APPENDIX D

Field Sampling Plan
Former Sylvania Electric Products Incorporated Facility
Hicksville, New York

FIELD SAMPLING PLAN

Former Sylvania Electric Products Incorporated Facility
Cantiague Rock Road
Hicksville, New York

GTE Operations Support Incorporated

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1. Introduction

1.1. General

This document is a Field Sampling Plan (FSP) for the investigation of the Former Sylvania Electric Products Corporation Facility, 70 - 140 Cantiague Rock Road, Hicksville, NY (site). This FSP provides specific field sampling procedures to be used during the implementation of site investigation activities. In addition to the FSP, the Work Plan also includes the Health and Safety Plan (HASP) and Quality Assurance Project Plan (QAPP) as Appendices C and E, respectively. The FSP will be implemented in conjunction with the procedures, requirements, and methods set forth in the QAPP and HASP. It should be noted that the Work Plan, and therefore, the FSP, is intended to have sufficient flexibility to respond to field conditions. For example, soil boring depths will be selected in the field in consultation with NYSDEC, based on the near-surface conditions encountered.

1.2. Background information

The former Sylvania facility is located in west-central Long Island, approximately one mile west of Hicksville, NY (Figure 1). Historically, the site consisted of lots 79 and 80 of Block 499, Section 11 (Figure 2). The corporate genealogy prepared by GTEOSI and detailed in the referenced Work Plan indicates that the site was actively used by GTEOSI's predecessor companies in interest from about 1952 to 1966 (GTEOSI, 1996). The facility consisted of a number of office and manufacturing buildings used to fabricate nuclear fuel elements. These buildings have been demolished, with the exception of a portion of the Air Techniques facility at 70 Cantiague Rock Road.

Process residuals identified as liquids and particulates contained in and transported by the liquids were reportedly discharged to four on-site recharge basins, leaching pools, or cesspools. These residuals consisted primarily of metals (e.g. copper and uranium), acids, and possibly the solvent tetrachloroethylene (PCE) (GTEOSI, 1996; NRC, 1994). The locations of these structures are also shown on Figure 2.

Presently, there are three facilities on-site: Gilbert Displays, Inc. at 140 Cantiague Rock Rd., Magazine Distributors at 100 Cantiague Rock Rd. and Air Techniques, Inc. at 70 Cantiague Rock Rd. (Figure 3). Magazine Distributors is currently a leasee of the facility at 100 Cantiague Rock Rd. which is reportedly owned by Harbor Distributing, Inc. Exclusive of a 1979 addition, the Air Techniques building is the only one remaining from those operations conducted by GTEOSI's predecessor companies. Greater than 90% of the site is covered by buildings or pavement with only small areas of exposed soils.

NYSDEC and NRC personnel have collected soil samples in exposed soils along the perimeter of the site behind Gilbert Displays and have had them analyzed for radionuclides. Six above-background radioisotopes were identified by these agencies: ^{228}Th, ^{230}Th, ^{232}Th, ^{234}U, ^{235}U, and ^{238}U. Additional work performed by GTEOSI, focused to ground water, has indicated the presence of low levels of radioactivity and PCE in ground water at the downgradient perimeter of the site.

1.3. Objectives

The overall objective of this FSP are to present the field investigation sampling locations, rationale for selecting the locations, methodologies to be utilized, and analytical requirements for the samples collected in support of the site work plan. The objectives of the field investigations will be to collect sufficient environmental data to:

- evaluate the nature and extent of residual radionuclides in surface soils on-site as well as those within the adjacent golf course driving range owned by Nassau County

- investigate the presence of residual radionuclides and PCE in accessible subsurface areas relative to their potential to act as sources to ground water (e.g. recharge basins and leaching pools). In the event that contamination is found that is not related to former site usage by GTEOSI's predecessor companies, such as gasoline, it will be reported to NYSDEC and its impact evaluated with respect to residual fate and transport mechanisms.

- evaluate the extent that process residuals, if any, may be migrating in ground water to off-site areas

- develop sufficient data that, when combined with existing data, the need for removal or remedial actions which are protective of human health and the environment can be evaluated

2. General field investigation guidelines

2.1. Underground utilities

Underground utilities, including electric, telephone, cable TV, sewers, water, etc., will be identified prior to any drilling and sampling. Public and privately owned utilities will be located by contacting responsible agencies by phone at least 48 hours prior to field activities, so their underground utilities can be marked at the site. Other potential on-site hazards such as sharp objects, overhead power lines, building hazards and underground storage tanks will be identified during the site visit.

2.2. Sample identification

Each sample will be given a unique identification. Sample identification will be classified by media, location, depth (if applicable), , name of the person collecting the sample, date, and time. Labels will be attached to each sample container.

2.3. Sampling equipment

The following is a general list of equipment necessary for sample collection:

- Stainless steel spoons and bowls for mixing soil samples;
- Appropriate sample containers provided by the laboratory;
- Sample bottles (kept closed and in the laboratory-shipped coolers until the samples are collected).

- Reagent-grade preservatives and pH paper or meter (or pre-preserved sample containers) for aqueous samples.
- Chain-of-Custody labels, tags, seals, and record forms.
- Log book, field sampling records, and indelible ink markers.
- Laboratory grade decontamination soaps (such as Alconox), reagent-grade solvents and control water to be used for decontaminating equipment between sampling stations.
- Buckets, wash basins, and scrub brushes to be used for decontaminating equipment;
- Camera and film to document sampling procedures and sample locations.
- Stakes and flagging tape to identify sampling locations.
- Shipping labels and forms;
- Knife;
- Packing/shipping material for sample bottles;
- Strapping tape;
- Clear plastic tape;
- Duct tape;
- Aluminum foil;
- Reclosable plastic bags;
- Portable field instruments, including a photoionization detector (PID), radiation instruments, pH meter, conductivity meter and water level indicator;

- Combustible gas indicator, RAM-1, and mini-ram;
- Poly-sheeting;
- Driller's jars (for archiving samples).

2.4. Field records

The Field Operations Supervisor will control field log books. Each field log book will receive a serialized number. Field log books will be maintained by the field team leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation. Entries will be signed and dated.

Information pertinent to the field investigation and/or sampling activities will be recorded in the log books. The books will be bound with consecutively numbered pages. Entries in the log book will include, at a minimum the following information:

- Name and title of author, date and time or entry, and physical/environmental conditions during the field activity.
- Purpose of sampling activity;
- Location of sampling activity;
- Name and address of field contact;
- Name and title of field crew members;
- Name and title of any site visitors;
- Sample media (soil, sediment, ground water, air)
- Sample collection method;
- Number and volume of sample(s) taken;
- Description of sampling point(s);
- Volume of ground water removed before sampling;

- Preservatives used;
- Date and time of collection;
- Sample identification number(s);
- Sample distribution (e.g., laboratory);
- Field observations;
- Any field measurements made, such as pH, temperature, conductivity, water level, etc.
- References for all maps and photographs of the sampling site(s);
- Information pertaining to sample documentation such as:
  - Bottle lot numbers;
  - Dates and method of sample shipments
  - Chain-of-Custody Record numbers;
  - Federal Express Air Bill Number.

Original data recorded in Field Log Books, Sample Tags, and Chain-of-Custody Records will be written with waterproof ink. None of these accountable, serialized documents will be destroyed.

If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by crossing a single line through the error and entering the correct information. The erroneous information will not be erased. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry. Subsequent corrections will be initialed and dated.

3. Field instruments

Field analytical equipment will be calibrated, and tested to see if it is in good working condition immediately prior to each day's use and more frequently if required. The calibration procedures will conform to manufacturer's standard instructions. This calibration will ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Records of all instrument calibration will be maintained by the Field Operations Supervisor and will be subject to audit by the Quality Assurance Officer. Copies of all of the instrument manuals will be maintained on-site by the Field Operations Supervisor.

3.1. Portable photoionization detector

The photoionization detector will be a PID (or equivalent), equipped with a minimum 10.6 eV lamp. The PID should be capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. This accounts for approximately 70% of the volatile organic compounds on the NYSDEC ASP Target Compound List. Calibration will be performed at the beginning of each day of use with a standard calibration gas specified by the manufacturer. If the unit exhibits abnormal or erratic readings, additional calibration will be required. All calibration data will be recorded in field notebooks and on calibration log sheets to be maintained on-site.

A battery check will be completed at the beginning of each working day. If erratic readings are experienced, the battery will be checked for proper voltage. This information will also be recorded in field notebooks and on the calibration log sheets.

3.2. Radiation survey instruments

Radiation survey instruments will be used to screen soil samples for radioactivity and monitor breathing zone levels for exposure to radioactive particles. Prior to use preoperational checks shall be performed on radiation survey instruments including the following:

- Annual Calibration - generally instruments are calibrated annually. The calibration sticker will be checked prior to use to ensure that the instrument is in current calibration. If the calibration sticker is missing or the calibration due date has passed, set the instrument aside for calibration and acquire a calibrated instrument.

- Physical inspection - briefly inspect each instrument for evidence of physical damage which could impair the proper operation of the instrument. Particular attention should be paid to the detector window and cable.

- Battery check - will be completed at the beginning of each working day. The instrument function switch shall be left in the BATT position for a few minutes to allow potential residual charge decay. If erratic readings are experienced, the instrument will be replaced.

- Zero check - with the function switch in the OFF position check that the meter needle is positioned over "0" or in the case of logarithmic scales, the lowest division. This may reveal possible damage to the meter movement or the shifting of the meter zero.

- Response time setting - on instruments with a "response" knob, turn it to "fast" while searching and to "slow" while attempting to take accurate readings.

- Daily Source Check - each instrument will be source checked daily. A certified Cs -137 source (or other gamma emitter) will be counted for one minute on each instrument before use each day. A bracket or other fixture will be used to hold both the source and the instrument during the source check to provide a reproducible geometry. The observed counts will be recorded, and shall be within 10% of the standard value established during calibration.

3.3. Air monitoring instruments

The Real-Time Aerosol Monitor (RAM) and the Miniram Personal Monitor Model PDM-3 (Miniram) or equivalents will be used for air monitoring purposes. The instruments will be operated in accordance with their respective operations manual. Each instrument will be will be zeroed prior to each use. Each instrument is required to be factory calibrated annually. In addition, secondary calibrations will be implemented in accordance with the operations manual.

3.4. Water quality monitoring system

A YSI 3500 series model water quality monitoring system will be used to monitor pH, temperature, oxidation-reduction potential, and conductivity of ground water during low flow sampling operations. The monitoring system will be used in conjunction with a turbidity meter. The system will be operated in accordance with the manufacturers operating instructions. In addition, daily calibration checks of pH and conductivity will be performed. National Institute of Standards and Technology - traceable standard pH buffer solutions and conductivity solutions will be used for the calibration checks. The pH standards will most likely be pH of 7.0 and 10.0 standard units. The conductivity probe will be calibrated on a daily basis using a reference solution specified by the manufacturer. Readings must be within 5 percent to be acceptable. The system thermometer will be calibrated in accordance with manufacturers requirements

4. Equipment decontamination

4.1. Drill rig and heavy equipment

Equipment and materials associated with sampling must be cleaned before and after use at a site and between discrete investigation locations including individual soil borings and test pits. Items such as drill rigs, auger flights, backhoes, and miscellaneous heavy equipment present potential sources of interference to environmental samples. These items may contact the materials to be sampled and may retain contaminants from other sources such as roadways or storage areas. They may also hold soil material from previous sites that have not been removed. A central location at the site will be established for decontamination of the drill rig and backhoe.

Two options are available to clean heavy materials:

Steam cleaning. A steam generator uses high pressure to remove visible debris and residuals. Steam generators are typically easy to handle, and they generate low volumes of waste water. This method also has disadvantages. It requires a fixed or portable power source, and they may not be economical for use on small pieces of equipment or for sampling events that are of short duration.

Manual scrubbing. This procedure can be as effective as steam cleaning, or it can be preferred in situations where steam cleaning fails to remove visible material. The field technician scrubs the equipment with a laboratory grade detergent solution to remove material. After the scrubbing, the technician rinses the equipment with water. Manual scrubbing is labor-intensive, and it generates large volumes of wash and rinse solutions.

4.2. Decontamination of sampling equipment

Decontamination procedures are designed to remove particles and compounds which could affect the integrity and, thus, the interpretation of environmental sampling data. To establish decontamination methods for a particular site, the field manager must have an understanding of the conditions of the site and the expected type and concentrations of the contaminants. An awareness of site contaminants aids in the selection of reagents for decontamination. For example, if acetone is a contaminant of concern it cannot be used in the solvent rinse step of decontamination.

Decontamination methods and materials are selected based upon the type of contamination and the decontamination method's ability to remove the contaminants. The following are the basic elements of the decontamination procedure:

- Equipment which has the potential to contact the environmental medium to be sampled should be washed with a detergent solution and rinsed with control water before it is used. Control water is clean water from a supply with a known chemical composition.

- A solvent, acetone for example, is used to remove contamination from organic compounds. The solvent causes the contaminant to enter the decontamination solution.

- Acid is used when sampling for inorganic contaminants. It provides a low pH solution and causes the inorganic contaminant to withdraw from the equipment and enter solution.

- The materials used to contain solutions and scrub the equipment must be resistant to attack from the solvent and acid solutions.

Specific limitations to field decontamination include the following items:

Weather. Cold temperatures reduce the potential of solvents to volatilize.

Space requirements. Decontamination requires space both for the decontamination process itself and for the storage of equipment and materials after decontamination. This space must be available at the site of the work and must be away from the area of contamination.

Disposal issues. Materials generated by the decontamination process, such as rinse waters, must be properly disposed.

A field decontamination station should be located away from the source of contamination (to prevent potential cross contamination) but close enough to the sampling team to facilitate equipment handling. The decontamination station should be set up in a way to not affect clean areas of the site. Whenever possible, field sampling should be initiated in that area of the site with the lowest known contamination and proceed to the area of highest known or suspected contamination.

The following is a step-by-step procedure for field equipment decontamination:

1. Using a laboratory grade detergent and control water, remove visible particles and residuals. Note the following:
    - This step may be preceded by a steam or high pressure wash in order to facilitate residual removal
    - For equipment that cannot be adequately cleaned with a brush due to internal mechanisms or tubing, the decontamination solution should be circulated through the equipment
2. Rinse the equipment thoroughly with control water to remove the detergents.
3. If the samples are to be analyzed for inorganic compounds, apply an acid rinse to remove trace metals. The acid solution can be made with 10% nitric or hydrochloric acid solution made from reagent grade or nitric or hydrochloric acid and deionized/distilled water: that is, one part acid to 10 parts water.
4. Thoroughly rinse the equipment with control water.
5. Rinse the equipment with a high purity solvent (pesticide grade) to remove traces of organic compounds. Acetone, methanol, and other water soluble solvents are acceptable for the solvent rinse step. Acetone is recommended as it is an excellent solvent and miscible in water. Base the choice of the particular solvent on site conditions.
6. Allow the solvent rinse to evaporate and the equipment to air dry.

7. Give the equipment a thorough rinse with control water to remove any residual traces of solvent.

8. Wrap the sampling equipment with a clean inert material such as aluminum foil for transport to the sample collection area. Note that household aluminum foil often has a coating of oil and should not be used for this purpose.

The decontamination process should be well documented. Each step, materials used, and the disposition of waste should be recorded in a field notebook. Miscellaneous items such as weather conditions, nearby activities, and other issues which could affect results should also be recorded. Decontamination fluids that contain solvents or acid will be contained in 5 gallon polyethylene buckets sealed and labeled.

4.3. Disposition of derived wastes

Wastes generated during the implementation of field activities will be managed as follows.

Aqueous waste - authorization will be sought to discharge water to the ground surface or local POTW. If authorization is not granted aqueous derived waste generated during well development, evacuation, and decontamination procedures will be stored on-site in containers that are clearly labeled and placed in an area of the site designated by the existing property users. Provisions will be taken so that waste materials are not spilled due to freezing, storage, etc.

Non-aqueous wastes - including soils, sediments and solid waste generated during the implementation of field activities, as well as disposable materials used by O'Brien & Gere and their subcontractors, including PPE, disposable sampling equipment, and other potentially contaminated materials used during the implementation of the field investigations. Non-aqueous investigation-derived wastes (IDW) that are not returned to the source will be containerized in drums or rolloff containers and placed in an area of the site designated by the existing property owners.

5. Field investigation activities

Field activities will be performed in a staged progression with one task determining the need for and extent of the succeeding task. Where possible, tasks which are not interrelated in this manner will be performed concurrently. To avoid the need to investigate an area more than once, the investigation will address both organics and inorganics such as uranium and thorium.

5.1. Site visit

The primary objectives of the site visit activities are to verify sampling locations for the field sampling program, select an area for placement of the field trailer (if any), verify components of the health and safety plan such as the hospital route, introduce the field operations supervisor to owners and individuals with whom he will be in contact during the investigation, and allow the risk assessor and hydrogeologist to review site topography and environs to expedite risk assessment preparation and hydrogeologic fate and transport modeling.

On-site and off-site utilities, to the extent possible, will be identified for the health and safety of field personnel and to prevent damage to underground utilities during intrusive activities. The site visit should be scheduled at least three weeks prior to the initiation of field activities, in order to allow ample time for locating potentially affected subsurface utilities and services, and to arrange for access to the proposed drilling/sampling locations.

5.2. Ground penetrating radar (GPR) survey

Objectives

A GPR survey was conducted to evaluate and confirm the presence of on-site subsurface structures (i.e. recharge basins), define the depth of the structures prior to installation of borings, evaluate the methodology by which the structures were filled (soil vs, building rubble), and support the selection of soil boring locations.

Method
The GPR survey was completed by pulling the GPR antenna across the land surface in a linear trace along a pre-determined grid. The spacing of the GPR profile lines were either 5 ft or 10 ft and were selected on the basis of potential target size and the real-time results from the GPR survey. The GPR data set was examined at the end of each profile to assure that the data record was complete and of high quality. The raw GPR data were collected on a portable collection device model SIR-2 manufactured by GSSI, Inc. GPR information was downloaded daily to a portable computer and further evaluated for potential locations of subsurface structures.

Data uses
The profiles developed during the GPR survey were used, together with the exterior radiation survey, to assist in the selection of surface soil sampling and boring locations. The GPR survey results are presented in the Interim Technical Memorandum Exterior Radiation and Ground Penetrating Radar Survey Results, March 1998.

5.3. Exterior radiation surveys

Objectives
The purpose of the survey was to define, to the extent practicable, the lateral extent of above-background gamma emitting radioactive materials that may indicate the presence of process residuals, particularly uranium and thorium progeny.

Method
The exterior radiation survey was conducted by the NYSDEC Bureau of Pesticides and Radiation and Chemrad Tennessee Corporation assisted by O'Brien & Gere, using USRADS (ultrasonic ranging and detection system). The USRADS survey provided detailed coverage of a large survey area and provided data that identified areas of gross radioactivity which were higher than background .

Areas inaccessible (e.g. along fence-lines) to the USRADS system were hand surveyed. The hand survey was conducted with a Sodium Iodide (NaI) detector coupled to a portable scalar capable of acting as a Single Channel Analyzer (SCA). A 2" by 2" NaI detector was used for maximum sensitivity.

The SCA was calibrated with the NaI detector using a Cs-137 check source to be consistent with the procedures used in the USRADS survey. The window and discriminator settings were recorded by the analyst.

The survey was performed with the NaI detector pointed down about 6 inches above the ground. The survey was conducted at a rate of about one foot per second. Each survey pass covered an approximate three foot wide area. The count rate was noted continuously by the operator. Any time the operator observed a count rate increase of more than 20% above the ambient background he stopped and allowed the instrument to stabilize. The peak count rate was noted.

<u>Data uses</u>

After the survey was completed the results of the radiation survey were plotted on maps that were referenced to the location of the fence-line and on-site buildings. The maps presented total radiation readings in counts per minute. Areas where counts were substantially greater than background readings are proposed to be investigated further in the surface and subsurface sampling portion of site investigation activities.

5.4. Site survey

<u>Objectives</u>

A benchmark survey will be conducted by a licensed surveyor to accurately define the locations of former subsurface structures such as the recharge basins and solvent storage building using the 1960 survey prepared by Holzmacher, et al. The location of existing structures such as leaching pools, sanitary pools, storm drains, and underground tanks will be included in the survey to the extent practicable. Monitoring wells on the NCDPW and General Instruments site targeted for use in the evaluation of ground water conditions will be surveyed, if access to the properties can be obtained in a reasonable period of time and without undue difficulty as noted in the work plan. Otherwise, NCDPW and General Instruments wells will be excluded from the ground water sampling program (see Section

5.7). The survey will be conducted for multiple purposes: to demonstrate that a reasonable standard of care was used to relocate the structures, to compare the results of the USRADS survey, ground penetrating radar GPR survey, and soil boring survey with the locations of the underground structures to determine the relationship among them, and to assist in positioning the soil borings.

Method

During the survey, the surveyor will establish a coarse grid from which later surveys may be referenced. The grid will be based on the common fence that separates the site from Cantiague Park golf driving range. The surveyor will be required to provide a survey map for subsequent use in the investigation and possible remediation of the site. Subsequent to completion of site investigations the location of surface soil samples and soil borings will be established with a site survey. Each sampling location will be identified on the survey map and will include the coordinates and ground surface elevation. Buildings, roadways, waterways, and utilities will be clearly labeled. Elevations will be referenced to the National Geodetic Vertical Datum (NGVD) of 1929.

5.5. Surface and subsurface soil investigation

Objective

Surface and subsurface soil samples will be collected and analyzed to evaluate the nature and extent of process residuals related to former site usage.

Method

Seventy-one soil borings are currently proposed and will be installed as follows based on existing information:

- up to 63 borings will be installed at the specific locations as recommended in the *Interim Technical Memorandum, Ground Penetration Radar Survey and Exterior Radiation Survey Results* report dated March 1998, and as requested by NYSDEC on March 26, 1998.

- up to 8 additional borings will be installed as necessary to further assess subsurface conditions. Specific locations will be discussed with NYSDEC.

- Proposed soil boring locations are shown on Figure 4.

Actual location of soil borings will be established based on the relocation of former historic structures in the site survey. The location of borings in areas identified from the radiation survey will be verified by pre-screening with a radiation survey instrument.

A direct-push drilling methodology, either Geoprobe® or equivalent, will be used to obtain soil samples. Soil samples will be collected by this methodology in 2 or 4 ft soil cores within a Lexan® sleeve. The soil core will start from the ground surface at each sample location, proceeding to a depth dictated by the presence or absence of above-background levels of radioactivity or volatile organic compounds (VOCs). At a minimum, in areas where fill is found to exist, the borings will be advanced into the underlying native material.

In the event hard fill and rubble near the ground surface preclude the use of direct-push methodologies, hollow-stem auger drilling methodologies and split-spoon sampling techniques in accordance with ASTM D 1586-84 will be employed.

A hydrogeologist will be on-site during the drilling and sampling operations to fully describe each soil sample, including but not limited to: 1) soil type, 2) color, 3) percent recovery, 4) moisture content, 5) odor and other observations, such as organic content and cohesiveness. The Wentworth Soil Classification System will be used to describe the soil samples. The supervising hydrogeologist will be responsible for retaining a representative portion of each sample for analysis in a glass jar labeled at a minimum with: 1) site name; 2) boring number; 3) sample interval; 4) date; and, 5) time of sample collection.

Upon collection the soil samples will be divided with one portion being placed into precleaned 4 oz. sample containers for VOC analysis, and a second portion placed into a glass container and covered with aluminum foil or placed into ziplock ® bags and sealed for PID headspace screening. The headspace sample will be allowed to attain ambient temperatures prior to screening with the PID.

Equipment and general procedural elements for radioactive core screening and soil sampling are as follows:

1) Basic goals - Soil screening and sampling will be performed for a variety of purposes:

   - worker protection
   - to identify the point at which to obtain samples from subsurface soil cores
   - to evaluate the vertical and horizontal extent of process residuals that are present within the study area and which are related to former activities by GTE's predecessor companies
   - to obtain sufficient data of suitable quality to establish a database for use in assessing risks to human health and the environment.

2) Equipment - Soil cores will be scanned for radioactivity using both a 2" x 2" NaI detector attached to a rate meter as well as a thin windowed G-M probe attached to a second rate meter. The NaI probe will be used in the open window mode. Rate meters will be equipped with digital read-outs.

3) Core screening - While contained in the Lexan® sleeve, readings will be obtained from a soil core using the G-M and NaI probes. It is anticipated that readings will be obtained at 6 inch intervals, where a change in soil type is observed, or where the field geologist or analyst determines a count is necessary to obtain a representative radioactive reading. For each reading obtained, the probe will be positioned immediately above the core for 30 seconds to allow the rate meter to come to equilibrium. Afterwards, the core will be rotated 180 degrees and the procedure repeated. The actual position at which readings are taken may be somewhat greater or less than 6 inches depending on the characteristics of the core.

4) Sample collection - The decision of where to cut a core and collect soil samples will be made in the field at the discretion of the supervising geologist or analyst based on:

   - scan peak locations
   - overall radionuclide and VOC distribution
   - soil composition

- background

5) Generic sampling procedure - Assuming that a 6 inch increment will provide enough sample for analysis (refer to item 6 for a discussion of soil volume), the procedure for the collection of samples from a boring installed to 10 ft and from which five 2 ft core sections are obtained would be to:

   a) Collect a minimum of 1 primary sample for radionuclide analysis from each 2 ft core section for radionuclide analyses by the laboratory methods specified in the quality assurance project plan. Also collect a portion of the core for headspace analysis. If volatile organics are present, collect samples for chemical analyses (note: the number of samples actually sent to the laboratory for chemical analysis will depend on the overall character of the 10 ft boring. For example, if the entire boring was found to have elevated VOC readings, the field supervisor would be responsible for the selection of the most appropriate sample locations in consultation with NYSDEC). Archive the remainder of the core for further radiological analyses at a later date, if needed. In those instances where it is necessary to install the 10 ft boring solely to penetrate into native soil and radiation readings do not exceed background (generally the accepted action level is twice background, see ASTM D 5928 - 96 *Standard Test Method for Screening of Waste for Radioactivity*), a field decision will be made by the field supervisor in consultation with NYSDEC as to the appropriate number of laboratory analyses to be conducted on cores obtained from that particular boring. NYSDEC will also be consulted as to the number of samples to be collected and archived from a boring that does not exhibit above background levels of radioactivity.

      (note: According to NYSDEC archived samples are exempt from licensing requirements for the storage of radioactive materials. In addition, samples will only be stored until such time as the number and type of samples are determined sufficient to profile site soils.)

   b) Label each radiological sample with the date, time, core location (core # or site grid location), depth from surface or position in core segment, and the name of person collecting the sample. Record other information in the field logbook such as an interpretation of core material composition as well as any distinguishing features of the material, samples taken for other analyses, and core scan data.

c) At the discretion of the field supervisor, additional samples may be analyzed for radionuclides at this time. The reason for the additional sample analysis would be to adequately characterize the activity of the soil for the purpose of setting guidelines or determining possible cleanup needs. Consultation with NYSDEC will take place in the field as the character of the soil becomes better defined.

d) Split samples with NYSDEC. It is anticipated that approximately 20 split samples will be collected in consultation with NYSDEC and in consideration of: the samples should not have a strong organic odor, they should be taken from segments where the core scans indicate that the activity is relatively constant so that a sufficient sample can be taken that will satisfy both analytical laboratories, and they should cover roughly the range of activities observed - some from background like conditions, some from the higher activities, and some from in the mid range. It may be necessary to approximate conditions for the second and third items.

e) Discuss alterations to the sampling procedure with NYSDEC before such alterations are implemented.

6) Soil volume considerations - Soil volume may be insufficient if it is necessary to obtain samples for both radionuclide and chemical analyses from a single core. To address this issue, the supervising geologist will determine whether the additional soil volume should be obtained by using a longer core length (> 6 inches) or whether the soil should be obtained from a second core collected in close proximity to the first. Since chemical residuals would be expected to be uniformly distributed over short distances, the soil from a second core of this type will be analyzed for its chemical content as opposed to its radionuclide content.

7) Field logs - Each reading obtained for screening purposes will be recorded in a field notebook. The readings will be designated in inches below the top of the core in order to develop a vertical core and soil profile.

8) Core compaction, recovery considerations, and cavings - In the event that the analyst observes core compaction, or core recovery that is less than 100%, the analyst will determine whether the condition warrants

the collection of a second core proximate to and at the same depth interval as the first. The analyst will consult with NYSDEC prior to collecting a second core of this type.

If cavings are evident in a core, they will be removed by the supervising geologist and their presence recorded in the field notebook.

9) Background readings of individual cores - At a minimum, at least 5 samples will be collected site-wide to confirm that only background levels of radiation are present as indicated by field readings. Background readings of this type will be collected for quality control purposes.

10) Background borings - Two background borings will be installed at a location selected in consultation with NYSDEC and samples collected and analyzed for background levels of radioactivity. Collocated samples will also be collected to evaluate background levels of metals. It is anticipated that background borings will be installed upgradient of the site in Cantiague Park.

11) For those holes that remain open after the rod has been removed, downhole gamma readings will be obtained using a 1" x 1" NaI probe connected to an appropriate rate-meter. These readings will be profiled at 6 inch intervals or at intervals selected by the supervising geologist for comparison to the core profiles. The downhole probe will be connected to a 15 ft cable, marked at O.5 ft intervals. For boreholes ≤15 ft in depth, a 10 min count interval will be used to verify that the boring does not need to be advanced further. A reading within 30% of background will be considered equivalent of background. A decision to shield the detector will be made following the analyses of samples obtained from the background borings in consultation with NYSDEC.

A boring will be terminated when a single 2 or 4-foot core is found to contain no more than background levels of radioactivity and VOCs. Borings in the recharge basins and other potential source areas will, at a minimum, be advanced into native soils beneath the bottom of the basin unless field conditions indicate that to do so would introduce process residuals to potentially uncontaminated depth.

Surface soil samples

The upper 3-inches of each core will be considered the surface soil sample. Up to 20% of the surface, for a total of 25 samples, will be selected based on screening results and analyzed for radionuclides. In addition, each surface soil sample selected will be analyzed for target analyte list (TAL) metals and mercury as summarized in Table 6-1.

Subsurface soil samples

Soil cores below 1 ft bls will be considered subsurface soil samples. Up to 71 subsurface samples, one per soil boring, will be selected based on screening results and analyzed for VOCs, semivolatile organic compounds (SVOCs), TAL metals and mercury, as summarized in Table 6-1. In addition, in the event that more than one discrete subsurface zone within a soil boring exhibits evidence of process residuals either by visual observation or by field screening, an additional soil sample may be collected and analyzed for the described parameters. A discrete zone of contamination may extend over a interval that is larger than the typical 2 ft sample interval. As such, the hydrogeologist or field supervisor will establish the extent of a discrete zone of process residuals and select one representative sample for laboratory analysis.

A TAL metals (including cyanide) sample will be collected in those borings located at former leaching pools (11,12, 30 to 38), recharge basins (1 to 3, 23 to 28, 41& 42) and metals storage tank area (10). The sample will be collected at the depth assessed to be the bottom of the structure.

Two soil borings will be completed to a depth of 12 ft bls at the golf course driving range in areas without fill to collect background soil samples. Two soil samples will be collected from each soil boring, a near surface and one from the bottom of the boring. Each sample will be analyzed for TAL metals.

Data Uses

Surface soil laboratory analysis data will be used to evaluate potential direct exposure pathways associated the former site activities.

Subsurface soil sampling will be used to evaluate potential exposure pathways which may affect public health and a human health assessment.

5.6. Soil vapor surveys

Objectives

The purpose of soil vapor surveys will be to identify the possible presence or absence of solvents or other potentially site-related residuals associated with known structures and or previous site activities.

Method

A soil vapor sample will be collected to screen for the presence of VOCs on a preliminary basis at those soil borings which are located at the former location of historic structures. In addition, in order to address unknown sources, the following criteria will be used for collecting a soil gas sample:

- if a boring indicates the presence of residuals a series of soil vapor points will be placed away from, but in close proximity to, the initial soil boring to evaluate the lateral extent of the residuals.
- if no structures are identified in an area known or believed to contain previously used structures based on the GPR survey and radiation surveys, a soil vapor survey may be conducted in conjunction with borings to obtain areal representativeness.

Should quantities of VOCs be identified, the soil vapor survey will be expanded by collecting soil gas samples at distances of 10 ft north, south, east, and west of the original location. The soil gas survey will terminate when target analytes are no longer observed above the established detection limit. Specific soil gas sampling and analysis procedures are provided in Attachment B.

Data uses

The data collected in this manner will assist in locating future borings and optional ground water collection locations.

5.7. Ground water investigation

Objectives
Ground water sampling from existing wells will be conducted to corroborate previous sampling results and update site ground water quality conditions.

Method
One round of ground water sampling will be conducted at the site. Ground water samples will be collected from two monitoring wells at the General Instruments site (designated as wells W-7-7I and W-3D-112), five monitoring wells on the Air Techniques property, and up to four upgradient wells at the Nassau County Department of Public Works (NCDPW). Sample collection will be performed in accordance with the detailed procedures described in the Attachment C.

Up to five ground water samples will be collected with the Geoprobe® system to evaluate ground water quality conditions in areas not monitored by the existing monitoring well network. The turbidity of ground water samples collected using Geoprobe® methodologies will be evaluated and minimized as follows:

- Turbidity of ground water samples collected for metals and radioactivity will be measured with a turbidity meter.
- If turbidity is < 50 NTU's, samples will be submitted to the laboratory for the appropriate analysis.
- If turbidity of the samples > 50 NTUs, then both filtered and unfiltered metal and radioactivity samples will be collected and analyzed. Samples will be filtered through 0.45 micron filter.

Ground water samples will be analyzed for VOC, SVOC, TAL metals including cyanide, and radionuclide parameters in accordance with the QAPP and as summarized in Table 6-1.

Data Uses
Ground water sampling will be used to evaluate potential exposure pathways which may affect public health.

5.8. Indoor air survey

The indoor air survey protocol presented in this section describes the procedures to be used in the event that the exterior portion of the investigation indicates that an indoor air survey is warranted at one or more of the on-site buildings. The decision criteria for initiating a survey will consist of: 1) the presence of near surface source area; 2) modeling of source emissions to evaluate whether they could penetrate the concrete building floors tot he extent that an adverse human health effect would be created. If an indoor air survey is conducted based on these criteria, a chemical use survey of the building or buildings will be conducted prior to its initiation.

Objective

The objective of the indoor air quality (IAQ) investigation is to gather data regarding the indoor atmosphere that may be affected by chemical substances previously used at this property site. The data will be compared to applicable occupational exposure data identified by the Occupational Safety and Health Administration (OSHA) as published in Title 29 of the Code of Federal Regulation, Part 1910 (29 CFR 1910).

Method

O'Brien & Gere will conduct measurements for airborne VOCs and radionuclides. These parameters will be monitored at up to 5 work area locations per building. Sample collection locations will be based on current building configuration and the heating, ventilation, and air-conditioning (HVAC) supply.

Volatile Organic Compounds
Air sample collection locations will be based on air current flows and worker locations in the building work areas. These two factors will be considered for placement of sample collection locations that have a potential to represent a worst-case worker exposure to airborne materials in the indoor air work environment.

Up to 15 continuous area air samples, consisting of 5 samples per building, will be collected over one 8-hour work day for VOCs according to a modified National Institute for Occupational Safety and Health (NIOSH) Method 1500. The VOC scan method has the capability of measuring approximately 130 VOCs commonly associated with manufacturing activities, such as perchloroethylene, toluene, and gasoline. Air sample measurement will consist of collecting an air sample on an activated charcoal-containing glass ampule connected by plastic tubing to a personal air sampling pump. The sample flow rate will be calibrated and set at approximately 0.1 liter per minute and will collect a composite sample over an 8-hour time period. A sample data sheet will document the sample location, sample pump identification, sample designation, sample collection start and stop times, and the pre and post calibration data.

Upon completion of sample collection, the ampules will be sealed and prepared for shipment to an American Industrial Hygiene Association (AIHA) accredited laboratory. Two field blanks will also be collected in accordance with the sampling method. The samples and blanks will be analyzed by gas chromatography. Chain-of-custody documentation will be maintained through the analysis of the samples.

Radionuclide Survey

A radionuclide screening survey will be conducted within buildings at sample locations associated with intrusions into the concrete floor slab, such as water pipes, drains, utility conducting devices, naturally occurring cracks, sumps, and pits. Screening measurements will be collected in real time with a hand-held Ludlum Model 2221 NaI crystal probe attached to a Ludlum Micro R Meter. Measurements will be collected and recorded at the floor level for ionizing radiation levels in millirem per hour units.

Data Uses

The results of the IAQ investigation will consist of air exposure and radionuclide activity data. Results of the VOC scan will be reported as airborne levels for specific VOC materials in milligrams per cubic meter of air. The individual VOC levels will be compared to specific permissible exposure level (PEL) values identified by OSHA for an 8-hour work day, 5-day per week exposure in an occupational environment. Radionuclide survey results will be compared to OSHA exposure values for an unregulated radiation area.

6. Analytical program

The analytical program has been designed to facilitate the identification of chemical and radioactive constituents associated with historic site activities. Laboratory analyses of environmental samples will be conducted in accordance with the NYSDEC 1995 Analytical Services Protocol (NYSDEC 1995 ASP). The QAPP presents the analytical methods and quality control objectives to be utilized for the field investigation. Table 6-1 presents a summary of the analytical program for the Former Sylvania Electronics Products Corporation Facility exclusive of radionuclides which are discussed on page D-23. Table 6-2 presents a summary of sample containers, holding times, and sample preservation for chemical as well as radionuclide analyses.

Table 6-1 Analytical Program Summary

Field Task	Rationale	Analyses	Environmental samples	QC Samples		
				Field duplicates	Trip blanks*	MS/MSDs
Subsurface soil samples	•Quantify process residuals formerly used at the site •Verify soils not affected, if warranted	VOC SVOC PCB(10)[1] Metals [2]	71	4	8	4
Surface soil samples	•Quantify process residuals formerly used at the site	Metals	25	2	0	2
Ground water samples	•Quantify process residuals formerly used at the site	VOC SVOC Metals [2]	15	1	1	1

Note: *Analyses for radionuclides will include thorium 230, 232, uranium 234, 235, 238, gross alpha, and gross beta. Field duplicates will be collected at an appropriate rate of 1 duplicate for each 20 samples. If possible, depending on the sample volume available, matrix spikes will also be collected at a rate of 1/20 for Th and U isotopic analyses*

[1] PCB samples to be collected from former transformer yard and recharge basin-up to 10 samples.

[2] TAL Metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc. In addition mercury

Table 6-2
Summary of sample containers, holding times, and preservation

Matrix	Parameter	Sample containers and volumes	Preservation	Holding times (from collection)
Ground water	VOCs	2-40 milliliter glass vials with Teflon® septum	4°C pH<2	10 days
Ground water	SVOCs	1-one liter amber glass container with Teflon® lined screw caps	4°C	5 days to extraction; 40 days from extraction to analysis
Ground water	Metals (except Hg)	1-250 or 500 milliliter plastic bottle	HNO_3 to pH<2, 4°C	180 days
Ground water	Hg	1-250 or 500 milliliter plastic bottle	HNO_3 to pH<2, 4°C	28 days
Ground water	Radionuclides, Gross alpha and gross beta	4 liter glass	Nitric acid to pH<2, 4°C	6 months
Soil boring	VOCs	125 milliliter wide mouth glass container sealed with a septum	4°C	7 days
Soil boring	SVOCs	250 milliliter wide mouth glass container with Teflon® lined lid	4°C	5 days to extraction; 40 days from extraction to analysis
Soil boring and surface soil	Metals (except Hg)	4 ounce wide mouth glass container with Teflon® lined lid	4°C	180 days
Soil boring and surface soil	Hg	4 ounce wide mouth glass container with Teflon® lined lid	4°C	28 days
Soil boring and surface soil	Radio nuclides, Gamma Spectroscopy	2-250 milliliter wide mouth container with Teflon® lined lid	4°C	180 days

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11/97

LEGEND

SITE BOUNDARY

C01

NOTE: ADAPTED FROM SYLVAN ASCENT INC. CD/MAPS.

IN CHARGE OF ______
DESIGNED BY ______ CHECKED BY ______
DRAWN BY ______

500 0 500 1000
1"=1000'

NO.	DATE	REVISION	INIT.

O'BRIEN & GERE

FORMER SYLVANIA
ELECTRIC PRODUCTS INCORPORATED FACILITY
HICKSVILLE, NEW YORK

SITE LOCATION MAP

FILE NO. 5816.009.001a

DATE Nov. 1997

1

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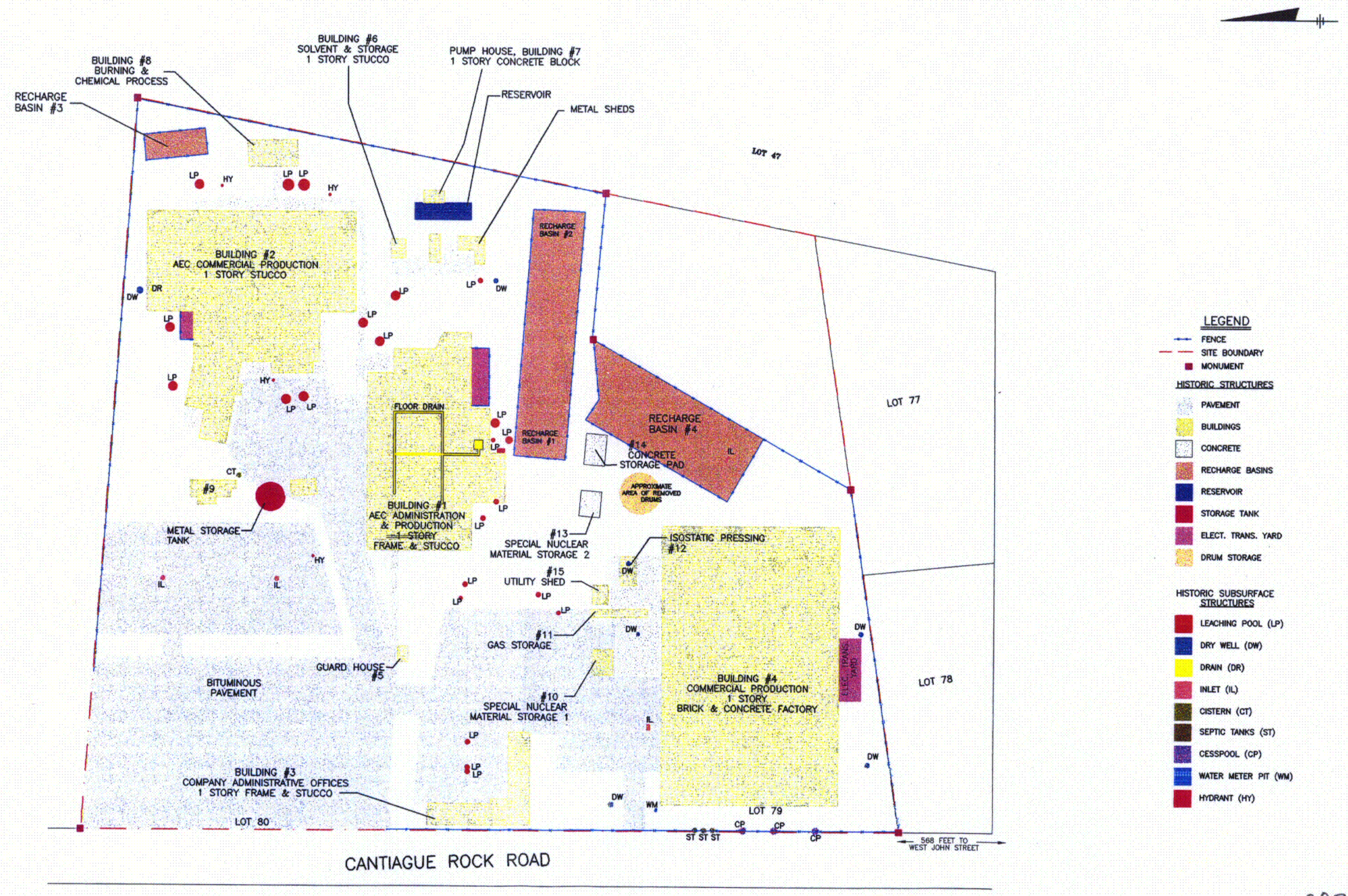

C02

NOTE: ADAPTED FROM
H.G.HOLTZMACHER
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HICKSVILLE, NEW YORK.

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IN CHARGE OF ____________________

DESIGNED BY ______ CHECKED BY _____

DRAWN BY ____________________

50 0 50 100

1"=100'

NO.	DATE	REVISION	INIT.

O'BRIEN & GERE

FORMER SYLVANIA
ELECTRIC PRODUCTS INCORPORATED FACILITY
HICKSVILLE, NEW YORK

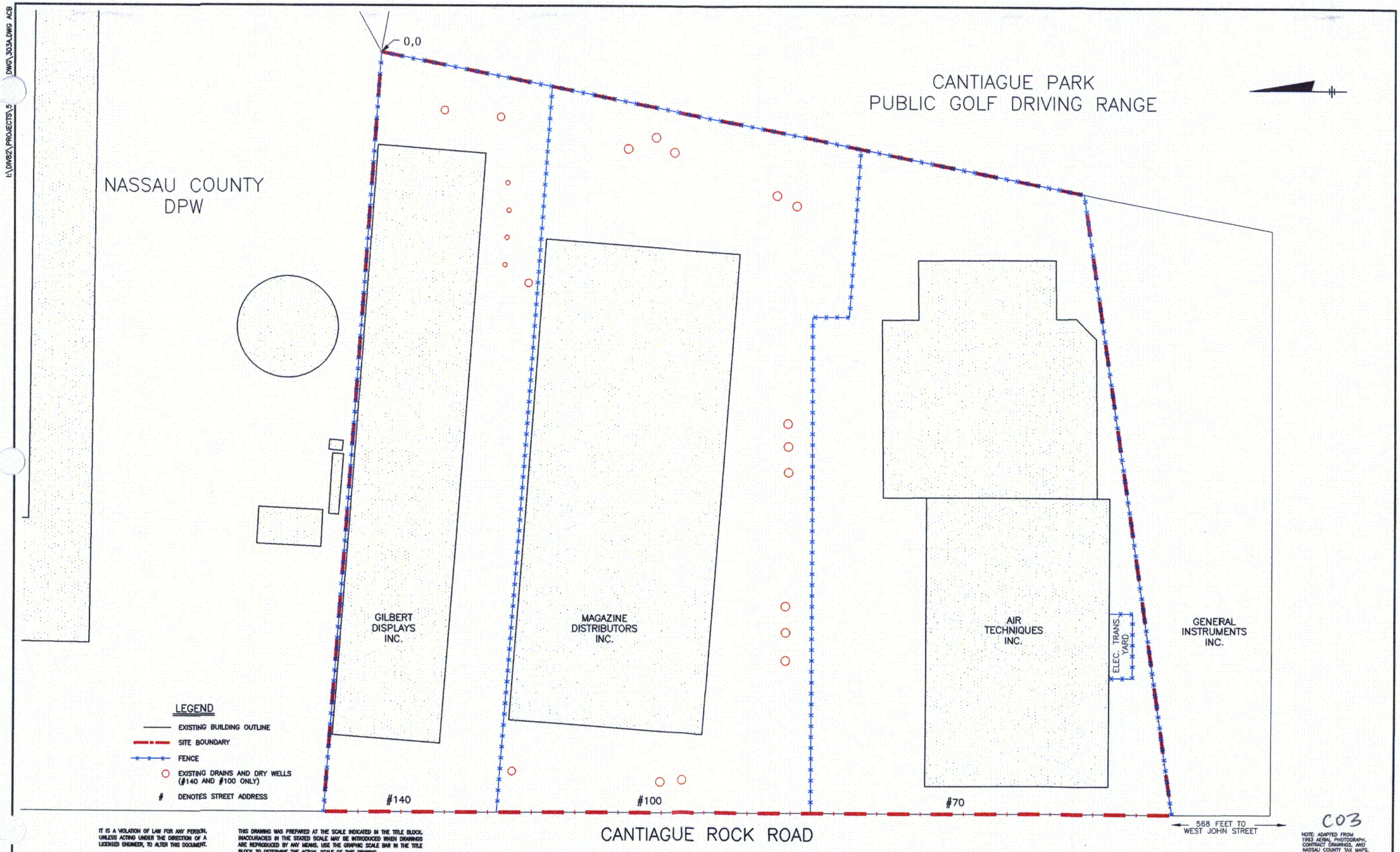
1960 FORMER
SITE MAP

FILE NO.
5816.009.002a

DATE
Nov. 1997

2

11/97



LEGEND

- EXISTING BUILDING OUTLINE
- SITE BOUNDARY
- FENCE
- ○ EXISTING DRAINS AND DRY WELLS (#140 AND #100 ONLY)
- # DENOTES STREET ADDRESS

C03

NOTE: ADAPTED FROM 1993 AERIAL PHOTOGRAPH, CONTRACT DRAWINGS, AND NASSAU COUNTY TAX MAPS.

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DESIGNED BY ______ CHECKED BY _____

DRAWN BY ____________________

40 0 40 80

1"=80'

NO.	DATE	REVISION	INIT.

O'BRIEN & GERE

FORMER SYLVANIA
ELECTRIC PRODUCTS INCORPORATED FACILITY
HICKSVILLE, NEW YORK

CURRENT
SITE MAP

FILE NO.
5816.009.303A

DATE
March 1998

3

3/98

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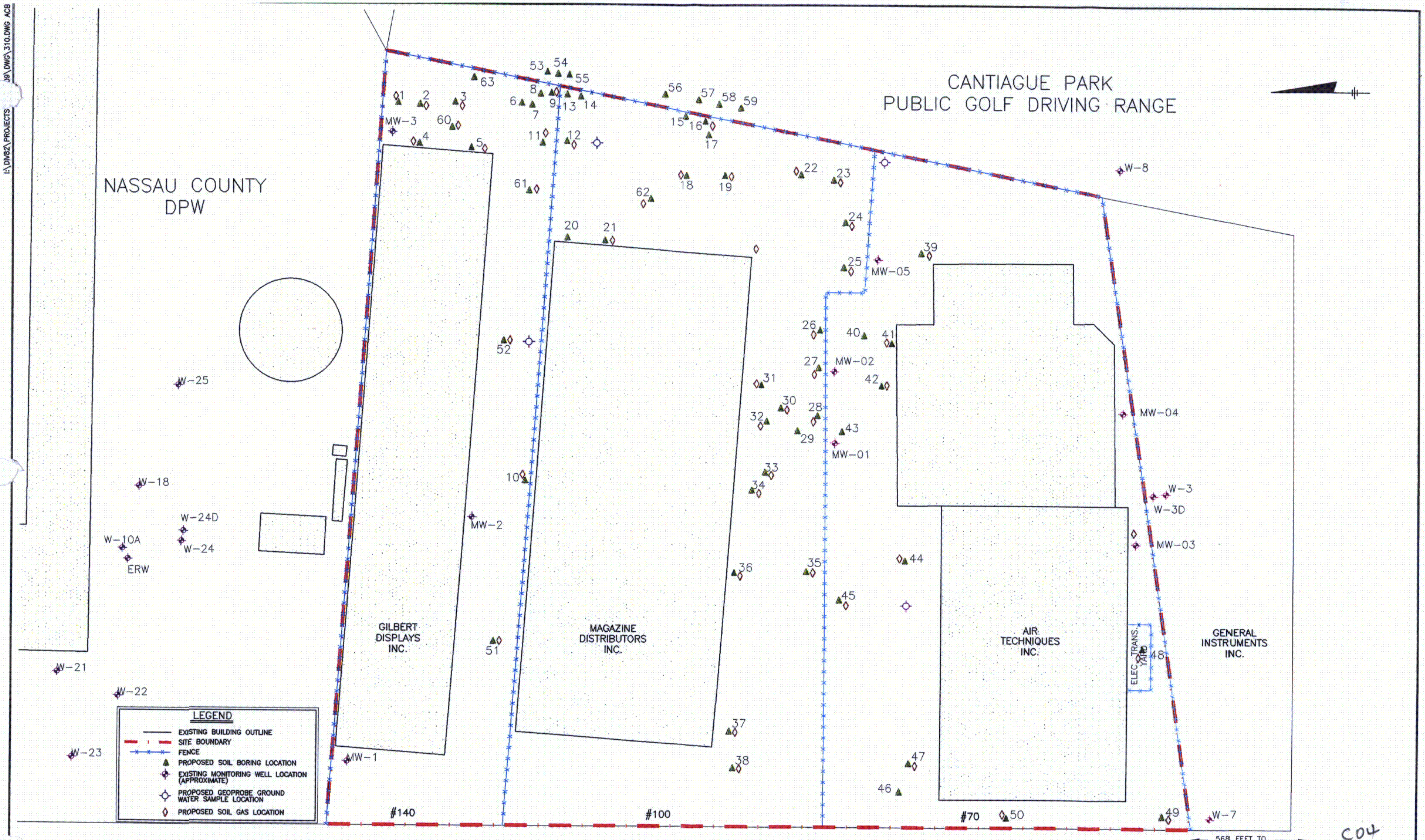

C04

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CONTRACT DRAWINGS, AND
NASSAU COUNTY TAX MAPS.

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3/98

IN CHARGE OF ____________
DESIGNED BY ______ CHECKED BY ______
DRAWN BY ____________

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1"=80'

NO.	DATE	REVISION	INIT.

O'BRIEN & GERE

FORMER SYLVANIA
ELECTRIC PRODUCTS INCORPORATED FACILITY
HICKSVILLE, NEW YORK

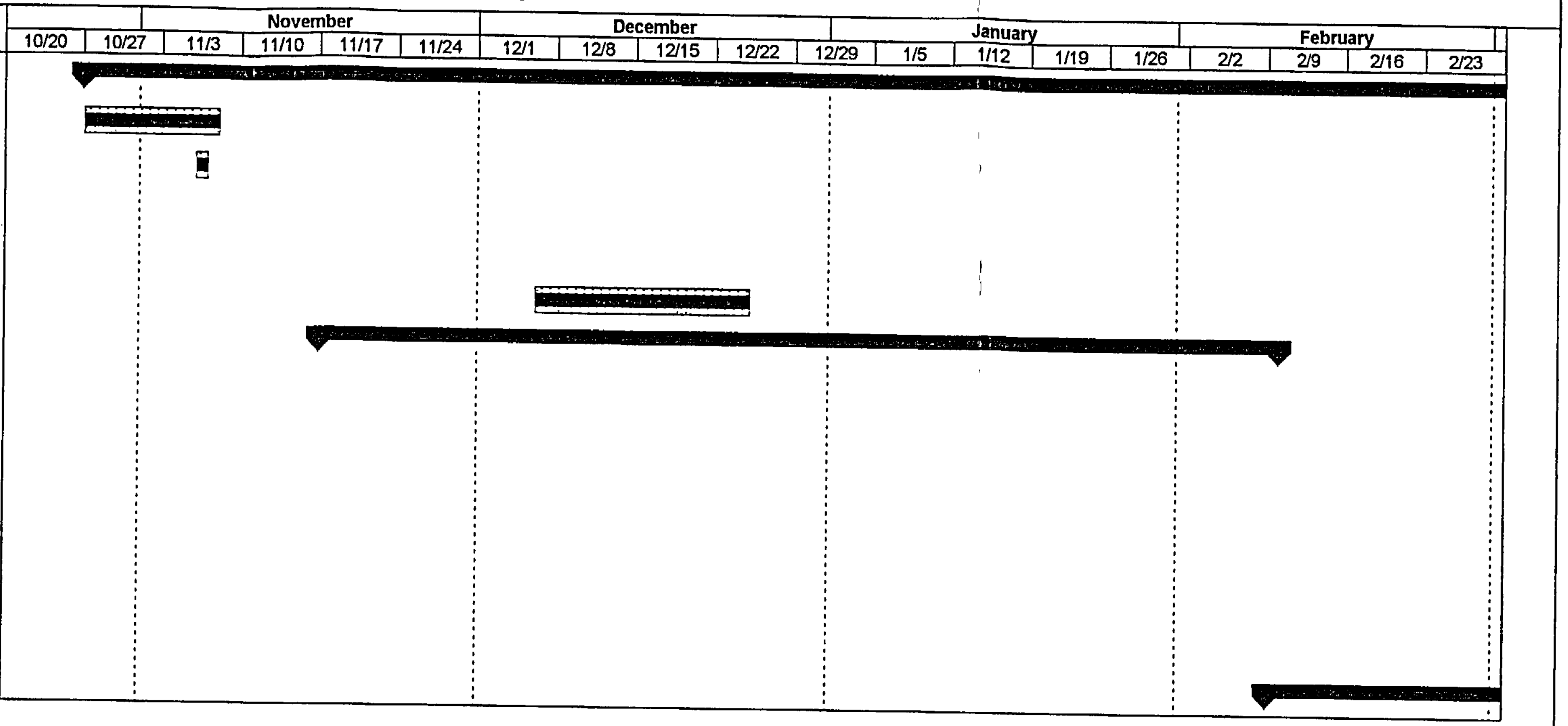
PROPOSED INVESTIGATION
LOCATIONS

FILE NO.
5816.009.310
DATE
May 1998

4

Figure 5
Project Schedule
Former Sylvania Electronics Products Incorporation Facility

ID	Task Name	Duration	Start	Finish
1	**1.0 Project Planning**	**168d**	**10/27/97**	**6/15/98**
2	1.1 Completion of the environmental assessment form	2w	10/27/97	11/7/97
3	1.2 Site Visit	1d	11/6/97	11/6/97
4	1.3 Finalization of Application and Work Plan	14.2w	3/9/98	6/15/98
5	1.4 NYSDEC Approval of Application and Work Plan	1d	6/15/98	6/15/98
6	**2.0 Ground Penetrating Radar Survey**	**3w**	**12/6/97**	**12/24/97**
7	**3.0 Radiation Survey**	**63d**	**11/17/97**	**2/9/98**
10	**4.0 Mobilization**	**20d**	**6/16/98**	**7/13/98**
11	4.1 Execute property access agreements	4w	6/16/98	7/13/98
12	4.2 Subcontracting	2w	6/16/98	6/29/98
13	**5.0 Survey**	**2w**	**7/14/98**	**7/27/98**
14	**6.0 Surface and Subsurface Soil Investigation**	**30d**	**7/28/98**	**9/7/98**
17	**7.0 Ground Water Investigation**	**30d**	**6/16/98**	**7/27/98**
20	**8.0 Restoration of Surfaces**	**2w**	**9/8/98**	**9/21/98**
21	**9.0 Report preparation activities**	**219d**	**2/9/98**	**12/10/98**

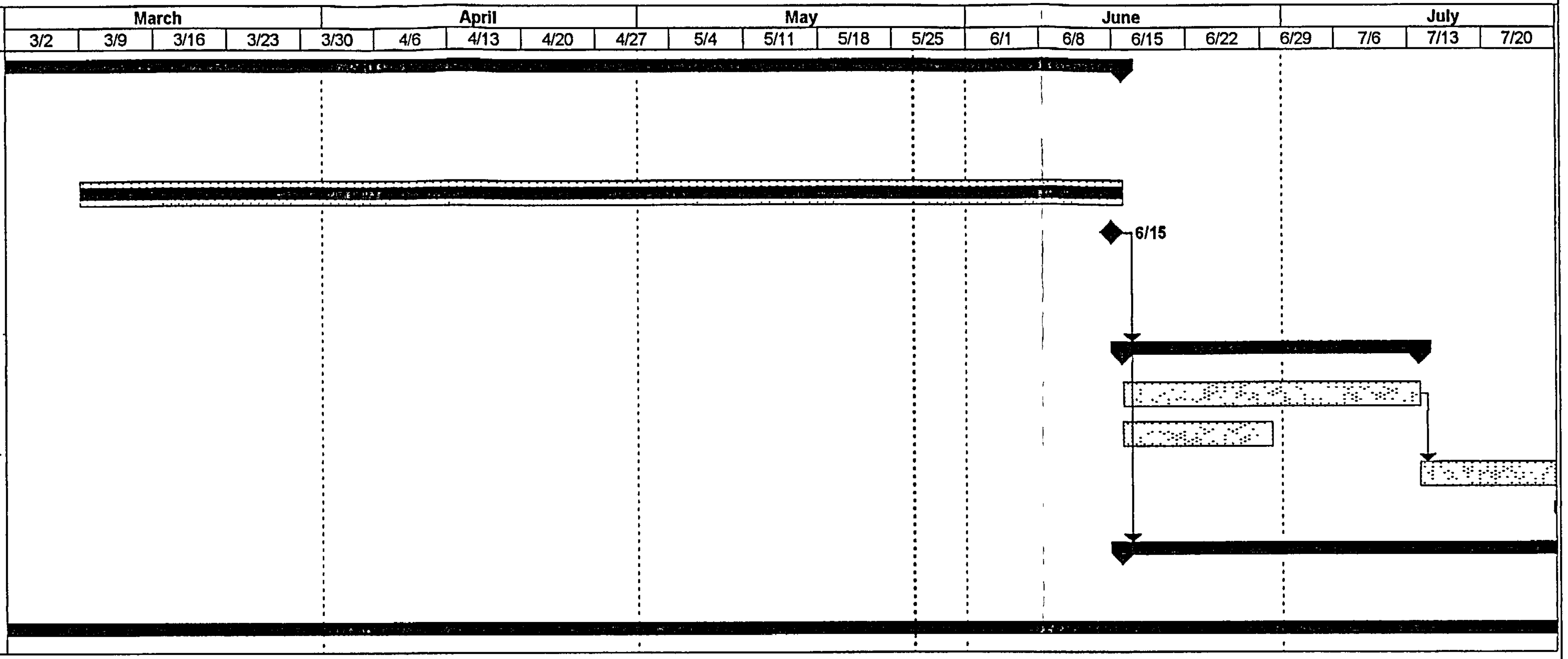


Project: Former Sylvania Products, Inc
Date: 3/13/98 Revised 5/27/98

Task ▨ Milestone ◆ Rolled Up Task ▨ Rolled Up Progress ▬
Progress ▬ Summary ▬ Rolled Up Milestone ◇

Figure 5
Project Schedule
Former Sylvania Electronics Products Incorporation Facility

ID	Task Name	Duration	Start
1	**1.0 Project Planning**	**168d**	**10/27/97**
2	1.1 Completion of the environmental assessment form	2w	10/27/97
3	1.2 Site Visit	1d	11/6/97
4	1.3 Finalization of Application and Work Plan	14.2w	3/9/98
5	1.4 NYSDEC Approval of Application and Work Plan	1d	6/15/98
6	**2.0 Ground Penetrating Radar Survey**	**3w**	**12/6/97**
7	**3.0 Radiation Survey**	**63d**	**11/17/97**
10	**4.0 Mobilization**	**20d**	**6/16/98**
11	4.1 Execute property access agreements	4w	6/16/98
12	4.2 Subcontracting	2w	6/16/98
13	**5.0 Survey**	**2w**	**7/14/98**
14	**6.0 Surface and Subsurface Soil Investigation**	**30d**	**7/28/98**
17	**7.0 Ground Water Investigation**	**30d**	**6/16/98**
20	**8.0 Restoration of Surfaces**	**2w**	**9/8/98**
21	**9.0 Report preparation activities**	**219d**	**2/9/98**

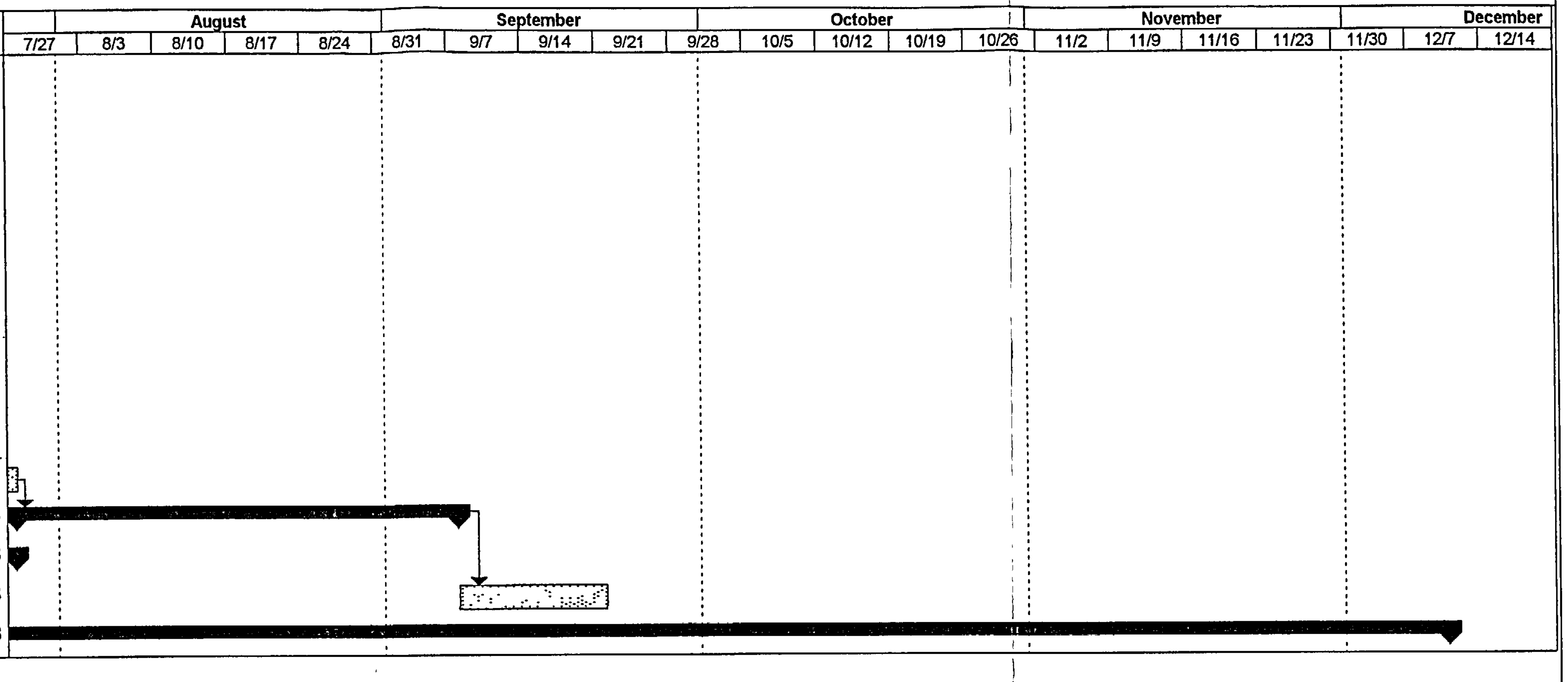


ect: Former Sylvania Products, Inc
3/13/98 Revised 5/27/98

Task ▨ Milestone ◆ Rolled Up Task ▨ Rolled Up Progress ■
Progress ■ Summary ▬ Rolled Up Milestone ◇

Figure 5
Project Schedule
Former Sylvania Electronics Products Incorporation Facility

ID	Task Name	Duration	Start
1	**1.0 Project Planning**	**168d**	**10/27/97**
2	1.1 Completion of the environmental assessment form	2w	10/27/97
3	1.2 Site Visit	1d	11/6/97
4	1.3 Finalization of Application and Work Plan	14.2w	3/9/98
5	1.4 NYSDEC Approval of Application and Work Plan	1d	6/15/98
6	**2.0 Ground Penetrating Radar Survey**	**3w**	**12/6/97**
7	**3.0 Radiation Survey**	**63d**	**11/17/97**
10	**4.0 Mobilization**	**20d**	**6/16/98**
11	4.1 Execute property access agreements	4w	6/16/98
12	4.2 Subcontracting	2w	6/16/98
13	**5.0 Survey**	**2w**	**7/14/98**
14	**6.0 Surface and Subsurface Soil Investigation**	**30d**	**7/28/98**
17	**7.0 Ground Water Investigation**	**30d**	**6/16/98**
20	**8.0 Restoration of Surfaces**	**2w**	**9/8/98**
21	**9.0 Report preparation activities**	**219d**	**2/9/98**



Project: Former Sylvania Products, Inc
Date: 3/13/98 Revised 5/27/98

Task ▨
Progress ■
Milestone ◆
Summary ▬
Rolled Up Task ▨
Rolled Up Milestone ◇
Rolled Up Progress ■

APPENDIX E

Quality Assurance Project Plan
Former Sylvania Electric Products Incorporated Facility
Hicksville, New York

QUALITY ASSURANCE PROJECT PLAN

Former Sylvania Electric Products Incorporated Facility
Cantiague Rock Road
Hicksville, New York

GTE Operations Support Incorporated

March 1998 (revised May 1998)

Contents

1. Introduction

This Quality Assurance Project Plan (QAPP) has been developed by O'Brien & Gere Engineers, Inc. (O'Brien & Gere Engineers) for GTE Operations Support Incorporated (GTEOSI). It provides quality assurance/quality control (QA/QC) criteria for work efforts associated with sampling of environmental media at the former Sylvania Electric Products Incorporated facility (the site) in Hicksville, New York. This QAPP is one component of the work plan, which also includes a Health and Safety Plan.

This document has been prepared in accordance with the New York State Department of Environmental Conservation's (NYSDEC) *RCRA Quality Assurance Project Plan Guidance* (NYSDEC 1991) and the United States Environmental Protection Agency's (USEPA's) *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (USEPA 1980a).

This QAPP will assist in generating data of a known and acceptable level of precision and accuracy. The QAPP provides information regarding the project description and personnel responsibilities, and sets forth specific procedures to be used during sampling of relevant environmental matrices, other field activities, and analyses of data.

The following quality assurance topics are addressed in this plan:

- Project organization and responsibilities;
- QA objectives for data measurement;
- Sampling procedures;
- Documentation and chain-of-custody;
- Calibration procedures;
- Sample preparation and analytical procedures;
- Data reduction, validation, and reporting

- QA/QC checks;
- Performance and system audits;
- Preventative maintenance;
- Data assessment procedures;
- Corrective actions; and,
- QA reports to management.

The remainder of this document provides details on these topics. Additional sampling procedure details will be provided in separate site-specific QAPPs which will be developed at a later date.

2. Project organization and responsibilities

While each person involved in the investigation and in the generation of data are implicitly part of the QA program for the project, certain individuals have specifically designated responsibilities. Within O'Brien & Gere Engineers, these are the Project Officer, the Project Manager, the Assistant Project Manager, QA Officer, the Data Validators, and the Environmental Technicians. It is anticipated that O'Brien & Gere Laboratories, Inc. of Syracuse, New York, and ThermoNUtech of Oak Ridge, Tennessee will provide analytical services for the investigation. Laboratory personnel with QA/QC responsibilities include the Laboratory QA Coordinator and Laboratory Sample Custodian.

2.1. Project Officer

The Project Officer will be Swiat Kaczmar, PhD, CIH, who will be responsible for the overall corporate management of the investigation and for the completion of work specified in the work plan. It will be his responsibility to provide for the allocation of staff and other resources required to complete the project within the specified schedule and budget.

2.2. Project Manager

The Project Manager will be Jeffrey Banikowski, CPG, LSP, who will have responsibility for the implementation and completion of each of the tasks identified in the Work Plan. He will manage the technical and administrative aspects of the project and function as the firm's principal client contact for the project.

2.3. QA Officer

The QA Officer will be Stuart Spiegel, who will be responsible for overall project QA. He will review project plans and revisions to such plans to maintain proper QA throughout the investigation. In addition, the QA Officer will be responsible for performance and system audits, data processing activities, data processing QC, data quality review, corrective actions, and coordinating the QA/QC efforts between O'Brien & Gere Engineers and the laboratory.

2.4. Data Validator

The data validator will be Karen Storne who will be responsible for reviewing chemical data and validating laboratory analytical data. Validation reports will be submitted to the QA Officer for review. The QA Officer will have overall responsibility for data validation.

2.5. Sampling Personnel

Sampling tasks required by this investigation will be conducted by experienced chemists, engineers, geologists, hydrogeologists, and/or environmental technicians. Their responsibilities will include the documentation of proper sample collection protocols, sample collection, equipment decontamination, and chain-of-custody documentation.

Each sampling team will be organized under a team leader. In addition to the responsibilities above, team leader responsibilities include the initializing and accurate verification of field notebooks, chain-of-custody records, sample labels, and other field-related documentation.

2.6. Laboratory QA Coordinator

The Laboratory QA Coordinator will be responsible for the laboratory's QA/QC activities associated with the project. The specific duties of the Laboratory QA Coordinator include determining whether analyses are conducted within the appropriate holding times and that laboratory custody procedures are followed. Moreover, the Laboratory QA Coordinator monitors daily precision and accuracy records, maintains detailed copies of all procedures, reschedules analyses based upon unacceptable data accuracy or precision, and identifies and implements corrective actions necessary to maintain QA standards.

The Laboratory QA Coordinator or his or her designee will conduct initial validations and assessments of analytical data results and report the findings directly to the QA Officer.

2.7. Laboratory Sample Custodian

The Laboratory Sample Custodian's responsibilities include verifying proper sample entry and sample handling procedures by laboratory personnel.

3. Data quality objectives

3.1. Objectives

Data quality objectives (DQOs) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision making process. DQOs define the total acceptable uncertainty in the data for each specific activity conducted during the investigation. The uncertainty includes both sampling error and analytical error. Ideally, zero uncertainty is the intent. However, the variables associated with the process (field and laboratory) inherently contribute to the uncertainty of the data. It is the overall objective to keep the total uncertainty within an acceptable range that will not hinder the intended use of the data. The QA/QC requirements have been established such that there will be a high degree of confidence in the measurements.

The principal DQOs of this investigation are to generate data of sufficient quality to support both qualitative and quantitative conclusions concerning the evaluation of the nature and extent of process residuals at the facility, to support interim remediation measure (IRM) activities as well as general remediation objectives, and to support the human health risk assessment. In order to achieve these DQOs, the process of data generation was designed to develop a body of analytical data of sufficient quality to be used to support conclusions made as a result of this investigation. Specific data quality requirements such as criteria for precision, accuracy, representativeness, completeness, comparability, and sensitivity are specified in this document.

Laboratory analyses and analytical levels will adhere to the guidelines described in USEPA's *Data Quality Objectives for Remedial Response Activities* (USEPA 1987). Analytical levels are defined in the guidance document as follows:

- Level I implies field screening or analysis using portable instruments. Results are often not compound specific and not quantitative but results are available on a real-time basis.

- Level II implies field analyses using more sophisticated portable analytical instruments. In some cases, the instruments may be set up in a mobile laboratory on-site. There is a wide range of the quality of data that can be generated for Level II analyses. In general, data quality depends on the use of suitable calibration standards, reference materials, sample preparation equipment, and training of the instrument operator. Results are available on a real-time basis or within several hours.

- Level III implies that all analyses be performed in an off-site laboratory. Level III analyses may or may not use USEPA Contract Laboratory Program (CLP) procedures, but may not utilize documentation procedures required of Level IV analyses. The laboratory may or may not be a CLP laboratory. Level III analyses can provide data of the same quality as Level IV, but USEPA methods such as *Test Methods for Evaluating Solid Waste* (SW-846) (USEPA, July 1992) are utilized instead of CLP methods.

- Level IV implies CLP routine analytical services (RAS). All analyses are performed in an off-site CLP analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation.

- Level V implies analyses by non-standard methods. All analyses are performed in an off-site analytical laboratory which may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits. CLP special analytical services (SAS) are Level V.

Table 3-1 contains sampling efforts, objectives, analyses, data uses, and analytical levels. The remainder of this QAPP describes the specific approaches that will be taken to achieve the required DQOs.

In order to assess adherence to DQOs, O'Brien & Gere Engineers has developed the QA/QC program described in this QAPP. The USEPA states that the purpose of a QA/QC program "is the definition of procedures for the evaluation and documentation of sampling and analytical methodologies and the reduction and reporting of data. The objective is to provide a uniform basis for sample collection and handling, instrument and methods maintenance, performance evaluation, and analytical data gathering and reporting." NYSDEC, in its guidance document for QAPPs, states that "quality assurance is a management system for ensuring that all information, data, and decisions resulting from an investigation are technically sound, and properly documented." QC is defined as the "functional mechanism through which QA achieves its goals." This QAPP is consistent with the requirements set forth by the NYSDEC's *RCRA Quality Assurance Project Plan Guidance* (NYSDEC, March 1991).

Table 3-1. ***Sampling efforts, objectives, analyses, data uses, and analytical level.***

Sampling effort	Objective	Types of analysis	Data uses	Analytical level
Ground water sampling	Quantify process residuals formerly used at the site, if any	VOCs SVOCs metals radionuclides	Support human health assessment	III
Soil boring sampling	Quantify process residuals formerly used at the site, if any	VOCs SVOCs metals radionuclides	Support human health assessment	I, II and III
Surface soil sampling	Quantify process residuals formerly used at the site, if any	radionuclides	Support human health assessment	I, II and III
Soil boring sampling	Quantify process residuals formerly used at the site, if any	radionuclides	Public health and safety, and support human health assessment	I, II and III

Note: VOCs indicate volatile organic compounds
SVOCs indicate semivolatile organic compounds
Metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc
Radionuclides include thorium 228, 230, 232, uranium 234, 235, 238, gross alpha, and gross beta.
Field analytical methods (I and II) described in the work plan and Field Sampling Plan.

The following is a brief description of the data quality parameters addressed in the QAPP and is specific to chemical analytes.

Precision describes the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements, that have been made in an identical manner, compared to their average value. Precision can be expressed in a variety of manners, including absolute methods such as deviation from the mean or median values, standard deviation and variance, or relative methods, such as relative deviation from the mean or median. The overall precision may be established through the analysis of field duplicate and laboratory duplicate samples. For this project, a DQO goal for precision has been established that 80% of the chemical analytes must meet the established precision criteria. If this goal is met, the data will have acceptable precision and will be considered usable. If this goal is not met, appropriate corrective actions will be taken.

Accuracy is defined as the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement is. Accuracy is expressed in terms of absolute or relative error. Accuracy will be determined through analysis of spiked samples and the analysis of standards with known concentrations. An overall project DQO goal for accuracy has been established that 80% of the analytes must meet established accuracy criteria. If this goal is met, the data will have acceptable accuracy and will be considered usable. If this goal is not met, appropriate corrective actions will be taken.

Representativeness refers to the degree to which a sample taken from a site accurately reflects the matrix at the site. It is a qualitative parameter which is most concerned with the design of the sampling program. Factors that should be considered in the determination of representativeness include appropriateness of sampling and analytical methodologies, representativeness of the selected media, and representativeness of the selected analytical procedures. Representativeness will be achieved by the use of procedures for the collection and preservation of samples as described in the methods, the NYSDEC's *RCRA Quality Assurance Project Plan Guidance* (NYSDEC, March 1991), the work plan, and this QAPP.

Comparability refers to the use of consistent procedures, second source reference standards, reporting units, and standardized data format with document control. Adherence to standard procedures and the analysis of external source standard materials maximizes the probability that data generated from a particular method at a given laboratory can be validly compared to the data of another. This QAPP has been written to provide data which will be comparable to other data collected, as standard methods will be utilized for this investigation.

Completeness refers to the process of obtaining the required data as outlined in the work plan. Completeness is also defined as the percentage of measurements judged to be useable. Samples for which the critical data points fail completeness objectives will require reanalysis of samples (within the specified holding times) until the DQOs are met. The completeness goal has been specified at 90% for this investigation.

Sensitivity refers to a measurable concentration of an analyte which has an acceptable level of confidence. Method detection limits (MDLs) are the lowest concentration of an analyte that can be measured with 99% confidence that the analyte concentration is greater than zero. Practical quantitation limits (PQLs) and/or reporting limits (RLs) are levels above the MDLs at which the laboratory has demonstrated the quantitation of analytes. The chemical analytical methods associated with this project have MDLs, PQLs, and RLs at sufficiently low levels to adequately assess the project DQOs.

For radiochemical analyses, detection levels are estimated based on the characteristics and observations of the analyses of a given sample and are, therefore, sample based. Here. detection levels are referred to as minimum detectable concentrations or MPCs..

3.2. Field sampling

The objective of field sampling procedures is to obtain samples that represent the environmental matrix being investigated. This will be accomplished through the use of proper sampling techniques and equipment as presented in the NYSDEC's *RCRA Quality Assurance Project Plan Guidance* (NYSDEC 1991), where applicable. Appropriate sampling techniques are presented in the work plan.

3.3. Laboratory analyses

To obtain data of a quality sufficient to meet the applicable project DQOs, the following methods will be performed:

- VOC analysis by gas chromatography/mass spectrometry (GC/MS);
- SVOC analysis by gas chromatography/mass spectrometry (GC/MS);
- Metal analysis by inductively coupled plasma (ICP);
- Radionuclide analysis by alpha and gamma spectroscopy, and gas-flow proportional counting.

The specific methods, analytical QA/QC, and data reporting will adhere to the analytical methods listed in Table 3-2 along with NYSDEC Analytical Services Protocol (ASP) 10/95 revisions, Exhibit E requirements as applicable to chemical as well as radiochemical analyses.

Table 3-2. *Analytical methods*

Parameter	Analytical method	Reference
VOCs	SW-846 method 8260A	1
SVOCs	SW-846 method 8270B	1
Metals	SW-846 method 6010A	1
Gross alpha and gross beta	900.0 Modified (water) LANL MLR-100 Modified (soil)	2 3
Thorium 228, 230, 232	EML TH-01 Modified	4
Uranium 234, 235, 238	EML U-02 Modified	4
Gamma Spectroscopy	Method 901.1 Modified (water) LANL ER-130 Modified (soil)	2 3

Note: VOCs indicate volatile organic compounds
SVOCs indicate semivolatile organic compounds
Metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.
Reference 1- *Test Methods for Evaluating Solid Waste, 3rd Edition.* Washington, D.C. USEPA, 1992.
Reference 2 - *Prescribed Procedure for Measurement of Radionuclides in Drinking Water*, EPA-600/4-80-032 Washington, D.C. USEPA, 1980
Reference 3 - *Health and Environmental Chemistry: Analytical Techniques, Data Management, and Quality Assurance*, LA-10300-M, Vol.II, Los Alamos National Laboratory (LANL), Los Alamos, New Mexico, May 1986, revised March 1995.
Reference 4 - Environmental Measurements Laboratory (EML) Procedures Manual, 27th Edition, Volume 1, U.S. Department of Energy, New York, NY, November 1990.

4. Sampling procedures

4.1. Objectives

Sampling procedures and practices that will be used in the investigation are presented elsewhere in the work plan. Information will be obtained as to the identity, location, and amount of contamination in the ground water, soil boring, and surface soil samples as defined in the work plan.

4.2. Sampling locations

Sampling locations for the investigation are presented in the work plan.

4.3. Field QA/QC samples

In order to evaluate data quality, QA/QC samples will be collected during the field investigation. Table 4-1 lists the environmental and corresponding QC samples to be collected by analyses and matrix type. It should be noted that the discussion of field QA/QC samples is directed largely to samples collected for chemical analyses.

4.3.1. Field duplicate samples

Collection of field duplicate samples provides for the evaluation of the laboratory's performance by comparing analytical results of two samples from the same location. Field duplicate samples are also collected to evaluate field sample collection procedures. Field duplicate samples are duplicate samples collected from one location and sent to the laboratory blind (with two different sample identification). One field duplicate sample will be collected for every 20 environmental samples (i.e., minimum frequency of 5%).

Table 4-1. *Field sampling summary table*

Parameter	Matrix	Sample containers and volumes	Preservation	Holding times (from verified time of sample receipt (VTSR))	Environmental samples*	QC Samples		
						Field duplicates (frequency)	Trip blanks	MS/MSDSs (frequency)
VOCs	Ground water	2-40 milliliter glass vials with Teflon® septum	4°C pH<2	10 days	TBD	5%	1 ea. per shipment	5%
SVOCs	Ground water	1-one liter amber glass container with Teflon® lined screw caps	4°C	5 days to extraction; 40 days from extraction to analysis	TBD	5%	0	5%
Metals (except Hg)	Ground water	1-250 or 500 milliliter plastic bottle	HNO_3 to pH<2, 4°C	180 days	TBD	5%	0	5%
Hg	Ground water	1-250 or 500 milliliter plastic bottle	HNO_3 to pH<2, 4°C	26 days	TBD	5%	0	5%
Radionuclides, Gross alpha and gross beta	Ground water	4 liter glass	Nitric acid to pH<2, 4°C	6 months	TBD	5%	0	5%
VOCs	Soil boring	125 milliliter wide mouth glass container sealed with a septum	4°C	10 days	TBD	5%	1 ea. per shipment	5%

Table 4-1. *Field sampling summary table*

Parameter	Matrix	Sample containers and volumes	Preservation	Holding times (from verified time of sample receipt (VTSR))	Environmental samples*	QC Samples		
						Field duplicates (frequency)	Trip blanks	MS/MSDSs (frequency)
SVOCs	Soil boring	250 milliliter wide mouth glass container with Teflon® lined lid	4°C	5 days to extraction; 40 days from extraction to analysis	TBD	5%	0	5%
Metals (except Hg)	Soil boring and surface soil	4 ounce wide mouth glass container with Teflon® lined lid	4°C	180 days	TBD	5%	0	5%
Hg	Soil boring and surface soil	4 ounce wide mouth glass container with Teflon® lined lid	4°C	26 days	TBD	5%	0	5%
Radio nuclides, Gamma Spectroscopy	Soil boring and surface soil	2-250 milliliter wide mouth containers with Teflon® lined lid	4°C	6 months	TBD	0%	0	0%

Table 4-1. *Field sampling summary table*

Parameter	Matrix	Sample containers and volumes	Preservation	Holding times (from verified time of sample receipt (VTSR))	Environmental samples*	QC Samples		
						Field duplicates (frequency)	Trip blanks	MS/MSDSs (frequency)

Note: MS/MSD indicates matrix spike/matrix spike duplicate sample
VOCs indicate volatile organic compounds
SVOCs indicate semivolatile compounds
Metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc
Radionuclides include thorium 228, 230, 232, uranium 234, 235, 238, gross alpha, and gross beta. MDs for radio nuclides will be performed according to the MD criterion presented in section 4.3.2.

* Note: The actual number of samples will be determined in the field in accordance with the work plan.

4.3.2. Matrix spikes and matrix spike duplicates, matrix duplicates

For chemical analyses, matrix spike/matrix spike duplicates (MS/MSD) samples are duplicate samples that have spiking solutions added. MS/MSD samples are considered identical to the original sample and require that the sampled material be homogenized in the field and laboratory prior to analyses. Due to the potential loss of volatile compounds during homogenization, samples collected for VOCs analyses will not be homogenized in the field. Since they will not be homogenized, field samples must make every effort to collect representative samples of the location sampled for VOCs. The percent recovery of the spiked amount indicates the accuracy of the extraction as well as interferences caused by the matrix. Relative percent differences (RPDs) between spike sample recoveries will indicate the precision of the data. One MS/MSD sample set will be collected for every 20 environmental samples submitted to the laboratory (i.e., minimum frequency of 5%).

For radiochemical analyses, matrix duplicate (MD) analyses will be performed according to the following criteria. A Relative Error Ratio (RER) less than 2.0 for 80% of the total radiochemical measurements and less than 3.5 for all measurements will be considered acceptable. An RER is a ;measure of precision which is dependent of the actual analyte concentration being measured. The RER may be calculated as:

$$RER = \frac{R_1 - R_2}{\sqrt{TPU^2_{1(1\sigma)} + TPU^2_{2(2\sigma)}}}$$

where: R_1 = analytical sample result
R_2 = analytical duplicate result
$TPU_{(1\sigma)}$ =1 sigma total propagated uncertainty for sample (1) or duplicate (2)

In addition, for alpha spectrometry measurements, each sample will be spiked with appropriate tracers to evaluate recovery.

4.3.3. Field/equipment blanks

Field/equipment blanks will consist of samples of analyte-free water that are passed through and or over decontaminated sampling equipment. One field/equipment blank will be collected per set of sampling equipment per sampling event. Field/equipment blanks will not be required if dedicated sampling equipment are utilized. The field/equipment samples will be subject to the same analyses as the environmental samples.

4.3.4. Trip blanks

Trip blanks will consist of samples of distilled and/or deionized water that have undergone shipment from the sampling site to the laboratory in coolers with the environmental samples to be analyzed for VOCs. Trip blanks will be analyzed for VOCs to determine if contamination has taken place during sample handling and/or shipment. Trip blanks will be utilized for aqueous samples at a frequency of one each per shipment sent to the laboratory for volatile organic analysis.

4.4. Sampling procedures

Protocols for the various sampling activities are described in detail elsewhere in the Work Plan.

4.5. Sample preparation and preservation

Immediately after collection, samples will be transferred to properly labeled sample containers and properly preserved. Table 4-1 lists the proper sample containers, volume requirements, and preservations. Samples requiring refrigeration for preservation will be promptly transferred to coolers packed with wet ice and/or ice packs. Samples will be shipped or transported within 24 hours of being collected and will arrive at the laboratory no later than 48 hours after sample collection. Proper chain-of-custody documentation will be maintained as discussed in Section 5 of this QAPP. Samples will be extracted, digested and/or analyzed within the holding times specified in Table 4-1.

4.6. Decontamination of sampling equipment

A decontamination station will be established prior to field sampling efforts in accordance with the HASP. Equipment decontamination procedures will take place at the decontamination station. The decontamination station will be staffed by person(s) knowledgeable in decontamination of sampling equipment. Decontamination procedures are discussed elsewhere in this Work Plan.

5. Sample custody

Chain-of-custody procedures will be instituted and followed throughout the investigation. These procedures include field custody, laboratory custody, and evidence files. Samples are physical evidence and will be handled according to strict chain-of-custody protocols. The QA Officer must be prepared to produce documentation that traces the samples from the field to the laboratory and through analyses. The USEPA has defined custody of evidence as follows:

- In actual possession;
- In view after being in physical possession;
- In a locked laboratory; or,
- In a secure, restricted area.

QA measures for this project will begin with the sample containers. Pre-cleaned sample containers will be purchased from a USEPA-certified manufacturer (I-Chem 200 or equivalent).

Chain-of-custody records will be kept starting in the field when sample collection is completed. In the field log book, samplers will note climatic data and equipment employed during collection. Physical characteristics of the sample, date, time of day, sample location, and any abnormalities noted during sampling will be recorded in the field log book.

The field sampler will indicate the sample identification number, date time, sample matrix, sample type (*i.e.*, grab or composite), number of containers and the analysis requested on the appropriate chain-of-custody form. The chain-of-custody form will be signed and placed in a sealed ziploc bag in the cooler. An example chain-of-custody form is included as Figure 5-1. The shipping container will be closed, and two paper or plastic seals will be affixed to the latch and lid (only if the samples are shipped via overnight courier) and the field sampler will initial the seal. The seals must be broken to open the cooler and will indicate tampering if the seal is broken before receipt at the laboratory. The cooler will be shipped via an overnight delivery service or hand delivered to the laboratory at the conclusion of each day of sampling activities. When the samples arrive at the laboratory, the sample custodian will sign the vendor's air bill or bill of lading (unless hand-delivered). If shipped, the shipping label will be attached to the chain of custody.

Figure 5-1. *Example chain-of-custody*

Project Name________________________
Job No ________________________
Sheet ____ of ____

Office: ______________________
Address: ______________________
Phone: ______________________

CHAIN OF CUSTODY

CLIENT: LOCATION:	COLLECTED BY: (Signature)

SAMPLE DESCRIPTION/LOCATION	Date	Time	Sample Matrix[1]	Sample Type[2]	No. of Containers	ANALYSIS REQUESTED/COMMENTS[3]

[1] Matrix = water, wastewater, air, sludge, sediment, etc. [3] VOC - SW8260A; SVOC- SW8270B; ; TAL - SW6010A[2] Type = grab, composite

Relinquished by:__________ of.__________	Date	Time	Received by:__________ of:__________	Date	Time
Relinquished by:__________ of:__________	Date	Time	Received by:__________ of.__________	Date	Time
Relinquished by:__________ of.__________	Date	Time	Received by:__________ of:__________	Date	Time
Use this space if shipped via courier (e.g., Fed Ex) Relinquished by:__________ of:__________	Date	Time	Courier Name:__________ __________ ***Attach delivery/courier receipt to Chain of Custody**	Date	Time
Relinquished by:__________ of__________	Date	Time	Received by:__________ of:__________	Date	Time

The sample custodian's duties and responsibilities upon sample receipt will be to:

- Document receipt of samples;
- Inspect sample shipping containers for the presence or absence of custody seals (only if shipped via overnight courier) and for container integrity;
- Sign the appropriate forms or documents, verify and record the agreement or disagreement of information on sample documents and, if there are discrepancies, record the problem and notify the QA Officer;
- Label sample with laboratory sample number; and
- Place samples in secure, limited-access storage.

At the laboratory, the analysts will be required to log samples and extracts in and out of storage as the analysis proceeds. Samples and extracts will be returned to secure storage at the close of business. Written records will be kept of each time the sample or extract changes hands. Care must be exercised to properly complete, date, and sign items needed to generate data. Copies of the following will be stored for incorporation into the sample file:

- Documentation of the preparation and analysis of samples, including copies of the analyst's notebooks;
- Bench sheets, graphs, computer printouts, chromatograms, and mass spectra, as applicable;
- Copies of QA/QC data;
- Instrument logs showing the date, time, and identity of the analyst; and
- Analytical tracking forms that record the date, time, and identity of the analyst for each step of the sample preparation, extraction, and analysis.

Upon completion of the analyses, the QA Officer or his designee will begin assimilating the field and laboratory notes. In this way, the file for the samples will be generated. The final file for the sample will consist of the following:

- Laboratory data packages, including summary and raw data from the analysis of environmental and QC samples, chromatograms, mass spectra, calibration data, work sheets, sample preparation logs; and

- Chain-of-custody records.

6. Calibration and frequency

6.1. Laboratory equipment calibration

Proper calibration of laboratory analytical instrumentation is essential for the generation of reliable data which meets the project's DQOs. Analytical instrument calibration is monitored through the use of control limits which are established for individual analytical methods. Calibration procedures to be followed are specified, in detail, as listed in the analytical methods and in NYSDEC ASP 10/95 revisions, Exhibit E. These procedures specify the type of calibration, calibration materials to be used, range of calibration, and frequency of calibration.

The laboratory will be responsible for proper calibration and maintenance of laboratory analytical equipment. Calibration procedures are presented in the analytical methods and the laboratory QA Manual. The following subsections detail some of the calibration procedures outlined in the analytical methods and the laboratory QA Manual.

6.1.1. Gas chromatography/mass spectrometry (GC/MS)

Before the GC/MS is calibrated, the mass calibration and resolutions of the instruments are verified by a 50 ng injection of 4-bromofluorobenzene (BFB) for VOCs. The tune must meet the ion abundance criteria specified in the analytical method. The system must be verified every 12 hours of analysis and when the instrument performance check solution fails to meet criteria. After re-tuning, the performance check solution is reanalyzed. Samples are not analyzed until tuning criteria are met.

An initial five-point calibration is performed for the target compounds prior to start-up and whenever system specifications change or if the continuing calibration acceptance criteria have not been met. One of the calibration standards must be at a concentration between 1-5 times reporting limit (RL). A calibration curve is generated for unheated purge for water sample analysis. The relative response factors (RRFs) and % RSD of specific compounds must meet established criteria as specified in the method. If these parameters fail to meet criteria, corrective actions must be implemented and the initial calibration must be repeated.

A midpoint continuing calibration standard containing the target compounds is analyzed at the beginning of every 12-hour period following the GC/MS tune. This standard must meet specific QC limits listed in the method to verify that the initial five-point calibration is still valid.

6.1.2. Metals

Instrument calibration for metal analyses is performed daily. A two point calibration for inductively coupled plasma (ICP) analyses and a five point curve for graphite furnace is performed. The calibration curves must have correlation coefficients greater than or equal to 0.995. Calibration verification is monitored by analyzing a calibration verification standard and a calibration blank following calibration, every ten samples, and at the end of the analytical sequence. The calibration verification standard recovery must be withing 90% to 110% for all metals, of the instrument must be resloped and, if necessary, recalibrated. The calibration blank must not contain target compounds at concentrations greater than the RL or corrective actions are implemented. To verify interelement and background corrective factors for ICP analysis, interference check samples (ICSA and ICSAB) must be analyzed at the beginning and end of the analysis sequence or a minimum of twice per eight hours. The percent recoveries for ICS solutions must be withing 80% to 120% or corrective actions must be implemented. In addition, for ICP analyses, a serial dilution analysis must be performed per sample matrix. If the analyte concentration is greater than fifty times the method detection limit (MDL) in the original sample, a serial dilution (five fold dilution) must agree within ten percent of the original determination. Detection limits, interelement corrective factors, and linear ranges must be established at the frequency specified in the method.

6.1.3. Radionuclides

For gross alpha and gross beta analyses, on an annual basis, National Institute of Science and Technology (NIST)-traceable sources, which are weightless, are used for determining alpha and beta efficiency of each proportional detector. Absorption standards are prepared using solutions of the same alpha and beta emitters as was used for efficiency determination, along with absorbent salts, at the same frequency. The criterion is <5mg/cm^2 for gross alpha and <10mg/cm^2 for gross beta. The mass of each standard is plotted on a line against the change in efficiency from the weightless standard. The equation of the line (absorption curve) is used to correct the efficiency of the proportional detector to the mass of each sample counted. On a daily basis, alpha and beta sources are counted prior to counting samples. The reproducibility of these check sources verifies that the initially determined efficiencies are valid. When the counting gas tanks are charged, a plateau is determined and an optimum detector voltage is set. The plateaus are determined by counting an alpha or beta source individually at increasing voltages until a level response area is found where the change in response is less than 5% over a 50 volt change. The operating voltage is set within that range. System backgrounds are determined weekly and subtracted from sample results. The efficiency calibration sources used are thorium-230 for alphas and strontium/yttrium-90 for betas.

For isotopic analyses, on an annual basis, NIST-traceable sources, are used for determining detector efficiencies of solid-state detectors. These efficiencies are checked weekly using non-NIST standards. The check source data are only used to verify reproducibility of the detectors. On a quarterly basis, system amplifiers are calibrated to align source energies into calibrated sources. The reproducibility of the energy calibrations are checked weekly. Peak resolution checks are performed on a daily basis using electronic pulsers. The resolutions are determined to not exceed 100 keV FWHM. System backgrounds are determined weekly and subtracted from sample results. Calibration sources will contain a mixture of alpha emitters giving well separated peaks which cover the region from 2 to 4 mev.

For field isotopic analyses equipment will be initially calibrated by the manufacturer. During the investigation, the working condition of the equipment will be evaluated using check sources at the beginning and ending of each days work using standardized check sources.

6.2. Standards and solutions

The use of standard materials of a known purity and quality is necessary for the generation of reproducible data. The laboratory will monitor the use of laboratory materials including solutions, standards, and reagents. Standards and standard solutions are obtained from the USEPA or USEPA-certified commercial vendors. Standard reference materials and performance evaluation materials are obtained from the NIST or USEPA-certified commercial vendors.

Standards and standard solutions are verified prior to use. This verification may be in the form of a certification from the supplier. Standards may also be verified by comparison to a standard curve or another standard from a separate source. Standards are routinely checked for signs of deterioration, including unusual volume changes, discoloration, formation of precipitates, or changes in analyte response.

Solvent materials are also verified prior to use. Each new lot of solvent is analyzed to verify the absence of interfering constituents. Reagent and method blanks are routinely analyzed to evaluate possible laboratory-based contamination of samples.

6.3. Records

A records book will be kept for standards and will include the following information:

- Material name;
- Control or lot number;
- Purity and/or concentration;
- Supplier/manufacturer;
- Receipt/preparation date;
- Recipient's/preparer's name; and,
- Expiration date.

These records will be checked periodically as part of the laboratory internal laboratory controls review.

6.4. Equipment

Each major piece of analytical laboratory instrumentation that will be used on this project has been documented and is on file with the laboratory. An equipment form will be prepared for each new purchase and old forms will be removed from the instrument area and filed when an instrument is replaced.

The laboratory will be required to maintain an equipment form detailing both preventative maintenance activities and the required QA testing and monitoring. In the event the instrument does not perform within the limits specified on the monitoring form, the Laboratory Manager will be notified and a decision will be made as to what corrective action is necessary. The corrective action procedure shall be documented in the instrument log. If repair is necessary, an "out-of-order" sign will be placed on the instrument until repairs are completed. Repairs made to the instrument will be documented in the instrument log book. Required QA/QC testing and monitoring will be completed prior to the resumption of sample analysis.

6.5. Calibration records

A bound notebook will be kept with each instrument that requires calibration. The notebook will contain a record of activities associated with QA monitoring and instrument repairs. These records will be checked during periodic equipment review and internal and external QA/QC audits.

7. Analytical procedures

7.1. Laboratory analytical procedures

The accuracy and precision of the analytical data generated by the laboratory will be determined through the analysis of duplicate samples, spiked samples, reference standard samples, laboratory control samples, and field and laboratory blank samples analyzed along with each set of environmental samples.

Interferences will be identified and documented. When matrix interferences are noted during sample analysis, actions will be taken by the laboratory to achieve the specified detection limits. Samples may be diluted only if analytes of concern generate responses in excess of the linear range of the instrument. The selection of analytical cleanup methodologies will follow method requirements. In such cases, the Laboratory QA Coordinator will document that the laboratory demonstrates good analytical practices and that such practices are documented in order to achieve the specified detection limits.

The accuracy of the method will be determined by spiking the sample matrix with analytes and surrogates. Standards and reference materials will also be analyzed to determine analyte concentrations for comparison with expected concentrations to provide a measure of accuracy of the methods. Percent recoveries of the spikes will be calculated and compared with control limits. A measure of precision will be obtained through the RPD between matrix spikes and matrix spike duplicates and laboratory duplicates. Sampling precision will be evaluated based on the RPD of duplicate field samples. RPDs will be compared to established control limits.

The generated data will be input into the laboratory's database management system. Records described in Sections 5 and 6 will be incorporated into the final file for the samples. Complete descriptions of analytical procedures to be used in the laboratory are described in the methodologies and in the laboratory's QA Manual.

7.2. Method detection limits

The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. For inorganics, the instrument detection limit (IDL) is determined by multiplying the Students t-Test value the standard deviation obtained for the analysis of a standard solution at a concentration of 3 to 5 times the estimated IDL on three days with a minimum of seven measurements. The PQL is the lowest concentration that can be reliably quantified within specified limits of precision and accuracy during routine laboratory operations. Tables 7-1, 7-2, 7-3, and 7-4, and 7-5 list typical laboratory PQLs or reporting limits.

For radionuclides the MDC is typically reported at the 95% confidence level.

Table 7-1. *Laboratory PQLs and guidance limits for volatile organics (SW8260).*

Parameter	Water PQL (ug/L)	Soil PQL (ug/kg), wet wt
Chloromethane	1	5
Vinyl chloride	1	5
Bromomethane	1	5
Chloroethane	1	5
Acetone	10	10
1,1-Dichloroethene	0.5	2.5
Methylene chloride	2	5
Carbon disulfide	0.5	2.5
trans-1,2-Dichloroethene	0.5	2.5
1,1-Dichloroethane	0.5	2.5
2-Butanone	10	10
cis-1,2-Dichloroethene	0.5	2.5
Chloroform	0.5	2.5
1,1,1-Trichloroethane	0.5	2.5
Carbon tetrachloride	0.5	2.5
1,2-Dichloroethane	0.5	2.5
Benzene	0.5	2.5
Trichloroethene	0.5	2.5
1,2-Dichloropropane	0.5	2.5
Bromodichloromethane	0.5	2.5
4-Methyl-2-Pentanone	5	5
cis-1,3-Dichloropropene	0.5	2.5
Toluene	0.5	2.5
trans-1,3-Dichloropropene	0.5	2.5
1,1,2-Trichloroethane	0.5	2.5
Dibromochloromethane	0.5	2.5
2-Hexanone	5	5
Tetrachloroethene	0.5	2.5

Table 7-1. *Laboratory PQLs and guidance limits for volatile organics (SW8260).*

Parameter	Water PQL (ug/L)	Soil PQL (ug/kg), wet wt
Chlorobenzene	0.5	2.5
Ethylbenzene	0.5	2.5
Xylene (total)	0.5	2.5
Styrene	0.5	2.5
Bromoform	0.5	2.5
1,1,2,2-Tetrachloroethane	0.5	2.5

Notes: PQL indicates practical quantitation limit
NA indicates not applicable
1- NYSDEC. April 1995. *Division of Hazardous Waste Remediation Divisional Technical and Administrative Guidance Memorandum (TAGM).*

Table 7-2. ***Laboratory PQLs and guidance limits for semivolatile organics (SW8270).***

Parameter	Water PQL (ug/L)	Soil PQL (ug/kg), wet wt
Phenol	10	330
Bis(2-chloroethyl)ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
Bis(2-chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitroso-di-n-propylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethyl phenol	10	330
Carbazole	10	330
Bis(2-chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1600
2-Chloronaphthalene	10	330

Table 7-2. *Laboratory PQLs and guidance limits for semivolatile organics (SW8270).*

Parameter	Water PQL (ug/L)	Soil PQL (ug/kg), wet wt
2-Nitroaniline	50	1600
Dimethyl phthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	50	1600
Acenaphthene	10	330
2,4-Dinitrophenol	50	1600
4-Nitrophenol	50	1600
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphthalate	10	330
4-Chlorophenyl-phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	50	1600
4,6-Dinitro-2-methylphenol	50	1600
N-Nitrosodiphenylamine	10	330
4-Bromophenyl-phenyl ether	10	330
Hexachlorobenzene	10	330
Pentachlorophenol	50	1600
Phenanthrene	10	330
Anthracene	10	330
Di-n-butyl phthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butylbenzylphthalate	10	330

Table 7-2. ***Laboratory PQLs and guidance limits for semivolatile organics (SW8270).***

Parameter	Water PQL (ug/L)	Soil PQL (ug/kg), wet wt
3,3-Dichlorobenzidine	20	660
Benzo(a)anthracene	10	330
Chrysene	10	330
Bis(2-ethylhexyl)phthalate	10	330
Di-n-octylphthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenzo(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330

Notes: PQL indicates practical quantitation limit
MDL indicates method detection limit
NA indicates not applicable
1- NYSDEC. April 1995. *Division of Hazardous Waste Remediation Divisional Technical and Administrative Guidance Memorandum (TAGM 4046).*

Table 7-3. *Laboratory PQLs and guidance limits for TCL metals (SW6010).*

Parameter	Water PQL (ug/L)	Soil PQL (mg/kg), wet wt.
Aluminum	100	50
Antimony	60	6
Arsenic	5	0.5
Barium	100	10
Beryllium	5	1
Cadmium	5	1
Calcium	1000	100
Chromium	10	1
Cobalt	50	5
Copper	10	2.5
Iron	50	5
Lead	5	0.5
Magnesium	1000	100
Manganese	50	5
Mercury	0.2	0.1
Nickel	50	5
Potassium	5000	500
Selenium	5	0.5
Silver	10	1
Sodium	1000	100
Thallium	5	0.5
Vanadium	50	5
Zinc	10	1

Notes: PQL indicates practical quantitation limit
SB indicates site background
* indicates background levels for lead vary widely
HEAST indicates the value is contained in the USEPA's Health Effects Assessment Summary Tables
1- NYSDEC. April 1995. *Division of Hazardous Waste Remediation Divisional Technical and Administrative Guidance Memorandum (TAGM 4046)*

Table 7-4. *Laboratory reporting and guidance limits for radionuclides (modified USEPA method 907.0, SW9310).*

Compound	**RL water (picocuries/L)**	**RL soil (picocuries/g)**
Thorium 228, 230, 232	1.0	0.4
Uranium 234, 235, 238	1.0	0.4
Gross alpha/gross beta	2.0	5.0/15
Gamma spectroscopy	10 for cesium-137	0.1

Note: RL indicates reporting limit
1- NYSDEC. April 1995. *Division of Hazardous Waste Remediation Divisional Technical and Administrative Guidance Memorandum (TAGM).*

8. Data reduction, validation, and reporting

For data to be scientifically valid, legally defensible, and comparable, valid procedures must be used to prepare this data. Laboratory analytical Level III (USEPA, 1987) documentation will be required for each sample analysis. The following describes the data reduction, validation and reporting procedures to be used for the Analytical Level III laboratory data.

8.1. Data production, handling, and reporting

Specific laboratory procedures and instrumentation can be found in the QA Manual and/or standard operating procedures (SOPs) from the laboratory. The data production and reporting procedures described below will be employed at the laboratory.

8.1.1. Data reduction

Data reduction consists of manual and computer data reduction procedures and calculations. Computer data reduction procedures and calculations will be checked manually by the laboratory to verify that compound identification and quantitation adhere to method requirements. The laboratory will be responsible for maintaining a listing of computer-based data reduction programs and SOPs for data reduction. Sample preparation or extraction logs will be used to document sample preparation information (for example, preparation weights, volumes, reagents). Instrument injection logs or bench sheets will also be maintained for each instrument.

Qualitative identification and quantitation of organic analytes will be performed by experienced analysts in accordance with analytical method requirements.

8.1.2. Laboratory data review

Analytical results are generally entered into the laboratory computer system by the analyst, independently reviewed by another analyst or supervisor experienced in the method, and approved by the Laboratory Manager. The following are requirements that are generally examined as part of this review:

- Initial calibration criteria were met. Standards in the calibration curve covered the expected concentration ranges of the samples including the PQL or RL.
- Initial and continuing calibrations met the acceptance criteria defined in the method standard procedure.
- Sample results fell within the range of the standard curve.
- For GC/MS methods requiring internal standards, retention times and area responses were evaluated against limits established by the daily calibration.
- Method blanks were processed with each analytical batch and no detectable levels of contamination were identified.
- MS/MSDS were performed at the required frequency and recoveries were within acceptable control limits.
- Duplicate analyses were performed at the required frequency and results were within the control limits.
- LCS analyses were performed with each analytical batch and the results obtained were within control limits.
- For organic compound analyses, surrogate spike recoveries were within control limits.
- Compounds identified by GC/MS have been manually rechecked by comparison with the data system library for both target compounds and tentatively identified compounds. Retention times and ratios of fragmentation were verified.
- Calculations have been accurately performed.
- Reporting units are correct.

- Data for the analysis provide a complete audit trail.
- Reported detection limits comply with data quality indicator requirements.

The analyst's supervisor will check a minimum of 10% of the data back to raw data in the secondary review. When required analyses on the samples in a project are complete, entered, and reviewed, a report will be generated. The report will be forwarded to the assigned Laboratory Project Supervisor or designee for review. The report will then be reviewed for the following items (at a minimum):

- QC data will be reviewed to identify whether or not internal specification and contract requirements have been met.
- Non-conformance reports, if any, will be reviewed for completion of corrective actions and their impact of results. Non-compliance and corrective action procedures will be documented in the case narrative in the final report.

The report requires the signature of the Laboratory Project Supervisor or designee. Electronic data are copied onto computer tape, inventoried, and stored off-site in a secure facility, or within locked cabinets on site. This data archive system is maintained minimally for ten years.

Following final review, two copies of the report will be shipped to O'Brien & Gere.

Analytical data packages which are fully validatable, and document sample preparation, extraction, and analysis, will be provided for the analyses. Data report forms will be securely bound and the pages will be sequentially numbered. The analytical reports for sample matrices will conform to the data deliverable requirements as listed in the NYSDEC ASP 10/95 revision, Category B. In addition to the hardcopy version of the analytical data packages, the laboratory will provide electronic deliverables.

8.2. Data validation

Data validation will be performed in accordance with QA/QC criteria established in this QAPP, as listed in Tables 9-1, 9-2, 9-3, and 9-4, and the analytical methods. Excursions from QA/QC criteria will be qualified based on guidance provided in *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review EPA 540/R-94/012* (USEPA 1994a) and for *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review EPA* 540/R-94/013 (USEPA 1994b) or most recent USEPA data validation guidelines.

For approximately 10% of the analytical data from each method and matrix, data validators will be responsible for reviewing the following QC parameters: Chain of Custody Records, holding times and sample preservation, percent solids, calibration, blank analyses, detection limits, surrogates, MS/MSD analyses, LCS analyses, field duplicate analyses, ICP interference check samples, furnace atomic absorption criteria, internal standards, corrective actions, compound identification and quantitation, instrument performance, and data package completeness. Data validators will recalculate laboratory sample calculations using raw data when verifying sample results. In addition, data validators will review raw data to verify that compound identification was performed correctly and transcription errors are not present.

Data quality will be evaluated using method control limits. When method control limits are not available, laboratory control limits will be used to evaluate data. Any control limits outside of the acceptable range specified shall be identified. Sample data will be qualified based on excursions from control limits. Data not within control limits require corrective action by the laboratory. Data validators will check corrective action reports and results of reanalysis if available.

Minor deficiencies in the data generation process noted in the data validation will result in approximation of sample data. Approximation of a data point indicates uncertainty in the reported concentration of the chemical but not its assigned identity. Major deficiencies noted in the data validation will result in the rejection of sample results. Rejected data would be considered unusable for quantitative or qualitative purposes. Data qualifiers may include the following:

U Indicates that the compound was analyzed for, but was not detected. The sample quantitation limit is presented and adjusted for dilution and percent moisture. This qualifier is also used to signify that the detection limit of an analyte was raised as a result of analytes detected in laboratory and/or field blank samples.

J Indicates that the detected sample result should be considered approximate based on excursions from QA/QC criteria. Additionally, for organic analyses this qualifier is used either when estimating a concentration for tentatively identified compounds or when the mass spectra data indicate the presence of a compound that meets identification criteria but, the sample result is less than the compound quantitation limit.

UJ Indicates that the detection limit for the analyte in this sample should be considered approximate based on excursions from QA/QC criteria.

R Indicates that the previously reported detection limit or sample result has been rejected due to a major excursion from QA/QC criteria, for example percent recoveries of less than ten percent. The data should not be used for qualitative or quantitative purposes.

If compounds are detected in blanks at concentrations greater than PQL, data will be qualified based on blank action levels calculated at five times (ten times for common laboratory contaminants) the highest concentration detected in the associated blanks. Samples collected, prepared, or analyzed in conjunction with contaminated blanks, which contain analytes less than calculated action levels will be qualified as blank contaminants and flagged with the "U" qualifier. For solid samples, the action level will be calculated taking into account preparation weights and volumes and percent solid determinations. Qualification of sample results will be based on date of analysis for calibration blanks, date of sample preparation for method blanks, and date of sample collection for trip and equipment blank samples.

The following method specific QA/QC parameters will be evaluated during the data validation, if applicable.

8.2.1. GC/MS analyses for VOCs and SVOCs

- Holding Times and Sample Preservation
- Percent Solids
- GC/MS Tuning Criteria
- Initial and Continuing Calibration
- Blank Analysis
- Surrogate Recovery

- MS/MSD Analysis
- Field Duplicate Analysis
- LCS Analysis
- Internal Standards Performance
- Compound Identification and Quantitation
- Reported detection limits
- System Performance
- Documentation Completeness
- Overall Assessment

8.2.2. Metal analyses

- Holding Times and Sample Preservation
- Percent Solids
- Initial and Continuing Calibration
- Blank Analysis
- MS/MSD Analysis
- Field Duplicate Analysis
- LCS Analysis
- Furnace Duplicate Injection and Post Spike Recovery Criteria (if required)
- ICP Interference Check Sample Analysis
- ICP Serial Dilution Analysis
- Analyte Quantitation
- Reported detection limits
- Instrument Performance
- Documentation Completeness
- Overall Assessment

8.2.3. Radionuclides analyses

- Holding Times and Sample Preservation
- Percent Solids
- Calibration
- Blank Analysis
- MS/MSD Analysis
- Field Duplicate Analysis
- LCS Analysis
- Compound Quantitation
- Reported detection limits

- System Performance
- Documentation Completeness
- Overall Assessment

The laboratory will be conducting analyses on samples in accordance with USEPA protocols and the laboratory's QA Manual.

9. Internal quality control checks

9.1. Laboratory QA/QC checks

The overall effectiveness of a quality control program depends upon operating in the field and laboratory according to a program that systematically ensures the precision and accuracy of analyses by detecting errors and preventing their recurrence or measuring the degree of error inherent in the methods applied.

Tables 9-1 through 9-4 summarize the laboratory quality control checks, frequency of analysis, control limits, and laboratory corrective actions by analytical method. Requirements as listed in NYSDEC ASP revision 10/95 Exhibit E will be adhered to. A brief description of laboratory QA/QC analyses are contained in the following subsections.

9.1.1. GC/MS tuning

Tuning and performance criteria are established to verify mass resolution, identification, and to some degree, instrument sensitivity. These criteria are not sample specific; conformance is determined using standard materials. Therefore, these criteria should be met in all circumstances.

9.1.2. Calibration

Compliance requirements for satisfactory instrument calibration are established to verify that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of analysis, and continuing calibration and performance checks document satisfactory maintenance and adjustment of the instrument on a day-to-day basis.

9.1.3. Blanks

Several types of blanks will be analyzed by the laboratory. Corrective action procedures will be implemented for blank analyses if target compounds are detected at concentrations greater than the PQL (or five times the PQL for acetone, 2-butanone, methylene chloride, toluene, and phthalate compounds). The criteria for evaluation of blanks apply to any blank associated with a group of samples. If problems with a blank exist, data associated with the project must be carefully evaluated to determine whether or not there is an inherent variability in the data for the project, or if the problem is an isolated occurrence not affecting other data.

A reagent blank consists of laboratory distilled water and any reagents added to a sample during analysis only, or straight solvent. This type of sample is analyzed to evaluate whether contamination is occurring during the analysis of the sample. A reagent blank is usually analyzed following highly contaminated samples to assess the potential for cross-contamination during analysis.

A method blank is a water or soil blank which undergoes the preparation procedures applied to a sample (*i.e.*, extraction, digestion, clean-up). These samples are analyzed to examine whether sample preparation, clean-up, and analysis techniques result in sample contamination. The laboratory will prepare and analyze a method blank with each group of twenty samples of similar matrix that are extracted, digested, or analyzed at the same time (within same 12 hour period for GC/MS analysis).

Equipment and trip blanks will also be collected and submitted for laboratory analysis, where appropriate. Equipment and trip blanks will be handled in the same manner as environmental samples. Equipment and trip blanks are analyzed to assess contamination introduced during field sampling procedures and sample shipment, respectively.

9.1.4. Internal standards performance

Internal standards, which are compounds not found in environmental samples, will be spiked into blanks, samples, MS/MSDs, and LCSs at the time of analysis for VOC and SVOC analyses. Internal standards are used to quantitate results and correct for injection variability for VOC and SVOC analyses. Internal standards must meet retention time and performance criteria specified in the analytical method or the sample will be reanalyzed.

9.1.5. Surrogate recovery

Accuracy and matrix biases for individual samples are monitored for organic analyses using surrogate additions. Surrogates are compounds similar in nature to the target analytes which are spiked into environmental samples, blanks, and quality control samples prior to sample preparation for organic analyses. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is frequently subjective.

9.1.6. LCS analyses

LCSs are standard solutions that consist of known concentrations of the target analytes spiked into laboratory distilled water or a clean sand. They are prepared or purchased from a certified manufacturer from a source independent from the calibration standards to provide an independent verification of the calibration procedure. They are spiked with target analytes listed in Tables 7-1, 7-2, 7-3, and 7-4. These QC samples are then prepared and analyzed following the same procedures employed for environmental sample analysis to assess method accuracy independently of sample matrix effects. The laboratory will prepare and analyze a LCS with each group of twenty samples of similar matrix that are extracted, digested, or analyzed at the same time (within same 12 hour period for GC/MS analysis). Percent recoveries will be evaluated to assess the efficiency of preparation and analysis method independent of environmental sample matrix effects.

9.1.7. MS/MSD or laboratory duplicate samples

MS/MSD or laboratory duplicate analyses will be performed on environmental samples at a frequency of one per sample matrix and every twenty samples of similar matrix. Whenever possible MS/MSD/laboratory duplicate samples will be prepared and analyzed within the same batch as the environmental samples. MS/MSD samples will be spiked at the laboratory with target analytes. MS/MSD/laboratory duplicate data are generated to determine long-term precision and accuracy of the analytical method with respect to sample matrices.

9.1.8. Compound identification and quantitation

The objective of the qualitative criteria is to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present). The identification criteria can be applied much more easily in detecting false positives than false negatives. Negatives, or non-detected compounds, on the other hand represent an absence of data and are, therefore, much more difficult to assess. The objective for quantitative requirements is to maximize the accuracy of data and sensitivity of the instrument. Samples should be analyzed undiluted to maximize sensitivity. Samples must be reanalyzed at the appropriate dilution when concentrations exceed the linear calibration range to maximize accuracy.

9.2. Control limits

In the event that method control limits are not provided, laboratory control limits will be established separately for each matrix type for spike and duplicate analyses. Laboratory control limits can be considered action limits. These limits are defined as ±three standard deviations of the mean and correspond to 99.7% confidence limits of a normal distribution curve. The laboratory will establish control limits for each analyte of concern using a minimum of twenty data points. Laboratory control limits may change since limits are minimally updated on a yearly basis with the addition of new data points.

The laboratory control limits used to assess data for this program will be summarized by the laboratory in the analytical report.

9.3. Field sampling QA/QC

Field sampling crews will always be under direct supervision of a field sampling leader. Bound log books and appropriate data sheets will be used to document the collection of samples and data so that an individual sample or data set can be traced back to its point of origin, sampler, and type of sampling equipment. Sampling will be performed according to the methods provided in the Work Plan and in this QAPP. Blind field duplicate samples will be collected by the sampling team. These samples will be sent to the laboratory for analysis in conjunction with the environmental samples. Field sampling precision will be evaluated through the RPD of the duplicate sample analyses results. Control limits for field duplicate precision have been established at ±50% for water samples and ±100% for soil samples. Decontamination of sampling equipment will be verified through the analysis of equipment blanks. Proper chain-of-custody protocols, as presented in Section 5 of this QAPP, will be followed.

Table 9-1
Volatiles (GC/MS) Quality Control Requirements and Corrective Actions
SW-846 8260A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Holding times	Samples must be extracted and analyzed within holding time.	VOCs: Analyze within 10 days from VTSR.	If holding times are exceeded for initial or any reanalyses required due to QC excursions, notify QAO immediately since resampling may be required.
MS Tuning	Once every 12 hours.	BFB key ions and abundance criteria listed in the method must be met for all 9 ions.	1. Tune the mass spectrometer. 2. Document corrective action - samples cannot be analyzed until control limit criteria have been met.
Initial Calibration	Prior to sample analysis and when continuing calibration criteria are not met.	1. Five concentrations bracketing expected concentration range for all compounds of interest. 2. Criteria as listed in NYSDEC ASP 10/95 Exhibit E.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Continuing Calibration	Every 12 hours, following BFB.	Within criteria as listed in NYSDEC ASP 10/95 Exhibit E.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Preparation Blank Analysis	Every 12 hours, following continuing calibration	Common laboratory contaminants less than 3 X PQL; anything else less than PQL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument, recalibrate analytical system, and reanalyze all samples if detected for same compounds as in blank. 3. Document corrective action - samples cannot be analyzed until blank criteria have been met.

Table 9-1
Volatiles (GC/MS) Quality Control Requirements and Corrective Actions
SW-846 8260A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Field / Equipment Blank Analysis	Every 20 samples.	Common laboratory contaminants less than 3 X PQL; anything else less than PQL.	1. Investigate problem, contact QAO. 2. Write an explanation.
Trip Blank	1 per cooler containing VOC samples.	Common laboratory contaminants less than 3 X PQL; anything else less than PQL.	1. Investigate problem, contact QAO. 2. Write an explanation.
Laboratory Control Sample Analysis	Each analytical batch (every 12 hours). Prepared independently from calibration standards.	Recovery within matrix spike blank limits (NYSDEC ASP Exhibit E) if available, otherwise within laboratory control limits. Spike must contain all target analytes.	1. If recovery failures are above control limits and these compounds are not detected in the associated samples, contact QAO. 2. Reanalyze LCS and examine results of other QC analyses. 3. If recovery is still outside limits, and other QC criteria are met, contact QAO. 4. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 5. Document corrective action.
Internal Standards	All samples and blanks (including MS/MSD)	1. Response -50% - +100% of internal standards from continuing calibration of the day. 2. RT must be ± 30 sec. from associated standard.	1. Reanalyze. 2. If still outside of the limits, qualify data. 3. Document corrective action.
Surrogate Spike	All samples and blanks (including MS/MSD)	Recovery within NYSDEC ASP 10/95 Exhibit E control limits.	1. Reanalyze any environmental or QC sample with surrogates that exceed control limits. 2. Qualify the data. 3. Document corrective action.

Table 9-1
Volatiles (GC/MS) Quality Control Requirements and Corrective Actions
SW-846 8260A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Matrix Spike/ Matrix Spike Dup. (MS/MSD) Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	Recovery and RPD within NYSDEC ASP 10/95 Exhibit E limits, if available, otherwise within laboratory limits. Spike must contain all analytes.	1. Reanalyze if <10%. 2. If >10% and LCS criteria are met, document in case narrative; no additional corrective action required. 3. If LCS criteria are exceeded also, examine other QC data for source of problem; *i.e.*, surrogate recoveries for extraction efficiency and calibration data for instrument performance issues. 4. Take corrective action as required, re-extract or reanalyze samples and associated MS/MSD and LCSs as required.
Field Dup. Analysis	1 per matrix and analytical batch and every 20 samples of similar matrix	50% RPD for waters and 100% RPD for soil.	If these criteria are not met, sample results will be evaluated on a case by case basis.

Table 9-2
Semivolatile (GC/MS) Quality Control Requirements and Corrective Actions
SW-846 8270B with NYSDEC ASP Exhibit E requirements

Audit	Frequency	Control Limits	Corrective Action
Holding Times	Samples must be extracted and analyzed within holding time.	SVOCs: Extract within 5 days of VTSR. Analyze extracts within 40 days from extraction.	If holding times are exceeded for initial or any reanalyses required due to QC excursions, notify the QAO immediately since resampling may be required.
MS Tuning	Once every 12 hours.	DFTPP key ions and abundance criteria listed in the method must be met for all 13 ions.	1. Tune the mass spectrometer. 2. Document corrective action - samples cannot be analyzed until control limit criteria have been met.
Initial Calibration	Prior to sample analysis and when continuing calibration criteria are not met.	1. Five concentrations bracketing expected concentration range for all compounds of interest. 2. Criteria as listed in NYSDEC ASP 10/95 Exhibit E.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Continuing Calibration	Every 12 hours, following DFTPP.	Criteria as listed in NYSDEC ASP 10/95 Exhibit E.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Preparation Blank Analysis	With each extraction batch, of no more than 20 analytical samples.	Common laboratory contaminants less than 3 X PQL, anything else less than PQL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument, recalibrate analytical system and reextract and reanalyze all samples if detected for same compounds as in blank. 3. Document corrective action - samples cannot be analyzed until blank criteria have been met.

Table 9-2
Semivolatile (GC/MS) Quality Control Requirements and Corrective Actions
SW-846 8270B with NYSDEC ASP Exhibit E requirements

Audit	Frequency	Control Limits	Corrective Action
Field / Equipment Blank Analysis	Every 20 samples.	Common laboratory contaminants less than 3 X PQL; anything else less than PQL.	1. Investigate problem, contact QAO. 2. Write an explanation.
Laboratory Control Sample Analysis	With each extraction batch, of no more than 20 analytical samples. Prepared independently from calibration standards.	Recovery within matrix spike blank limits (NYSDEC ASP Exhibit E) if available, otherwise within laboratory control limits Spike must contain all target compounds.	1. If recovery failures are above control limits and these compounds are not detected in the associated samples, contact QAO. 2. Reanalyze LCS and examine results of other QC analyses. 3. If recovery is still outside limits, and other QC criteria are met, contact QAO. 4. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 5. Document corrective action.
Internal Standards	All samples and blanks (including MS/MSD).	1. Response -50% - +100% of the internal standards from the continuing cal of the day. 2. RT must be ± 30 sec. from associated standard.	1. Reanalyze. 2. If recovery is still outside criteria, qualify data. 3. Document corrective action.

Table 9-2
Semivolatile (GC/MS) Quality Control Requirements and Corrective Actions
SW-846 8270B with NYSDEC ASP Exhibit E requirements

Audit	Frequency	Control Limits	Corrective Action
Surrogate Spike	All samples and blanks (including MS/MSD).	Recovery within NYSDEC ASP 10/95 Exhibit E control limits.	1. If more than 1 AE or 1 BN fails, or if any one surrogate %R is < 10%, reanalyze. 2. If recovery is still outside control limits, qualify the data; if < 10% reextract if still in holding time. 3. Document corrective action.
Matrix Spike/ Matrix Spike Dup. (MS/MSD) Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	Recovery within NYSDEC ASP Exhibit E control limits if available, otherwise within laboratory control limits Spike must contain all analytes.	1. Reanalyze if <10%. 2. If > 10% and LCS criteria are met, document in case narrative no additional corrective action required. 3. If LCS criteria are exceeded also, examine other QC data for source of problem; ie surrogate recoveries for extraction efficiency and calibration data for instrument performance issues. 4. Take corrective action as required, re-extract or reanalyze samples and associated MS/MSD and LCSs as required.
Field Dup. Analysis	1 per matrix and analytical batch and every 20 samples of similar matrix.	50% RPD for waters and 100% RPD for soil.	If these criteria are not met, sample results will be evaluated on a case by case basis.

Table 9-3
Radionuclides Quality Control Requirements and Corrective Actions
Modified method EML Th-0l-and EMLU-02, and modified EPA 900 and LANL MLR-100 (gross alpha and gross beta) with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
Holding Times	Samples must be extracted and analyzed within holding time.	Extract and analyzed within 6 months of VTSR for aqueous or soil samples.	If holding times are exceeded for initial or any reanalyses required due to QC excursions, notify the QAO immediately since resampling may be required.
Initial Calibration	For thorium and uranium: Efficiency - annually Efficiency check - monthly or prior to use (PTU) Energy - quarterly or PTU Energy check, resolution, background - weekly or PTU For gross alpha/gross beta: Efficiency - daily or PTU Self absorption - annually Plateau - annually or after every gas change Background - weekly or PTU	All calibrations should be evaluated statistically against determinations performed previously. If results are outside of statistical range, an explanation of the change in performance shall be provided.	If calibration results are measured outside of statistical ranges, the QAO will be notified. Explanations will be provided in the case narrative and in the instrument maintenance logbook.
Method Blank Analysis	1 per 20 samples of similar matrix extracted at the same time or 1 per batch.	Results must be ≤ minimum detectable concentration (MDC) or < 5X below lowest activity of the sample.	1. Reanalyze the batch. 2. If holding times have elapsed, contact the QAO immediately since resampling will be required.
LCS Analysis	1 per 20 samples of similar matrix extracted at the same times or 1 per batch for both alpha and beta emitter.	For thorium and uranium: 75 - 125% recovery For gross alpha/gross beta: 40 - 60% recovery.	1. Reanalyze the batch 2. If holding times have elapsed, contact the QAO immediately since resampling will be required.

Table 9-3
Radionuclides Quality Control Requirements and Corrective Actions
Modified method EML Th-0l-and EMLU-02, and modified EPA 900 and LANL MLR-100 (gross alpha and gross beta) with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
Matrix Spike Analysis	For thorium and uranium: 1 per matrix type or per batch and every 20 samples of similar matrix.	For thorium and uranium: 45 - 105% recovery.	1. If LCS criteria are met, document in case narrative; no additional corrective action required.
Matrix Spike Duplicate Analysis	1 per matrix type or per batch and every 20 samples of similar matrix.	Relative error ratio (RER) ≤3.	1. If LCS criteria are met, document in case narrative; no additional corrective action required.
Equipment Blank Analysis	1 per sampling equipment and after every 20 samples, where applicable.	Result ≤ CRDL.	1. Investigate problem; examine for potential cross contamination at lab or at field 2. Notify the QAO immediately since resampling may be necessary.
Field Duplicate Analysis	1 per matrix type and every 20 samples of similar matrix.	RER ≤ 3.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case by case basis during the validation process.
Tracer Recoveries	For thorium and uranium: Samples and QC samples	For thorium and uranium: 45 - 105% recovery.	1. If recovery is outside control limit, repeat analysis. 2. If reanalysis is outside control limit, notify QAO and document a matrix specific QC problem in the case narrative.

Note: For initial calibration, select the least stringent criteria; for example, weekly or PTU is defined as must be performed prior to use of action has not been performed within a week prior to use.

Table 9-4
Metal Quality Control Requirements and Corrective Actions
SW-846 6010A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Holding Times	Samples must be digested and analyzed within holding time.	Analyze 180 days from VTSR (Hg is 26 days).	If holding times are exceeded for initial or any reanalyses required due to QC excursions, notify the QAO immediately since resampling may be required.
Calibration Verification (ICV, CCV)	Calibrate daily according to method and each time instrument is set up; verify at more frequent of 10% or each 2 hours. Also verify at the end of each run. Analyze highest mix std. before sample analysis. Standard at or below the PQL should be analyzed after initial cal.	90% to 110% of expected value for ICP and AA. NYSDEC ASP Exhibit E requirements.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria have been met.
Calibration Blank	At beginning and end of run and at a rate of 10% during run.	NYSDEC ASP Exhibit E requirements.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action - samples cannot be analyzed until blank control limit criteria have been met.

Table 9-4
Metal Quality Control Requirements and Corrective Actions
SW-846 6010A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Preparation Blank Analysis	1 per batch of samples digested, or 1 in 20, whichever is greater.	NYSDEC ASP Exhibit E requirements.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument and recalibrate analytical system and reprep and reanalyze affected samples if detected. 3. Document corrective action - samples cannot be analyzed until blank criteria are met.
Field / Equipment Blank Analysis	Every 20 samples, where applicable	NYSDEC ASP Exhibit E requirements.	1. Investigate problem, contact QAO. 2. Write an explanation.
Laboratory Control Sample Analysis	Every 20 samples or each digestion batch. Prepared independently from calibration standards.	Recovery within NYSDEC ASP Exhibit E limits if available, otherwise within laboratory control limits.	1. Reanalyze LCS and examine results of other QC analyses. 2. If recovery is still outside limits, and other QC criteria are met, contact QAO. 3. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 4. Document corrective action.
Serial Dilution Analysis	Only required when analyte concentration is >50 times the PQL after dilution, except Hg.	NYSDEC ASP Exhibit E requirements.	1. Qualify data. 2. Document corrective action.

Table 9-4
Metal Quality Control Requirements and Corrective Actions
SW-846 6010A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Interference Check Sample Analysis	Beginning and end of each analytical run or twice during every 8 hours, whichever is more frequent.	NYSDEC ASP Exhibit E requirements.	1. Reanalyze. 2. If limits are still exceeded, adjust instrument. 3. Restart analytical run and reanalyze samples analyzed since last satisfactory ICS. 4. Document corrective action.
Matrix Spike Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	Recovery within NYSDEC ASP Exhibit E limits if available, otherwise within laboratory control limits. Spike must contain all analytes.	1. Analyze post spike. 2. Document corrective action.

Table 9-4
Metal Quality Control Requirements and Corrective Actions
SW-846 6010A with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Laboratory Duplicate Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	NYSDEC ASP Exhibit E requirements	1. Investigate problem and reanalyze. 2. Document corrective action.
Field Dup. Analysis	1 per matrix and analytical batch and every 20 samples of similar matrix	50% RPD for waters and 100% RPD for soil.	If these criteria are not met, sample results will be evaluated on a case by case basis.

10. Performance and system audits

10.1. Performance audits

At the discretion of the Project Manager, field and laboratory performance audits consisting of on-site performance evaluations will be performed once during the field program and during the laboratory analysis program. The audits will be performed by O'Brien & Gere Engineers' QAO or his designee. These audits will evaluate the adherence of the field and laboratory programs to the QA program outlined in this QAPP. The protocols used to conduct the audits may be found in the following sections. Acceptance criteria used in determining the need for corrective action will be those criteria defined in this QAPP. Where acceptance criteria are not defined for laboratory procedures and analytical methods, the laboratory's standard operating procedure and QA Manual will be consulted. The results of the field and laboratory audits will be documented and submitted to the Project Manager. These reports and any corrective actions which were implemented as a result of the audits will be included in the technical report.

10.1.1. Laboratory audit protocol

The laboratory audit will note factors which may affect the quality of the analytical results. Minimum QA/QC criteria specified in this QAPP and the analytical methods must be adhered to. The areas of concern of the laboratory audit will include:

- Implementation of a scientifically sound QA/QC program addressing precision, accuracy, reproducibility, comparability, completeness, and blank contamination;
- Sufficient documentation and record keeping for technical personnel external to the laboratory to recreate each analytical event; and
- Compliance with the project requirements for laboratory analysis.

- The specific parameters to be evaluated include:
- Data comparability;
- Calibration and quantitation;
- QC execution;
- Out-of-control events;
- Standard operating procedures;
- Sample management;
- Record keeping;
- Instrument calibration records;
- Other analytical records;
- QC records;
- Corrective action reports;
- Maintenance logs;
- Data review;
- Limits of detection;
- QC limits; and,
- Analytical methods.

10.1.2. Field audit protocol

The purpose of a field audit is to identify whether the systems and procedures described in the Work Plan and QAPP are operational in the field and contributing to the production of accurate and defensible analytical results. An on-site evaluation will be preformed by the QA Officer or his designee. The areas of concern in a field audit include:

- Sampling procedures;
- Decontamination of sampling equipment, if applicable;
- Chain-of-custody procedures;
- Standard operating procedures; and,
- Proper documentation in field notebooks.

10.2. System audits

Routine laboratory and field performance will be monitored through the analysis of equipment and laboratory blanks, spiked samples, laboratory control samples, laboratory and field duplicates, and performance evaluation samples. The Laboratory QA Coordinator, in conjunction with the QA Officer and the Project Manager, will formulate corrective actions in the event that QC limits specified in this document are exceeded. The results of the system audits will be documented in the investigation report.

11. Preventive maintenance

Preventive maintenance procedures will be carried out on field equipment in accordance with the procedures outlined by the manufacturers' equipment manuals. Field equipment used during this project will have a specific maintenance instruction sheet accompanying it. Maintenance activities involving field equipment will be recorded in a field log book.

Major analytical equipment at the laboratory is typically covered by some type of maintenance contract, usually with the instrument manufacturer. The degree and extent of contracted routine or preventive maintenance assistance is a function of the complexity of the equipment, amount of equipment redundancy and the laboratory in-house expertise relative to repair and maintenance of the particular piece of equipment. Maintenance activities are documented and maintained in permanent files and logbooks.

12. Data assessment procedures

The procedures employed by the laboratory to assess the quality of data generated in the laboratory include, but are not limited to, the following:

- Determination of analytical precision per method;
- Determination of analytical accuracy per method;
- Determination of analytical completeness; and
- Determination of MDLs, IDLs, and PQLs.

Data quality reviews by analysts, supervisors, managers, laboratory directors, and QA personnel contribute to the total process.

Precision and accuracy will be assessed utilizing control charts. Control charts will consist of line graphs which provide a continuous graphic representation of the state of each analytical procedure. The standard deviation of the mean of the QC measurement is calculated and the upper and lower warning limits are set at plus or minus two standard deviation units. The upper and lower control limits are set at plus or minus three standard deviation units. Acceptable data are realized when results fall between the lower and upper warning limits. If the QC value falls between the control limit and the warning limit, the analysis should be scrutinized as possibly out of control.

In general, the accuracy of the methods will be determined by spiking the sample matrix with the analyte and by analyzing reference materials with known concentrations. The spiking levels will be selected to reflect the concentration range of interest. Percent recoveries of the spikes and reference materials will be calculated and compared to the established limits. The precision of the methods will be determined by the analysis of matrix spike and laboratory and field duplicate samples. The precision will be evaluated by calculating the RPD between the duplicates. RPD calculations will be compared to the established limits.

The definitions and equations used for the assessment of data quality are discussed below.

Accuracy - Is a measure of the nearness of an analytical result, or a set of results, to the true value. It is usually expressed in terms of error, bias, or percent recovery (%R).

Normally, the term accuracy is used synonymously with percent recovery. It describes either the recovery of a synthetic standard of known value, or the recovery of known amount of analyte (spike) added to a sample of known value. The %R or accuracy can be calculated by using:

standards: %R = (observed value/true value) x 100

spikes: %R = ((conc. spike + sample conc.) - sample conc. x 100)/conc. spike

Precision - Refers to the agreement or reproducibility of a set of replicate results among themselves without assumption of any prior information as to the true result. It is usually expressed in terms of the percent difference (%D) or RPD. The %D is calculated by using:

%D = (larger SR - smaller SR x 100)/ smaller SR

where SR is the sample result. The RPD is calculated by using:

RPD = (|OSR - DSR| x 100)/ ((OSR + DSR)/2)

where OSR is the original sample result and DSR is the duplicate sample result.

Average - The average or arithmetic mean (X) of a set of n values (Xi) is calculated by summing the individual values and dividing by n:

$X = (\sum Xi_{1=1 \text{ to } n})/n$

Range - The range (R_i) is the difference between the highest and lowest value in a group. For n sets of duplicate values (X_2, X_1) the range (R_i) of the duplicates and the average range (R) of the n sets are calculated by the following:

$$R_i = X_2 - X_1$$

$$R = \sum Ri_{i=1 \text{ to } n}/n$$

Standard Deviation and Variation - The standard deviation (S) of a sample of n results is the most widely used measure to describe the variability of a data set. It is calculated by using the following equation:

$$S = \sqrt{\frac{\sum (Xi - X)^2_{i-1 \text{ to } n}}{n}}$$

where X is the average of the n results and Xi is the value of result I. Normally, X ± S will include 68% and X ± 2S includes about 95% of normally distributed data.

The variance is equal to S^2. The percent relative standard deviation (%RSD) or coefficient of variation (CV) is the standard deviation divided by the mean and multiplied by 100 as follows:

$$CV = 100S/X$$

The Laboratory QA Coordinator, with individual laboratory group leaders, will identify any data that should be rated as "unacceptable", based on the assessment of the QA/QC criteria. Data assessment will be evaluated during data validation and discussed in the data validation report(s).

13. Corrective action

Corrective action procedures will be implemented based on unacceptable audit results or upon detection of data unacceptableness during validation. Two types of audits will be performed during this investigation. The data generation process will be audited by assessing adherence to method or laboratory control limits and by performing an on-site laboratory audit, if requested by the Project Manager. The field program will be audited by assessing adherence to the procedures outlined in the Work Plan and in this document by the analysis of field QC samples and by performing an on-site field audit, if requested by the Project Manager. If required, corrective action procedures will be developed on a case-by-case basis. The enacted corrective actions will be documented in the appropriate notebook, log, or case file. File and laboratory personnel are encouraged to discuss specific issues and proposed corrective actions with the QA Officer.

Generally, the following corrective actions may be taken by the laboratory. When calibration, instrument performance, and blank criteria are not met, the cause of the problem will be located and corrected. The analytical system will then be recalibrated. Sample analysis will not begin until calibration, instrument performance, and blank criteria are met. When matrix spike, reference standard, or duplicate analyses are out of control, samples analysis will cease. The problem will be investigated. Depending on the results of overall QC program for the sample set, the data may be accepted, accepted with qualification, or determined unusable. If the laboratory determines data to be unusable, those samples will be reprepared and reanalyzed. If matrix interferences are suspected, samples will be subjected to one or more of the clean-up techniques specified in the analytical methods. If QC criteria are met upon reanalysis, only the new results are reported. If QC criteria are still not met upon reanalysis, both sets of sample results will be reported.

The laboratory will make every reasonable effort to correct QC excursions and to document the presence of matrix interferences. In this way, unnecessary resampling of difficult matrices may be avoided. However, if matrix interferences are not documented resampling may be required.

Corrective actions for the field investigation program, if required, will generally involve altering the incorrect field procedure to match the guidelines set forth in the Work Plan and in this QAPP. If problems arise with procedures or guidelines set forth herein, the client, the QA Officer, and the Project Manager, in conjunction with the appropriate agencies, will formulate an appropriate corrective action.

14. QA reports to management

The deliverables associated with the investigation will contain separate QA sections in which data quality information collected during the investigation is summarized. These reports will be prepared under the direction of the Project Manager and will include the QA Officer's report on the accuracy, precision, and completeness of the data and the results of the performance and system audits.

References

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Los Alamos National Laboratory (LANL). 1995. *Health and Environmental Chemistry: Analytical Techniques, Data Management, and Quality Assurance*, LA-10300-M, Vol. II.

NYSDEC. 1991. *RCRA Quality Assurance Project Plan Guidance.*

NYSDEC. 1995. *Division of Hazardous Waste Remediation Divisional Technical and Administrative Guidance Memorandum (TAGM).*

NYSDEC. 1995b. *NYSDEC Analytical Services Protocol (ASP) Methods, 1995 Revisions.*

USEPA. 1980a. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80.

USEPA. 1980b. Prescribed Protocol for Measurement of Radionuclides in Drinking Water, EPA-600/4-80-032.

USEPA. 1987. *Data Quality Objectives for Remedial Response Activities, EPA/540/6-87/003.*

USEPA. 1992. *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), 3rd Edition.*

USEPA. 1994a. *Contract Laboratory Program National Functional Guidelines for Organic Data Review EPA 540/R-94/012.*

USEPA. 1994b. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review EPA 540/R-94/013.*

APPENDIX F

Key Project Individual Resumes
Former Sylvania Electric Products Incorporated Facility
Hicksville, New York

Swiatoslav W. Kaczmar, Ph.D., C.I.H.

O'Brien & Gere Engineers, Inc.

Project Officer

PROFESSIONAL PROFILE

Dr. Kaczmar joined O'Brien & Gere Engineers, Inc. in 1983. He was promoted to the position of Manager of Environmental Toxicology and Industrial Hygiene in 1986, and to Vice President in 1990. Dr. Kaczmar's professional career has focused on hazardous waste site investigations and accompanying ecological and human health risk assessments. He has performed noted research on the distribution, fate and transport of chlorinated dioxins, and is an accomplished trace residue chemist.

As an Adjunct Professor in the Department of Civil and Environmental Engineering at Syracuse University, Dr. Kaczmar has developed and teaches three graduate courses: "Environmental Toxicology", "Principles of Industrial Hygiene", and "Hazardous Waste Management".

As a member of O'Brien & Gere's Operating Committee on Quality, Dr. Kaczmar serves as the Principal Quality Assurance Officer for the Firm's scientific activities.

Dr. Kaczmar serves as the Director on the Board of Directors of O'Brien & Gere Laboratories, Inc., a corporate affiliate of O'Brien & Gere Engineers, Inc.

In 1986, Dr. Kaczmar became certified by the American Board of Industrial Hygiene in the comprehensive practice of Industrial Hygiene.

Education

Northern Michigan University, 1976, Bachelor of Science with 3 Majors: Chemistry; Biology; Water Science
Michigan State University, 1979, MS/Chemical Limnology
Michigan State University, Department of Fisheries and Wildlife. 1983, Ph.D./Environmental Toxicology

Professional Certifications

Certified Industrial Hygienist, 1986

Professional Affiliations

American Chemical Society - Environmental Chemistry Section
American Society of Mechanical Engineers Committee on Dioxin Emissions from Resource Recovery Operations
Health Physics Society
Society for Risk Analysis
Society of Environmental Toxicology and Chemistry
American Industrial Hygiene Association

Adjunct Assistant Professor - Syracuse University
Member-Review Committee - Standard Methods for the Examination of Water and Wastewater - 17th Edition
Past Chairman- Dioxin Methods Development Committee - Standard Methods for the Examination of Water and Wastewater
Appointed to USEPA/NACEPT Committee on Innovative Technologies

TECHNICAL EXPERTISE

- Evaluation of the toxicology and environmental disposition of chemical, biological and physical contaminants and hazardous waste
- Oversees the preparation of ecological and human health hazard evaluations and risk assessments for hazardous waste sites, industrial discharges, chemical emergencies and occupational exposures to determine an appropriate level of response
- Management and technical direction of Remedial Investigations/ Feasibility Studies
- Comprehensive Practice of Industrial Hygiene

REPRESENTATIVE PROJECTS

CERCLA ACTIVITIES/RISK ASSESSMENTS AND FIELD INVESTIGATIONS:

Cliffs-Dow Site, Marquette, MI - USEPA Superfund site. Managed the overall Remedial Investigation/Feasibility Study on behalf of the PRP group. Site involved evaluation of wood production byproducts including wood tars. Prepared a human health and environmental risk assessment on the information generated during the remedial investigation and provided evaluation of remedial options.

AlliedSignal, Syracuse, NY:

- Project Officer, Semet RI/FS. Remedial Investigation of benzene production waste tar lagoons.
- Project Officer, Willis Avenue RI/FS. Remedial investigation of former chlorobenzene production plant.

Spiegelberg Site, Green Oak Township, MI - USEPA Superfund Site. Designed and directed a field study independent of USEPA efforts in support of PRP interests to generate data for a risk evaluation of a paint sludge disposal area. Conducted test pit investigation to determine the nature and volume of waste materials, including waste tars and paint sludges.

Baird and McGuire Site, Holbrook, MA - USEPA Superfund Site. Provided oversight of field activities and critique of a risk assessment at an inactive pesticide and household chemical formulating facility on behalf of PRP.

Major Pesticide Manufacturing Facility - Prepared a risk assessment of an uncontrolled pesticide manufacturing waste tar landfill. Investigated potential impact of releases to an adjacent estuary on behalf of the PRP. Utilized chemical measurements, bioassays and tidal dilution modeling to quantify the degree of potential impacts to the estuarine system.

Mystery Bridge and Highway 20 Site, Evansville, WY - Project Manager for RI/FS involving industrial zone and adjacent residential subdivision. Project management through RI/FS and Record of Decision.

Essex Specialty Products, Inc. - Project Officer for Remedial Investigation/Feasibility Study at former Essex Specialty Products Facility in Jamestown, NY. Investigation focused on residual solvents in groundwater.

United States Air Force, Cape Canaveral, FL - Preparation and implementation of Quality Assurance Program and Human Health/Ecological Risk Assessments at various sites on installation.

Major Electronics Manufacturer - Project Officer for site investigation of PCBs in sediments of Hudson River.

PCB, DIOXIN and DIBENZOFURAN ACTIVITIES:

Jones, Day, Reavis & Pogue, Cleveland, OH - Provided lead in interpretation of GC/MS data and risk assessment of potential dioxin and dibenzofuran residues following an electrical transformer explosion at Neal's Landfill, Bloomington, IN. Evaluation of potential transport, fate and potential toxic effects of PCB contamination at a major Superfund site.

Major Electronics Manufacturer - Prepared a toxicological risk assessment of potential releases from a waste landfill containing heavy metal and organic solvent wastes on behalf of the PRP.

Ludlow Sanitary Landfill, Paris, NY - Prepared a human health and environmental risk assessment at a New York State Superfund site on behalf of the PRP group. The site was a mixed waste municipal landfill with PCB-containing wastes. Assessment involved modeling of human exposures as well as evaluation of potential impacts to a designated wetland area.

Moyer's Landfill, Philadelphia, PA - Conducted a review of a Remedial Investigation/Feasibility Study document prepared by a Superfund Contractor and formulated an independent preliminary risk assessment on behalf of PRP group.

Peter Cooper Corporation, Gowanda, NY - Risk assessment on behalf of PRP at two riverside sites used for the disposal of tannery wastes containing chromium.

Town of Conklin, NY - Municipal Waste Landfill - Risk assessment on behalf of PRP of a former mixed waste municipal landfill adjacent to a designated wetland.

City of Niagara Falls, NY - Consultation and preparation of a report outlining the economic and toxicological impact of the proposed "S" Area Settlement Agreement, which involved the City of Niagara Falls, Hooker Chemical Co., the USEPA and the New York State Department of Environmental Conservation. Project included discussions with legal advisors, regulatory agencies and City officials, and resulted in detailed estimates for costs to the City from the settlement.

Niagara Mohawk Power Corporation, Syracuse, NY - Hazard ranking on behalf of PRP at the Cherry Farm and Gowanda sites, situated on the River. Utilized the USEPA Hazard Ranking System Model. Coordinated comments with New York State Department of Environmental Conservation. Prepared Work Plan and Quality Assurance Plan for RI/FS of the two sites, consistent with NYSDEC and USEPA requirements.

PPG Corporation, Barberton, OH - Risk assessment of eight inactive waste lagoons/landfills and a surface impoundment used for the disposal of Solvay Process and solvent production wastes. Investigation included evaluation of waste tars generated during mercury cell chlorine production.

Syracuse University, Syracuse, NY - Human health risk assessment of chromium contamination of drinking water system.

Crab Orchard National Wildlife Refuge, Marion, IL - Risk assessment on behalf of the United States Department of Interior of twelve army munitions loading and storage sites within the Wildlife refuge for potential human health and environmental impacts.

Sangamo Electric Corp., Marion IL - Risk Assessment on behalf Sangamo Electric of potential human health and environmental impacts of PCB contamination in a manufacturing facility and an adjacent industrial landfill. Assessment included evaluation of potential remedial options.

Wyman Gordon Corporation - Risk assessment on behalf of PRP of ground water contamination by arsenic.

TRW Corporation. Numerous Locations - Prepared human health and environmental risk assessments of releases from underground storage tanks under national contract between TRW Corporation and O'Brien & Gere Engineers, Inc.

NL Industries, Four Locations - Provided human health and environmental risk assessments of lead smelting operations at three secondary lead smelting operations and one waste landfill.

Major Pharmaceuticals Manufacturer - Project Officer for investigation of former vaccine production facility. Investigation focused on potential residual pathogenic bacteria and viruses in biological wastes present on site. Investigation involved development of sampling and evaluation protocols, human health and ecological risk assessment as well as a feasibility study of alternatives for disposal of waste residuals.

Public Utility, Confidential, Former Coal Gas Facilities - Site investigation, human health and ecological assessment at former coal gas production facility in the Northeast.

Ludlow Sanitary Landfill, Paris, NY - Prepared a human health and environmental risk assessment at a New York State Superfund site on behalf of the PRP group. The site was a mixed waste municipal landfill with PCB-containing wastes. Assessment involved modeling of human exposures as well as evaluation of potential impacts to a designated wetland area.

Rasmussen Landfill, Green Oak Township, MI - USEPA Superfund site. Review of PCB, dioxin and dibenzofuran residues in a mixed waste landfill following a major fire in the landfill. Investigation performed as a review of USEPA contractor activities on behalf of PRP group. Activities included evaluation of residue dynamics, potential risks and feasible remedial options.

Times Beach, MO - Review of government contractor activities investigating the presence and distribution of dioxins in a residential area. Work conducted on behalf of PRP group. Activities included review of field investigations, risk assessment and feasibility study of remedial alternatives. Alternatives evaluated included incineration of contaminated soils in a mobile on-site as well as off-site incinerator.

Environmental Protection Agency, Dioxin Contract Laboratory Program - Provided lead in coordinating analytical efforts and data evaluation of environmental samples analyzed for dioxins under the Superfund Program.

Metropolitan Water Board, Onondaga Co., NY - Interpretation of GC/MS data and human health assessment of water from Lake Ontario analyzed for 2,3,7,8-TCDD.

New York State Energy Research and Development Authority, Albany, NY - Participated as a member of the Pittsfield Incinerator Research Project to evaluate the formation of dioxins and dibenzofurans in a municipal waste resource recovery facility under various temperature and operating conditions. Provided backup analytical support for analytical measurements.

American Society of Testing Materials/American Society of Mechanical Engineers - Participated in the design and writing of a standardized analytical protocol for the analysis of chlorinated dioxins and dibenzofurans in samples of stack emissions from waste incinerators collected using the USEPA Method 5 sampling train.

Adirondack Resource Recovery Corporation - Acted as a consultant and expert witness on the formation and potential human health effects of potential chlorinated dioxins and dibenzofuran emissions from a municipal resource recovery facility. Reviewed and provided comment on existing air pollution control designs and Environmental Impact Studies.

Amchem Corporation, Ambler, PA - Preparation of a dioxin sampling plan at a railroad siding where chlorophenoxy herbicides were loaded.

Major metals recycling company - Performed an investigation into the formation of chlorinated dioxins and dibenzofurans along various process points in a metals recycling operation.

Chlorinated solvent manufacturer - Evaluated the potential formation of chlorinated dioxins during the commercial synthesis of a chlorinated solvent. Evaluation included a review of applicability of current regulatory requirements on dioxins.

EXPERT WITNESS AND LITIGATION SUPPORT:

Most of the risk assessment and field investigation activities presented above involved the preparation of documents for future or potential litigation. The following activities represent projects which involved a greater degree of involvement with PRP counsel. As such, the law firms for which the activities were conducted are listed.

Beveridge and Diamond, Washington, DC - Conducted field investigations and risk assessments at uncontrolled hazardous waste sites on behalf of industrial clients.

Dickinson, Wright, VanDusen and Freeman, Detroit, MI - Conducted risk assessment and field investigations on behalf of a major automobile manufacturer. Served as expert witness under affidavit for pending litigation. Obtained and reviewed information under the Michigan Freedom of Information Act. Provided major review and comprehensive critique of Risk Assessment and Phased Feasibility Study prepared by USEPA contractor. The field activities and critique were prepared under an extremely fast track during the public comment period as the primary basis for future litigative defense.

Jones, Day, Reavis and Pogue, Cleveland, OH - Neal's Landfill Superfund site. Provided evaluation of environmental impacts related to contamination by PCBs on behalf of a major electronics manufacturer.

Nixon, Hargrave, Devans and Doyle, Rochester, NY:

- Provided expert testimony for defense against a class action citizen's suit for aqueous discharge permit violations.

- Provided expert testimony on behalf of New York State Superfund Coalition regarding technical shortcomings of the New York State Superfund Act - Part 375. Resulted in court decision to nullify and remand the rules of the Act, which was in full effect at the time, back to the New York State Department of Environmental Conservation for revision to address the specific issue raised in the testimony.

Bond, Schoeneck and King, Syracuse, NY - Provided technical support and evaluations of hazardous waste releases for industrial clients.

Lewis and Rice, St. Louis, MO - Provided technical support review and evaluations of a major Superfund investigation at Times Beach, MO on behalf of PRP group.

Montgomery, Green, Jarvis, Kolodny and Markesson, Denver, CO - Key Expert Witness for defendants in toxic tort related to Superfund Investigation at Brookhurst, WY

McElroy, Deutsch and Mulvaney:

- Expert witness support and testimony on behalf of defendant as related to alleged chromium exposures within industrial building situated adjacent to chromium processing waste piles.

- Litigation support related to identification of major degradation components of a fuel spill.

Montgomery, Green, Jarvis, Kolodny and Markesson, Denver, CO - Key expert witness in litigation between the Dow Chemical Company and the Little America Refinery Company regarding LARCO's claim of exemption from CERCLA liability under the CERCLA petroleum exclusion. Dr. Kaczmar's technical support and testimony assisted Dow in successfully winning its claim against LARCO.

New York Power Pool, New York State Utilities Manufactured Gas Plant Task Force - Provided technical direction to Task Force in preparation of a Risk-Based standard remedy for remediation of manufactured gas plant sites. Prepared support document and participated in discussion with NYSDEC for its approval.

INDUSTRIAL HYGIENE:

Corning Glass Works, Corning, NY:

- Provided oversight of glass kiln demolition and rebuilding. Reviewed safety and hygiene issues related to the OSHA lead and arsenic standards, heat stress, worker monitoring and safety training, personal protective equipment, construction of protective barriers and disposal of waste materials.

- Design of a mobile personnel decontamination facility for use during the demolition and reconstruction of glass kilns.

Alcan Aluminum Company, Cryscon Electronics, Phoenix, AZ - Survey of gallium arsenide crystal growing facility for arsenic contamination.

Onondaga Community College, Syracuse, NY - Analysis of air samples in a classroom for residues of domestic use pesticides. Evaluation of ventilation system.

Armstrong World Industries, Inc., Fulton, NY - Industrial hygiene survey of roll dryer unit. Evaluation of ventilation system.

Webster Elementary School, Syracuse, NY - Air monitoring for formaldehyde residues.

City of Syracuse Schools - Monthly air monitoring for nuisance dusts during construction and renovation of five school buildings.

Trans-Tech Industries, Adamstown, MD - Performed industrial hygiene audit of microwave component fabrication facility.

Eric Mower Company, Syracuse, NY - Conducted industrial hygiene audit and workplace sampling program of a printing and publishing facility.

Major Aircraft Component Manufacturer - Conducted an industrial hygiene audit and workplace sampling.

American Cyanamid, Bound Brook, NJ - Preparation of a Safety and Health Plan for excavation and disposal activities from a series of chemical waste lagoons. Included preparation of a videotaped Safety Training program.

Major Metals Recycler - Occupational exposure evaluation of chlorinated dioxins and dibenzofurans produced during the processing and reclamation of recycled metals.

ASBESTOS EVALUATION AND REMEDIATION PROGRAMS:

NIOSH Asbestos analysis proficiency program - Laboratory Director for O'Brien & Gere Laboratories, Inc., assuring the quality of determination of bulk and airborne asbestos samples.

EPA/RTI Quality Assurance Program - Laboratory Director for O'Brien & Gere Laboratories, Inc., assuring quality control for bulk sample analysis.

Supervision and oversight of the laboratory analytical program for bulk and air analysis for asbestos. Responsibilities include:

- In-house quality assurance/quality control program for asbestos sample analysis;
- NIOSH and EPA quality assurance programs;
- Internal quality control manual;
- Inter-laboratory exchange program;
- Data management system for storage, documentation and report generation; and
- Design of asbestos laboratory specifications for proper ventilation and filtration requirements.

RESEARCH ACTIVITIES:

Conducted research into the photolysis of 2,3,7,8-TCDD adsorbed to soil surfaces.

Michigan State University - Performed trace analyses outlining the geographic distribution of part-per-trillion residues of 2,3,7,8-tetrachlorodibenzo-p-dioxin in Michigan fishes.

- Developed an in vitro technique for predicting the volatilization rates of trihalomethanes from rivers and streams.

- Synthesized all 22 tetrachlorodibenzo-p-dioxin isomers. Conducted investigations into the photodegradation rates of various chlorinated dioxin congeners.
- Performed a structure-activity assay on the 22 tetrachlorinated dioxin isomers by monitoring their ability to induce rat hepatic mixed function oxidase systems.
- Evaluated the synergistic effects of polybrominated biphenyls on renal injury induced by cephalosporins.

PUBLICATIONS and PRESENTATIONS

Kaczmar, S.W., Zabik, M.J. and D'Itri, F.M., **Occurrence and behavior of halomethanes in the aquatic environment.** Submitted to Environmental Management.

Kaczmar, S.W., Zabik, M.J. and D'Itri, F.M., **Aqueous volatilization of selected haloforms.** Env. Tox. and Chem. 3:31-5. 1984

Kaczmar, S.W., Zabik, M.J. and F.M. D'Itri. **Part per trillion determination of 2,3,7,8-TCDD in Michigan fish.** To appear in Chlorinated Dioxins and Dibenzofurans in the Total Environment. L.H. Keith and G. Choudhary, ed. Ann Arbor Science, 1984.

Kaczmar, S.W., **Mass balance of Curene 442 in the Adrian, Mich. sludge landfill.** Report to the Michigan Toxic Substance Control Commission.

Occurrence and behavior of haloforms in the aquatic environment. A poster presented at the first national meeting of the Society of Environmental Toxicology and Chemistry. Washington, D.C. November 1980.

A method for measuring the aqueous volatilization rates of hydrophobic organic materials. Third Midwest Water Chemistry Workshop. Ann Arbor, Michigan. February 1981.

Occurrence and behavior of haloforms in the aquatic environment. Poster presented at the first "Toxicology in Michigan Today" Conference. East Lansing, Michigan. April 1981.

Haloforms in Natural Waters. Michigan State University Fisheries and Wildlife Seminar Series. May 1981.

Quality Control Techniques Used in Dioxin Analysis at the Part Per Trillion Level. Michigan State University Pesticide Research Center Annual Conference. July 1981.

Synthesis and Identification of the 22 Congeners of TCDD. Michigan State University Pesticide Research Center Annual Conference. May 1982.

Rat Hepatic Enzyme Induction by Various Congeners of TCDD. Poster presented at the 2nd "Toxicology in Michigan Today" Conference. East Lansing, Michigan. June 1982.

The Extent and Geographic Distribution of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Residues in Michigan. Paper presented at the 1983 Conference of the International Association of Great Lakes Research. Oswego, NY. May 25, 1983.
Part Per Trillion Determination of 2,3,7,8-TCDD in Michigan Fish. Paper presented at the fall 1983 meeting of the American Chemical Society. Washington, D.C. August 29, 1983.

Invited participant in a workshop on Sampling and Analytical Techniques during the **"Dioxins in the Environment"** symposium held at Michigan State University, East Lansing, MI. December 6-7, 1983.

Invited participant in workshop for the **Development of Standard Methods for Sampling, Analysis, and Monitoring of Municipal Incinerators for the Emission of Chlorinated Dioxins, Dibenzofurans and Related Compounds.** Sponsored by the U.S. D.O.E., Argonne National Laboratory, Washington, D.C. January 23-27, 1984.

Significance of Environmental Concentrations of Dioxins in Fish, Water and Sediment. Presentation at the 8th Symposium on Aquatic Toxicology. American Society of Testing Materials. April 17, 1984. Fort Mitchell, KY.
Human Health Impacts of Chlorinated Dioxins from Resource Recovery Operations. Speaker at the Eleventh Bi-Annual meeting of the Solid Waste Processing Division, American Society of Mechanical Engineers. Orlando, Florida. May 1984.

Human Health Impacts of Resource Recovery. Speaker at the Annual Meeting of the Northeast States for Coordinated Air Use Management (NESCAUM). August 14, 1984, Sturbridge, MA.

What is the Level of Risk to Humans from Dioxin? Speaker at the Fall, 1984 Resource Recovery Workshop of the Institute of Resource Recovery. October 16, 1984, New York, NY.

Site Assessment Under CERCLA: "The Importance of Distinguishing Hazard from Risk". Paper presented at the 5th National Conference on Management of Uncontrolled Hazardous Waste Sites. November 8, 1984, Washington, DC.

Photolytic Destruction of 2,3,7,8-TCDD Adsorbed to Soil Surfaces. Platform paper presented at the 5th annual meeting of the Society of Environmental Toxicology and Chemistry. November 6, 1984, Washington, DC.

Structure-Activity Studies on Enzyme Induction by Various TCDD Congeners. Poster presented at the 4th annual meeting of the Society of Environmental Toxicology and Chemistry held in Washington, D.C. November 6-9, 1983.

Jeffrey E. Banikowski, C.P.G., L.S.P.

Project Manager

PROFESSIONAL PROFILE

Mr. Banikowski joined O'Brien & Gere Engineers in 1988. He has extensive experience in hazardous and toxic waste management, mixed waste, radon assessment and mitigation, air and ground water sampling, data validation, and quality assurance for municipal and industrial clients.

Mr. Banikowski is thoroughly familiar with both chemical and radiological regulations governing the investigation and remediation of hazardous and solid waste sites.

Prior to joining the firm, Mr. Banikowski served for 15 years with the Onondaga County Health Department, Bureau of Public Health Engineering, where he provided oversight for the investigation of hazardous and non-hazardous waste sites. He also acted to implement overseeing the County ground water protection program and Radon Pilot Screening Program.

Education

State University of New York at Fredonia, 1972, BS/Geology
Syracuse University, 1984, MS/Geology

Professional Certifications

Certified as a Senior Public Health Sanitarian by the State of New York, Certificate #1526.
Certified Professional Geologist (National), No. 8780
Licensed Site Professional (LSP) - Massachusetts, No. 5977

Professional Affiliations

Health Physics Society: Western New York Chapter
Society for Risk Analysis
American Institute of Professional Geologists
American Industrial Hygiene Association

MANAGEMENT CAPABILITIES

Mr. Banikowski manages projects involving multidisciplinary teams of scientists and engineers. He serves as liaison with the clients' technical managers and coordinates project activities with laboratories performing the project sampling. He also supervises report writing and is responsible for billing, quality control, and technical accuracy.

As manager of Remedial Investigations/Feasibility Studies (RI/FS), Mr. Banikowski is conversant with both federal and state regulatory issues and agencies, and has worked extensively with the New York State Department of Environmental Conservation (NYSDEC). He provides technical support for other divisions within the firm, particularly in the areas of risk assessment and quality assurance plans. Mr. Banikowski also supervises laboratory and field audits to assess compliance with regulatory standards.

REPRESENTATIVE PROJECTS

HAZARDOUS AND TOXIC WASTE MANAGEMENT:

Mr. Banikowski's hazardous and toxic waste management experience includes a wide range of programs, involving:

- RI/FS
- Risk assessment
- Biological waste
- Soil-gas vapor surveys
- QA/QC Plans
- Landfill closures
- Health and Safety Plans

He has managed numerous sampling programs for RI/FS and has prepared QA/QC plans for activities associated with them. In addition, Mr. Banikowski has written Health and Safety Plans for a variety of health risks related to worker exposure to toxic substances, and has developed sampling methods to determine the presence of pathogenic organisms at biological waste sites.

Mr. Banikowski is thoroughly familiar with procedures for the collection, transport, and analysis of samples, as detailed by EPA's Compendium of Field Sampling and individual state guidelines. A representative list of his hazardous and toxic waste management projects includes:

Chemical Manufacturer, NY:

- Responsible for overall RI/FS management for an 11-acre, state-listed site containing a variety of PAHs derived from the distillation of coke light oil. Developed project deliverables, maintained client contact, and performed budgetary and scheduling oversight throughout the project. Deliverables have included review of site history, development of Work Plan, Quality Assurance Project Plan, Community Relations Plan, RI Report, Infiltration Test Plan, and a Treatability Study Work Plan targeting a variety of thermal technologies.

- Provided project management for the RI/FS of a former chlor-alkali facility of about 10 acres. A major concern was the presence of mercury and chlorobenzene isomers. Responsibilities included client contact, scheduling, and budget oversight.

City of Utica, NY:

- RI/FS at a former metal plating facility located in a residential neighborhood where health concerns arose from the on-site disposal of metals, cyanides, and solvents. Responsibilities included project coordination, a public health evaluation, and implementation of interim remedial measures.

- State-listed site involving remediation of a former metal stamping facility; included typical study components as well as the salvage of usable equipment (e.g. 50-ton metal stamping presses), removal of PCB-contaminated material, and the recommendation for building demolition rather than renovation. The project was partially funded through the NYS Superfund program.

Department of the Air Force - Provided technical coordination on a company-wide basis for a $50 million contract with the USAF. Projects included Whiteman AFB (soil removal), AF Plant 85, Columbus, OH (contaminated soil and ground water), the Duluth International Airport (contaminated ground water), and Patricks AFB/Cape Canaveral (on-going, 13 RI/FS).

Manufacturer, Syracuse, NY - Conducted oversight of Phase I and Phase II investigations conducted by a private consulting firm on behalf of the Onondaga County Department of Health and NYSDEC.

Chemical Corporation, NY - Reviewed interim clean-up measures and assisted the NYS Department of Health in assessing the health implications associated with an on-site landfill.

Waste Site, NY - Prepared bid specifications for the installation of monitoring wells, provided field oversight for all work activities, obtained ground water samples and soil samples; presented findings to Town Officials and members of the County Legislature.

Inventoried hazardous waste sites located in Onondaga County in conjunction with City-County Planning Agency.

Administered environmental lead program on behalf of Onondaga County for a period of 2 years.

NPL Site, Casper, WY - Participated in soil-gas vapor survey.

Landfill, Van Buren, NY - Developed criteria for a Phase II investigation prior to closure.

Landfill, West Caln Township, PA - Prepared QA/QC Plan for pre-design activities associated with RI/FS.

Landfill, Parkersburg, WV - Prepared site Health and Safety Plan for drum disposal characterization and removal work.

Fort Drum, NY - Administered preparation of QA/QC Plan for RI/FS.

Fort Drum, Fort Drum, NY - Prepared Health and Safety Plan for RI/FS work activities.

Sussex County, NJ - Prepared site Health and Safety Plan for workers engaged in the excavation and heat treatment of 10,000 cubic yards of soil.

Schilling Atlas Missile Sites 3,4,5,6,7, and 8, KS and MO - Wrote Health and Safety Plans for work associated with the evaluation of potential on-site chemical contamination.

Richards-Gebaur AFB, Belton, MO - Developed Health and Safety Plans for an RI/FS related to five areas of potential chemical contamination.

MIXED WASTE:

Mr. Banikowski has supervised and performed risk assessments and survey and sampling plans for hazardous waste sites containing both chemical and radioactive wastes. In addition, he has supervised the development and implementation of Health and Safety Plans for investigation of such sites. Representative mixed waste projects include:

Electronics Manufacturer, SC - Supervised the preparation of a risk assessment to evaluate the risks associated with potential on- and off-site contamination from the disposal of both chemical and radioactive waste material; included several on-site inspections, preparation of exposure scenarios for review by U.S. EPA, and a final risk characterization report.

Airplane Component Manufacturer, OH - Developed a survey and sampling scheme to identify locations where radiation levels would exceed conservatively established limits for the protection of on-site workers at a privately owned, former municipal landfill. Consulted with U.S. EPA prior to development of a sit-wide Health and Safety Plan.

Norton AFB, CA - Designed a statistically valid sampling plan to compare the radioactivity content of upgradient and downgradient ground water wells.

GSA, Watertown, MA - Developed and supervised the implementation of a Health and Safety Plan for the investigation of the Watertown Arsenal. The plan incorporated applicable provisions OSHA 29CFR1910 and USNRC 10CFR20. The major hazard at the site, as identified by Argonne National Laboratory, was depleted uranium at a former burn-pit area. Following the investigation, an assessment was prepared in accordance with U.S. EPA requirements for risks related to depleted uranium and its progeny.

Dexter Electronic Materials, NY - Developed and implemented a decommissioning plan in accordance with NRC, NYSDOL, and NYSDEC regulations. Assisted the client in the disposal of spent uranyl nitrate and uranium acetylacetonate and associated contaminated materials. Prepared a NESHAPs reporting form in compliance with USEPA requirements.

RISK ASSESSMENT:

Mr. Banikowski has supervised and prepared over sixty evaluations of potential risk from exposure to hazardous materials. These evaluations were conducted using both U.S. EPA and applicable state guidance materials, and involved:

- PCBs
- heavy metals
- lead
- biological waste
- VOCs
- petroleum hydrocarbons

Representative projects include:

Medical Research Facility, Midwest - Evaluation of biological waste residues at a former vaccine production and research facility; included risk characterization and development of sampling and analytical methods.

NPL Site, WY - Risk assessment addressing exposures at an oil refinery complex. Quantitated risks associated with exposures to petroleum hydrocarbons in ground water and soil, and modeled flow rates and fate and transport of chemical residuals.

Pedricktown, NJ - Risk assessment of exposures at a former secondary lead smelter. Exposures to heavy metals and volatile organic compounds in soil, ground water, sediments, and surface water were quantitated.

U.S. Army Corps of Engineers, Richards-Gebaur AFB, MO - Risk assessment involving six spill areas; quantifies exposures to lead, petroleum hydrocarbons, and jet fuel.

Automotive Manufacturer, NY - Evaluated health and environmental risks associated with PCBs in soils, surface water, and sediment.

INDUSTRIAL HYGIENE/OCCUPATIONAL HEALTH:

Mr. Banikowski provides expert guidance to clients on the evaluation of exposures to chemical and physical hazards and the development of appropriate remedial actions. He has a broad range of experience in industrial hygiene/occupational health programs involving such diverse concerns as:

- dioxins
- infectious organisms
- aldehydes
- toxic fumes
- acids
- noxious odors

Mr. Banikowski has performed relevant exposure evaluations, risk assessments, and air surveys, sampling, and monitoring. Representative industrial hygiene projects include:

Manufacturer, NY:

- Developed occupational risk assessment for dioxin exposure at a 500 person manufacturing facility; assessment used current TCDD-equivalent methodology.

- Literature review of esophageal cancer risk to workers exposed to fumes created in an anechoic chamber. Provided client with overview in anticipation of litigation.

Syracuse City School District, NY - Prepared sampling program to evaluate exposures to chlamydia and cryptococci.

Public Service Electric and Gas, NJ - Developed and implemented indoor air survey and sampling procedures related to former coal gas manufacturing plant.

Fairmount Gardens Senior Citizen Center, Camillus, NY - Developed indoor air sampling program for formaldehyde and other aldehydes; recommended changes in ventilation system and removal of source materials.

Stanton Foundries, Solvay, NY - Evaluated health risk posed to workers following an acid spill inside a production facility.

Syroco Corporation, Van Buren, NY - Assessed source and impact of fumes creating noxious odors inside plant facility following its evacuation.

North Area Garage Facility, North Syracuse, NY - Developed sampling program for airborne pollutants and made recommendations for ventilation and structural changes; building housed 40 vehicles.

AIR AND GROUND WATER SAMPLING:

Mr. Banikowski has designed and implemented a broad range of programs involving air and ground water sampling and monitoring, particularly related to public health issues such as:

- odor control
- drinking water supplies near landfills
- radon screening and abatement
- asbestos compliance review
- formaldehyde screening and abatement

Representative projects include the following:

Developed ground water evaluation program for Onondaga County, NY, in conjunction with Syracuse University and the Central New York Environmental Management Council.

Initiated program to sample over 200 private drinking water supplies situated in the vicinity of active and inactive landfills.

Performed ambient air monitoring for ammonia and hydrogen sulfide at the Allied-Signal waste beds in Camillus, NY, in response to odor complaints; determined health risk to area residents.

Established ground water and surface water sampling program on behalf of residents living near a former chemical recycling center in Pompey, NY. As a result of the program, the EPA established an emergency water supply for several residents and placed the center on the National Priorities List (NPL) of hazardous waste sites.

Implemented a sampling program involving 45 private water supplies located around the Clay Landfill, Clay, NY, following allegations of PCB laden material entering the waste stream; presented findings to the Onondaga County Legislature, and a public water supply line was installed for the affected residential units.

Designed and implemented a Radon Pilot Screening Program on behalf of the Onondaga County Department of Health. This program won recognition from the NY State and National Association of Counties as an innovative and model program for local health departments. Findings from the program were presented to the County Executive, New York State Department of Health, County Legislature, news media, Home Builders Association, and numerous civic groups by request.

Administered a residential program on behalf of New York State to assess short and long term retention of formaldehyde in air following installation of urea-formaldehyde foam insulation.

North Syracuse High School, North Syracuse, NY - Performed indoor air sampling related to the replacement of a hot-tar roof; reviewed asbestos documentation to determine compliance with existing regulations and recommended additional necessary work.

EMERGENCY RESPONSE:

Mr. Banikowski has extensive experience dealing with emergency response to the accidental release of potentially hazardous substances. He has coordinated relevant activities for schools, commercial and residential buildings, industrial facilities, and public water supplies.
Mr. Banikowski's experience includes:

- source determination
- alternatives evaluation
- Emergency Response Plans
- risk assessment
- odor abatement

Representative projects include:

Liverpool High School, Liverpool, NY - Assisted in the closure and reopening of the High School following a herbicide spraying incident in which 22 people required medical attention.

Amtrak, Minoa, NY - Coordinated with Chemtrek and local fire department to resolve problems associated with a tank car leaking fuming nitric acid.

Skaneateles Lake, Skaneateles, NY - Assisted NYS Department of Environmental Conservation in evaluating remedial alternatives after a truck overturned and released emulsified asphalt into Skaneateles Lake, which provides water to the City of Syracuse.

Prepared emergency response protocol to PCB ballast failures for use by local fire departments.

Developed procedure for removal of underground transformer located in a downtown building in the City of Syracuse.

Developed Division of Environmental Health, Onondaga County Department of Health Emergency Response Plan.

PUBLICATIONS

O'Brien & Gere Engineers, Inc. Innovative Engineering Technologies for Hazardous Waste Remediation, New York Van Nostrand and Reinhold, 1994. Jeffrey E. Banikowski, principal author of Chapter 3, **"Innovation in Risk Assessment and Risk Management."**

J.L. Kochian, A. Raza, J.E. Banikowski, S.W. Kaczmar, 4/27/94, **Evaluation of the Air Exposure Pathway at Landfills Without Analytical Air Data**, HMCRI Environmental Restoration and Waste Minimization Conference, New Orleans, Conference Proceeding.

J.E. Banikowski, K.E. Thomas, J.L. Zegarelli, **Cleaning Up Without Getting Cleaned Out**, American City and County, July 1994.

Hand, Bryce M. and Banikowski, Jeffrey E., 1988, **Radon in Onondaga County, New York: Paleohydrogeology and redistribution of uranium in Paleozoic sedimentary rocks**, Journal of Geology, v. 16, p. 775-778.

Hand, Bryce M., and Banikowski, Jeffrey E., 1988, **Geologic factors affecting indoor radon in Onondaga County, NY**, Northeastern Geology Abstracts:Radon in the Northeast: Perspectives and Geologic Research, v. 10, no. 3, p. 176.

Hand, Bryce M., and Banikowski, Jeffrey E., 1988, **Radon in Onondaga County, New York: Cenozoic Redistribution of Uranium in Paleozoic Sediments**, EOS, Transactions of the American Geophysical Union, v. 69, no. 16, p. 359-360.

ADDITIONAL COURSE WORK

Public Health (State of New York)
Epidemiology (State of New York)
Risk Analysis in Occupational and Environmental Health (Harvard University)
Occupational and Environmental Radiation Protection (Harvard University)
Fortran Programming (Onondaga Community College)
Environmental Toxicology (Syracuse University)
Hydrogeology (Syracuse University)

Aamer Raza

O'Brien & Gere Engineers, Inc.

Risk Assessor

PROFESSIONAL PROFILE

Mr. Raza joined O'Brien & Gere in 1989. He was promoted to Project Scientist in 1991, Senior Project Scientist in 1992, and Technical Associate in 1996. Mr. Raza is responsible for performing and overseeing human health risk assessments at the firm, and providing technical support on toxicological issues.

Education

Harvard University School of Public Health, 1989, MS/Environmental Health Sciences

University of Massachusetts, 1984, BS/Biochemistry

TECHNICAL EXPERTISE

- Human Health Risk Assessment
- Hazardous Waste Management
- Environmental Health Sciences and Biochemistry

REPRESENTATIVE PROJECTS

HUMAN HEALTH RISK ASSESSMENT:

U.S. Air Force (USEPA Region IV, RCRA RFI/CMS) - Prepared and supervised 24 risk assessments at launch complexes, fire training areas, and landfills at Cape Canaveral Air Force Station, Cocoa Beach, Florida. The risk assessments were prepared consistent with the requirements for the U.S.Air Force Instalation Restoration Program (IRP), as well as RCRA. The results of the risk assessments were used to support site specific CMS's and selection of remedial alternatives.

U.S. Air Force (USEPA Region IV, RCRA RFI/CMS) - Prepared and supervised 15 risk assessments at fire training areas, landfills, and other areas at Eglin Air Force Base, Fort Walton Beach, Florida. The risk assessments were prepared consistent with the requirements for the U.S.Air Force Instalation restoration Program (IRP), as well as RCRA.

Richards Gebaur Air Force Base, Belton, MO - Prepared a risk assessment for 6 sites at the base, under the USAF Installation Restoration Program (IRP). The sites included a POL storage yard, fire training areas, and hazardous waste storage areas. Included a detailed risk evaluation of PAH compounds in waste petroleum products.

TRW Corporation, Ziedrich Dump Site, Minerva, Ohio (USEPA Region V, Ohio EPA) - Baseline risk assessment addressing exposures at an abandoned industrial landfill. The assessment was performed under CERCLA risk assessment format and was used for the consideration of remedial actions at the site. The assessment evaluated exposures to volatile and semi-volatile organic compounds, and inorganic constituents in soil, ground water, surface water, and sediments.

Sullivans Ledge Superfund Site, MA (USEPA Region I) - Performed statistical analysis of temporal trends in ground water for evaluating design capabilities of ground water remediation systems at the site. The statistical analysis report was approved by USEPA Region I. As a result of the analysis, savings of approximately $ 300,000 were realized with respect to applied ground water remediation systems.

New York Power Pool, New York State Utilities Manufactured Gas Plant Task Force - Asssisted NYPP MGP Task Force in preparation of a Risk-Based standard remedy for remediation of manufactured gas plant sites. The standard remedy approach is currently being evaluated by NYSDEC for application at MGP sites across New York State.

Dewitt Landfill (Dewitt, NY) - Supervised a risk assessment for an inactive municipal landfill. The assessment involved the evaluation of the potential migration of compounds via air emissions, surface runoff, and leaching. Long term average air concentrations from the landfill emissions were estimated using U.S.EPA's Industrial Source Complex Long Term (ISCLT) model.

Ray Proof Systems (Norwalk, CT) - Prepared a risk assessment of chlorinated volatile organic compounds in groundwater. Included a site specific analysis of chemical fate at the site based on the observed biodegradation of chlorinated organic compounds in the groundwater, and U.S. EPA's AT123D groundwater transport model. Based on tne risk assessment, a continued monitoring program was accepted by the Connecticut DEP instead of the installation of a groundwater pump and treat system.

Amphenol Corporation (NY - Sidney) (Superfund Site - USEPA Region II) - Prepared work plan for baseline human health assessment addressing exposures at an abandoned landfill. The work plan addressed exposures to PCBs, volatile organic compounds, oil, and grease in ground water, surface water, and sediments.

Westinghouse Savannah River Co., Aiken, SC - Prepared a risk assessment of radionuclides and organic chemicals in ground water. The assessment involved the statistical evaluation of data from twenty ground water monitoring wells collected on a quarterly basis over a two year period.

Town of Dewitt Landfill, Dewitt, NY - Supervised a risk assessment for an inactive municipal landfill. The assessment involved the evaluation of the potential migration of compounds via air emissions, surface runoff, and leaching. Long term average air concentrations from the landfill emissions were estimated using U.S.EPA's Industrial Source Complex Long Term (ISCLT) model.

Mobil Oil Corporation, MA - Prepared risk assessments for gasoline releases at Mobil service stations in Massachusetts in support of Massachusetts Phase III site investigations.

Electric Power Research Institute, NY - Prepared a critical literature review and summary document on the toxicology of pentachlorophenol as a component of wood preservative formulations.

Mystery Bridge Rd./Highway 20 Site (WY - Natrona County) (Superfund Site) - Baseline risk assessment addressing exposures at a complex of oil refineries. Quantified risks associated with exposures to petroleum hydrocarbons in ground water and soil. Prepared a transport and exposure assessment of ground water containing chlorinated and aromatic solvents using USEPA Graphical Exposure Modeling System (GEMS).

Texas Eastern (NJ - various locations) - Baseline risk assessments addressing potential exposures at a natural gas pumping station. Evaluated exposures to PCBs in soil.

United States Army Corps of Engineers (NY - Fort Drum) - Baseline risk assessment addressing exposures at Ford Drum Military Installation. Quantified exposures to lead and petroleum hydrocarbons in ground water, surface water, soil, and air.

HAZARDOUS WASTE MANAGEMENT:

Project coordinator for a Remedial Investigation at a biological waste site in Indiana. Prepared a review of the potential viability of pathogenic bacteria and viruses in the environment for expert review. Developed Health and Safety Plan, Work Plan, and Field Sampling Plan. Coordinated contracting laboratories, analytical methods, and field work.

Prepared a Sampling and Analysis Plan for microorganisms, and evaluated the health risks related to pathogenic microorganisms in a municipal landfill in New York.

ANALYTICAL AND RESEARCH EXPERIENCE:

Research Assistant, Brigham and Womens Hospital, Boston, MA - Tested new and experimental drugs in animal models of gastric and duodenal ulcer disease. Performed an independent research project on the pathogenesis of gastric ulcer disease. Handled problems of experimental design, method selection and implementation, data analysis and interpretation, and writing and presenting abstracts.

Laboratory Assistant, Crystal Diagnostics, Woburn, MA - Conducted testing and calibration of passive samplers for ethylene oxide and formaldehyde according to manufacturing schedules and deadlines. Developed standard operating procedure for gas chromatographic determination of ethylene oxide.

PUBLICATIONS

Papers

New elements in the mechanism of prostaglandin induced gastric mucosal protection. Szabo, S., Raza, A., In: Advances in Pharmacological Research and Practice. Knoll, J., Klemen, K. (eds.), 1985, Pergamon Press, Elmsford, NY USA.

The role of endogenous non-protein and protein sulfhydryls in gastric mucosal injury and protection. Dupuy, D., Raza, A., Szabo, S. In: Ulcer Disease: New aspects of Pathogenesis and Pharmacology. Szabo, S., Pfeiffer, C.J. (eds.) CRC Press, Boca Raton, FL USA. (In press).

The sulfhydryl agent cysteamine protects gastric epithelia cell monolayers from a human cell line against taurocholate and indomethacin-induced damage in vitro. Romano, M., Razandi, M., Raza, A., Szabo, S., Ivey, K.J. Submitted to the Amer. J. Physiol.

Presentations

Biochemical changes in endogenous sulfhydryls in gastric mucosal injury and protection: studies with diethylmaleate and N-ethylmaleimide. Raza, A., Szabo, S., Dig. Dis. Sci., 1985, 30, A33. Presented at the 5th International Conference on Experimental Ulcer, 1985, Boston, MA USA.

Gastroprotection by glutathione depletors is not due to low gastric glutathione: role for protein sulfhydryl modification. Raza, A., Szabo, S. Presented at the 71st Annual Meeting of the Fed. Amer. Soc. Exp. Biol., 1987, Washington, DC USA.

The role of endogenous non-protein and protein sulfhydryls in gastric mucosal injury and protection. Szabo, S., Trier, J.S., Pihan, G., Raza, A., Dupuy, D. Dig. Dis. Sci., 1985, 30, A38.

Sulfhydryls as biochemical target and vascular endothelium as structural object in gastric mucosal injury and protection. Szabo, S., Raza, A., Proc. Int. Symp. Prog. Pathophysiol. Treatment Gastr. & Du. Ulcer Dis., Felix, Romania, 1985, 307-309.

Multiple mechanisms of cell injury in the gastric mucosa. Szabo, S., Pihan, G., Raza, A., Mullen, E.A., Haushka, P.V., 71st Annual Meeting of the Fed. Amer. Soc. Exp. Biol., 1987, Washington, DC USA.

Thomas R. LaVoy

O'Brien & Gere Engineers, Inc. Radiation Safety Officer/Industrial Hygienist

PROFESSIONAL PROFILE

Mr. LaVoy joined O'Brien & Gere Engineers, Inc. in 1993. Mr. LaVoy's duties involve industrial hygiene related services with specialization as a health physicist.

Education

University of Florida, Gainesville, FL, 1984, MS/Nuclear Engineering and Medical Physics

University of Florida, Gainsville, FL, 1979, BS/Nuclear Engineering and Health Physics

Professional Certifications

1995: American Board of Medical Physics, Diagnostic Radiology.

1989: American Board of Health Physics, Certified Health Physicist, Comprehensive

1988: American Board of Health Physics, Certified Health Physicist, Power Reactor

Professional Affiliations

1990, American Association of Physicists in Medicine, Member
1980, Health Physics Society, Member

EXPERIENCE

In addition to his current employment, Mr. LaVoy is also a consulting medical physicist involved in license writing, conducting audits, quality assurance testing and training of technicians.

<u>Prior to O'Brien & Gere Engineers</u>

Crouse Irving Memorial Hospital, Medical Physicist. Primary responsibilities included quality assurance in diagnostic radiology and nuclear medicine and radiation safety. Areas of responsibility included general radiology, ultrasound, nuclear medicine, special procedures, cardiac angiography, CT, mammography, and brachytherapy. Specific duties included all state and JCAHO required QC testing, equipment specification and acceptance testing, clinical support, training, license administration, radiation therapy surveys, dosimetry, and instrument calibrations.

Niagara Mohawk Power Corporation, Health Physicist. Primary duties were to assure all phases of work at Nine Mile Point complied with applicable State and Federal regulations regarding radiation. This involved audits of site records and activities, procedure reviews, design reviews, evaluation of

radiological incidents, administration of ALARA program and emergency planning.

Westinghouse Electric Corporation, Radiological Engineer, Nuclear Services Division. Supervisory position responsible for setup of nuclear county laboratory. Included physical assembly and testing of Canberra intrinsic Germanium 2048 channel multi-channel analyzer system, energy and efficiency calibrations, writing sample preparation and counting protocols. Also assembled, tested and calibrated Tennellec S100LB gas flow proportional counter, wrote sampling and counting protocols.

Samples analyzed with gamma spectroscopy system include air sample filters, water samples, soil samples and wipe samples. Samples analyzed with proportional counter include air and wipe samples. Wrote procedures for both instruments for periodic background checks, efficiency calibrations and energy calibrations.

University of Florida, Health Physicist, Division of Environmental Health and Safety. Performed radiation safety and quality assurance duties in support of a 600-bed teaching hospital, a 100 kW training reactor, and a biomedical research center. Specific duties included laboratory surveys, radiation surveys, calibration of radiation survey meters and laboratory counting instruments, leak testing sealed sources, radioactive waste processing, environmental monitoring, emergency planning and quality assurance testing of X-Ray equipment.

Timothy M. Eddy, P.H.

O'Brien & Gere Engineers, Inc. Field Operations Supervisor

PROFESSIONAL PROFILE

Mr. Eddy joined O'Brien & Gere Engineers, Inc. as a Hydrogeologist in 1989. He was promoted to Project Scientist in 1991 and Project Hydrogeologist in 1992.

Education

State University of New York College at Oneonta, 1989, BS/Water Resources

Syracuse University, currently engaged in graduate studies/Master of Business Administration

Professional Certifications

American Institute of Hydrology
Professional Hydrogeologist - 96-HG-1134
ISO 9001 Provisional Lead Auditor
ISO 14001 Provisional Lead Auditor

Special Training

- National Registration Scheme for Assessors of Quality Systems
  - 36-hour RAB accredited ISO 9001 Lead Auditor Course
- National Registration Scheme for Assessors of Environmental Management Systems
  - 36-hour RAB accredited ISO 14001 Lead Auditor Course
- National Ground Water Association (NGWA) Courses:
  - Analysis and Design of Aquifer Testing
  - Introduction to Carbonate Hydrogeology
- Groundwater Associates of Princeton
  - Groundwater Pollution and Hydrology
- US Navy - Naval Nuclear Power School - Health Physics Technician
- O'Brien & Gere Engineers, Inc. Hazardous Waste Operations Training Program (OSHA Qualified)
- O'Brien & Gere Engineers, Inc. Hazardous Waste Operations Supervisor Training Course (OSHA Qualified)

Professional Affiliations

American Institute of Hydrology
Association of Ground Water Scientists and Engineers
Central New York Association of Professional Geologists
Health Physics Society

TECHNICAL EXPERTISE

- Hazardous waste management
- Aquifer analysis and evaluations
- Water Supply Assessments and Evaluations
- Monitoring and recovery well installation methods
- Geophysical surveys and soil sampling techniques
- Radiological controls
- Environmental Management Systems - ISO 14000
- Quality Management Systems - ISO 9000

REPRESENTATIVE PROJECTS

HAZARDOUS WASTE MANAGEMENT:

Mr. Eddy's experience includes site investigations for industrial waste facilities, contaminant bases, and petroleum hydrocarbon bases. Confidentiality agreements preclude specific client identification and location:

Magnesium Electron Facility, Flemington, NJ - Supervised mixed waste (radiological and chemical) sludge characterization sampling program. Activities included field screening radioactive samples and supervising radiological health and safety measures.

Accurate Die Casting Facility, Fayetteville, NY - Executed project coordination and field manager activities for the remediation of distressed property. Designed and tested overburden and bedrock ground water remediation system. Assisted in soil remediation design.

Richardson Hill Road Municipal Landfill Superfund Site, Sidney, NY - Emergency response action field manager. Developed and supervised implementation of field testing plan. Performed remedial contractor oversight. Assisted with negotiations of time-critical response action with USEPA.

General Motors Corporation, Inland Fisher Guide, Syracuse, NY - Remedial Investigation/Feasibility Study. Implemented hydrogeologic aspects of RI/FS in the Ley Creek dredged material area. Investigation included evaluating extent of PCB contamination in soils and ground water.

Route 8 Landfill Site, Sidney, NY - Developed and coordinated the implementation of compliance monitoring program for ground water remedial system. Monitoring program was designed to evaluate effectiveness of remedial system. Utilized monitoring data to develop two-dimensional analytical ground water flow model to troubleshoot system and upgrade as required to achieve remedial objectives.

Barkhamsted Landfill Superfund Site, New Hartford, CT - Assisted in development of site remedial investigation work plan. Field manager for on-site remedial investigation activities. Supervised environmental sampling, installation of soil borings and monitoring wells, and health and safety monitoring. Performed liaison duties between client and regulatory agencies. Supervised development of Remedial Investigation Report. Assisted with feasibility study, responsible for contaminant transport modeling utilizing computer-based two dimensional solute transport model.

U.S. Air Force, Eglin AFB, Fl - Assistant site manager for six sites characterized in $6.4 million dollar RCRA Corrective Action project involving RCRA Facility Investigations at sixteen sites. Developed Work Plans, provided technical assistance and direction for field investigation efforts, supervised and developed RFI reports for regulatory agency review, developed corrective measure studies, reviewed decision documents and risk assessments.

S.T. Services, Bray Terminals Facility - Manage monthly and quarterly monitoring and reporting of free-phase oil recovery system operation. Trouble-shoot system to achieve compliance with New York State Department of Environmental Conservation Spill Group guidelines.

Brookhurst Superfund Site, Casper, WY - Performed site characterization on several oil refinery sites.

Greylock Estates, MA - Developed geologic cross sections from boring logs. Data reduction and calculation of in-situ permeability test data.

Lakeland, NY - Performed magnetic geophysical survey of storage drum burial site. Responsibilities included installing and mapping grid, a data reduction of survey results.

Confidential - Supervised drilling and installation of ground water recovery wells. Performed extended pump tests on newly installed wells to determine aquifer capacity, transmissivity, and well efficiency. Teamed with design engineers to design site specific remedial design system utilizing two-dimensional analytical ground water flow model to evaluate required aquifer drawdown and capture zone.

Confidential - Supervised recovery well dismantling and cleaning as well as redevelopment to increase well efficiency. Directed well reinstallation and testing.

Confidential - Conducted site investigation to assess the extent of hazardous waste contamination. Investigation included installation and sampling of ground water monitoring wells, soil sampling, and geophysical survey of potential drum storage area.

Confidential - Assisted in remedial investigation/feasibility study field program. Supervised installation of deep bedrock piezometers to determine vertical gradient of ground water.

Confidential - Augmented previous site investigation, including monitoring well installation and sampling, soil sampling in potential solid waste disposal pit in compliance with Ohio Department of Natural Resources.

Confidential - Ground water monitoring and soil sample collection program to determine extent of volatile contaminant bases and petroleum hydrocarbon contamination.

Confidential - Performed magnetic geophysical survey to locate underground storage tanks (UST).

Confidential - Performed magnetic geophysical survey of storage drum burial site. Installation and mapping of survey grid. Data reduction of survey results.

Tompkins County, NY - Supervised drilling of bedrock monitoring well, including logging of cored samples.

WATER SUPPLY DEVELOPMENT:

City of Beacon Water Supply - Supervised assessment of aquifer long term safe yield. Conducted aquifer performance testing and analysis. Used performance test data to evaluate aquifer drawdown and interference with existing supply wells. Developed water supply assessment report.

Latham Water District, Town of Colonie, NY - Ground water supply investigation. Performed investigation of the long-term safe yield of aquifer. Teamed with design engineers to evaluate system expansion scenarios to maximize the use of available ground water supply. Utilized computer-based, two-dimensional analytical flow model to evaluate aquifer drawdown and interference with existing supply wells. Final design expanded system available safe yield to 9.5 million gallons per day (mgd). Duties included the coordination and installation of ground water observation wells, aquifer performance testing and ground water flow modeling with two-dimensional analytical model to estimate maximum safe well yield available from the existing system. Supervised the installation and testing of an additional water supply well.

SOLID WASTE MANAGEMENT:

Tompkins County, NY - Supervised drilling of bedrock monitoring well, including logging of cored samples.

ENVIRONMENTAL MANAGEMENT SYSTEMS - ISO 14000 :

Assisting in the design and implementation of corporate environmental management system of O'Brien & Gere Manufacturing. Duties involve integrating requirements of ISO 14001:1996 standard into existing organization operations, training staff in the ISO 14001 requirements, and conducting second party audits to assess implementation of the environmental management system.

QUALITY MANAGEMENT SYSTEMS - ISO 9000 :

Assisted in the design and implementation of corporate ISO 9001 quality management system which was successfully registered to the ISO 9001:1994 standard for quality systems. Duties involved:

- development of the firm's policy, procedures and work instruction manuals;
- training of staff in the ISO 9001 standard and the policies, procedures and work instructions that affect various levels of staff.
- conducting internal audits to assess conformance with the corporate quality system and the ISO 9001 standard. Audit experience- 20 on-site audit days.