paint and primer must be removed from soil sampling equipment by sandblasting or other means before such equipment can be used for collecting soil samples.

5.7.6 Soil Samples Collected for Purgeable Organic Compounds Analyses (VOA)

When soil samples collected for purgeable organic compounds analyses need to be mixed in field, they should be done properly and placed in containers as soon as possible after sampling. The sample should be placed in the sample container so that no head space is left in the container after the container is closed.

5.7.7 Specific Sampling Equipment Quality Assurance Techniques

Drilling rigs and other major equipment used to collect soil samples shall be identified so that they can be traced through field records. A log book shall be established for this equipment so that all cleaning, maintenance and repair procedures can be traced to the person performing these procedures and to the specific repairs made. Sampling spoons, hand augers, Shelby tubes, and other minor disposable type equipment are exempted from this equipment identification requirement.

All equipment used to collect soil samples shall be cleaned as outlined in Section 4.0 and repaired, if necessary, before being stored at the conclusion of field studies.

Any cleaning conducted in the field (Section 4.0) or field repairs should be thoroughly documented in field records.

5.7.8 Auxiliary Data Collection

In addition to information pertaining to an area of specific site/location that may be available in DEC BSPR files from previous investigations (i.e., site screenings, water quality, well monitoring studies, etc.) information and data may be obtained from various city, county, federal, and other state agencies.

A system of logging all pertinent data collected during drilling and sampling operations should be maintained. The test hole locations should be recorded and referenced to the site map and/or datum base so that each location can be permanently established. Samples should be accurately tagged and labeled with all pertinent site information at the time of sampling.

APPENDIX 5X.1
RECOMMENDED SAMPLE CONTAINERS, SAMPLE PRESERVATION, MAXIMUM SAMPLE HOLDING TIMES, AND PERMISSIBLE SAMPLE TYPES

Parameter	Container	Preservative	Maximum Holding Time	Permissible Sample Type	Reference
Concentrated Waste Samples					
Organic Compounds	8-oz. widemouth glass with Teflon liner	None	7 days	G or C	A
Metals and Other Inorganic Compounds	8-oz. widemouth glass with Teflon liner	None	7 days	G or C	A
EP Toxicity	8-oz. widemouth glass with Teflon liner	None	7 days	G or C	B
Flash Point and/or Heat Content	8-oz. widemouth glass with Teflon liner	None	ASAP - NS	G	B
Fish Samples					
Organic Compounds	Wrap in aluminum foil	Freeze	ASAP	G or C	A
Metals and Other Inorganic Compounds	Place in plastic ziplock bag	Freeze	ASAP	G or C	A
Liquid - Low to Medium Concentration Samples					
Alkalinity	500-ml or 1-liter poly-[1] ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	12-14 days	G or C	C
Acidity	500-ml or 1-liter poly-[1] ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	12-14 days	G or C	C
Bacteriological Tests (coliform)	250-ml glass with glass closure or plastic capable of being autoclaved	Cool, 4°C	6 hrs.	G	C

Parameter	Container	Preservative	Maximum Holding Time	Permissible Sample Type	Reference
Liquid - Low to Medium Concentration Samples (Continued)					
Static Bioassay	1-gal. amber glass (not solvent rinsed)	Cool, 4°C	48 hrs.	G or C	D
Biochemical Oxygen Demand (BOD)	1/2-gal. polyethylene[1] with polyethylene closure	Cool, 4°C	48 hrs.	G or C	C
Chloride	500-ml or 1-liter polyethylene[1] with polyethylene or polyethylene lined closure	None	28 days	G or C	C
Chlorine Residual	In-situ, beaker or bucket	None	Analyze Immediately	G	C
Color	500-ml or 1-liter polyethylene[1] with polyethylene or polyethylene lined closure	Cool, 4°C	48 hrs.	G or C	C
Conductivity	500-ml or 1-liter polyethylene[1] with polyethylene or polyethylene lined closure	Cool, 4°C	28 days (determine on site if possible)	G or C	C
Chromium, Hexavalent	1-liter polyethylene with polyethylene closure	Cool, 4°C	24 hrs.	G	C
Cyanide	1-liter or 1/2-gallon polyethylene with polyethylene or polyethylene lined closure	Ascorbic Acid[2],[3] Sodium Hydroxide, pH > 12, Cool, 4°C.	14 days	G	C
Dissolved Oxygen (Probe)	In-situ, beaker or bucket	None	Determine On Site	G	C
Dissolved Oxygen (Winkler)	300-ml glass, BOD bottle	Fix on site, store in dark	8 hrs. (determine on site if possible)	G	C

Parameter	Container	Preservative	Maximum Holding Time	Permissible Sample Type	Reference
Liquid - Low to Medium Concentration Samples (Continued)					
EP Toxicity	1-gal. glass (amber) with Teflon liner	Cool, 4°C	7 days till extraction	G or C	B
Fluoride	1-liter polyethylene or [1] 1/2-gal. polyethylene with polyethylene or polyethylene lined closure	None	28 days	G or C	C
Hardness	500-ml or 1-liter polyethylene with polyethylene or polyethylene lined closure	50% Nitric[2] Acid, pH <2	6 months	G or C	C
LAS	500-ml or 1-liter poly-[1] ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	48 hrs.	G or C	C
Metals (Total)	1-liter polyethylene with polyethylene lined closure	50% Nitric[2] Acid, pH <2	6 months (except Hg, Cr^{+6})	G or C	C
Metals, Dissolved	1-liter polyethylene with polyethylene lined closure	Filter-on-site[3] 50% Nitric Acid, pH <2	6 months (except Hg, Cr^{+6})	G	C
Nutrients[4] (NH_3, COD, TOC, nitrate-nitrite, etc.)	1-liter polyethylene or 1/2-gal. polyethylene with polyethylene or polyethylene lined closure	50% Sulfuric[2] Acid, pH <2 Cool, 4°C	28 days	G or C	C
Oil and grease	1-liter widemouth glass with Teflon liner	50% Sulfuric[2] Acid, pH <2 Cool, 4°C	28 days	G	C

Parameter	Container	Preservative	Maximum Holding Time	Permissible Sample Type	Reference
Liquid - Low to Medium Concentration Samples (Continued)					
Organic Compounds -- Extractable and Pesticide Scan					C
No Residual Chlorine Present	1-gal. amber glass or 2 1/2-gal. amber glass with Teflon liner	Cool, 4°C	5-7 days[5]	G or C	C
Residual Chlorine Present	1-gal. amber glass or 2 1/2-gal. amber glass with Teflon liner	Add 3 ml 10% sodium thiosulfate per gallon Cool, 4°C	5-7 days[5]	G or C	C
Organic Compounds - Purgeable (VOA)					
No Residual Chlorine Present	2 40-ml vials with Teflon lined septum caps	4 drops conc. hydrochloric acid, Cool, 4°C	14 days	G	C
No Residual Chlorine Present	2 40-ml vials with Teflon lined septum caps	Cool, 4°C	7 days	G	C
Residual Chlorine Present	2 40-ml vials with Teflon lined septum caps	Footnote 6	14 days	G	C
Organic Compounds - Specified and Pesticides (Non-Priority Pollutants such as Herbicides)	1-gal. galss (amber) or 2 1/2-gal. glass (amber) with Teflon lined closure	Footnote 7	7 days[7]	G or C	C
Organic Halides - Total (TOX)	250-ml amber glass with Teflon lined septum closure	Cool, 4°C	7 days	G	E
pH	In-situ, beaker or bucket	None	Analyze Immediately	G	C
Phenols	1-liter amber glass with Teflon lined closure	50% Sulfuric Acid, pH <2 Cool, 4°C	28 days	G	C

Parameter	Container	Preservative	Maximum Holding Time	Permissible Sample Type	Reference
Liquid - Low to Medium Concentration Samples (Continued)					
Phosphate-Ortho	500-ml or 1-liter polyethylene with polyethylene or polyethylene lined closure	Filter-on-site Cool, 4°C	48 hrs.	G	C
Phosphorus, Total Dissolved	500-ml or 1-liter polyethylene with polyethylene or polyethylene lined closure	Filter-on-site 50% Sulfuric Acid, pH < 2, Cool,4°C	28 days	G	C
Solids, Settleable	1/2-gal. polyethylene with polyethylene closure	Cool, 4°C	48 hrs.	G or C	C
Solids (Total and Suspended, etc.)	500-ml or 1-liter poly-^{1} ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	7 days	G or C	C
Sulfates	500-ml or 1-liter poly-^{1} ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	28 days	G or C	C
Sulfides	500-ml or 1-liter poly-^{2} ethylene with polyethylene or polyethylene lined closure	2 ml Zinc Acetate^2 Conc. Sodium Hydroxide to pH >9, Cool, 4°C	7 days	G	C
Temperature	In-situ, beaker or bucket	None	Determine On Site	C	C
Turbidity	500-ml or 1-liter poly-^{1} ethylene with polyethylene or polyethylene lined closure	Cool, 4°C	48 hrs.	G or C	C

Parameter	Container	Preservative	Maximum Holding Time	Permissible Sample Type	Reference
Soil, Sediment or Sludge Samples - Low to Medium Concentration					
E.P. Toxicity	8-oz. widemouth glass with Teflon lined closure	Cool, 4°C	7 days till extraction	G or C	B
Metals	8-oz. widemouth glass with Teflon lined closure	Cool, 4°C	6 months	G or C	A
Nutrients Including: Nitrogen, Phosphorus, Chemical Oxygen Demand	500-ml polyethylene with polyethylene closure or 8 oz. widemouth glass with Teflon lined closure	Cool, 4°C	ASAP	G or C	A
Organics - Extractable	8-oz. widemouth glass with Teflon liner	Cool, 4°C	ASAP	G or C	A
Organics - Purgeable (VOA)	4-oz. (120 ml) widemouth glass with Teflon liner	Cool, 4°C	7 days	G or C	A
Other Inorganic Compounds - Including Cyanide	500-ml polyethylene with polyethylene closure or 8-0z. widemouth glass with Teflon lined closure	Cool, 4°C	7 days	G or C	A
Radiological Tests					
Alpha, beta, gamma	Polyethylene container with polyethylene closure	HNO_3 to pH < 2	6 months	G or C	

Abbreviation:
G = Grab
C = Composite
ASAP = As Soon As Possible
NS = Not Specified

Footnotes:

1. Use indicated container for single parameter requests, 1/2-gallon polyethylene container for multiple parameter requests except those including BOD, or 1-gallon polyethylene container for multiple parameter request which include BOD.

2. Must be preserved in the field at time of collection. For dissolved metals, the sample must be filtered through a 0.45 membrane filter immediately after collection and prior to preservation in the field.

3. Use ascorbic acid only if the sample contains residual chlorine. Test a drop of sample with potassium iodide-starch test paper; a blue color indicates need for treatment. Add ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the indicator paper. Then add an additional 0.6 g of ascorbic acid for each liter of sample volume.

4. May include nitrogen series (ammonia, total Kjeldahl nitrogen, nitrate-nitrite), total phosphorus, chemical oxygen demand and total organic carbon.

5. Samples must be extracted within seven days and extract must be analyzed within 40 days.

6. Collect the sample in a 4 oz. soil VOA container which has been pre-preserved with four drops of 10 percent sodium thiosulfate solution. Gently mix the sample and transfer to a 40 ml VOA vial that has been pre-preserved with four drops concentrated HCl, cool to 4° C.

7. See Organic Compounds - Extractable (the 4th page of this appendix). The Analytical Laboratory should be consulted for any special organic compound analyses in order to check on special preservation requirements and or extra sample volume.

References:

A. US-EPA, Region IV, Environmental Services Division, "Analytical Support Branch, Operations and Quality Control Manual," June 1, 1985 or latest version.

B. EPA Method 1310, Extraction Procedures, "SW 846," US-EPA, Office of Solid Wastes, Washington, DC, 1982.

C. 40 CFR Part 136, Federal Register, Vol. 49, No. 209, October 26, 1984.

D. US-EPA, Region IV, Environmental Services Division, "Ecological Support Branch, Standard Operating Procedures Manual," latest version.

E. EPA Interim Method 450.1, "Total Organic Halide," US-EPA, ORD, EMSL, Physical and Chemical Methods Branch, Cincinnati, Ohio, November 1980.

APPENDIX 5X.2 - CHAIN-OF-CUSTODY, DOCUMENT CONTROL, AND STANDARD OPERATING PROCEDURES

The objectives of this section are to present the laboratory proper operating procedures for sample identification, sample control, chain-of-custody, maintenance of records, and document control.

The laboratory should not deviate from the procedures described herein without the written approval of the Bureau of Spill Prevention and Response, or without a DEC approved equivalent.

1. Sample Chain-of-Custody

A sample is physical evidence collected from a facility or from the environment. An essential part of hazardous chemical or material investigations is that samples and data may be used as evidence in NYSDEC enforcement proceedings. To satisfy enforcement uses of the data, the following chain-of-custody procedures have been established.

1.1 Sample Identification

To ensure traceability of samples while in possession of the laboratory, a method for sample identification shall be developed and documented in laboratory Standard Operating Procedures (SOPs) (see Section 3). Each sample or sample preparation container shall be labeled with a unique number identifier (or the NYSDEC Sample Number). This identifier shall be cross-referenced to the NYSDEC Sample Number. There shall be a written description of the method of assigning this identifier and attaching it to the sample container included in the laboratory SOPs.

Samples, other than those collected for in-situ field measurements or analyses, are identified by using a sample tag which is attached to the sample container. In some cases, particularly with biological samples, the sample tag may have to be included with or wrapped around the sample. The sample tags are sequentially numbered and are accountable documents after they are completed and attached to a sample or other physical evidence. The following information shall be included on the sample tag:

- DEC spill, project number and name;
- field identification or sample point number;
- date and time of sample collection;
- designation of the sample as a grab or composite;
- type of sample (groundwater, wastewater, leachate, soil, sediment, etc.) and a very brief description of the sampling location;
- the signature(s) of the sampler(s);
- whether the sample is preserved or unpreserved;
- the general types of analyses to be conducted (VOA, PAH, EPA 624, etc.)
- any relevant comments (such as readily detectable or identifiable odor, color, or known toxic properties).

1.2.1 A Sample is under custody if:

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

1.2.2 - Upon receipt of the samples in custody, the laboratory shall inspect the shipping

FIGURE 5X.2-1 (Example)
Sample Chain-of-Custody Record*

Must be completed for samples that might be used for enforcement proceedings or litigation.

Sample ID (Lab Use Only)	Field Reference No.	Date/Time Collected	Sample Collection Point	Type/Number: Water, Air, Soil, Etc.	Remark

Specify Method of Preservation

______ NaOH

______ Cool, 4° C

______ Acidification (specify)

______ Other (specify)

Transporting Samples

During transport of the sample from sampling site to laboratory, the chain-of-custody must be unbroken. Generally, this will require that the sample be delivered by the sample collector or a designated representative, who will sign for the receipt, integrity, and transfer of the sample during shipment. <u>If integrity of sample is questioned, describe problem on reverse side of this form</u>.

CUSTODY OF SAMPLES

Time		Name		Affiliation	Date
1.	Sample Container: Prepared by:				
2.	Received by:				
3.	Received by:				
4.	Sample Collected by:				
5.	Sample Received by:				
6.	Sample Received by:				
7.	Sample Received by:				
8.	Sample Received by:				
9.	Sample Received by:				
10.	Sample Rec'd for Lab by:				
11.	Sample Accessed by:				

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[*] This form was developed based on the chain-of-custody report used by Center for Laboratories and Research, New York State Department of Health.

FIGURE 5X.2-2 (Example)
RECEIPT FOR SAMPLES FORM

PROJECT NO.:

PROJECT NAME:

Name of Facility/Site:

SAMPLERS (Signature)

Facility/Site Location:

Split Samples Offered

( ) Accepted ( ) Declined

STATION NO.	DATE	TIME	COMP	GRAB	SPLIT SAMPLES	TAG NUMBERS	SITE/STATION DESCRIPTION	NO. OF CONTAINERS	REMARKS

Transferred by: (Signature)

Received by: (Signature) Telephone

Date: Time:

Title: Date: Time:

stribution: Original to Coordinator Field Files; Copy to Facility/Site Representative container and sample bottles and shall document receiving information as specified in Section 3.2. The sample custodian or a designated representative shall sign and date appropriate receiving documents at the time of receipt (i.e. chain-of-custody forms (Figure 5X.2-1), Contract Lab Receipt of Samples Information Sheets (Figure 5X.2-2), airbills, etc.). The laboratory shall contact the Bureau of Spill Prevention and Response if documents are absent, if information on receiving documents does not agree, if custody seals are not intact, or if the sample is not in good condition. The laboratory shall document resolution of any discrepancies, and this documentation shall become a part of the permanent case file.

1.2.3 - Once samples have been accepted by the laboratory, checked, and logged in, they must be maintained in accordance with custody and security requirements specified in 3.3.

2. Document Control Procedures

The goal of the laboratory document control program is to ensure that all documents for a specified case will be accounted for when the project is completed. Accountable documents used by Contractor laboratories shall include, but not be limited to, logbooks, chain-of-custody records, sample work sheets, bench sheets, and other documents relating to the sample or sample analyses. The following document control procedures have been established to ensure that all laboratory records are assembled and stored for delivery to NYSDEC upon request from NYSDEC.

2.1 Pre-printed Data Sheet and Logbooks

Pre-printed data sheets shall contain the name of the laboratory and be dated and signed by the analyst or individual performing the work. All documents produced by the laboratory which are directly related to the preparation and analysis of NYSDEC samples shall become the property of the NYSDEC and shall be placed in the case file. For that reason, all observations and results recorded by the laboratory, but not on pre-printed data sheets, shall be entered into permanent laboratory logbooks. The person responsible for the work shall sign and date each entry and/or page in the logbook. When all data from a case is compiled, copies of all NYSDEC case-related logbook entries shall be included in the documentation package. Analysts' logbook entries must be in chronological order and shall include only one Case per page. Instrument run logs shall be maintained so as to enable a reconstruction of the run sequences of individual instruments.

Because the laboratory must provide copies of the instrument run logs to NYSDEC, the laboratory may exercise the option of using only laboratory or NYSDEC sample identification numbers in the logs for sample ID rather than government agency or commercial client names.

Using laboratory or NYSDEC Sample Number ID's only in the run sequences will assist the laboratory in preserving the confidentiality of commercial clients.

2.2 Error Correction Procedure

All documentation in logbooks and other documents shall be in ink. If an error is made, corrections shall be made by crossing a line through the error and entering the correct information. Changes shall be dated and initialed. No information shall be obliterated or rendered unreadable.

2.3 Consistency of Documentation

Before releasing analytical results, the laboratory shall assemble and cross-check the information on sample tags, custody records, lab bench sheets, personal and instrument logs, and other relevant data to ensure that data pertaining to each particular sample or case is consistent throughout the case file.

2.4 Document Numbering and Inventory Procedure

In order to provide document accountability of the completed analysis records, each item in a case shall be inventoried and assigned a serialized number and identifier associating it to the case and region.

Case # - Region - Serialized Number (For Example: 75-2-0240)

The number of pages of each item must be accounted for if each page is not individually numbered. All documents relevant to each case, including logbook pages, bench sheets, mass spectra; chromatographs, custody records, library search results, etc., shall be inventoried. The laboratory shall be responsible for ensuring that all documents generated are placed in the file for inventory and are delivered to NYSDEC in the Case File Purge package. Figure 1 is an example of a document inventory.

FIGURE 1 (Example)
DOCUMENT INVENTORY

Document Control #*	Document Type	# Pages
232-2-0001	Case File Document Inventory Sheet	1
232-2-0002	Chain-of-Custody Records	2
232-2-0003	Shipping Manifests	2
232-2-0004	Sample Tags	50
232-2-0005	Contract Lab Sample Information Sheets	10
232-2-0006	Inorganics Analysis Data Summary Sheets	10
232-2-0007	Analysts' Notebook Pages	14
232-2-0008	ICP and AA Instrument Logbook Pages	12
232-2-0009	GC/MS Spectra for Sample R-388-061-01	
232-2-0010	GC/MS Spectra for Sample R-388-0610-2	
etc.	etc.	etc.

* This number is to be recorded on each set of documents.

2.5 Shipping Data Packages and Case Files

The laboratory shall have written procedures to document shipment of deliverables packages to the recipients. These shipments require custody seals on the containers placed such that it cannot be opened without damaging or breaking the seal. The laboratory shall also document what was sent, to whom, the date, and the method (carrier) used.

3. Standard Operating Procedures

The laboratory must have written standard operating procedures (SOPs) for: (1) receipt of samples, (2) maintenance of custody, (3) sample storage, (4) tracking the analysis of samples, and (5) assembly of completed data.

An SOP is defined as a written narrative step-by-step description of laboratory operating procedures including examples of laboratory documentation. The SOPs must accurately describe the actual procedures used in the laboratory, and copies of the written SOPs shall be available to the appropriate laboratory personnel. These procedures are necessary to ensure that analytical data produced under this protocol are acceptable for use in NYSDEC enforcement case preparation and litigation. The laboratory's SOPs shall provide mechanisms and documentation to meet each of the following specifications and shall be used by NYSDEC as the basis for laboratory evidence audits.

3.1 The laboratory shall have a designated sample custodian responsible for receipt of samples and have written SOPs describing his/her duties and responsibilities.

3.2 The laboratory shall have written SOPs for receiving and logging in of the samples. The procedures shall include but not be limited to, documenting the following information:

- Presence or absence of appropriate chain-of-custody forms
- Presence or absence of airbills
- Presence or absence of appropriate Contract Lab Receipt of Samples Information Sheet
- Presence or absence of custody seals on shipping and/or sample containers and their condition
- Presence or absence of sample tags
- Sample tag ID numbers if not recorded on the chain-of-custody record(s) or packing list(s)
- Condition of the shipping container
- Condition of the sample bottles
- Verification of agreement or non-agreement of information on receiving documents
- Resolution of problems or discrepancies with the Bureau of Spill Prevention and Response.

3.3 The laboratory shall have written SOPs for maintenance of the security of samples after log-in and shall demonstrate security of the sample storage and laboratory areas.The SOPs shall specifically include descriptions of all storage areas for NYSDEC samples in the laboratory, and steps taken to prevent sample contamination. The SOPs shall include a list of authorized personnel who have access or keys to secure storage areas.

3.4 The laboratory shall have written SOPs for tracking the work performed on any particular sample. The tracking SOP shall include the following:

3.4.1 A description of the documentation used to record sample receipt, sample storage, sample transfers, sample preparations, and sample analyses.

3.4.2 A description of the documentation used to record instrument calibration and other QA/QC activities.

3.4.3 Examples of the document formats and laboratory documentation used in the sample receipt, sample storage, sample transfer, and sample analyses.

3.5 The laboratory shall have written SOPs for organization and assembly of all documents relating to each NYSDEC Case, including technical and managerial review. Documents shall be filed on a Case-specific basis. The procedures must ensure that all documents including logbook pages, sample tracking records, chromatographic charts, computer printouts, raw data summaries, correspondence, and any other written documents having reference to the Case are compiled in one location for submission to NYSDEC. The system must include a document numbering and inventory procedures.

3.6 The laboratory shall have written SOPs for laboratory safety.

3.7 The laboratory shall have written SOPs for cleaning of glassware used in preparing and analyzing samples under this protocol.

3.8 The laboratory shall have SOPs for traceability of standards used in sample analysis QA/QC.

4. Handling of Confidential Information

Laboratory conducting work under this protocol may receive NYSDEC designated confidential information from the Agency. Confidential information must be handled separately from other documentation developed under this contract. To accomplish this, the following procedures for the handling of confidential information have been estabiished.

4.1 All confidential documents shall be under the supervision of a designated Document Control Officer (DCO).

4.2 Confidential Information

Any samples or information received with a request of confidentiality shall be handled as "confidential". A separate locked file shall be maintained to store this information and shall be segregated from other non-confidential information. Data generated from confidential samples shall be treated as confidential. Upon receipt of confidential information, the DCO logs these documents into a Confidential Inventory Log. The information is then made available to authorized personnel but only after it has been signed out to that person by the DCO. The documents shall be returned to the locked file at the conclusion of each working day. Confidential information may not be reproduced except upon approval by the Bureau of Spill Prevention and Response. The DCO will enter all copies into the document control system. In addition, this information may not be disposed of except upon approval by the Bureau of Spill Prevention and Response. The DCO shall remove and retain the cover page of any confidential information disposed of for one year, and shall keep a record of the disposition in the Confidential Inventory Log.

APPENDIX 5X.3

CHEMICALS LISTED IN THE HAZARDOUS MATERIALS TABLE (49 CFR 172.101) USED FOR PRESERVING SAMPLES

PRESERVATIVE	SAMPLE TYPE/ PARAMETER	pH RECOMMENDATION	QUANTITY OF PRESERVATIVE ADDED PER LITER	WT. % OF PRESERVATIVE
HCl	Volatile Organic Analysis	<2 - ≥ 1	4 drops conc. HCL/40 ml	0.22% (2)
$HgCl_2$	Nitrogen Species	N.A.	40 mg.	0.004% (1)
HNO_3	Metals, Hardness	<2 - ≥ 1	5 ml of conc. (70%)	0.35% (1)
H_2SO_4	Nitrogen Species COD, Oil & Grease, P (hydrolyzable) Organic Carbon, Phenols	<2 - ≥ 1	2 ml of 36N	0.35% (1)
NaOH	Cyanides, Sulfides	>12 - ≤ 13	2 ml of 10N	0.080% (1)
Freezing* 0°C (Dry Ice)	Biological - Fish & Shellfish Tissue	N.A.	N.A.	N.A.

* - Dry ice is classified as a ORM-A hazard by DOT. There is no labeling requirement for samples preserved with dry ice, but each package must be plainly and durably marked on at least one side or edge with the designation "ORM-A". The package should also be marked "Dry Ice" or "Carbon Dioxide, Solid" and "Frozen Diagnostic Specimens". Samples must be packaged in accordance with the requirements of 49 CFR 173.615 and advance arrangements must be made between the shipper and each carrier.

N.A. - Not applicable.

REFERENCES

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

3. Handbook for Monitoring Industrial Wastewater, U. S. Environmental Protection Agency, Technology Transfer, 1973.

4. Handbook for Evaluating Water Bacteriological Laboratories, U. S. Environmental Protection Agency, ORD, Municipal Environmental Research Laboratory, Cincinnati, Ohio, 1975.

5. Microbiological Methods for Monitoring the Environment, Water and Waste, U. S. Environmental Protection Agency, ORD, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, 1978.

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

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

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

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

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

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

15. Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities, U. S.

Environmental Protection Agency, Office of Water and Waste Management, SW-611, 1977.

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

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

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

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

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

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

22. Preparation of Soil Sampling Protocol: Techniques and Strategies, US-EPA-600/4-83-020, EMSL, Las Vegas, August 1983.

23. Field Health and Safety Manual, U. S. Environmental Protection Agency, Region IV, August 1984.

24. Safety Manual for Hazardous Waste Site Investigations, U. S. Environmental Protestion Agency, Draft, 1979.

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

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

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

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

APPENDIX B

KEY PEOPLE

NAME	ADDRESS	TELEPHONE
Nicholas A. Laganella Principal	P.T.&L. Environmental Consultants, Inc. One Kalisa Way - suite 105 Paramus, New Jersey 07652	201-262-4141
Joseph Fairclough Project Manager	P.T.&L. Environmental Consultants, Inc. One Kalisa Way - Suite 105 Paramus, New Jersey 07652	201-262-4141
Marc Rembish Project Coordinator	P.T.&L. Environmental Consultants, Inc. One Kalisa Way - Suite 105 Paramus, New Jersey 07652	201-262-4141
Naresh Chintalacheruvu Project Manager	P.T.&L. Environmental Consultants, Inc. One Kalisa Way - Suite 105 Paramus, New Jersey 07652	201-262-4141
David Morris QA Officer	P.T.&L. Environmental Consultants, Inc. One Kalisa Way - Suite 105 Paramus, New Jersey 07652	201-262-4141
B.V. Rao, Ph. D. Data Validator	Groundwater Science & Environmental Technology, Inc. 600 East Crescent Avenue Upper Saddle River, NJ 07458	201-818-4583
Krishna M. Pamidi, Ph. D. Data Validator	Groundwater Science & Environmental Technology, Inc. 600 East Crescent Avenue Upper Saddle River, NJ 07458	201-818-4583
David A. Case Data Validator	Groundwater Science & Environmental Technology, Inc. 600 East Crescent Avenue Upper Saddle River, NJ 07458	201-818-4583

P.T.&L. Environmental Services

Corporate Headquarters: 1 Kalisa Way, Suite 105, Paramus, NJ 07652 (201)
Southeast Headquarters: 210 South Bumby Street, Suite B, Orlando, FL 32803 (407) 3

NICHOLAS LAGANELLA
PRESIDENT

PROFESSIONAL DATA AND CERTIFICATIONS

- San Diego State University
  Cum Laude, 1984—Bachelor of Science in Business Management
  Minor in Accounting
- Johnson and Wales College—Providence, Rhode Island
  Summa Cum Laude, 1980—Associate of Science in Business
- Professional Environmental Auditor
- EPA/AHERA Contractor/Supervisor
- Certified Hazardous Manager
- Health & Safety Hazardous Waste Site Investigator
- Building Operation & Maintenance for Indoor Air Quality
- Underground Storge Tanks Technical and Regulatory Training

PROFESSIONAL EXPERIENCE PROFILE

HAZARDOUS MATERIAL CONSULTATION AND REMEDIATION

AREAS OF EXPERTISE

Hazardous Material consultation:

- Site Assessment and Identification of Hazardous Materials
- Air and Bulk Sampling/Soil and Water Sampling
- Negative Air Methodology/Techniques for Asbestos Abatement
- Client Recommendations for Code Compliance
- Design of Engineering Controls/Work Practices
- Specification Development
- Value Engineering
- Waste Classification

Sales and Estimation:

- Sales Prospecting
- Client Pre-qualifications
- Project Estimating and Design
- Scope of Work Determination
- Job Cost Determination

PROJECT MANAGEMENT EXPERIENCE

1986-1989 HESCO Environmental Safety Company—Secaucus, New Jersey
Regional Manager

REPRESENTATIVE ASSIGNMENTS

Client: IBM Corporation/Edgewater Construction Co.
Site: Sterling Forest, Kingston, New York
Contract: $15,000,000
Size: 500,000 square feet
Nature of Project: Spray, Fireproofing, Removal, and Replacement in two separ
Commercial office buildings.

Responsibilities:

- Design of Engineering controls and Revised Phasing for demolition
abatement in a 24-hour active computer center.
- On-site management of 80-man work force.
- Interface and coordination of subcontractors for demolition, installat
of exterior hoist, electrical, HVAC, plumbing, and re-fireproofing.
- Quality Control Management
- Contract Negotiation and Administration.

Client: Port Authority of New York and New Jersey
Site: George Washington Apartment Complex
Contract: $2,500,000
Size: 150,000 square feet
Nature of Project: Spray, Fireproofing, Removal, and Replacement of entire apartm
complex.

Responsibilities:

- Unique design of engineering controls and project phasing
abatement project located above Cross Bronx Expressway on S-
Beams.
- Project Administration and Coordination of Subcontractors includ
scaffolding and re-spray.
- Manpower management of 60-man work crew.
- Contract Administration, progress billings, change orders,
close-out.

Client: Jack Resnick and Sons
Site: New York City, NY - Various Locations
Contract: $7,500,000
Size: 150,000 linear feet / 100,000 square feet
Nature of Project: Mechanical Asbestos Removal and Re-insulation of boilers, tanks, and piping insulation. Asbestos Spray Fireproofing removal in high rise office buildings.

Responsibilities:

- Complete on-site supervision of project.
- Specific design of engineering controls for Core Shaft and sensitive boiler room and HVAC mechanical rooms removals.
- Implementation and monitoring of Quality Control Systems.
- Contract Administration, Legal Documentation, and Close-out.

Client: Nabisco Brands, Inc.
Site: Fair Lawn, New Jersey
Contract: $3,500,000
Size: 125,000 square feet / 75,000 Lineal Feet
Nature of Project: Bakery Oven Asbestos Removal for oven duct and breaching insulation. Emergency Response Asbestos Removal.

Responsibilities:

- Complete on-site supervision of project.
- Specific design of engineering controls for 24-hour day asbestos removal adjunct to active bakery operations.
- Coordination of multi-shift manpower requirements in accommodation to bakery operations and routing needs.
- Contract Administration, Legal Documentations, and Close-out.

ADDITIONAL ASBESTOS ABATEMENT PROJECTS

Client: Rapid American Corporation—New York, New York
Nature of Project: Spray, Fireproofing, Removal, and Replacement in Commercial High-Rise Office Building

Client: Loews Summit Hotel—New York, New York
Nature of Project: Emergency project involving amosite duct insulation in fire-=damaged kitchen in fully-occupied hotel.

Client: Mayfair Regent Hotel—New York, New York
Nature of Project: Phased removals and replacement in boiler, tanks, pipes and ducts including "Le Cirque" Restaurant.

Client: New York Hilton—New York, New York
Nature of Project: Asbestos removal and replacement of Ballroom plaster ceiling and steam rooms piping insulation.

Client	Duro Construction Company—New York, New York
Nature of Project	Spray, Fireproofing, Removal and Replacement in Commercial Hig Office Building.
Client	Cushman and Wakefield—New York, New York
Nature of Project	Spray, Fireproofing, Removal and Replacement in Retail Store.
Client	Rudin Management—New York, New York
Nature of Project	Spray, Fireproofing, Removal, and Replacement in Commercial Hig Office Building.
Client	Cleary, Gottlieb, Stern, & Hamilton—New York, New York
Nature of Project	Spray, Fireproofing, Removal and Replacement in Commercial Hig Office Building.
Client	Kem Manufacturing—Fairlawn, New Jersey
Nature of Project	Boiler and piping insulation removal in Industrial Manufacturing Facil
Client	Hekemian and Company—Hackensack, New Jersey
Nature of Project	Piping Insulation Removal in Residential Apartment Buildings.

Summation: Over a span of three years, accomplished successful completion of ove Asbestos Abatement and Removal Projects valued at an excess of $20,00

RELATED PROFESSIONAL EXPERIENCE

1984-1986 Errecas, Inc.—Spring Valley, California

Project Engineer/Estimator

Responsibilities:

- Estimation and formulation of bids for Heavy Constructio Engineering projects; Roads and bridges, underground utilities ar development.
- Negotiation of Contracts.
- Contract Administration including: Change orders, billing progress payments, and contract compliance.
- Quality and material take-off.
- Extensive plan reading and interpretation.
- Budgeting, cost control, and material purchasing.

Project Engineer for 1,100 home site subdivision and site developmen
Contract Value: $12,000,000

1983-1984 R.E. Hazard Contracting—San Diego, California

Project Engineer

Responsibilities:

- Project Engineer for Major New Highway construction proj involving 5 miles on new roadway.
- Quantity and material take-off.
- Extensive plan reading and interpretation.
- Budgeting, cost control and material purchasing.

PROFESSIONAL ASSOCIATIONS

Bergen Pines County Hospital Foundation - Chairman of the Board: 1993 (Founding Member)

Rotary International - Paul Harris Fellow: 1989 - 1993

National Asbestos Council (NAC)—Charter Member: 1987-1993

Building Owners and Management (BOMA): 1987-1989

National Institute of Building Sciences (NIBS): 1987-1993

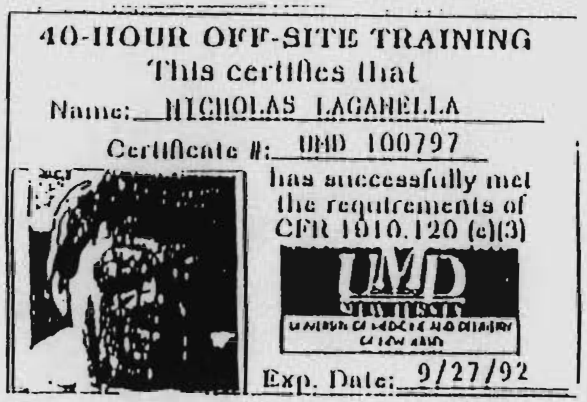
PROFESSIONAL REFERENCES

Richard Gilbert, Vice President
Floyd Anderson, Vice President
Jack Resnick and Sons
110 East 59th Street
New York, New York
(212) 421-1300

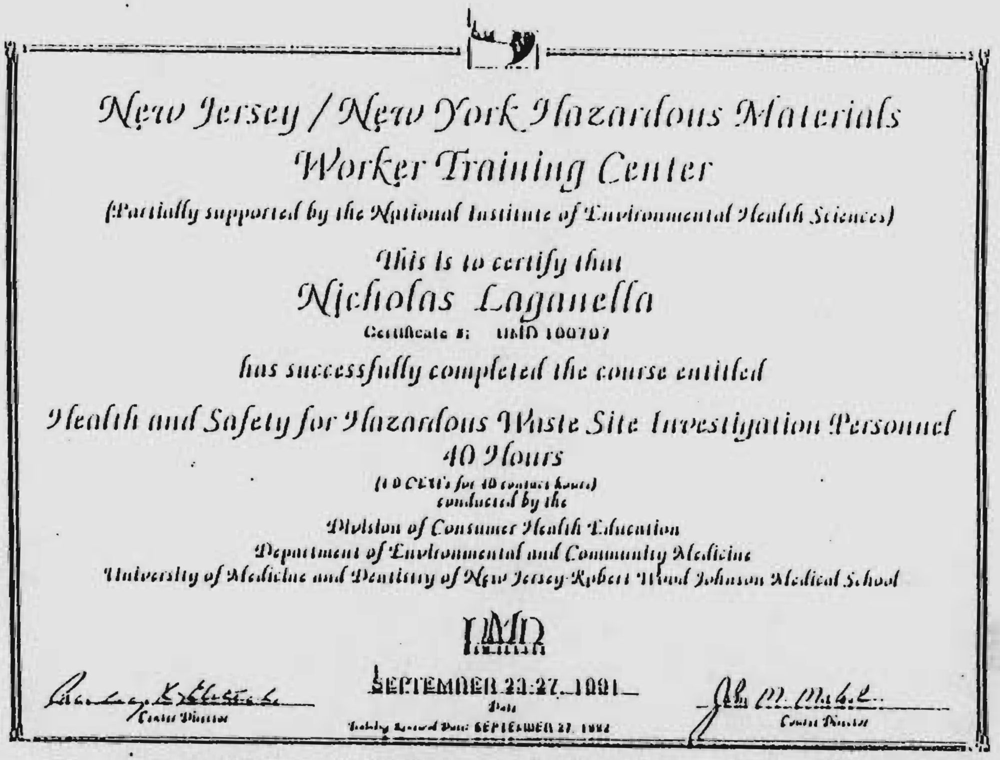
Clarence Fietje
Rich Knab
Nabisco Brands, Inc.
2211 Route 208
Fairlawn, New Jersey 07410
(201) 794-4000

George Koch
Jim Johnstone
Koch-Johnstone Associates
130 West 30th Street
New York, New York
(212) 594-5454

Robert Lawrence
General Foods Corporation
250 North Street
White Plains, New York
(914) 335-2208



40-HOUR OFF-SITE TRAINING
This certifies that
Name: NICHOLAS LAGANELLA
Certificate #: UMD 100797
has successfully met the requirements of CFR 1910.120 (e)(3)
UMD
Exp. Date: 9/27/92



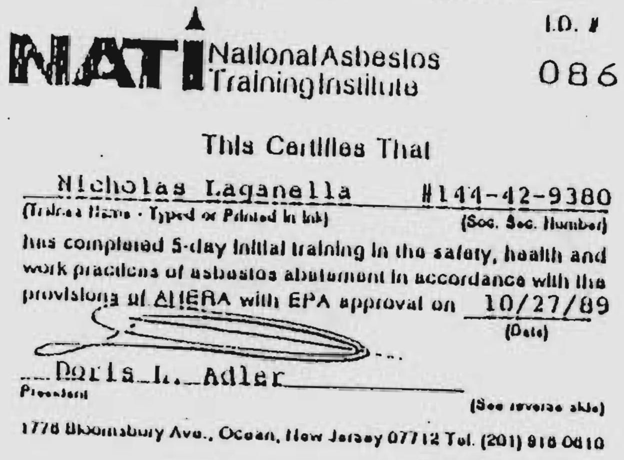
New Jersey / New York Hazardous Materials Worker Training Center
(Partially supported by the National Institute of Environmental Health Sciences)

This is to certify that
Nicholas Laganella
Certificate #: UMD 100797
has successfully completed the course entitled
Health and Safety for Hazardous Waste Site Investigation Personnel
40 Hours
(4.0 CEU's for 40 contact hours)
conducted by the
Division of Consumer Health Education
Department of Environmental and Community Medicine
University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School

UMD

SEPTEMBER 23-27, 1991
Date
[illegible] Date: SEPTEMBER 27, 1992

Center Director
Center Director



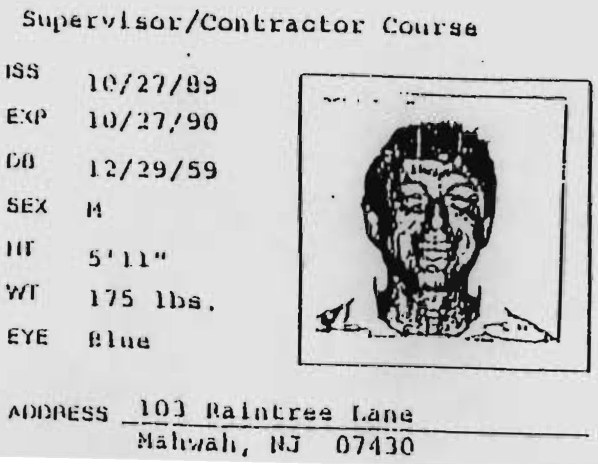
NATI National Asbestos Training Institute

I.D. # 086

This Certifies That
Nicholas Laganella #144-42-9380
(Trainee Name - Typed or Printed in Ink) (Soc. Sec. Number)
has completed 5-day initial training in the safety, health and work practices of asbestos abatement in accordance with the provisions of AHERA with EPA approval on 10/27/89
(Date)

Doris L. Adler
President
(See reverse side)

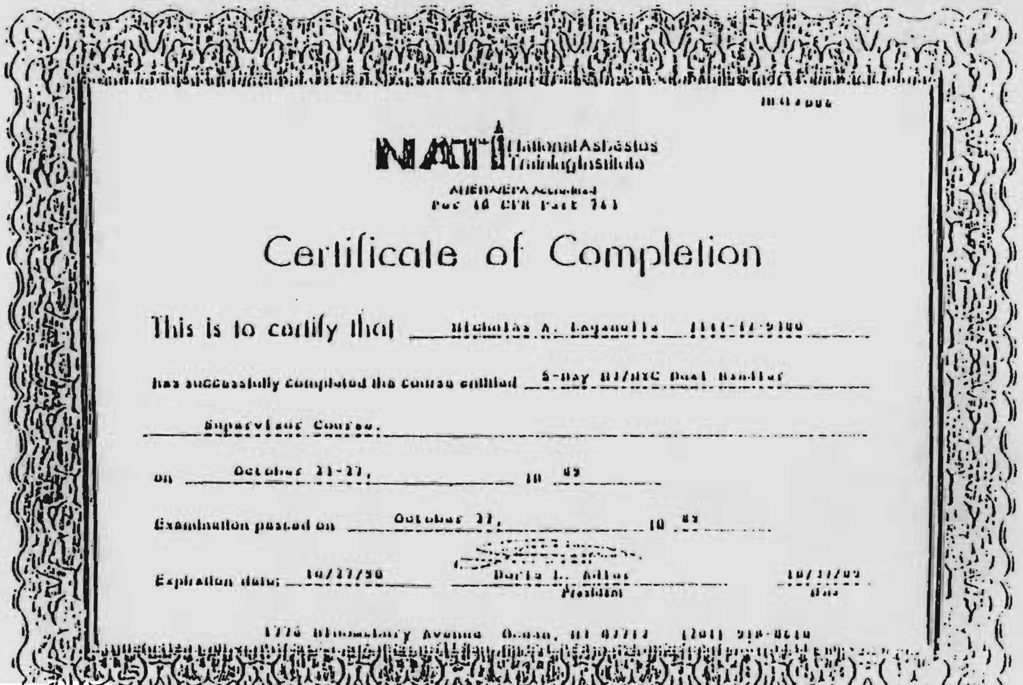
1778 Bloomsbury Ave., Ocean, New Jersey 07712 Tel. (201) 918 0610



Supervisor/Contractor Course

ISS 10/27/89
EXP 10/27/90
DB 12/29/59
SEX M
HT 5'11"
WT 175 lbs.
EYE Blue

ADDRESS 103 Raintree Lane
Mahwah, NJ 07430



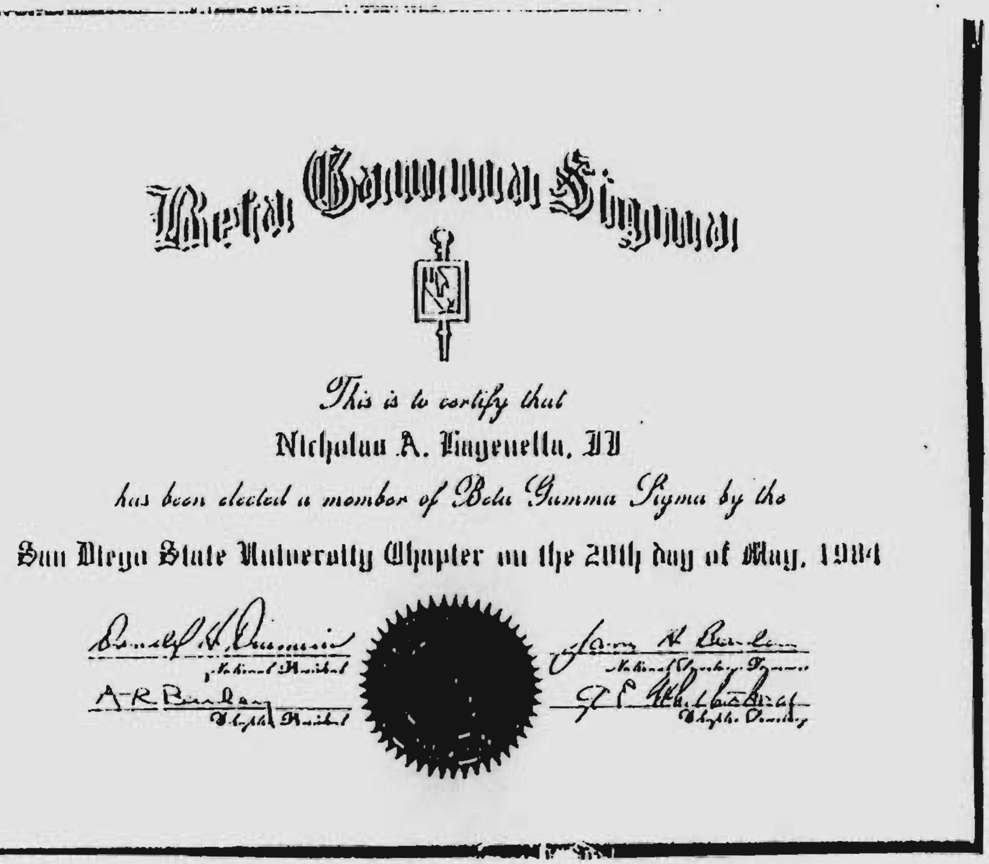
[illegible]

NATI National Asbestos Training Institute
AHERA/EPA Accredited
Per 40 CFR Part 763

Certificate of Completion

This is to certify that Nicholas A. Laganella #144-42-9380
has successfully completed the course entitled 5-Day NJ/NYC Dual Handler Supervisor Course.
on October 23-27, 19 89
Examination passed on October 27, 19 89
Expiration date: 10/27/90 Doris L. Adler 10/27/89
President Date

1776 Bloomsbury Avenue Ocean, NJ 07712 (201) 918-0610



Beta Gamma Sigma

This is to certify that

Nicholas A. Laganella, II

has been elected a member of Beta Gamma Sigma by the

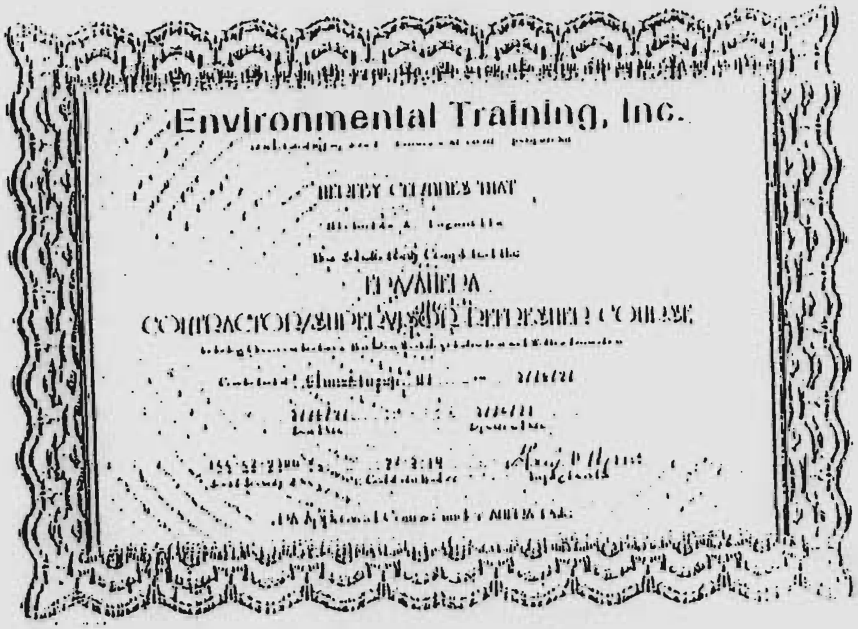
San Diego State University Chapter on the 20th day of May, 1984

National President

National Secretary-Treasurer

Chapter President

Chapter Secretary



Environmental Training, Inc.

[illegible]

HEREBY CERTIFIES THAT

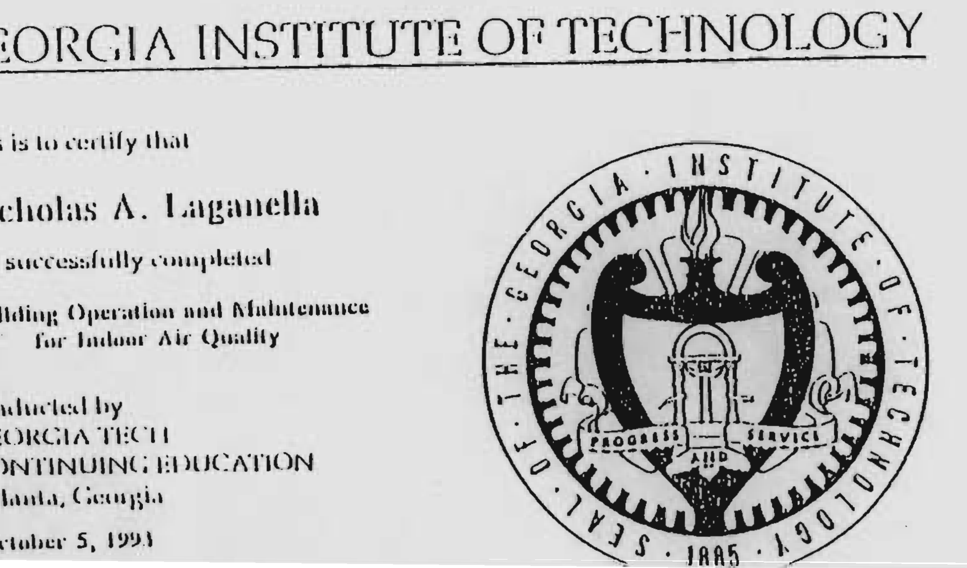
Nicholas A. Laganella

Has Satisfactorily Completed the

EPA/AHERA

CONTRACTOR/SUPERVISOR REFRESHER COURSE

[illegible]



EORGIA INSTITUTE OF TECHNOLOGY

s is to certify that

cholas A. Laganella

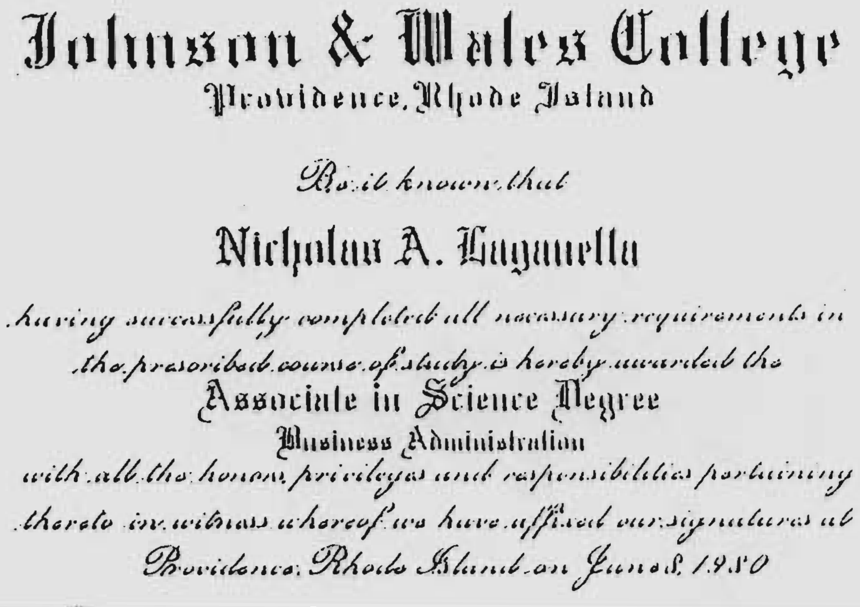
successfully completed

lding Operation and Maintenance
for Indoor Air Quality

nducted by
EORGIA TECH
ONTINUING EDUCATION
lanta, Georgia

ctober 5, 1993

1885



Johnson & Wales College

Providence, Rhode Island

Be it known that

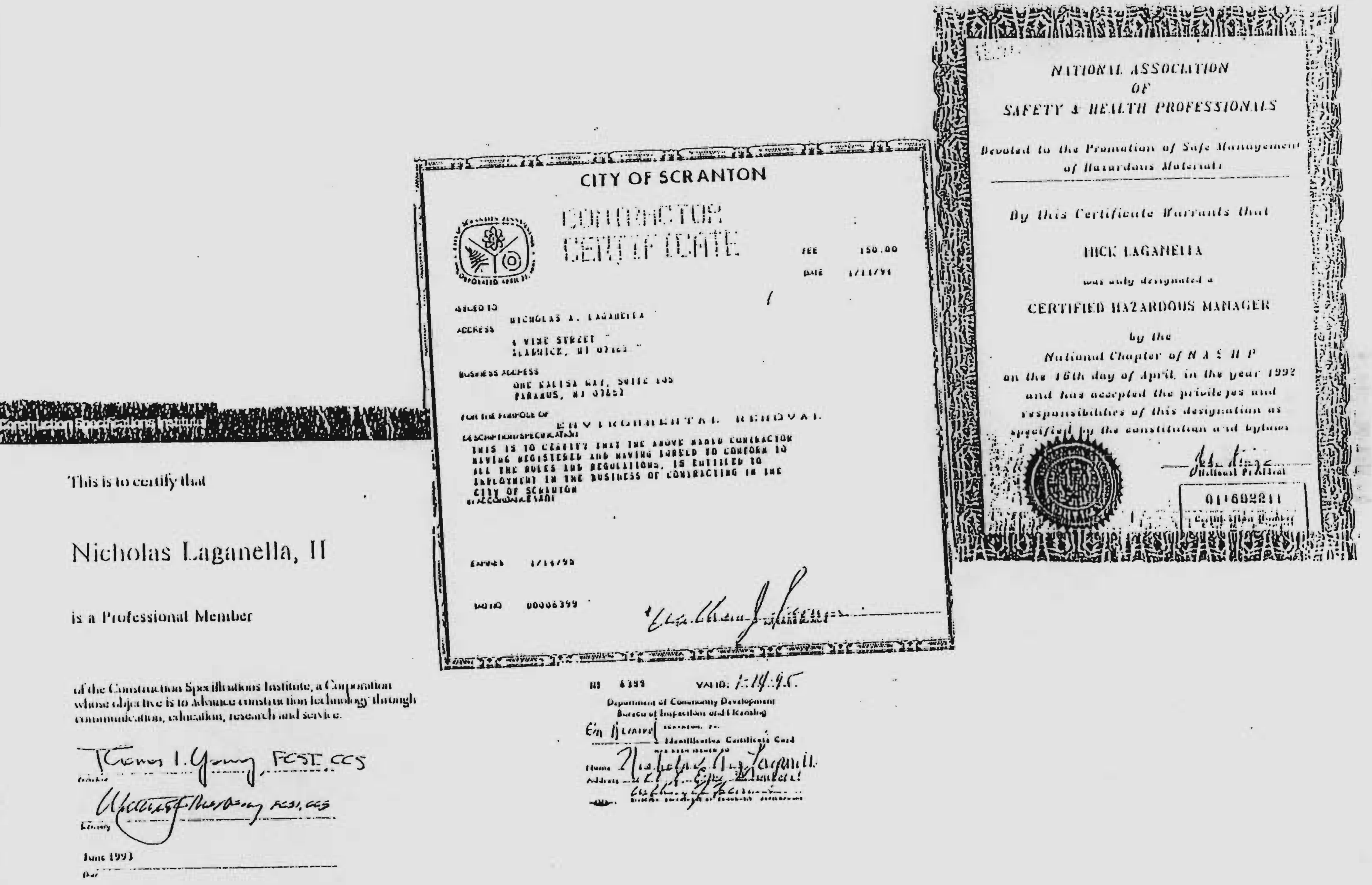
Nicholas A. Laganella

having successfully completed all necessary requirements in the prescribed course of study is hereby awarded the

Associate in Science Degree

Business Administration

with all the honors privileges and responsibilities pertaining thereto in witness whereof we have affixed our signatures at Providence, Rhode Island on June 8, 1980



Construction Specifications Institute

This is to certify that

Nicholas Laganella, II

is a Professional Member

of the Construction Specifications Institute, a Corporation whose objective is to advance construction technology through communication, education, research and service.

Thomas I. Young, FCSI, CCS

President

William [illegible] FCSI, CCS

Secretary

June 1993

Date

CITY OF SCRANTON

CONTRACTOR CERTIFICATE

FEE 150.00

DATE 1/14/94

ISSUED TO
NICHOLAS A. LAGANELLA

ADDRESS
4 VINE STREET
[illegible], NJ [illegible]

BUSINESS ADDRESS
ONE KALISA WAY, SUITE 105
PARAMUS, NJ 07652

FOR THE PURPOSE OF
ENVIRONMENTAL REMOVAL

DESCRIPTION/SPECIFICATION
THIS IS TO CERTIFY THAT THE ABOVE NAMED CONTRACTOR HAVING REGISTERED AND HAVING AGREED TO CONFORM TO ALL THE RULES AND REGULATIONS, IS ENTITLED TO EMPLOYMENT IN THE BUSINESS OF CONTRACTING IN THE CITY OF SCRANTON
[illegible]

EXPIRES 1/14/95

NO. 00006399

[illegible]

NO 6399 VALID: 1:14:95

Department of Community Development
Bureau of Inspections and Licensing

Env Removal
Scranton, Pa.
Identification Certificate Card
has been issued to

Name Nicholas A. Laganella
Address [illegible]

[illegible]

NATIONAL ASSOCIATION OF SAFETY & HEALTH PROFESSIONALS

Devoted to the Promotion of Safe Management of Hazardous Materials

By this Certificate Warrants that

NICK LAGANELLA

was duly designated a

CERTIFIED HAZARDOUS MANAGER

by the National Chapter of N A S H P on the 16th day of April, in the year 1992 and has accepted the privileges and responsibilities of this designation as specified by the constitution and bylaws

National President

01602811

Certification Number

San Diego State University

The Trustees of The California State University
upon recommendation of the Faculty
have conferred upon

Nicholas Anthony Laganella

the Degree of

Bachelor of Science in Applied Arts and Sciences
Business Administration (Management)

Cum Laude - With Distinction in Management

with all rights, privileges and honors thereunto appertaining.

Given at San Diego State University this
twenty fifth day of May, nineteen hundred eighty-four

JOHNSON & WALES COLLEGE

CERTIFICATE OF AWARD
PRESENTED TO

NICHOLAS A. LAGANELLA

in recognition of

MERITORIOUS ACHIEVEMENT - SUMMA CUM LAUDE

JUNE 8, 1980
Date

President

RUTGERS

Cook College

Continuing Professional Education

THIS CERTIFICATE IS AWARDED TO

NICHOLAS LAGANELLA

FOR THE COMPLETION OF
Technical and Regulatory Training
in
UNDERGROUND STORAGE TANKS

MARCH 7 & 8, 1994

THE NATIONAL GROUND WATER ASSOCIATION

acknowledges that

Nicholas Luganella

is a member of the National Ground Water Association, whose mission is to provide professional and technical leadership in the advancement of the ground water industry and in the protection, the promotion, and the responsible development and use of ground water resources.

national ground water association

Glenn Lyons

Glenn Lyons, CWD/PI
NGWA President

exp date 08/95

P.T.&L. Environmental Services

Corporate Headquarters: 1 Kalisa Way, Suite 105, Paramus, NJ 07652 (201) 262
Southeast Headquarters: 210 South Bumby Street, Suite B, Orlando, FL 32803 (407) 396

DAVID J. MORRIS

PROJECT MANAGER

PROFESSIONAL DATA AND CERTIFICATIONS

- Farnborough College, Farnborough, UK - 1988
  BSC Environmental Analysis & Pollution Monitoring

- Bournville College, Birmingham - 1984
  BTEC-OND Fine Art and Graphic Design

- Robert Wood Johnson Medical School
  Environmental & Community Medicine, Research Assistant

- OSHA 40 Hour Hazardous Waste Site Operations Worker Training
- OSHA 8 Hour Hazardous Waste Site Operations Supervisor Training
- NYC DEP / ACP Investigator
- Confined Space Entry Awareness
- 8 Hour Lead Detection / Radiation Safety
- Professional Environmental Auditor
- Certified Hazard Manager
- USEPA Accredited AHERA Asbestos Investigator
- USEPA Accredited AHERA Management Planner
- NYS DoSH Handler - Supervisor
- NYS DoSH Air Sampling Technician (RH II)
- NYS DoSH Inspector (RH III)
- NYS DoSH Project Monitor
- NYS DoSH Management Planner
- Airborne Asbestos Sampling & Identification / Microscopical Identification of Asbestos
- NIOSH 582
- ARC Cardiopulmonary Resuscitation
- ARC First Aid Progression
- MAP-SciTec Trained
- Radon Measurement & Mitigation
- PGT-XRF Trained
- OSHA, New Jersey, New York State Right-to-Know (Hazard Communication)
- Corporate Radiation Safety Officer
- RMS's LPA-1 Lead Paint Inspection System
- OSHA 8 Hour Annual Hazardous Waste Site Refresher
- Professional Environmental Auditor

RELEVANT EXPERIENCE

Prior to his employment with P.T.&L. Environmental Consultants, Inc., Mr. Morris was retained by the Testwell-Craig Group, working for three subsidiary companies in varying capacities. He supervised and executed the regional contracts with the Dormitory Authority of New York, completing surveys and preparing specifications for asbestos abatement projects in sites throughout New York.

Supplemental to this Mr. Morris spearheaded the move into the lead paint consulting field, managing hazard assessment surveys and specifically large litigation cases concerning lead poisoning. Incumbent on these operations was work with radioactive testing devices and employing adequate safety precautions and procedures, as well as procuring state licenses for such operations.

Additionally, Mr. Morris also assisted the Testwell Craig Education Division, importing his technical and logical experience to the lecture forum. With a strong Chemistry background Mr. Morris draws upon hands on experience of analytical methodologies to provide valuable resources for accurate site testing protocols.

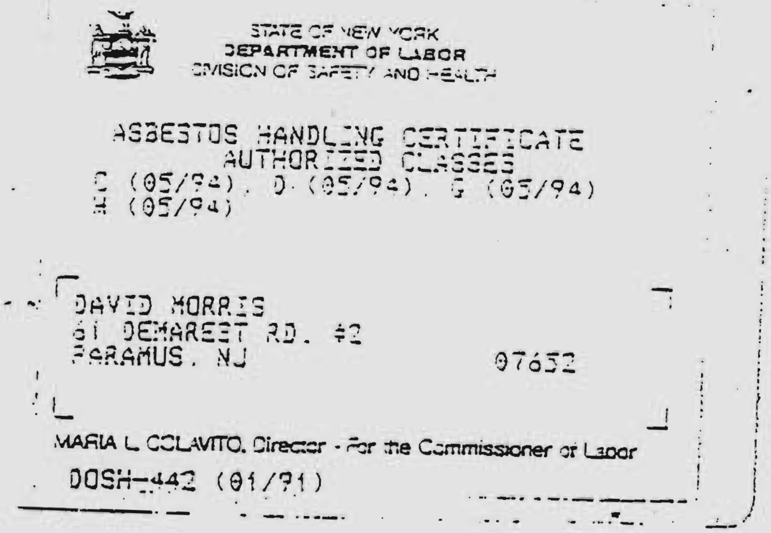
Mr. Morris' current duties include the management and development of waste classifications programs and hazardous waste removal and disposal programs in accordance with TCLP, RCRA and TSCA regulations. Assisting in the preparation of proposals and bids for environmental projects include UST removals, replacements and investigations, site assessments, soil and groundwater sampling programs, Phase I investigations, and soil and ground remediation programs. He has also assisted in the management of subcontractor relations including the reviewing of contracts and qualifications, and scheduling of subcontractor activities.

EMPLOYMENT HISTORY

1990 - 1993	Testwell Craig Laboratories
1989 - 1990	The Courdith-Roberts Group
1988-1989	Thomas Laboratories

PROJECT EXPERIENCE

- Trust Company of New Jersey, Jersey City, New Jersey
- City of Stamford Housing Authority, Stamford, Connecticut
- Dormitory Authority State of New York, New York, New York
- Woodbridge Township, Woodbridge, New Jersey
- ITT Defense / Avionics Division, New Jersey
- City University of New York, Brooklyn, New York
- City College of New York, New York, New York

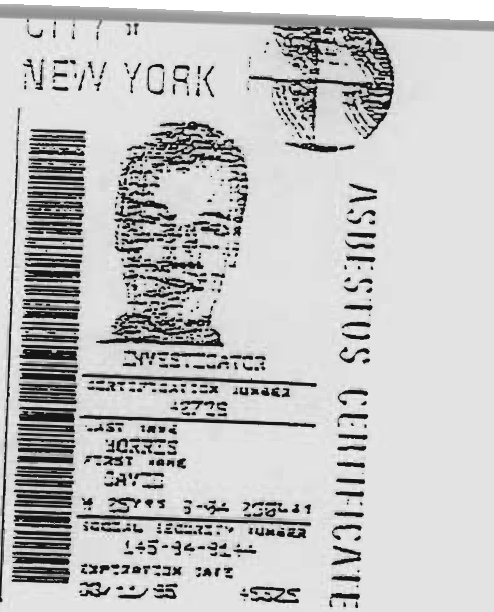


STATE OF NEW YORK
DEPARTMENT OF LABOR
DIVISION OF SAFETY AND HEALTH

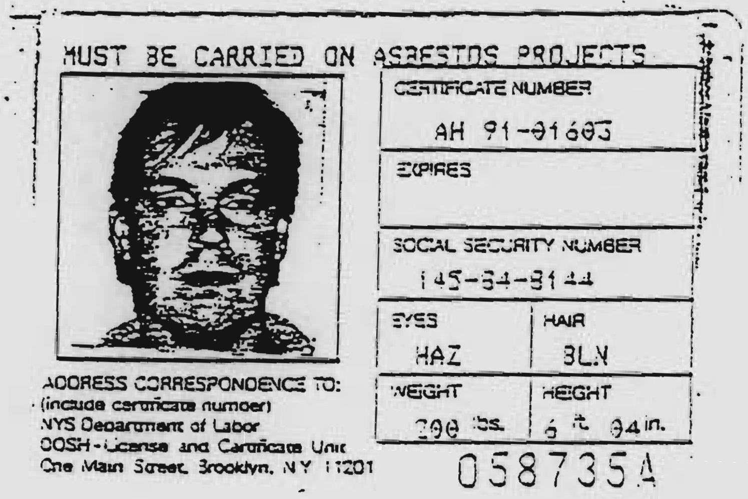
ASBESTOS HANDLING CERTIFICATE
AUTHORIZED CLASSES
C (05/94), D (05/94), G (05/94)
H (05/94)

DAVID MORRIS
61 DEMAREST RD. #2
PARAMUS, NJ 07652

MARIA L. COLAVITO, Director - For the Commissioner of Labor
DOSH-442 (01/91)



CITY of
NEW YORK
ASBESTOS CERTIFICATE
INVESTIGATOR
CERTIFICATION NUMBER
42779
LAST NAME
MORRIS
FIRST NAME
DAVID
M 25Y[illegible] 3-84 [illegible]
SOCIAL SECURITY NUMBER
145-84-8144
EXPIRATION DATE
03/[illegible]/95 45525

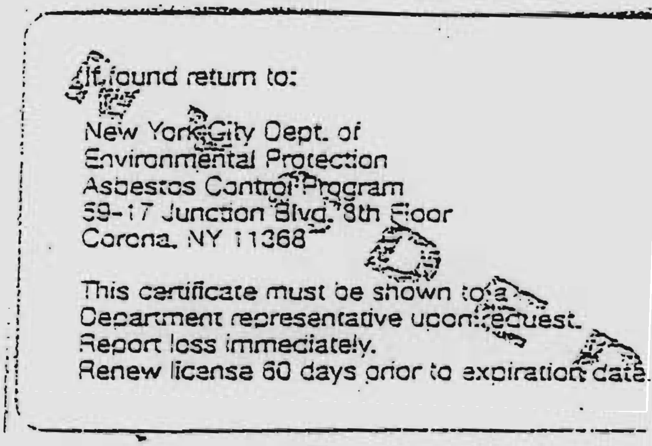


MUST BE CARRIED ON ASBESTOS PROJECTS

CERTIFICATE NUMBER AH 91-01603	
EXPIRES	
SOCIAL SECURITY NUMBER 145-84-8144	
EYES HAZ	HAIR BLN
WEIGHT 200 lbs.	HEIGHT 6 ft 04 in.

ADDRESS CORRESPONDENCE TO:
(include certificate number)
NYS Department of Labor
DOSH - License and Certificate Unit
One Main Street, Brooklyn, NY 11201

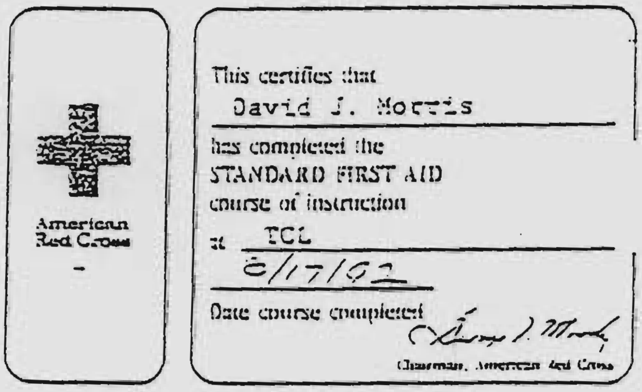
058735A



If found return to:

New York City Dept. of
Environmental Protection
Asbestos Control Program
59-17 Junction Blvd. 8th Floor
Corona, NY 11368

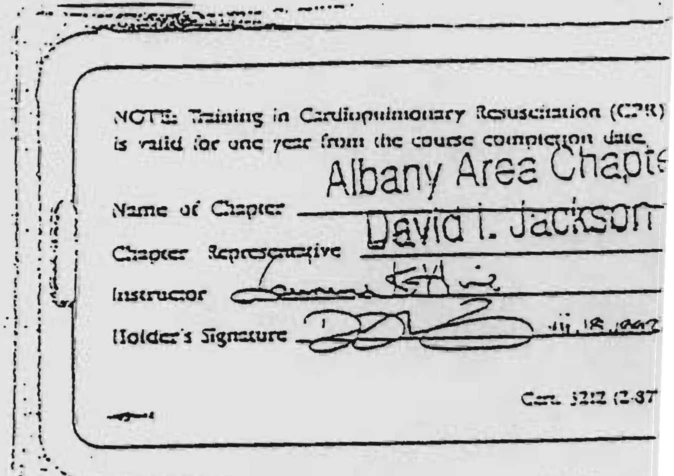
This certificate must be shown to a
Department representative upon request.
Report loss immediately.
Renew license 60 days prior to expiration date.



American Red Cross

This certifies that
David J. Morris
has completed the
STANDARD FIRST AID
course of instruction
at TCL
6/17/92
Date course completed

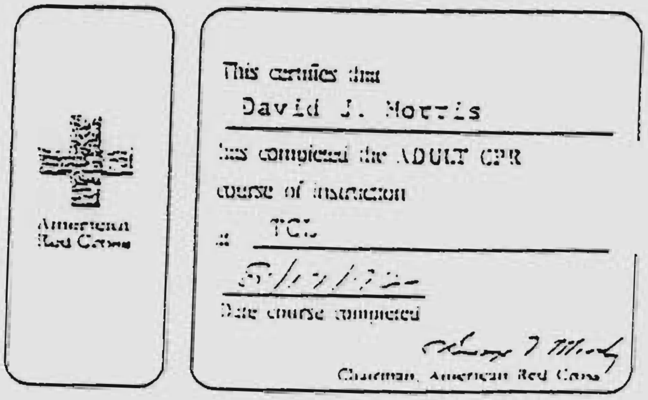
Chairman, American Red Cross



NOTE: Training in Cardiopulmonary Resuscitation (CPR)
is valid for one year from the course completion date.

Name of Chapter Albany Area Chapte
Chapter Representative David I. Jackson
Instructor
Holder's Signature

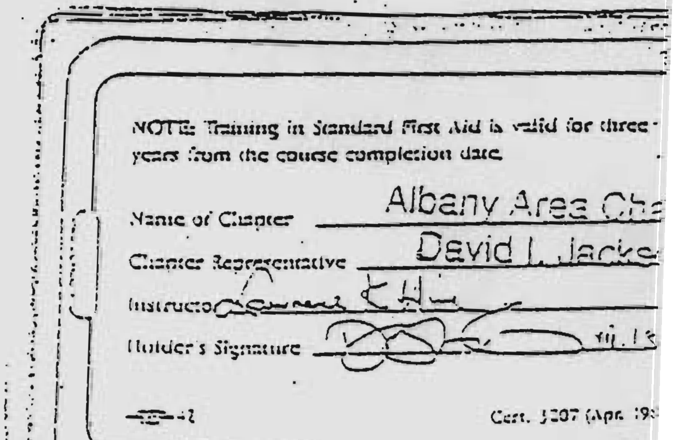
Cert. 3212 (2-87



American Red Cross

This certifies that
David J. Morris
has completed the ADULT CPR
course of instruction
at TCL
6/17/92
Date course completed

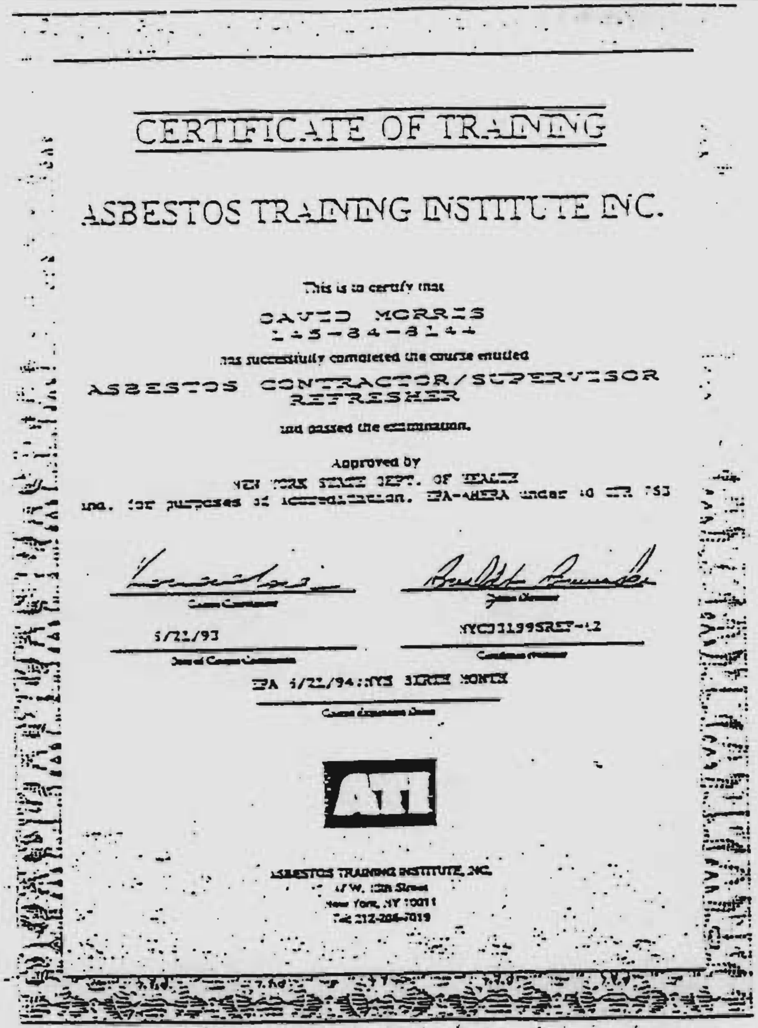
Chairman, American Red Cross



NOTE: Training in Standard First Aid is valid for three
years from the course completion date.

Name of Chapter Albany Area Cha
Chapter Representative David I. Jacks
Instructor
Holder's Signature

Cert. 3207 (Apr. 19



CERTIFICATE OF TRAINING

ASBESTOS TRAINING INSTITUTE INC.

This is to certify that

DAVID MORRIS
145-84-8144

has successfully completed the course entitled

ASBESTOS CONTRACTOR/SUPERVISOR
REFRESHER

and passed the examination.

Approved by
NEW YORK STATE DEPT. OF HEALTH
and, for purposes of accreditation, EPA-AHERA under 40 CFR 763

Course Coordinator
Course Director

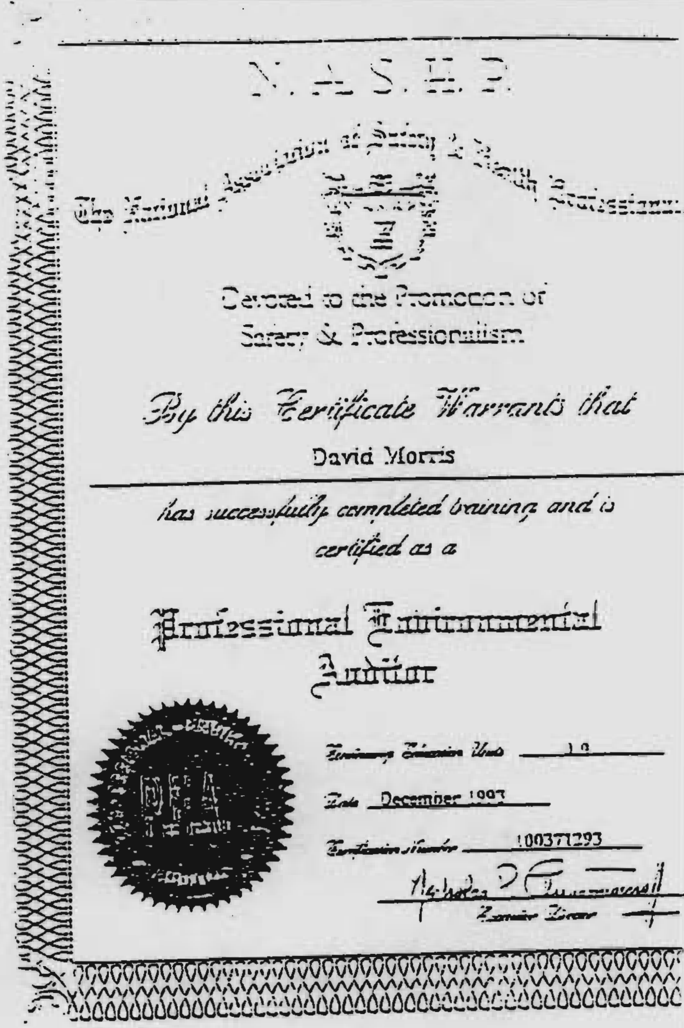
5/22/93
Date of Course Completion

NYC031199SREF-12
Certificate Number

EPA 5/22/94: NYS SIXTH MONTH
Course Expiration Date

ATI

ASBESTOS TRAINING INSTITUTE, INC.
47 W. 13th Street
New York, NY 10011
Tel 212-206-7019



N. A. S. H. P.

The National Association of Safety & Health Professionals

Devoted to the Promotion of
Safety & Professionalism

By this Certificate Warrants that

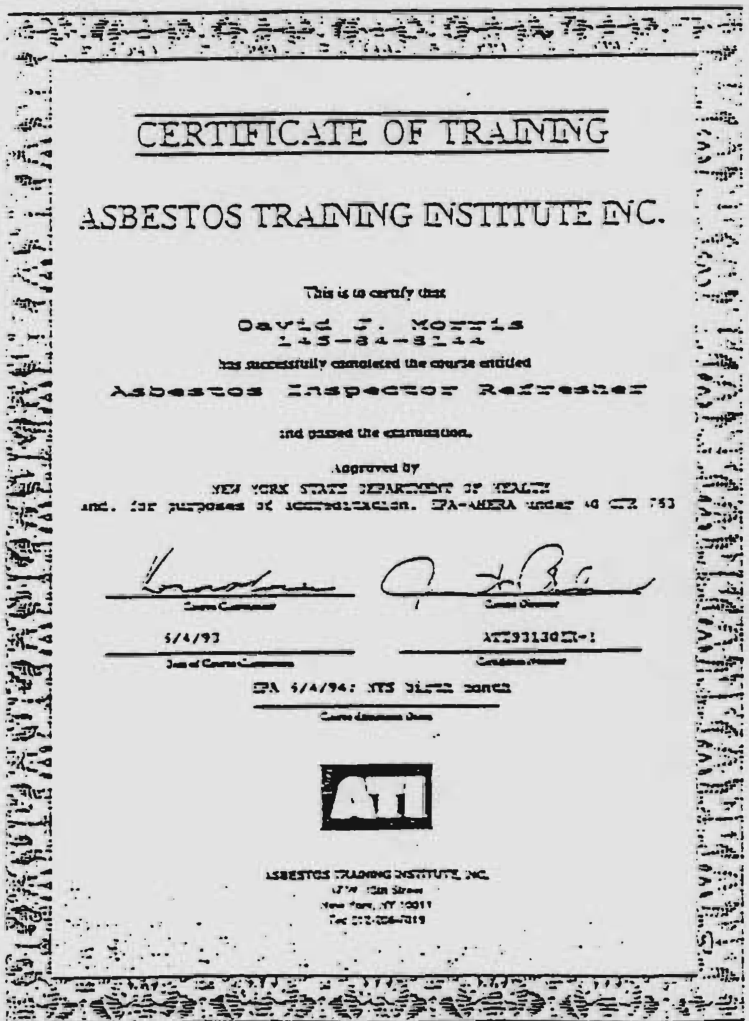
David Morris

has successfully completed training and is certified as a

Professional Environmental
Auditor

Continuing Education Units 10
Date December 1993
Certification Number 100371293

Executive Director



CERTIFICATE OF TRAINING

ASBESTOS TRAINING INSTITUTE INC.

This is to certify that

David J. Morris
145-84-8144

has successfully completed the course entitled

Asbestos Inspector Refresher

and passed the examination.

Approved by
NEW YORK STATE DEPARTMENT OF HEALTH
and, for purposes of accreditation, EPA-AHERA under 40 CFR 763

Course Coordinator
Course Director

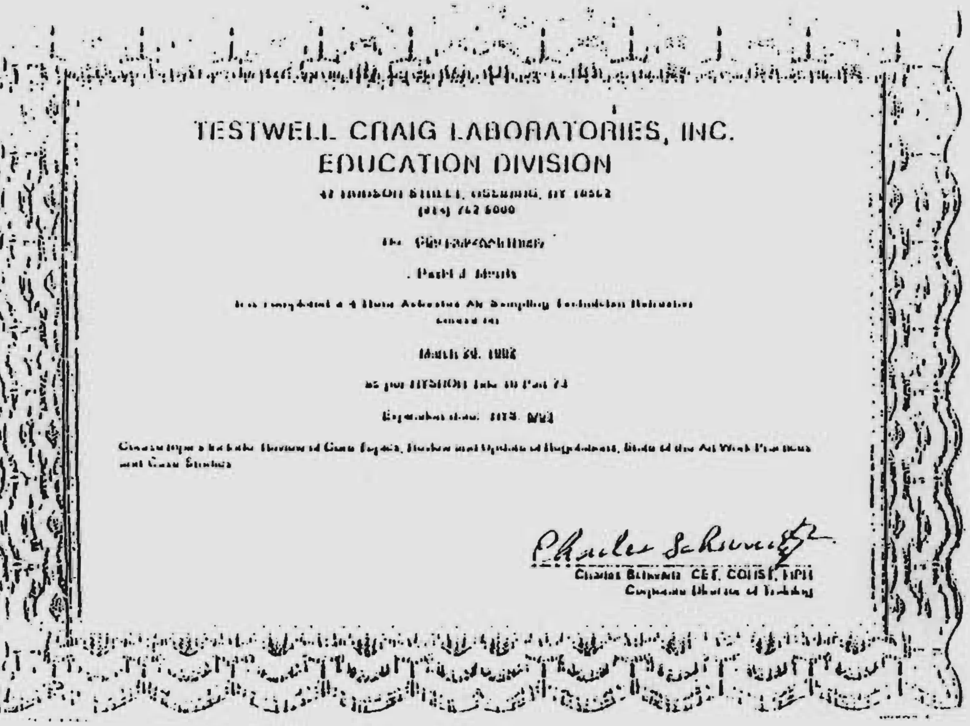
5/4/93
Date of Course Completion

ATI93130IR-1
Certificate Number

EPA 5/4/94: NYS SIXTH MONTH
Course Expiration Date

ATI

ASBESTOS TRAINING INSTITUTE, INC.
47 W. 13th Street
New York, NY 10011
Tel 212-206-7019



TESTWELL CRAIG LABORATORIES, INC.
EDUCATION DIVISION

[illegible]

[illegible]

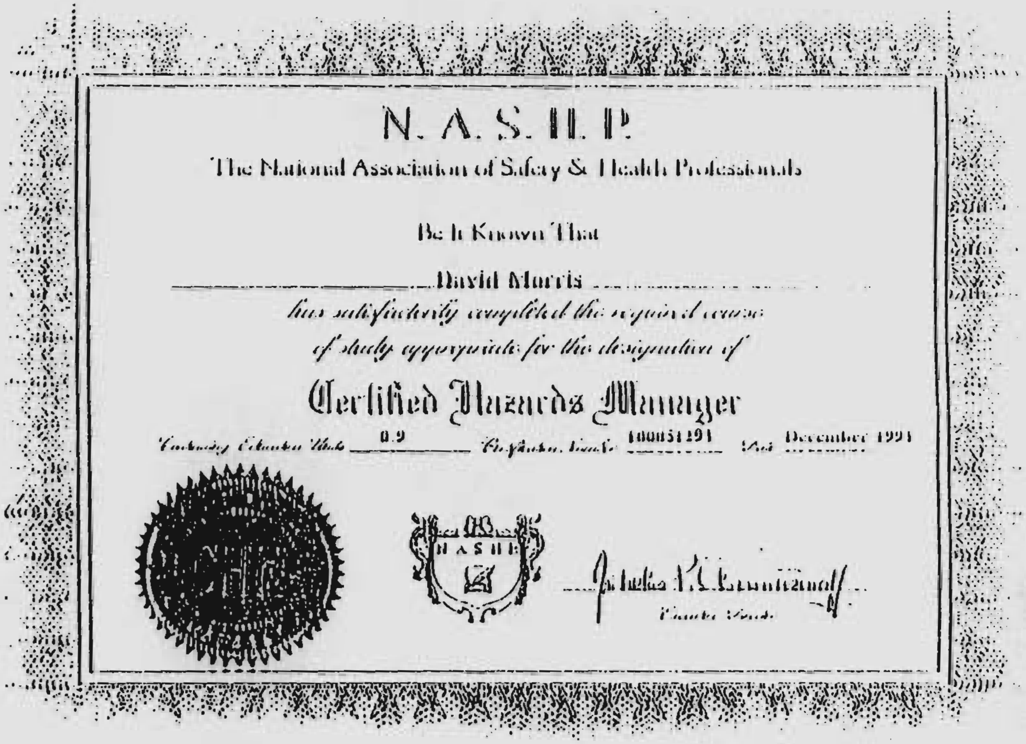
[illegible]

[illegible]

[illegible]

[illegible]

[illegible]



N. A. S. H. P.
The National Association of Safety & Health Professionals

Be It Known That

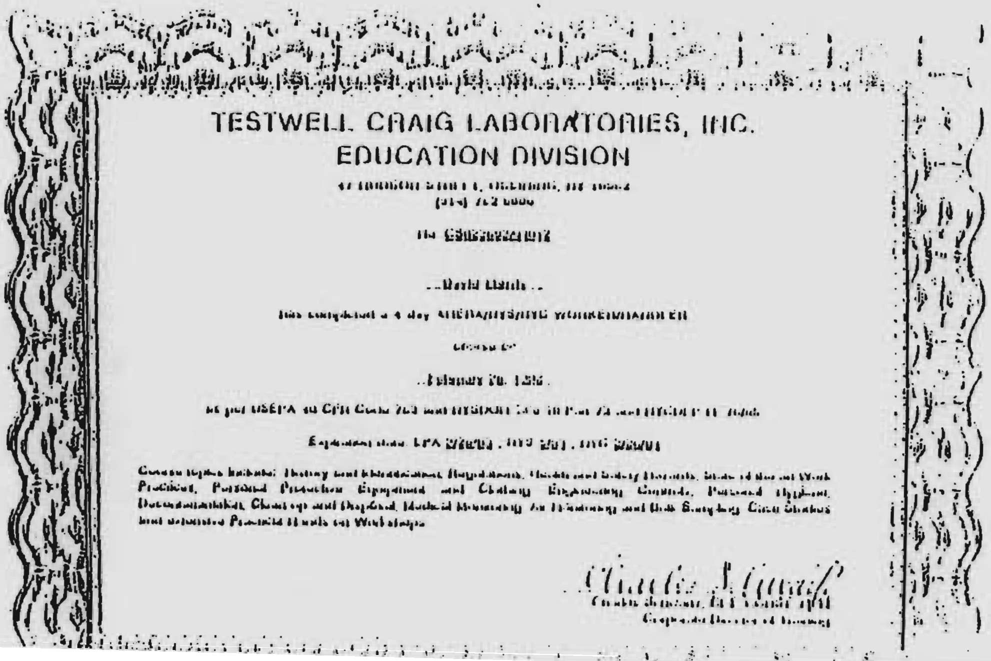
David Morris

has satisfactorily completed the required course
of study appropriate for the designation of

Certified Hazards Manager

Continuing Education Units 0.9 *Certification Number* 100051291 *Date* December 1991

NASHP



TESTWELL CRAIG LABORATORIES, INC.
EDUCATION DIVISION

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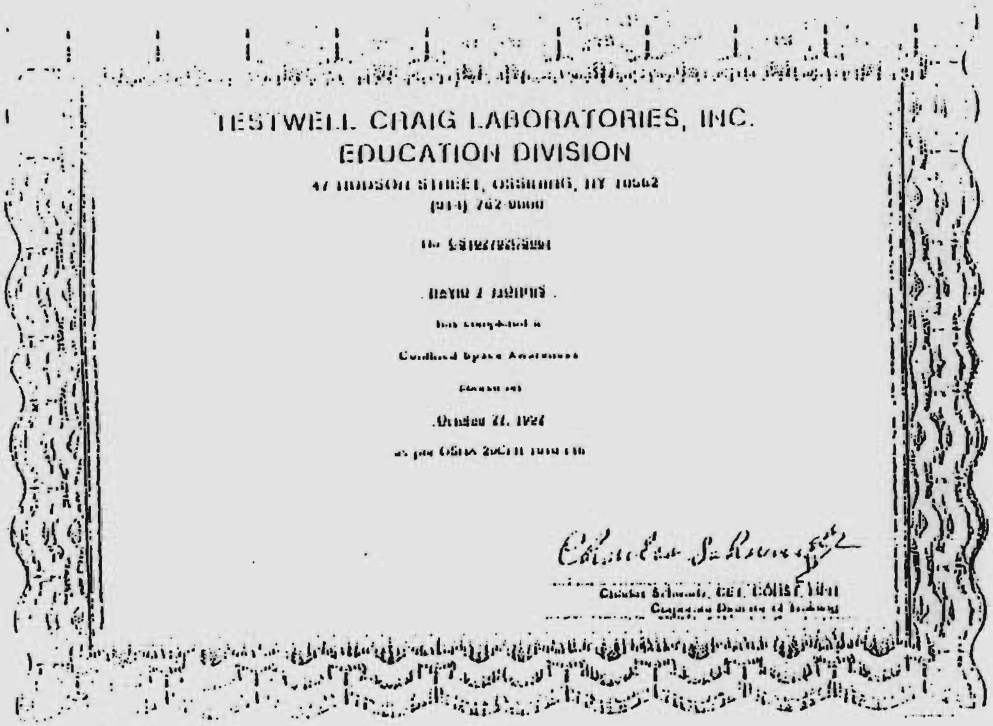
[illegible]

[illegible]

[illegible]

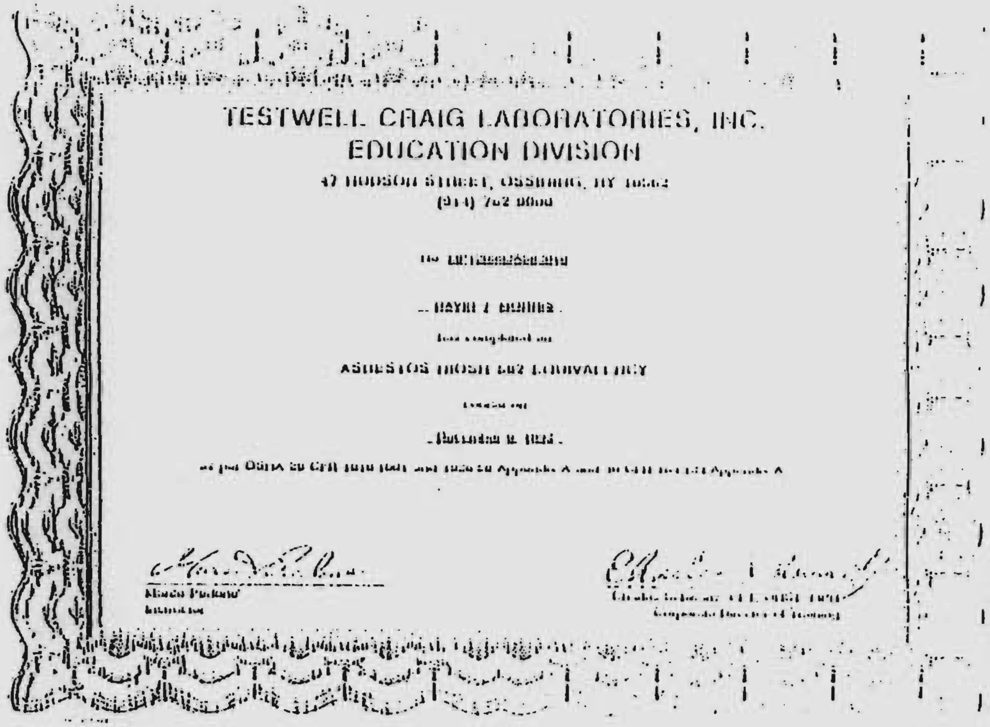


TESTWELL CRAIG LABORATORIES, INC.
EDUCATION DIVISION
47 HUDSON STREET, OSSINING, NY 10562
(914) 762-0000

[illegible]

[illegible]
[illegible]
Confined Space Awareness
[illegible]
[illegible]
as per OSHA 29CFR 1910.146

[illegible]



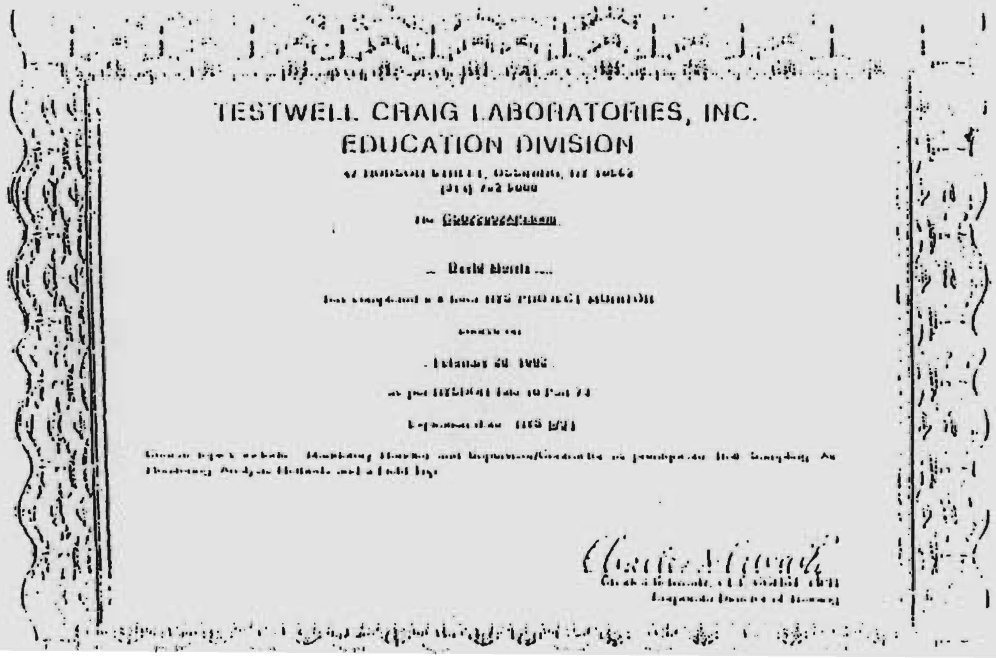
TESTWELL CRAIG LABORATORIES, INC.
EDUCATION DIVISION
47 HUDSON STREET, OSSINING, NY 10562
(914) 762-0000

[illegible]

[illegible]
[illegible]
ASBESTOS [illegible]
[illegible]
[illegible]
as per OSHA [illegible] Appendix A [illegible] Appendix A

[illegible]

[illegible]



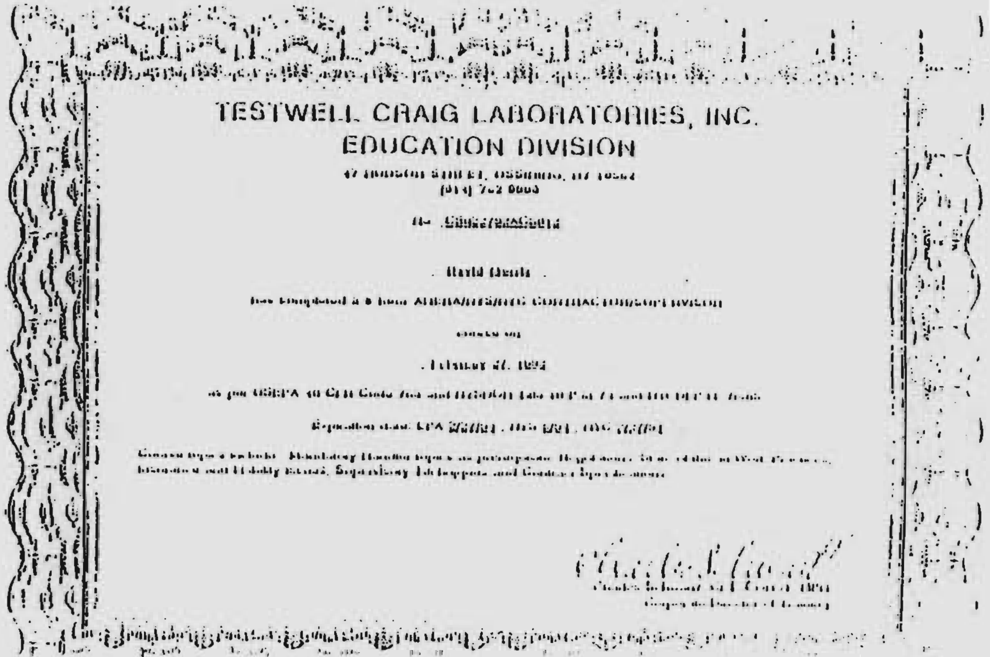
TESTWELL CRAIG LABORATORIES, INC.
EDUCATION DIVISION
[illegible]

[illegible]

[illegible]
[illegible] PROJECT MONITOR
[illegible]
[illegible]
[illegible]
[illegible]

[illegible]

[illegible]



TESTWELL CRAIG LABORATORIES, INC.
EDUCATION DIVISION
[illegible]

[illegible]

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

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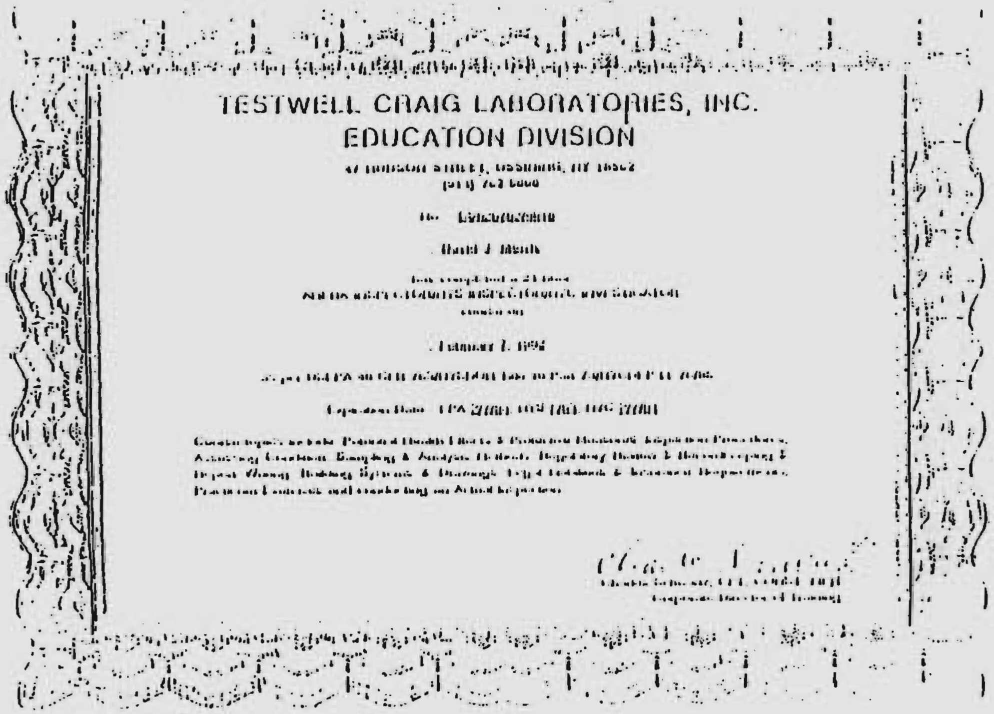


TESTWELL CRAIG LABORATORIES, INC.
EDUCATION DIVISION
47 HUDSON STREET, OSSINING, NY 10562
(914) 762 8000

[illegible]

David J. Morris

has completed a 24 hour
[illegible]
course on

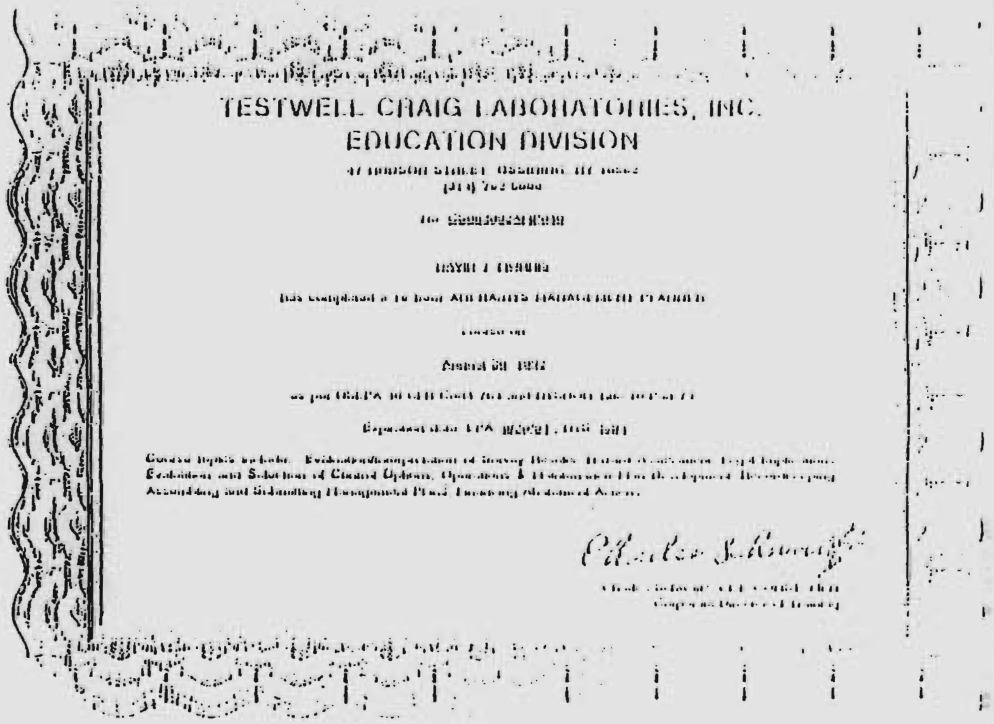
[illegible]

[illegible]

Expiration Date [illegible]

Course topics include [illegible]

Charles Schwartz, CIH, CHMM, [illegible]
Corporate Director of Training



TESTWELL CRAIG LABORATORIES, INC.
EDUCATION DIVISION
47 HUDSON STREET, OSSINING, NY 10562
(914) 762 8000

[illegible]

DAVID J. MORRIS

has completed a 16 hour ASBESTOS MANAGEMENT PLANNER

course on

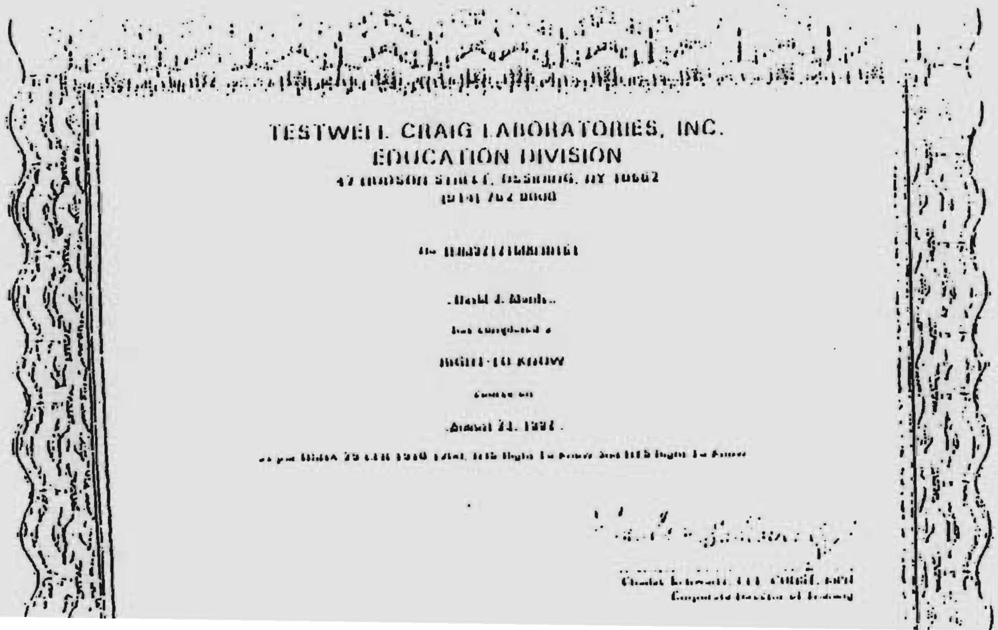
August [illegible]

[illegible]

Expiration date EPA [illegible]

Course topics include: Evaluation/Interpretation of Survey Results, Hazard Assessment, Legal Implications, Evaluation and Selection of Control Options, Operations & Maintenance Plan Development, Recordkeeping, Assembling and Submitting Management Plans, Financing Abatement Actions.

Charles Schwartz
Charles Schwartz, CIH, CHMM, [illegible]
Corporate Director of Training



TESTWELL CRAIG LABORATORIES, INC.
EDUCATION DIVISION
47 HUDSON STREET, OSSINING, NY 10562
(914) 762 8000

[illegible]

David J. Morris

has completed a

RIGHT-TO-KNOW

course on

August 21, [illegible]

as per OSHA 29 CFR 1910.1200, [illegible] Right To Know [illegible] Right To Know

Charles Schwartz, CIH, CHMM, [illegible]
Corporate Director of Training

Certificate of Training

№ 001354

RADIATION TRAINING PROGRAM

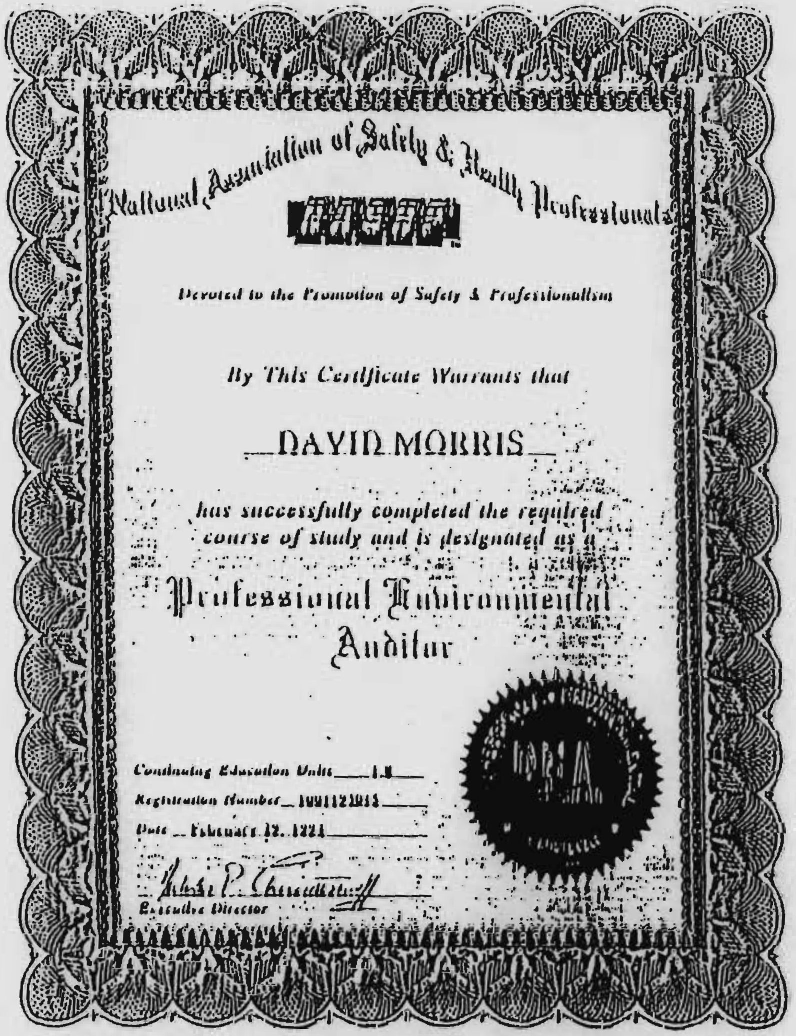
THIS IS TO CERTIFY THAT

DAVID J. MORRIS

HAS SATISFACTORILY COMPLETED SCITEC CORPORATION'S
WASHINGTON STATE APPROVED RADIATION TRAINING COURSE
CONSISTING OF EIGHT CLASSROOM HOURS.

SCITEC
CORPORATION

Instructor
Date June 17, [illegible]



National Association of Safety & Health Professionals

Devoted to the Promotion of Safety & Professionalism

By This Certificate Warrants that

DAVID MORRIS

has successfully completed the required course of study and is designated as a

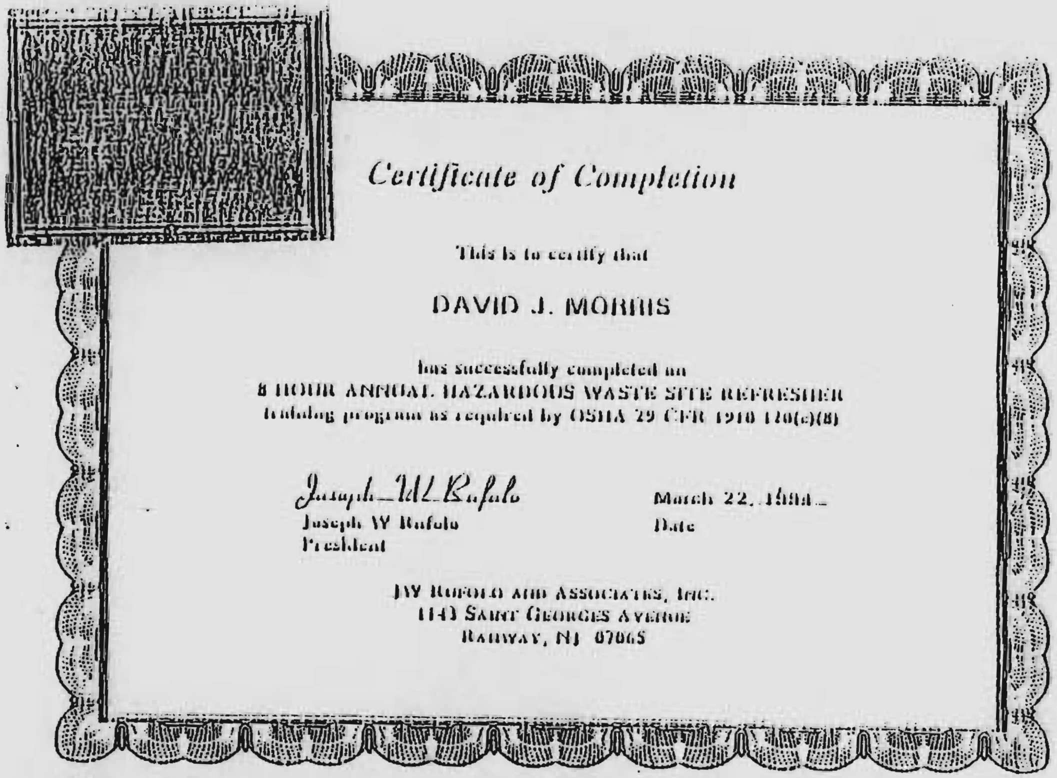
Professional Environmental Auditor

Continuing Education Units 1.8

Registration Number 1091121913

Date February 12, 1994

Executive Director



[redacted]

Certificate of Completion

This is to certify that

DAVID J. MORRIS

has successfully completed an
8 HOUR ANNUAL HAZARDOUS WASTE SITE REFRESHER
training program as required by OSHA 29 CFR 1910.120(e)(8)

Joseph W Rufolo
Joseph W Rufolo
President

March 22, 1994
Date

JW RUFOLO AND ASSOCIATES, INC.
1143 SAINT GEORGES AVENUE
RAHWAY, NJ 07065

Certificate of Achievement

This is to certify that

David J. Morris
of P.T. & L. Environmental Consultants

on the Twenty Fifth day of April 1994 successfully completed the factory training for

RMD's LPA-1 Lead Paint Inspection System

including, but not limited to, the topics of Radiation Safety
and the Proper Use of the Instrument.

Jacob Paster, Vice-President of RMD
44 Hunt St. Watertown, Massachusetts

P.T.&L. Environmental Services

Corporate Headquarters: 1 Kalisa Way, Suite 105, Paramus, NJ 07652 (201)
Southeast Headquarters: 210 South Bumby Street, Suite B, Orlando, FL 32803 (407)

JOSEPH FAIRCLOUGH JR.

PROJECT MANAGER

PROFESSIONAL DATA AND CERTIFICATIONS

- University of South Carolina - Columbia, South Carolina
  Bachelor of Science, 1985
- NYC Handler/Supervisor
- Professional Environmental Auditor
- Certified Hazardous Manager
- OSHA 40 Hour Health & Safety for Hazardous Waste Workers
- State of New Jersey - Underground Storage Tank Closure / Subsurface Evaluation

RELEVANT EXPERIENCE

Prior to his employment with P.T.&L. Environmental Consultants, Inc., Mr. Fairclough worked as an experienced field inspector and coordinator for Hall-Kimbrell projects. Mr. Fairclough was responsible for a variety of field activities necessary for the successful completion of an asbestos project.

As a field inspector, Mr. Fairclough has performed building asbestos surveys with a combined surface area of over 20 million square feet. The facilities which he has inspected, both locally and nationwide, have included: office buildings, warehouses, industrial facilities, universities, hotels, and retail stores. The performance of these inspections included: a thorough visual inspection of the facility; collection of bulk samples and air samples as necessary; the taking of photographs; a thorough evaluation of existing (if any) and potential asbestos hazards; recommended abatement actions and providing cost estimates for recommended abatement actions.

Mr. Fairclough has developed considerable expertise in many different types of investigative surveys including Cost-Recovery Programs. Some elements of a Cost-Recovery Program which he has performed are: a detailed and complex bulk sampling strategy; a collection of data for legal litigation concerning Asbestos Manufacturer liability; and an analysis of costs.

As a Hazardous Materials Project Coordinator, Mr. Fairclough has contact with clients during the planning phase of asbestos projects and coordinates and schedules field inspectors for assessment projects. As a supervisor, he is responsible for reassessment for quality assurance and also for reviewing field data. Resulting from his field experience, Mr. Fairclough has the capability to utilize his asbestos assessment expertise in the development of reports detailing the results of the study.

Mr. Fairclough has also performed numerous Phase I Environmental Studies of various commercial and industrial type properties for the purpose of evaluating on-site potential environmental liabilities. Specifically, a Phase I Environmental Study is a comprehensive study of a specific property for the purpose of accessing the presence of environmental contamination and/or the potential for the presence of environmental contamination thereon due to previous and/or existing activities conducted at the subject property and/or at nearby properties.

Mr. Fairclough also has prepared detailed work plans, health and safety plans, and quality assurance/quality control plans for several Phase II Environmental Studies and various remediation activities including underground storage tank removals, PCB contamination, and drummed waste disposal.

As an experienced Project Manager, Mr. Fairclough's expertise has been vital in the performance of several important hazardous waste projects. One such project, for the New Jersey Department of Transportation, involved the closure of fourteen (14) underground storage tanks. Mr. Fairclough participated in the on-site supervision of these removals, and conducted the very important groundwater assessment procedures. Furthermore, he reviewed and approved all work specifications and closure plans for the project.

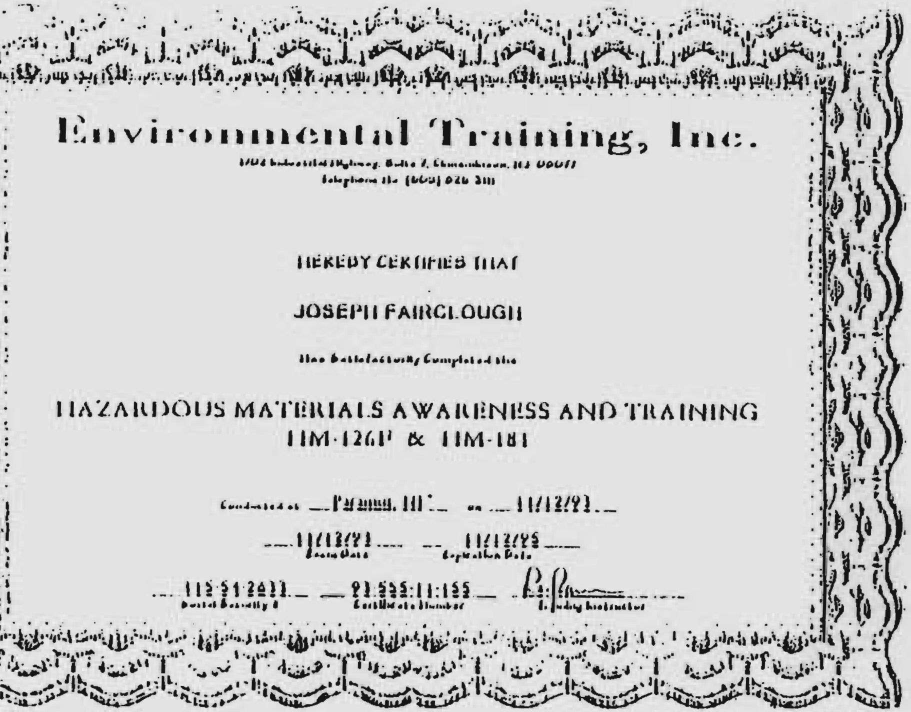
In a similar manner, Mr. Fairclough was involved with the closure of nine (9) storage tanks for Maxwell House Coffee Company. The closure of these tanks, with a fluid capacity of cover 200,000 gallons, involved dewatering, sheet piling, contaminated soil disposal, and groundwater monitoring and analysis. In addition to his on-site responsibilities, Mr. Fairclough advised and approved the final report for the project, referred to as the Closure Plan Implementation Summary. These documents summarize the procedures taken to complete each project and include a detailed analysis of water and soil samples taken. His expertise and experience with Groundwater Hydrology and underground contaminants has provided specialized consultation for any of P.T.&L.'s clients.

EMPLOYMENT HISTORY

1986 - 1988	Lamont-Doherty Geological Observatory
1988 - 1990	Hall Kimbrell Environmental Services

PROJECT EXPERIENCE

- Jack Resnick and Sons, Inc., New York
- Century Paramount Hotel, New York
- Maxwell House Coffee Company, New Jersey
- Phillips International, New York
- Dakota Hotel, New York
- Custom Chemical, New Jersey
- Sunset Asphalt, New Jersey
- Metropolitan Developers Inc.
- Skyview Owners Corporation, New York
- Dalton School, New York
- Wells Associates, New Jersey
- National Sign Company, New Jersey
- Trust Company of New Jersey, New Jersey
- New York City Law Department, New York
- Rockaway Metal Products, New York
- Morse Diesel International, New York
- Bellezza Company, New Jersey



Environmental Training, Inc.

[illegible]
[illegible]

HEREBY CERTIFIES THAT

JOSEPH FAIRCLOUGH

Has Satisfactorily Completed the

HAZARDOUS MATERIALS AWARENESS AND TRAINING
HM-126F & HM-181

Conducted at Paramus, NJ on 11/12/93

11/12/93 Issue Date — 11/12/95 Expiration Date

112-54-2611 Social Security # — 93-555-11-155 Certificate Number — Training Instructor

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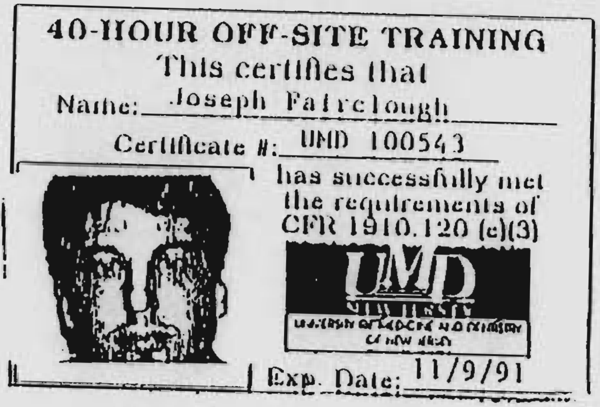


40-HOUR OFF-SITE TRAINING

This certifies that

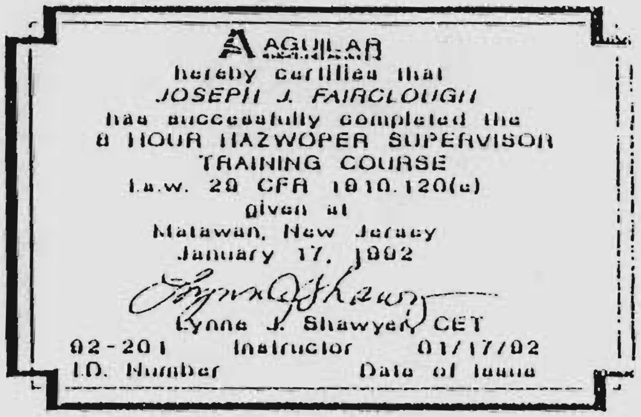
Name: Joseph Fairclough

Certificate #: UMD 100543

has successfully met the requirements of CFR 1910.120 (e)(3)

UMD
NEW JERSEY
UNIVERSITY OF MEDICINE AND DENTISTRY OF NEW JERSEY

Exp. Date: 11/9/91

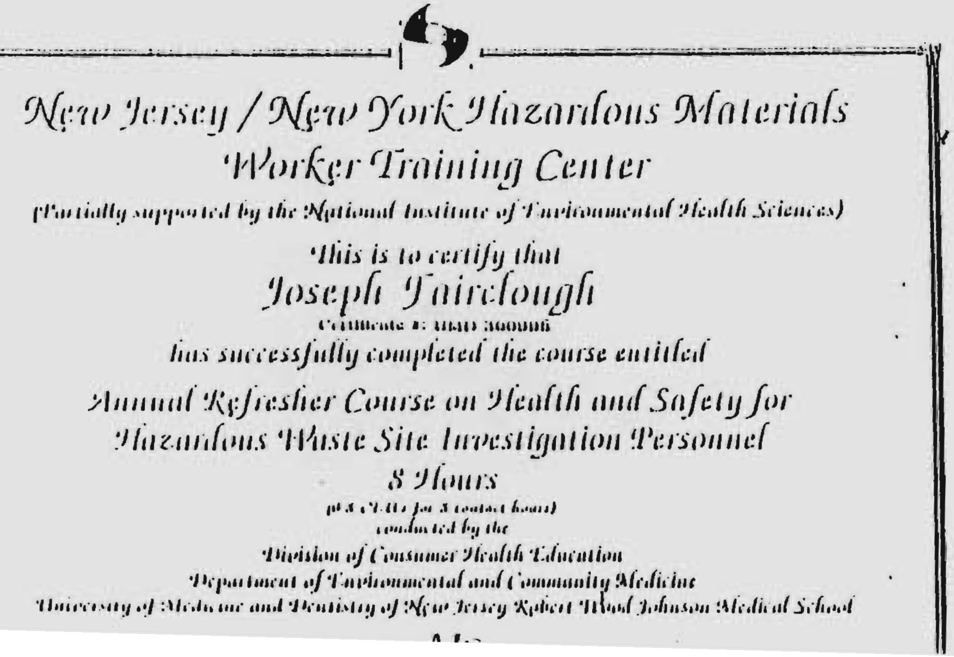


AGUILAR
hereby certifies that
JOSEPH J. FAIRCLOUGH
has successfully completed the
8 HOUR HAZWOPER SUPERVISOR
TRAINING COURSE
I.a.w. 29 CFR 1910.120(e)
given at
Matawan, New Jersey
January 17, 1992

Lynne J. Shawyer

Lynne J. Shawyer, CET

92-201 I.D. Number — Instructor — 01/17/92 Date of Issue



New Jersey / New York Hazardous Materials Worker Training Center

(Partially supported by the National Institute of Environmental Health Sciences)

This is to certify that

Joseph Fairclough

Certificate #: UMD 300006

has successfully completed the course entitled

Annual Refresher Course on Health and Safety for Hazardous Waste Site Investigation Personnel

8 Hours

[illegible]

conducted by the

Division of Consumer Health Education
Department of Environmental and Community Medicine
University of Medicine and Dentistry of New Jersey Robert Wood Johnson Medical School

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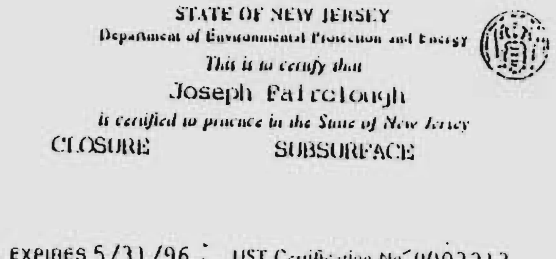


STATE OF NEW JERSEY
Department of Environmental Protection and Energy

This is to certify that

Joseph Fairclough

is certified to practice in the State of New Jersey

CLOSURE — SUBSURFACE

EXPIRES 5/31/96 . UST Certification No.

NATIONAL ASSOCIATION OF SAFETY & HEALTH PROFESSIONALS

PROFESSIONAL ENVIRONMENTAL AUDITING TRAINING

This Certificate is Awarded To

JOE FAIRCLOUGH

For Successfully Completing The

PROFESSIONAL ENVIRONMENTAL AUDITOR CERTIFICATION

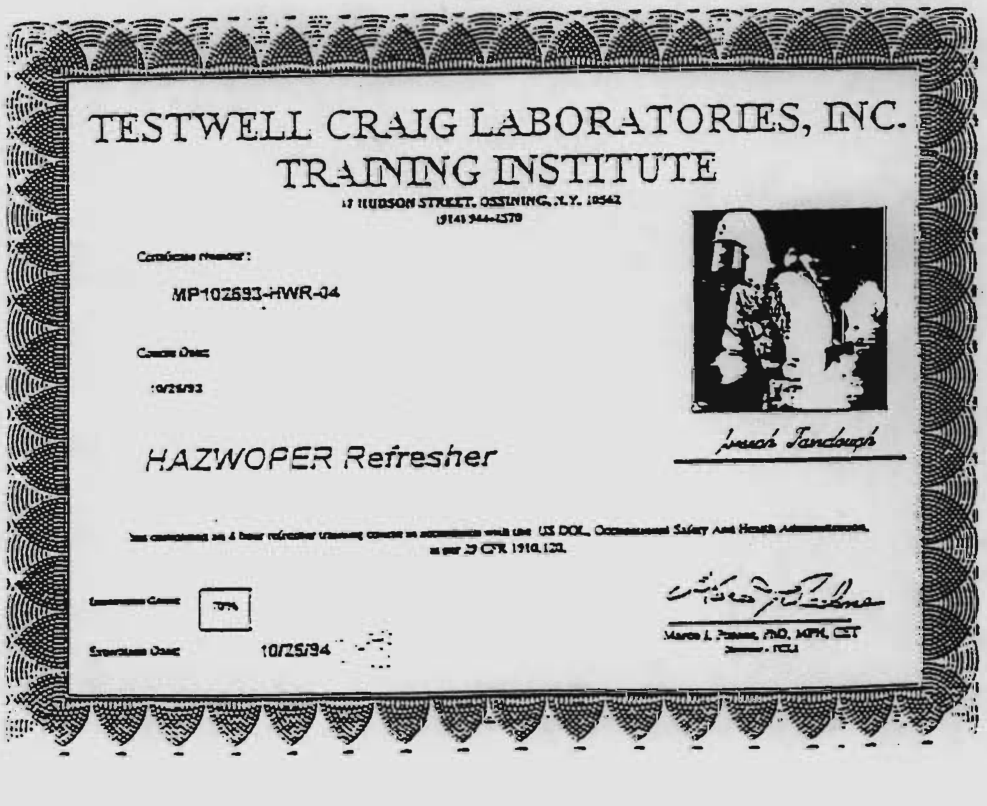
President, N.A.S.H.P.

Director of Training, N.A.S.H.P.

Course Instructor

CERTIFICATION
041692113

April 7, 1992
Date



TESTWELL CRAIG LABORATORIES, INC.
TRAINING INSTITUTE
17 HUDSON STREET, OSSINING, N.Y. 10562
(914) 944-2570

Certificate Number:
MP102693-HWR-04

Course Date:
10/26/93

HAZWOPER Refresher

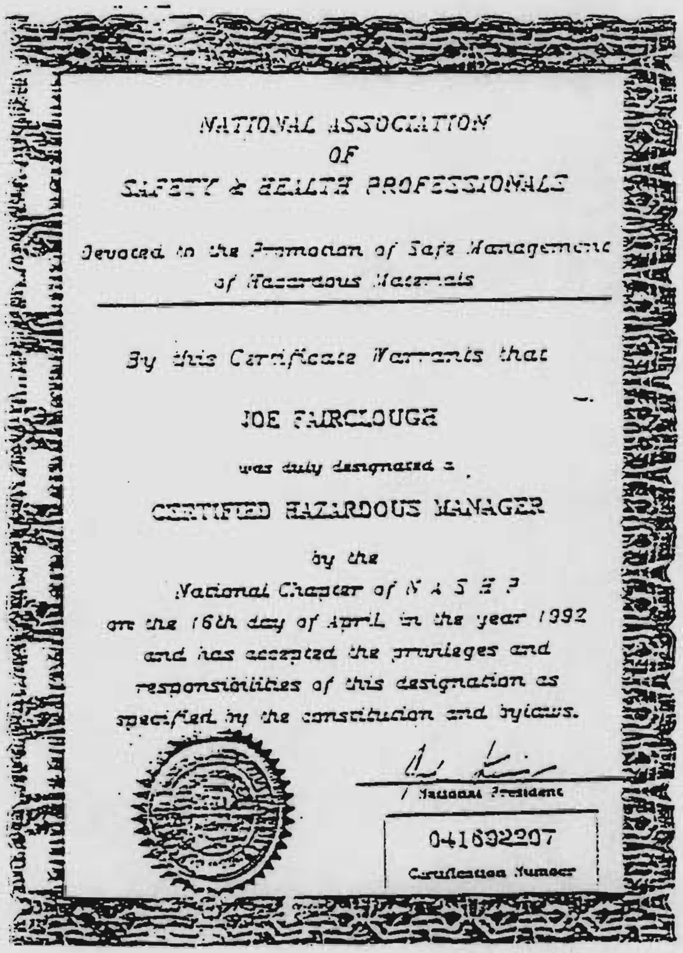
Joseph Fairclough

has completed an 4 hour refresher training course in accordance with the US DOL, Occupational Safety And Health Administration, as per 29 CFR 1910.120.

Examination Grade: 70%

Expiration Date: 10/25/94

Marco J. Pisano, PhD, MPH, CET
Director, TCLI



NATIONAL ASSOCIATION
OF
SAFETY & HEALTH PROFESSIONALS

Devoted to the Promotion of Safe Management
of Hazardous Materials

By this Certificate Warrants that

JOE FAIRCLOUGH

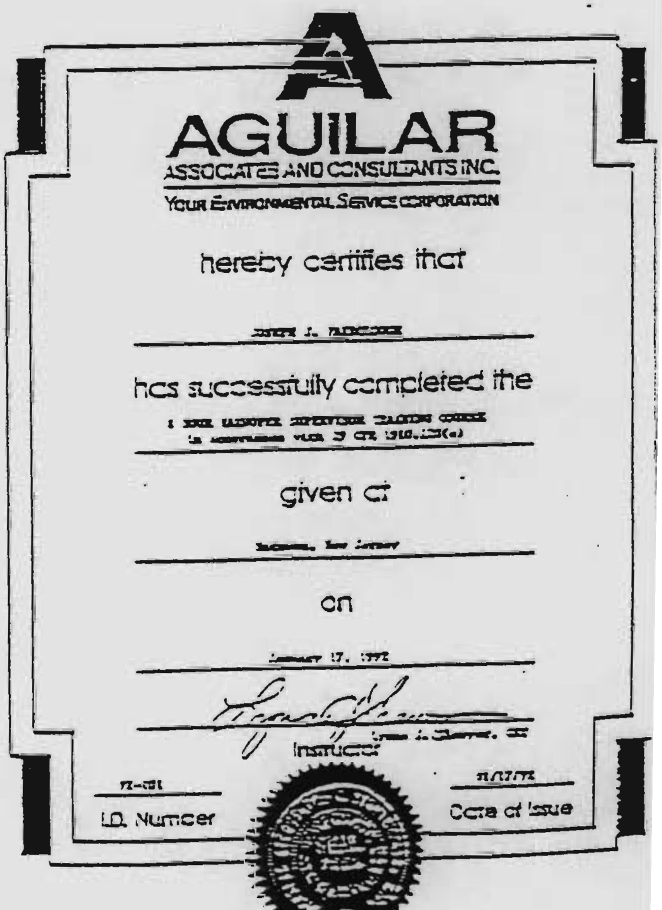
was duly designated a

CERTIFIED HAZARDOUS MANAGER

by the
National Chapter of N A S H P
on the 16th day of April in the year 1992
and has accepted the privileges and
responsibilities of this designation as
specified by the constitution and bylaws.

National President

041692207
Certification Number



AGUILAR
ASSOCIATES AND CONSULTANTS INC.
YOUR ENVIRONMENTAL SERVICE CORPORATION

hereby certifies that

[illegible]

has successfully completed the

[illegible]

given at

[illegible]

on

[illegible] 17, [illegible]

[illegible]
Instructor

[illegible]
I.D. Number

[illegible]
Date of Issue

P.T.&L. Environmental Services

Corporate Headquarters: 1 Kalisa Way, Suite 105, Paramus, NJ 07652 (201
Southeast Headquarters: 210 South Bumby Street, Suite B, Orlando, FL 32303 (407

MARC REMBISH

ENVIRONMENTAL COORDINATOR

PROFESSIONAL DATA AND CERTIFICATIONS

- Bloomfield College
  Bachelor of Science in Environmental Biology - 1981
- 40 Hour OSHA Hazardous Waste Operations and Emergency Response Training
- 8 Hour OSHA Hazardous Waste Operations - Supervisor's Course
- Certified Confined Space Entry
- Certified Hazards Manager
- Certified Tank Remover - Owens/Corning Fiberglass Tank
- Lead Abatement Training for Contractors - State of Massachusetts - 1993
- Professional Environmental Auditor
- New York State Asbestos Inspector / Investigator
- Certificate of training ENSYS Field Sampling Methods
- New Jersey Certified UST Closure
- Pennsylvania Certified UST Removal

PROFESSIONAL EXPERIENCE

Mr. Rembish is one of P.T.&L.'s specialists in Hazardous Waste Management. He gained much of his experience as an employee of United Environmental Systems where he served as a Technical Specialist for two years.

As a Technical Specialist, Mr. Rembish was responsible for the supervising and training of the technical field assistants. As part of his duties, he identified and classified waste streams, advised his company and generators on technical procedures, arranged for disposition of hazardous waste to TSD facilities, and supervised underground storage tank procedures.

Mr. Rembish also served as a Health and Safety Coordinator where he was responsible for developing Health and Safety Plans, determining PPE level. At this position he became thoroughly knowledgeable with current EPA/DOT/OSHA regulations. He developed company specifications for monitoring generator's conformity to state regulations. He implemented the use of various type of personnel and perimeter monitoring devices, addressing personnel safety, and public health and safety concerns. His responsibilities also included the scheduling of field operations, the coordination of outside contractors on various types of projects and the development of project bid proposals. Mr. Rembish acted as an Account Representative for large waste producing companies assisting them in the filing of year end hazardous waste reports, developing waste minimization programs, and the proper handling and storage of hazardous materials.

Added to his responsibilities at P.T.&L., Mr. Rembish coordinated and managed several major Underground Storage Tank Removal projects. He participated in the supervision of these removals and conducted groundwater assessments, reviewed and approved all work specifications, and the completed final reports for each project, referred to as the Closure Plan Implementation Summary. These documents summarize the procedures taken to complete each project, and include a detailed analysis of water and soil samples taken. His expertise and experience with Groundwater Hydrology and Underground Contaminants has provided specialized consultation for many of P.,T.&L.'s clients.

EMPLOYMENT EXPERIENCE

1984 - 1987	Quality Control Supervisor - Lillian Vernon Corporation
1987 - 1989	Quality Control Specialist - Comfortably Yours, Inc.
1990 - 1992	Technical Specialist - United Environmental Systems, Inc.

REPRESENTATIVE PROJECT EXPERIENCE

Underground Storage Tank & Hazardous Material Disposal and Related Engineering Services

- General Foods International, New Jersey
- New Jersey Department of Transportation
- Hoechst-Celanese, New Jersey
- James River Paper Mill, New Jersey
- Preakness Shopping Center, New Jersey
- Bellezza Company, New Jersey
- Barnes & Noble, New Jersey
- Forte Trucking, New Jersey
- Union Drydock, New Jersey
- All Brands Nissan, New Jersey

Air Monitoring and Related Engineering Services

- Port Authority of New York and New Jersey
- New York Department of Transportation

National Association of Safety and Health Professionals

Having Carefully Considered the Education, Professional Experience and Established Competence of

Marc Rembish

Issues this Certificate as

Professional Environmental Auditor

and has entered their name in the Registry of the

National Association of Safety & Health Professionals
Center for Training and Understanding

tificate No.: 030193426
te: March 1, 1993
piration Date: March 1, 1994

Executive Director

National Association of Safety and Health Professionals

Having Carefully Considered the Education, Professional Experience and Established Competence of

Marc Rembish

Issues this Certificate as

Certified Hazards Manager

and has entered their name in the Registry of the

National Association of Safety & Health Professionals
Center for Training and Understanding

Certificate No.: 030193226
Date: March 1, 1993
Expiration Date: March 1, 1994

Executive Director

New Jersey / New York Hazardous Materials Worker Training Center

(Partially supported by the National Institute of Environmental Health Sciences)

This is to certify that

Marc Rembish

Certificate #: UMD 301008

has successfully completed the course entitled

Annual Refresher Course on Health and Safety for Hazardous Waste Site Investigation Personnel

8 Hours

(0.8 CEU's for 8 contact hours)

conducted by the

Division of Consumer Health Education
Department of Environmental and Community Medicine
University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School

UMD

Environmental Training, Inc.

[illegible]
Telephone No. [illegible]

HEREBY CERTIFIES THAT

MARC REMBISH

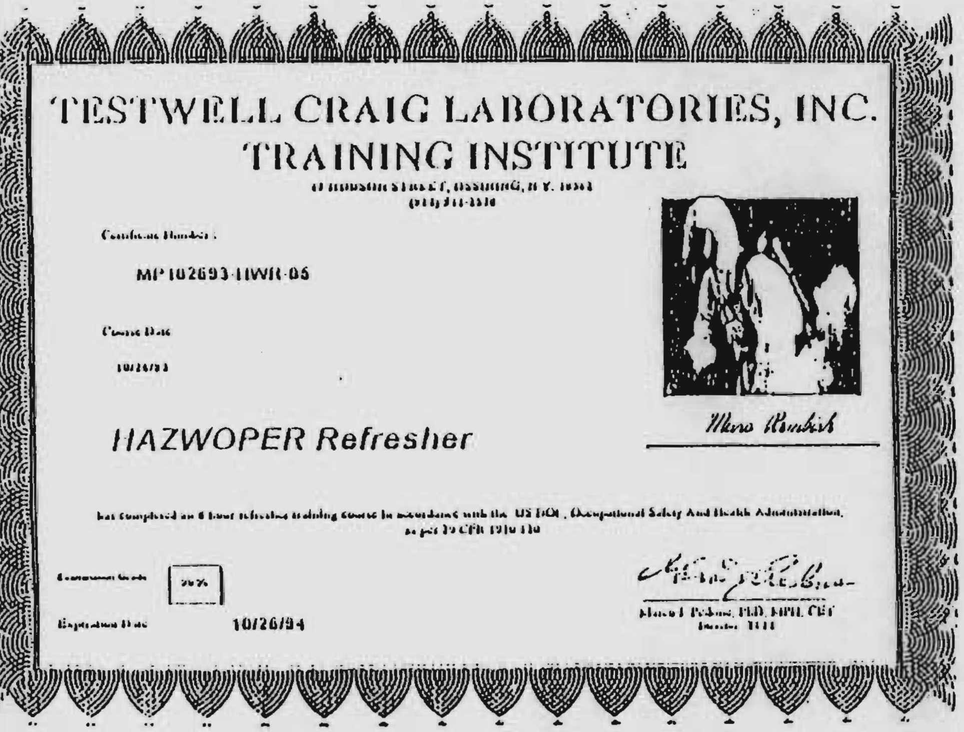
Has Satisfactorily Completed the

HAZARDOUS MATERIALS AWARENESS AND TRAINING HM-126F & HM-181

Conducted at Paramus, NJ on 11/12/93

11/12/93 Exam Date
11/12/95 Expiration Date

131-52-9896 Social Security #
93-555-11-162 Certificate Number
Training Instructor



TESTWELL CRAIG LABORATORIES, INC.
TRAINING INSTITUTE
[illegible] HUDSON STREET, OSSINING, N.Y. [illegible]
[illegible]

Certificate Number:

MP102693-HWR-05

Course Date

10/26/93

Marc Rembish

HAZWOPER Refresher

has completed an 8 hour refresher training course in accordance with the US DOL, Occupational Safety And Health Administration, as per 29 CFR 1910.120

Examination Grade [illegible]

Expiration Date 10/26/94

[illegible] Perkins, PhD, MPH, CET
Director, [illegible]

Certificate of Completion

This is to certify that

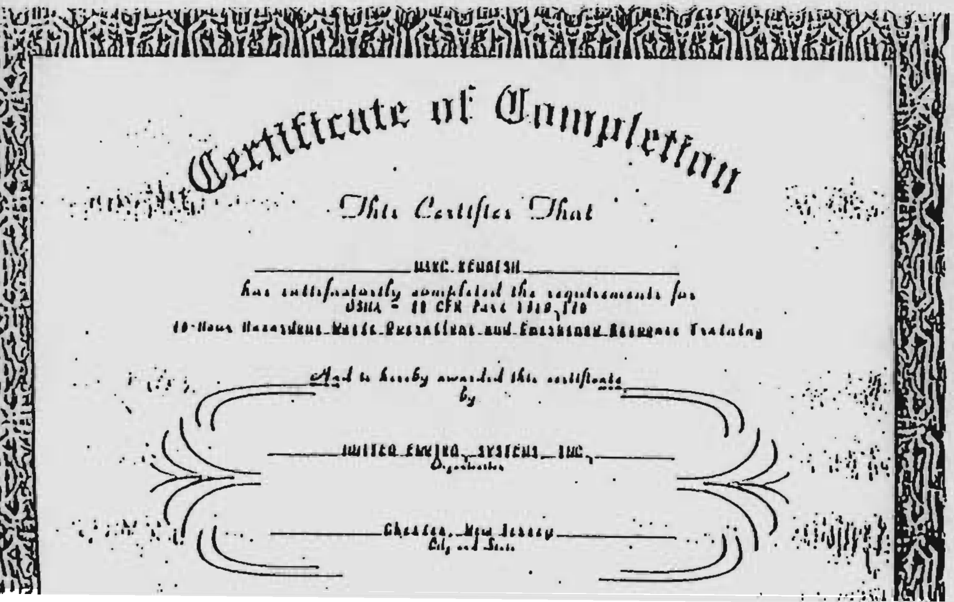
MARC REMBISH

has successfully completed a
CONFINED SPACE ENTRY
training program as required by OSHA 29 CFR 1910.146(g)(1)

Joseph W. Rufolo
Joseph W Rufolo
President

July 7, 1993
Date

JW RUFOLO'S
INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
1141 SAINT GEORGES AVENUE
RAHWAY, NJ 07065



Certificate of Completion

This Certifies That

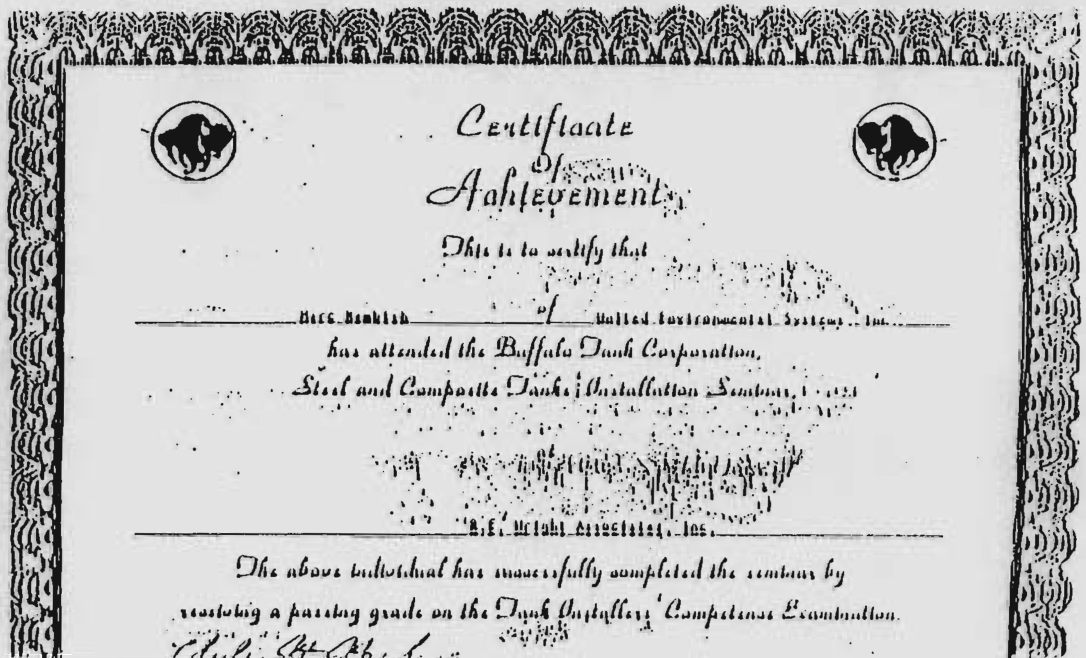
Marc Rembish

has satisfactorily completed the requirements for
OSHA – 29 CFR Part 1910.120
40-Hour Hazardous Waste Operations and Emergency Response Training

And is hereby awarded this certificate
by

United Enviro. Systems, Inc.
Organization

Chester, New Jersey
City and State



Certificate
Of
Achievement

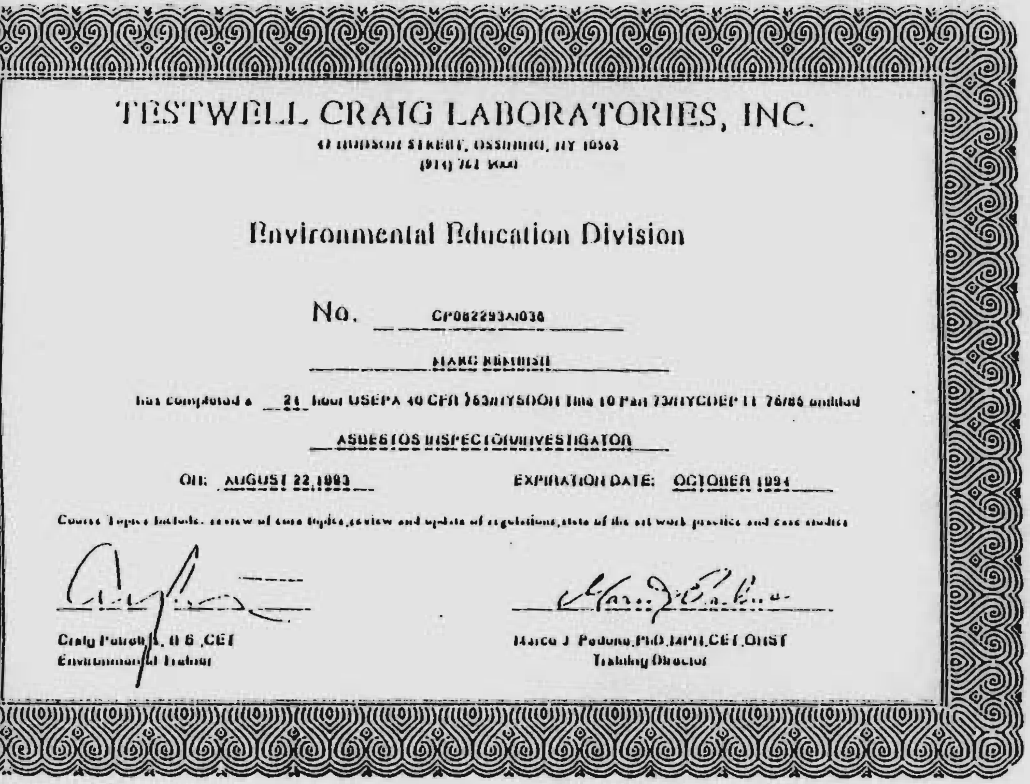
This is to certify that

Marc Rembish of United Environmental Systems, Inc.

has attended the Buffalo Tank Corporation,
Steel and Composite Tanks' Installation Seminar, [illegible]

R.E. Wright Associates, Inc.

The above individual has successfully completed the seminar by
receiving a passing grade on the Tank Installers' Competence Examination.



TESTWELL CRAIG LABORATORIES, INC.

47 HUDSON STREET, OSSINING, NY 10562
(914) 762 [illegible]

Environmental Education Division

No. CP082293AI036

MARC REMBISH

has completed a 24 hour USEPA 40 CFR 763/NYSDOH Title 10 Part 73/NYCDEP 11 76/86 entitled

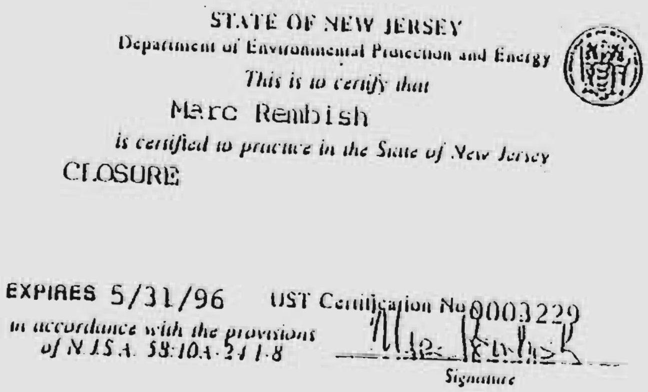
ASBESTOS INSPECTOR/INVESTIGATOR

ON: AUGUST 22,1993 EXPIRATION DATE: OCTOBER 1994

Course Topics Include: review of core topics, review and update of regulations, state of the art work practice and case studies

Craig Petrolli, B.S., CET
Environmental Trainer

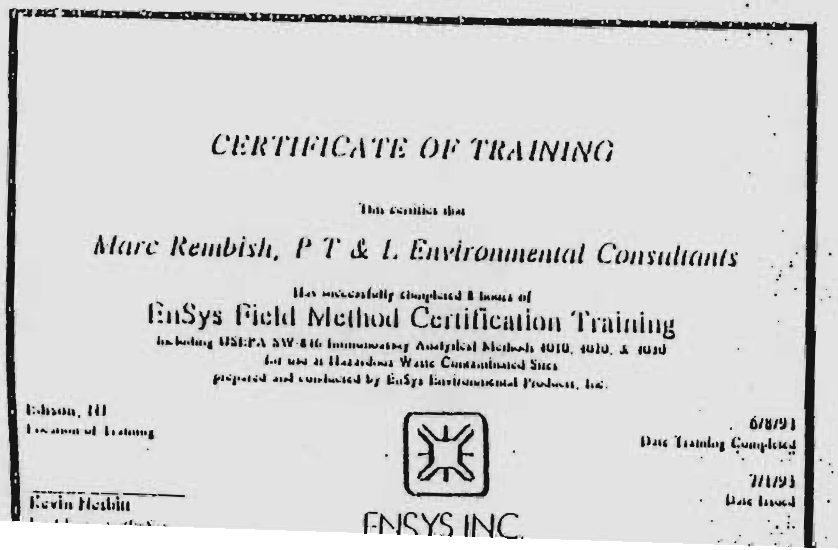
Marco J. Pedone, PhD, MPH, CET, OHST
Training Director



STATE OF NEW JERSEY
Department of Environmental Protection and Energy
This is to certify that
Marc Rembish
is certified to practice in the State of New Jersey
CLOSURE

EXPIRES 5/31/96 UST Certification No 0003229
in accordance with the provisions of N.J.S.A. 58:10A-24.1-8

Signature



CERTIFICATE OF TRAINING

This certifies that

Marc Rembish, P T & L Environmental Consultants

Has successfully completed 8 hours of

EnSys Field Method Certification Training

including USEPA SW-846 Immunoassay Analytical Methods 4010, 4020, & 4030
for use at Hazardous Waste Contaminated Sites
prepared and conducted by EnSys Environmental Products, Inc.

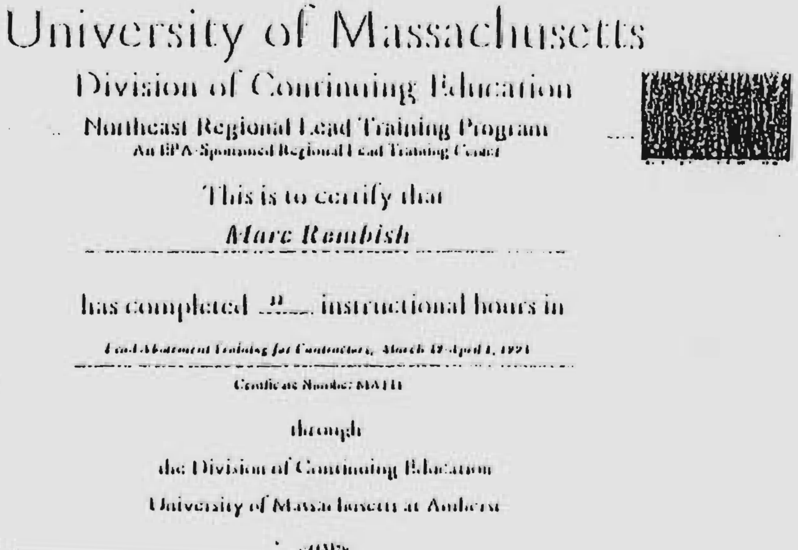
Edison, NJ
Location of Training

6/8/93
Date Training Completed

7/1/93
Date Issued

Kevin Nesbitt

ENSYS INC.



University of Massachusetts

Division of Continuing Education
Northeast Regional Lead Training Program
An EPA-Sponsored Regional Lead Training Center

This is to certify that

Marc Rembish

has completed 32 instructional hours in

Lead Abatement Training for Contractors, March 28-April 1, 1994

Certificate Number: MA[illegible]

through

the Division of Continuing Education
University of Massachusetts at Amherst

STATE OF NEW JERSEY
Department of Environmental Protection and Energy
This is to certify that
Marc Rembish
is certified to practice in the State of New Jersey

SUBSURFACE

EXPIRES 05/31/96 UST Certification No. 0003229
in accordance with the provisions of N.J.S.A. 58:10A-24.1-8
Marc Rembish
Signature

STATE OF NEW JERSEY
Department of Environmental Protection and Ene
This is to certify that
Marc Rembish
is certified to practice in the State of New Jer
CLOSURE

EXPIRES 5/31/96 UST Certification No. 000
in accordance with the provisions of N.J.S.A. 58:10A-24.1-8
Signature

MARC REMBISH

Certificate of Completion

This is to certify that

MARC REMBISH

has successfully completed a
COMPETENT PERSONS IN EXCAVATIONS
training program as required by OSHA 29 CFR 1926.650(b)

Joseph W Rufolo
Joseph W Rufolo
President

May 17 1994
Date

JW RUFOLO AND ASSOCIATES, INC.
1143 SAINT GEORGES AVENUE
RAHWAY, NJ 07065

PENNSYLVANIA
DER

P.O. Box 8763
Harrisburg, PA 17105-8763

November 5, 1993

717-772-559

Bureau of Water Quality Management

Marc Rembish
RR 2, Box 1038
Cunning Hill Drive
Highland Lakes, NJ 07422

RE: Applicant No. 5182

Dear Applicant:

This document certifies that

Marc Rembish

meets the qualifications established under Section 107(d) of the Storage Tank and Spill Prevention Act and Sections 245.111 and 245.113 of the Department's regulations for temporary certification in the following categories:

UM_R

Your certification number is: 3173

Your temporary certification expires on September 21, 1994, unless you successfully pass a certification examination administered or approved by the Department prior to the expireation date (25 Pa. Code Section 245.103(c)).

Your temporary certification is conditioned upon your compliance with the Storage Tank and Spill Prevention Act (35 P.S. Section 6021.101 et seq.), the Department's rules and regulations promulgated under the Act and the requirements for certification established under 25 Pa. Code 245.1 - 141. Failure to comply with the Act or rules and regulations promulgated under the Act constitutes unlawful conduct and could result in the assessment of fines or penalties, or in the suspension or revocation of certification.

This certification is invalid if obtained through fraud, deceit or the submission of inaccurate data or qualifications (25 Pa. Code Section 245.131).

Sincerely,

Cedric E. Karper
Acting Chief
Division of Storage Tanks

PENNSYLVANIA
DER

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
Post Office Box 8763
Harrisburg, Pennsylvania 17105-8763

October 19, 1993

(717) 772-5

Bureau of Water Quality Management

MARC REMBISH
RR #2 BOX 1038
CUNNING HILL DR
HIGHLAND LKS, NJ 07422

Re: Application No. 5182

Dear Applicant:

This document certifies that

MARC REMBISH

meets the qualifications established under Section 107(d) of the Storage Tank and Spill Prevention Act and Sections 245.111 and 245.113 of the Department's regulations for temporary certification in the following categories:

UM_R

Your certification number is: 4214

Your temporary certification expires on September 21, 1994 unless you successfully pass a certification examination administered or approved by the Department prior to the expiration date (25 Pa. Code Section 245.103(c)).

Your temporary certification is conditioned upon your compliance with the Storage Tank and Spill Prevention Act (35 P.S. Section 6021.101 et seq.), the Department's rules and regulations promulgated under the Act and the requirements for certification established under 25 Pa. Code 245.1 - 141. Failure to comply with the Act or rules and regulations promulgated under the Act constitutes unlawful conduct and could result in the assessment of fines or penalties, or in the suspension or revocation of certification.

This certification is invalid if obtained through fraud, deceit or the submission of inaccurate data or qualifications (25 Pa. Code Section 245.131).

Sincerely,

Cedric H. Karper, Acting Chief
Division of Storage Tanks

B. V. Rao, Ph. D., P. G., CPG.
Hydrogeochemist/Data Validation Specialist
Project Role - Project Manager

EDUCATION

Ph. D., Geochemistry/Geology, Indiana University, Bloomington, Indiana, 1981.
M.Sc. Tech., Applied Geology/Geochemistry, 1970.
B.Sc., Geology/Mathematics/Physics, 1967.

PREVIOUS EMPLOYMENT

Vice President and Director of Environmental Services, Dresdner Robin Environmental Management, Inc., Jersey City, New Jersey.
Vice President (Operations Manager)/Senior Project Advisor, Geraghty & Miller, Inc., Rochelle Park, New Jersey.
Division Manager/Senior Project Engineer, Woodward-Clyde Consultants, Baton Rouge, Louisiana.
Project Scientist/Hydrogeologist, Hydro-Search, Inc., Golden, Colorado.
Research Faculty/Visiting Scientist, University of Toronto and Ontario Geological Survey, Toronto, Canada.
Doctoral Research Associate, Indiana University, Bloomington, IN.
Hydrogeologist, Geological Survey

EXPERIENCE SUMMARY

Dr. Rao has managed and directed over 300 projects encompassing the RI/FSs for CERCLA, RCRA, ECRA/ISRA(New Jersey), UST, and State Superfund sites, groundwater monitoring programs, risk assessments, and solid and hazardous waste facility closures. As part of these projects, Dr. Rao directed and managed the preparation of Quality Assurance Project Plans and laboratory data validation. Specific examples of his data validation experience include:

- CLP data validation for a chromium remediation project in Jersey City, New Jersey , using NJDEP guidelines (Dresdner Robin Associates).

- CLP data validation for Volatile and Semi-Volatile Organics, PCBs/Pesticides, and Inorganics; Ironbound Pool Project, Newark, New Jersey, using USEPA Region II and NJDEP guidelines (Dresdner Robin Associates/Hoechst Celanese Corporation)

- Data validation for Volatile and Semi-Volatile Organics, PCBs/Pesticides and Inorganics in support of the RI/FS, St. Thomas, U. S. Virgin Islands, using USEPA Region II guidelines

- CLP data validation, Oil Refinery Site in Peurto Rico, using USEPA Region II guidelines.
- CLP data validation, McIntosh Plant Site(CERCLA), Olin Chemicals, Alabama.

Other Relevant Experience

University of Toronto (Canada)

Conducted geochemical research for investigating the nature of contamination in geologic systems by using trace element, stable and radiogenic isotopes, geochemical modeling and statistical analysis. Four years of experience in chemical analysis of solids and liquids by using Atomic Absorption / Inductively Coupled Plasma (ICP), solid and gas source mass spectrometers, and gas chromatograph.

Indiana University, Bloomington, IN (U.S.A)

Conducted geochemical researches focusing on the evaluation of contamination in geologic systems using chemical, isotopic, computer modeling, and statistical techniques. Participated in organic geochemistry research. Four years of experience in chemical analysis of solids and liquids by using AA/ICP, gas chromatography/mass spectrometry (GC/MS), and gas source mass spectrometers.

GS&ET GROUNDWATER SCIENCE
& ENVIRONMENTAL TECHNOLOGY, INC.
Hydrogeologists *Scientists* *Technologists*

KRISHNA M. PAMIDI, Ph.D.
Analytical Chemist/Data Validator

EDUCATION

Ph.D., Physical/Analytical Chemistry, Indian Institute of Science, Bangalore, India, 1980
M.Sc., Physical Chemistry, Andhra University, Waltair, India, 1974
B.Sc., Chemistry, 1972

PREVIOUS EMPLOYMENT

Senior Analytical Chemist, Champion Paper Mills
Post-Doctoral Research Associate, Dept. of Chemistry, Louisiana State University, Baton Rouge, LA.
Post-Doctoral Research Associate, Dept. of Chemistry, University of New Orleans, LA.
Post-Doctoral Research Associate, Dept. of Chemistry, University of Florida, Gainsville, FL.
Post-Doctoral Research Associate, Dept. of Chemistry, University of Dayton, OH.

EXPERIENCE SUMMARY

Dr. Pamidi has over 15 years of experience in analytical chemistry with specialization in gas chromatography/mass spectrometry(GC/MS) techniques. He has conducted validation of laboratory analytical data using EPA methodologies for Champion Paper Mills and many CLP contract laboratories. Dr. Pamidi audited Quality Assurance/Quality Control criteria for the analysis of organics for several contract laboratories. His project experience is summarized below:

- Dr. Pamidi is responsible for the operation of high resolution GC/MS (10-15,000 resolution) and coordination of extraction laboratory activities for the trace level (ppt and ppq) analysis of chlorinated dioxins and furans in Champion's pulp mill effluent, pulp, sludge and sediment samples by using EPA isotope dilution methods. As the Senior Chemist of Champion Papper Mills, Dr. Pamidi was also responsible for the validation of laboratory chemical data in accordance with the EPA protocols including (1) U.S. EPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration and Low Concentration Water, December, 1990 (revised June, 1991), (2) USEPA Contract Laboratory Program, Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (July 1988), and (3) Region II Modifications to the National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration, June 1992.

- Dr. Pamidi initiated, developed and managed sample preparation (analyte enrichment) method development projects for aqueous and solid matrices: 1. Reverse Phase Chromatography with non-polar bonded silica, 2. Automated Chromatographic column applications, 3. Supercritical Fluid Extractions, 4. Sample clean-up methods by steam distillation and acid digestion.

- Dr. Pamidi developed methods for trace organic analysis of volatile and non-volatile compounds in food packaging, inks and food samples by static and dynamic head space, steam distillation/solvent extraction and thermal desorption methods followed by GC/MS. He also applied GC/MS techniques for solving several process-related problems in paper industry.

- Dr. Pamidi has extensive Quality Control/Quality Assurance experience. Analysis of dioxins and furans at parts per trillion and parts per quadrillion level require high level of quality control in the extraction and analysis laboratory. Dr. Pamidi introduced quality control mechanisms which include control charts, external interlaboratory studies, analysis of standards for purity, daily GC/MS performance checks of the instrument, good laboratory notebook practices and educating the staff with the principles of quality control both in sampling and analysis. He was also responsible for introducing an in-house quality assurance program for Champion for all GC/MS work.

- Operated high resolution and tandem mass spectrometers for the analysis of biological samples to support chemistry and biochemistry research projects.

DAVID A. CASE

Project Role: Data Review and Data Validation

EDUCATION

B.A. Environmental Studies, Montclair State University, NJ, May 1992

EMPLOYMENT

Data Validator, Groundwater Science & Environmental Technology, Inc. (1 year)
Data Validator, BEM Engineers (2 years)

KEY PROJECTS

- Performed Quality Assurance/Quality Control (QA/QC) data validation procedures according to the USEPA SW-846, Test Methods forEvaluating Solid Waste and the NJDEP Bureau of Environmental Measurements and Quality Assurance and Data Validation of Analytical Deliverables for both TCL-Organics and TAL-Inorganics.

- Performed Data Management in terms of creating applicable Paradox tables enhancing the assessment of the analytical data associated with the QA/QC report, consulted with laboratories in receiving electronic analytical deliverables and QA/QC concerns or questions, and implemented the analytical data accordingly.

- Assisted in the development of a detailed deliverable tracking schedule including all sampling events already completed as well as upcoming sampling events. Assisted with the creation of a Data Validation/Data Management summary of unit costs for analytical methodology.

- Performed initial reviews of Routine Analytical Services (RAS) organic and inorganic data and special Analytical Services (SAS) data for environmental samples according to USEPA Region II and Region III protocols.

- Validated organic and /or inorganic environmental samples using theCLP 3/90 Statement of Work for Multi-Concentration, Low-Concentration or High-Concentration sample analysis, as well as using the Laboratory Functional Guidelines for Evaluating Organic and Inorganic analysis.

- Validated environmental samples using the "Methods for Chemical Analysis of Water and Wastes, "the " Analytical Method for Determination of Asbestos Fibers in Water", and the Methodology for the Measurement of Airborne Asbestos by Electron Microscopy." (EPA-600 Series)

- Validated environmental samples using methods for Gross Alpha and Gross Beta Radioactivity, Radium-228, Alpha-Emitting Radium Isotopes, Thorium and Uranium, and Gamma Emitting Radionuclides, all in drinking water. (EPA - 900 Series)

APPENDIX C

ATLANTIC
ENVIRONMENTAL SERVICES, INC.

engineers
geologists
scientists

FAX TRANSMISSION MEMO

DATE: 7/6/93

TO: Joe Fairclough
PTL Environmental

FAX NUMBER: (201) 262-~~4441~~ 6778

FROM: Terry Taylor

NUMBER OF PAGES: 9 (including this page)

Atlantic Project No.: 1283-03

MESSAGE:

Joe,

Here are the TCL results for surface water samples collected in the manhole to the brick sewer located southwest of the NMPC site. NMSSSW0601 represents low flow conditions and NMSSSW0602 represents high flow conditions. If you have any questi please give me a call.

NOTE: IF YOU DO NOT RECEIVE THE CORRECT NUMBER OF PAGES FOR THIS TRANSMISSION, PLEASE CALL (203) 537-0751 IMMEDIATELY.

SARATOGA SPRINGS REMEDIAL INVESTIGATION
CHEMICAL ANALYSIS SUMMARY FOR VOLATILE ORGANIC COMPOUNDS

****
* SAMPLE ID: NMSSSW0601 *
****

Lab Receipt Date: 7/17/91 Method: CLP Units: UG/L Laboratory ID: 11668

Analyte	Lab Result or CRQL		Validation Data
1,1,1-Trichloroethane	U	10.0000	
1,1,2,2-Tetrachloroethane	U	10.0000	
1,1,2-Trichloroethane	U	10.0000	
1,1-Dichloroethane	U	10.0000	
1,1-Dichloroethene	U	10.0000	
1,2-Dichloroethane	U	10.0000	
1,2-Dichloroethene (total)	U	10.0000	
1,2-Dichloropropane	U	10.0000	
2-Butanone	U	20.0000	R
2-Hexanone	U	20.0000	UJ
4-Methyl-2-Pentanone	U	20.0000	
Acetone		22.0000	22.0000U
Benzene		39.0000	
Bromodichloromethane	U	10.0000	
Bromoform	U	10.0000	
Bromomethane	U	20.0000	
Carbon Disulfide	U	10.0000	
Carbon Tetrachloride	U	10.0000	
Chlorobenzene	U	10.0000	
Chloroethane	U	20.0000	
Chloroform	U	10.0000	
Chloromethane	U	20.0000	
Dibromochloromethane	U	10.0000	
Ethylbenzene		200.0000	
Methylene Chloride	U	10.0000	
Styrene	U	10.0000	
Tetrachloroethene	U	10.0000	
Toluene		43.0000	
Trichloroethene	U	10.0000	
Vinyl Acetate	U	20.0000	
Vinyl Chloride	U	20.0000	
Xylene (total)		310.0000	
cis-1,3-Dichloropropene	U	10.0000	
trans-1,3-Dichloropropene	U	10.0000	

SARATOGA SPRINGS REMEDIAL INVESTIGATION
CHEMICAL ANALYSIS SUMMARY FOR SEMIVOLATILE ORGANIC COMPOUNDS

****
* SAMPLE ID: NMSSSW0601 *
****

Lab Receipt Date: 7/17/91 Method: CLP Units: UG/L Laboratory ID: 11668

Analyte	Lab Result or CRQL		Validation Data	Analyte	Lab Result or CRQL		Validatio Data
1,2,4-Trichlorobenzene	U	20.0000		1,2-Dichlorobenzene	U	20.0000	
1,3-Dichlorobenzene	U	20.0000		1,4-Dichlorobenzene	U	20.0000	
2,4,5-Trichlorophenol	U	100.0000		2,4,6-Trichlorophenol	U	20.0000	
2,4-Dichlorophenol	U	20.0000		2,4-Dimethylphenol	U	20.0000	
2,4-Dinitrophenol	U	100.0000		2,4-Dinitrotoluene	U	20.0000	
2,6-Dinitrotoluene	U	20.0000		2-Chloronaphthalene	U	20.0000	
2-Chlorophenol	U	20.0000		2-Methylnaphthalene		580.0000	
2-Methylphenol	U	20.0000		2-Nitroaniline	U	100.0000	
2-Nitrophenol	U	20.0000		3,3'-Dichlorobenzidine	U	40.0000	
3-Nitroaniline	U	100.0000	UJ	4,6-Dinitro-2-Methylphenol	U	100.0000	
4-Bromophenyl-phenylether	U	20.0000		4-Chloro-3-Methylphenol	U	20.0000	
4-Chloroaniline	U	20.0000		4-Chlorophenyl-phenylether	U	20.0000	
4-Methylphenol	U	20.0000		4-Nitroaniline	U	100.0000	
4-Nitrophenol	U	100.0000		Acenaphthene		240.0000	
Acenaphthylene		250.0000	J	Anthracene		62.0000	
Benzo(a)Anthracene	J	19.0000	J	Benzo(a)Pyrene	U	20.0000	
Benzo(b)Fluoranthene	U	20.0000		Benzo(g,h,i)Perylene	U	20.0000	
Benzo(k)Fluoranthene	U	20.0000		Benzoic Acid	U	100.0000	
Benzyl Alcohol	U	20.0000		Butylbenzylphthalate	U	20.0000	
Chrysene		20.0000	J	Di-n-Butylphthalate	U	20.0000	
Di-n-Octyl Phthalate	U	20.0000		Dibenz(a,h)Anthracene	U	20.0000	
Dibenzofuran	J	19.0000	J	Diethylphthalate	U	20.0000	
Dimethyl Phthalate	U	20.0000		Fluoranthene		45.0000	
Fluorene		150.0000	J	Hexachlorobenzene	U	20.0000	
Hexachlorobutadiene	U	20.0000		Hexachlorocyclopentadiene	U	20.0000	
Hexachloroethane	U	20.0000		Indeno(1,2,3-cd)Pyrene	U	20.0000	
Isophorone	U	20.0000		N-Nitroso-Di-n-Propylamine	U	20.0000	
N-Nitrosodiphenylamine (1)	U	20.0000		Naphthalene		94.0000	
Nitrobenzene	U	20.0000		Pentachlorophenol	U	100.0000	
Phenanthrene		240.0000	J	Phenol	J	11.0000	
Pyrene		60.0000	J	bis(2-Chloroethoxy)Methane	U	20.0000	
bis(2-Chloroethyl)Ether	U	20.0000		bis(2-Chloroisopropyl)Ether	U	20.0000	
bis(2-Ethylhexyl)Phthalate	U	20.0000					

SARATOGA SPRINGS REMEDIAL INVESTIGATION
CHEMICAL ANALYSIS SUMMARY FOR PESTICIDE AND PCB COMPOUNDS

****
* SAMPLE ID: NMSSSW0601 *
****

Lab Receipt Date: 7/17/91 Method: CLP Units: UG/L Laboratory ID: 0357-11668

Analyte	Lab Result or CRQL		Validation Data
4,4'-DDD	U	.1000	
4,4'-DDE	U	.1000	
4,4'-DDT	U	.1000	
Aldrin	U	.0500	
Aroclor-1016	U	.5000	
Aroclor-1221	U	.5000	
Aroclor-1232	U	.5000	
Aroclor-1242	U	.5000	
Aroclor-1248	U	.5000	
Aroclor-1254	U	1.0000	
Aroclor-1260	U	1.0000	
Dieldrin	U	.1000	
Endosulfan I	U	.0500	
Endosulfan II	U	.1000	
Endosulfan sulfate	U	.1000	
Endrin	U	.1000	
Endrin ketone	U	.1000	
Heptachlor	U	.0500	
Heptachlor epoxide	U	.0500	
Lindane	U	.0500	
Methoxychlor	U	.5000	
Toxaphene	U	1.0000	
alpha-BHC	U	.0500	
alpha-Chlordane	U	.5000	
beta-BHC	U	.0500	
delta-BHC	U	.0500	R
gamma-Chlordane	U	.5000	

SARATOGA SPRINGS REMEDIAL INVESTIGATION
CHEMICAL ANALYSIS SUMMARY FOR INORGANIC COMPOUNDS

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********************************
* SAMPLE ID:  NMSSSW0601       *
********************************
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Lab Receipt Date: 7/17/91 Method: CLP Units: UG/L Laboratory ID: 57-11668S

Analyte		Lab Result or CRDL	Validation Data
Aluminum	B	65.3000	
Antimony	U	30.0000	UJ
Arsenic	U	3.0000	
Barium		894.0000	
Beryllium	U	1.0000	
Cadmium	U	3.0000	
Calcium		133000.0000	
Chromium	U	5.0000	
Cobalt	U	5.0000	
Copper	U	5.0000	
Cyanide	U	5.0000	UJ
Iron		1230.0000	
Lead	U	2.0000	
Magnesium		33200.0000	
Manganese		221.0000	
Mercury	U	.2000	
Nickel	U	5.0000	
Potassium		14700.0000	
Selenium	U	2.0000	
Silver	U	5.0000	UJ
Sodium		206000.0000	
Thallium	U	2.0000	
Vanadium	U	5.0000	
Zinc		29.5000	R

SARATOGA SPRINGS REMEDIAL INVESTIGATION
CHEMICAL ANALYSIS SUMMARY FOR VOLATILE ORGANIC COMPOUNDS

****
* SAMPLE ID: NMSSSW0602 *
****

Lab Receipt Date: 9/27/91 Method: CLP Units: UG/L Laboratory ID: 16264

Analyte	Lab Result or CRQL		Validation Data
1,1,1-Trichloroethane	U	5.0000	
1,1,2,2-Tetrachloroethane	U	5.0000	
1,1,2-Trichloroethane	U	5.0000	
1,1-Dichloroethane	U	5.0000	
1,1-Dichloroethene	U	5.0000	
1,2-Dichloroethane	U	5.0000	
1,2-Dichloroethene (total)	U	5.0000	
1,2-Dichloropropane	U	5.0000	
2-Butanone	U	10.0000	
2-Hexanone	U	10.0000	
4-Methyl-2-Pentanone	U	10.0000	
Acetone	U	10.0000	
Benzene		23.0000	
Bromodichloromethane	U	5.0000	
Bromoform	U	5.0000	
Bromomethane	U	10.0000	
Carbon Disulfide	U	5.0000	
Carbon Tetrachloride	U	5.0000	
Chlorobenzene	U	5.0000	
Chloroethane	U	10.0000	
Chloroform	J	2.0000	5.0000J, U
Chloromethane	U	10.0000	
Dibromochloromethane	U	5.0000	
Ethylbenzene		14.0000	J
Methylene Chloride	U	5.0000	
Styrene	U	5.0000	
Tetrachloroethene	U	5.0000	
Toluene		6.0000	J
Trichloroethene	U	5.0000	
Vinyl Acetate	U	10.0000	
Vinyl Chloride	U	10.0000	
Xylene (total)		16.0000	J
cis-1,3-Dichloropropene	U	5.0000	
trans-1,3-Dichloropropene	U	5.0000	

SARATOGA SPRINGS REMEDIAL INVESTIGATION
CHEMICAL ANALYSIS SUMMARY FOR SEMIVOLATILE ORGANIC COMPOUNDS

****
* SAMPLE ID: NMSSSW0602 *
****

Lab Receipt Date: 9/27/91 Method: CLP Units: UG/L Laboratory ID: 16264

Analyte	Lab Result or CRQL		Validation Data
1,2,4-Trichlorobenzene	U	10.0000	
1,3-Dichlorobenzene	U	10.0000	
2,4,5-Trichlorophenol	U	50.0000	
2,4-Dichlorophenol	U	10.0000	
2,4-Dinitrophenol	U	50.0000	
2,6-Dinitrotoluene	U	10.0000	
2-Chlorophenol	U	10.0000	
2-Methylphenol	U	10.0000	
2-Nitrophenol	U	10.0000	
3-Nitroaniline	U	50.0000	
4-Bromophenyl-phenylether	U	10.0000	
4-Chloroaniline	U	10.0000	
4-Methylphenol	U	10.0000	
4-Nitrophenol	U	50.0000	
Acenaphthylene	U	10.0000	
Benzo(a)Anthracene	U	10.0000	
Benzo(b)Fluoranthene	U	10.0000	
Benzo(k)Fluoranthene	U	10.0000	
Benzyl Alcohol	U	10.0000	
Chrysene	U	10.0000	
Di-n-Octyl Phthalate	U	10.0000	
Dibenzofuran	U	10.0000	
Dimethyl Phthalate	U	10.0000	
Fluorene	U	10.0000	
Hexachlorobutadiene	U	10.0000	
Hexachloroethane	U	10.0000	
Isophorone	U	10.0000	
N-Nitrosodiphenylamine (1)	U	10.0000	
Nitrobenzene	U	10.0000	
Phenanthrene	U	10.0000	
Pyrene	U	10.0000	
bis(2-Chloroethyl)Ether	U	10.0000	
bis(2-Ethylhexyl)Phthalate	U	10.0000	

Analyte	Lab Result or CRQL		Validation Data
1,2-Dichlorobenzene	U	10.0000	
1,4-Dichlorobenzene	U	10.0000	
2,4,6-Trichlorophenol	U	10.0000	
2,4-Dimethylphenol	U	10.0000	
2,4-Dinitrotoluene	U	10.0000	
2-Chloronaphthalene	U	10.0000	
2-Methylnaphthalene	U	10.0000	
2-Nitroaniline	U	50.0000	
3,3'-Dichlorobenzidine	U	20.0000	
4,6-Dinitro-2-Methylphenol	U	50.0000	
4-Chloro-3-Methylphenol	U	10.0000	
4-Chlorophenyl-phenylether	U	10.0000	
4-Nitroaniline	U	50.0000	
Acenaphthene	J	4.0000	
Anthracene	U	10.0000	
Benzo(a)Pyrene	U	10.0000	
Benzo(g,h,i)Perylene	U	10.0000	
Benzoic Acid	U	50.0000	
Butylbenzylphthalate	U	10.0000	
Di-n-Butylphthalate	U	10.0000	
Dibenz(a,h)Anthracene	U	10.0000	
Diethylphthalate	U	10.0000	
Fluoranthene	U	10.0000	
Hexachlorobenzene	U	10.0000	
Hexachlorocyclopentadiene	U	10.0000	
Indeno(1,2,3-cd)Pyrene	U	10.0000	
N-Nitroso-Di-n-Propylamine	U	10.0000	
Naphthalene	U	10.0000	
Pentachlorophenol	U	50.0000	
Phenol	U	10.0000	
bis(2-Chloroethoxy)Methane	U	10.0000	
bis(2-Chloroisopropyl)Ether	U	10.0000	

SARATOGA SPRINGS REMEDIAL INVESTIGATION
CHEMICAL ANALYSIS SUMMARY FOR PESTICIDE AND PCB COMPOUNDS

****

* SAMPLE ID: NMSSSW0602 *

****

Lab Receipt Date: 9/27/91 Method: CLP Units: UG/L Laboratory ID: 16264

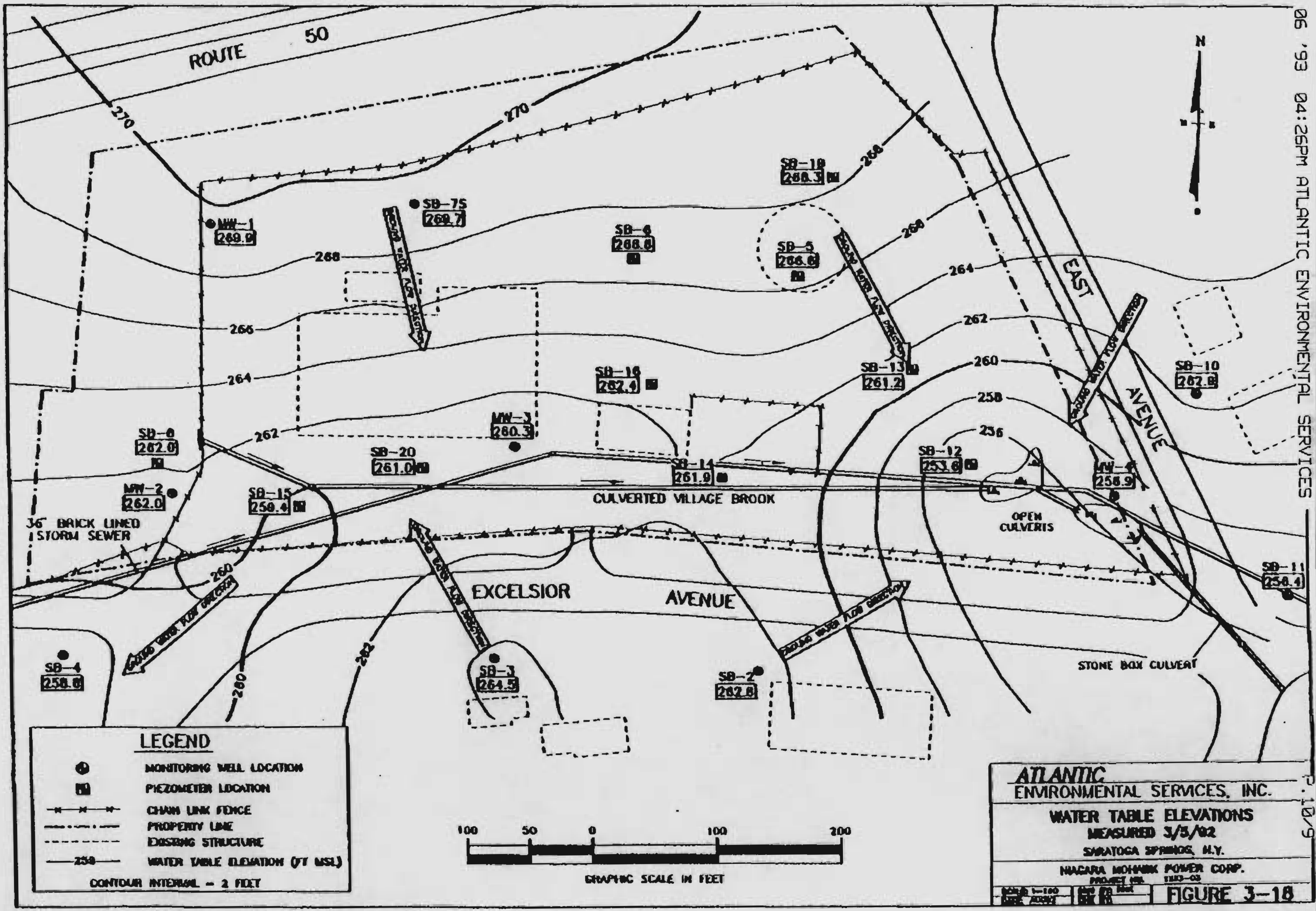
Analyte	Lab Result or CRQL		Validation Data
4,4'-DDD	U	.1000	
4,4'-DDE	U	.1000	
4,4'-DDT	U	.1000	
Aldrin	U	.0510	
Aroclor-1016	U	.5100	
Aroclor-1221	U	.5100	
Aroclor-1232	U	.5100	
Aroclor-1242	U	.5100	
Aroclor-1248	U	.5100	
Aroclor-1254	U	1.0000	
Aroclor-1260	U	1.0000	
Dieldrin	U	.1000	
Endosulfan I	U	.0510	
Endosulfan II	U	.1000	
Endosulfan sulfate	U	.1000	
Endrin	U	.1000	
Endrin ketone	U	.1000	
Heptachlor	U	.0510	
Heptachlor epoxide	U	.0510	
Lindane	U	.0510	
Methoxychlor	U	.5100	
Toxaphene	U	1.0000	
alpha-BHC	U	.0510	
alpha-Chlordane	U	.5100	
beta-BHC	U	.0510	
delta-BHC	U	.0510	UJ
gamma-Chlordane	U	.5100	

SARATOGA SPRINGS REMEDIAL INVESTIGATION
CHEMICAL ANALYSIS SUMMARY FOR INORGANIC COMPOUNDS

****
* SAMPLE ID: NMSSSW0602 *
****

Lab Receipt Date: 9/27/91 Method: CLP Units: UG/L Laboratory ID: 16264S

Analyte	Lab Result or CRDL		Validation Data
Aluminum	U	20.0000	
Antimony	U	30.0000	
Arsenic	U	3.0000	
Barium		690.0000	
Beryllium	U	1.0000	
Cadmium	U	3.0000	UJ
Calcium		113000.0000	
Chromium	B	7.0000	
Cobalt	U	5.0000	
Copper	B	16.5000	
Cyanide	U	10.0000	UJ
Iron		945.0000	
Lead	U	2.0000	
Magnesium		26800.0000	
Manganese		176.0000	J
Mercury	U	.2000	
Nickel	U	5.0000	
Potassium		14200.0000	
Selenium	U	2.0000	
Silver		21.1000	J
Sodium		156000.0000	
Thallium	U	2.0000	
Vanadium	B	7.6000	
Zinc	B	18.1000	J



ATLANTIC
ENVIRONMENTAL SERVICES, INC.

WATER TABLE ELEVATIONS
MEASURED 3/5/92
SARATOGA SPRINGS, N.Y.

NIAGARA MOHAWK POWER CORP.
PROJECT NO. 1183-03

FIGURE 3-18

*** ACTIVITY REPORT ***

RECEPTION OK

TX/RX NO.	5316
CONNECTION TEL	203 537 6347
CONNECTION ID	
START TIME	07/06 16:22
USAGE TIME	03'30
PAGES	10
RESULT	OK